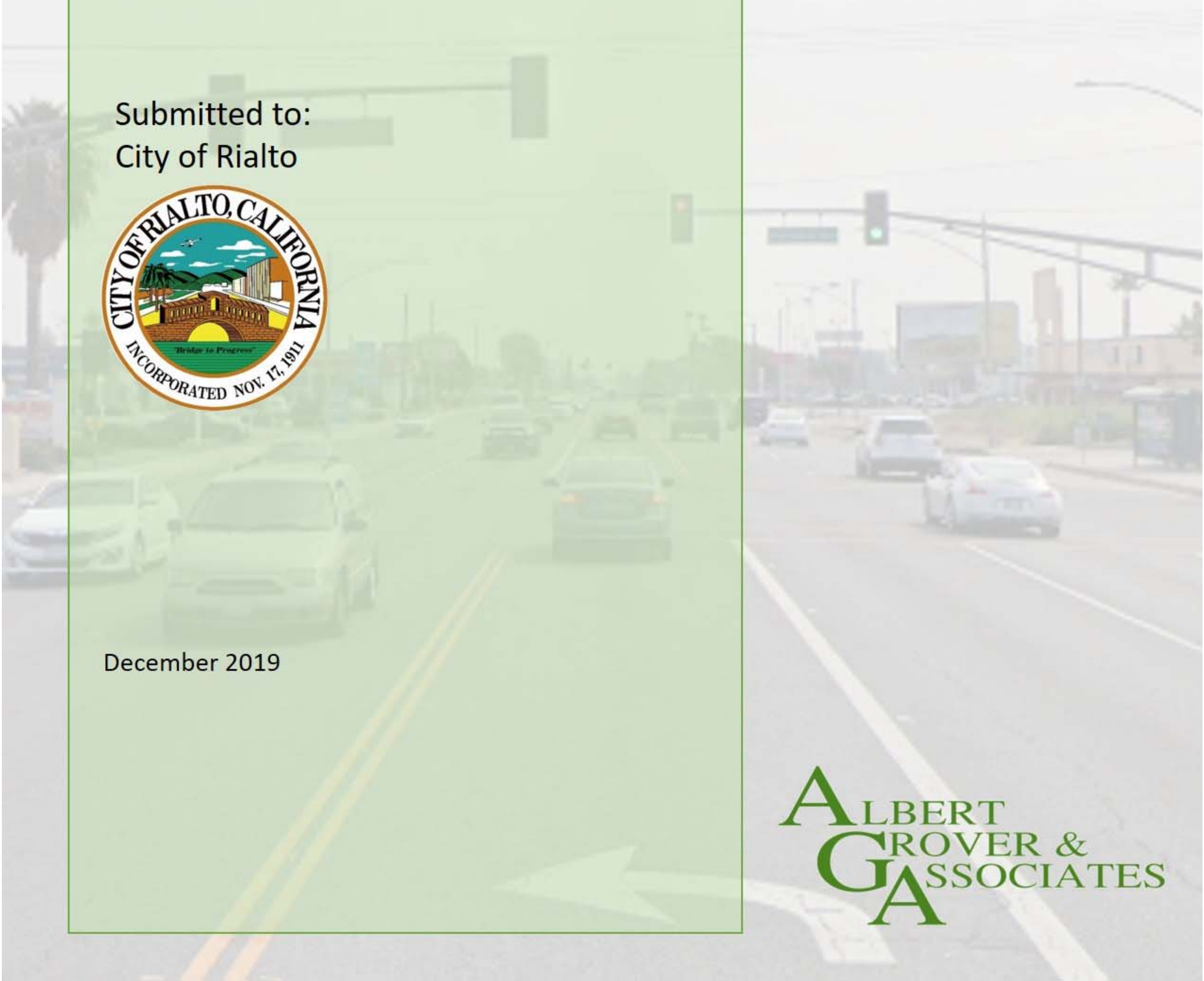
Systemic Safety Analysis Report Program



Submitted to:
City of Rialto

December 2019

Albert Grover & Associates

Final Report

Systemic Safety Analysis Report Program

Prepared for

City of Rialto

Department of Public Works
150 South Palm Avenue
Rialto, California 92376

December 2019

Prepared by

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1. Executive Summary

As a part of Caltrans' Systemic Safety Analysis Report Program (SSARP), Albert Grover & Associates (AGA) conducted a Citywide collision assessment to identify potential traffic control modifications and safety improvements to address collision rates throughout the City. This report highlights the study findings and recommendations, including a list of potential safety improvement projects that could be eligible for future grant funding at the local and federal level.

1.1. Collision Assessment and Systemic Analysis

This systemic traffic safety and collision history analysis includes the following tasks:

- **Data Analysis:** Four years of collision data was analyzed to identify collision concentrations, patterns, and trends. Traffic collisions were also evaluated to determine prevalent types (such as broadsides, side-swipes, rear-ends) and causes (such as right-of-way, unsafe speed, driving under the influence).
- **Field Review:** Locations with elevated traffic collision rates or elevated risk factors for collisions were evaluated in the field. Engineers identified possible environmental, traffic, or human factors that might be contributing to those collisions. Roadway characteristics and adjacent land uses were also noted to provide the assessment team with a comprehensive understanding of the environment in which collisions are occurring. Field reviews were further enhanced through the use of aerial and ground-level imagery.
- **Countermeasure Selection:** Based on the data analysis and field review, countermeasures designed to address the root causes of collisions for public benefit at reasonable costs were determined. Additional low-cost measures were also identified based on safety considerations and engineering judgement.
- **Recommendations:** The traffic safety countermeasures were then expanded and detailed as to specific projects for implementation. Corridor improvement projects with the potential for future grant funding were identified, while intersection improvement projects are divided into low-cost operational implementation and capital improvement program implementation.

1.2. Results and Findings

Over the four-year study period (2014-2017), a total of 2,197 reported collisions were documented, of which 66% were injury collisions, with 23 incidents resulting in fatalities. **Table 1** gives the top three collision types and primary collision factors within the study period.

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Table 1: Citywide Collision Analysis

Top Collision Types		
1	Broadside	34%
2	Rear End	22%
3	Hit Object	14%

Top Collision Factors		
1	Unsafe Speed	24%
2	Driving Under the Influence	18%
3	Right-of-Way Violation	16%

Within California, in 2016 the City of Rialto ranked 30th safest out of 58 cities of similar population sizes. Overall, Rialto generally sits in the middle of the pack with regard to the statewide safety rankings; however, the City has ranked in the bottom 30th percentile for alcohol-related and nighttime injury collisions in five of the last six years.

1.3. Challenge Areas

The study identified the following challenge areas of particular concern to the City of Rialto:

- Unsafe speed or speeding
- Driving Under the Influence (DUI) of drugs or alcohol

Programmatic recommendations were provided to combat speeding and DUI collisions such as increased enforcement, high profile DUI checkpoints, conducting safety campaigns and emphasizing traffic safety at City-supported functions.

1.4. Recommended Improvements

Based on the analysis, the project team developed recommendations for both study corridors and specific intersections throughout the City. Corridor improvements range from traffic signal operational improvements such as shorter cycle lengths and rest-in-red operation (to deter speeding) to larger-scale improvements such as new raised median and traffic signal installations.

Intersection improvements range from smaller-scope improvements such as renewing intersection striping to the installation of additional traffic signal equipment or a full-scale overhaul of traffic control measures at the intersection. The intersection improvements recommended are divided into low-cost operational improvements and capital improvement projects, the latter of which are estimated to cost a total of approximately **$2.2 million**.

2. Engineer's Seal and Statement of Protection of Data from Discovery and Admissions

By signing and stamping this Systemic Safety Analysis Report, the engineer is attesting to this report's technical information and engineering data upon which the City of Rialto's recommendations, conclusions, and decisions are made.

Prepared by:

12-31-2019

Mark H. Miller, PE, TE, PTOE — Date
Professional Civil Engineer
Albert Grover & Associates, Inc.

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Director of Public Works/City Engineer
City of Rialto

Per Section 148 of Title 23, United States Code [23 U.S.C. §148(h) (4)], regarding reports prepared under the State of California Strategic Highway Safety Plan and Highway Safety Improvement Program:

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

3. Introduction

3.1. Systemic Safety Analysis Report Program (SSARP)

The California Department of Transportation (Caltrans) Division of Local Assistance (DLA) is responsible for administering federal safety funding intended for local roadway safety improvements. This funding primarily comes to the state through two federal programs: the Highway Safety Improvement Program (HSIP), which focuses on reducing serious injuries and fatalities on public roads, and the Active Transportation Program (ATP), which focuses on promoting non-motorized travel and active transportation.

In 2016, Caltrans established the Systemic Safety Analysis Report Program (SSARP) to assist local agencies in performing system-wide data-driven collision analyses, identifying potential roadway safety issues, and developing systemic, low-cost countermeasures for future applications. State funding for the SSARP was made available by exchanging local HSIP federal funds for State Highway Account (SHA) funds.

3.2. Project Location

The project study area spans the entire City of Rialto, which is located in San Bernardino County between its border with Riverside County and the Lytle Creek Wash, and encompasses approximately 22.3 square miles. As shown in **Figure 1**, the City is bounded on the north by the Lytle Creek Wash and unincorporated San Bernardino County, on the east by the Cities of San Bernardino and Colton, on the south by the Santa Ana River and City of Riverside, and on the west by the City of Fontana.

Settled in the 19th century and incorporated in 1911, the City is home to approximately 103,440 residents (2017 US Census), several major regional distribution centers, and a portion of Historic US Route 66. The Interstate 210 (I-210) freeway runs through the northern section of the City and the Interstate 10 (I-10) freeway runs through the southern section of the City.

3.3. Project Background

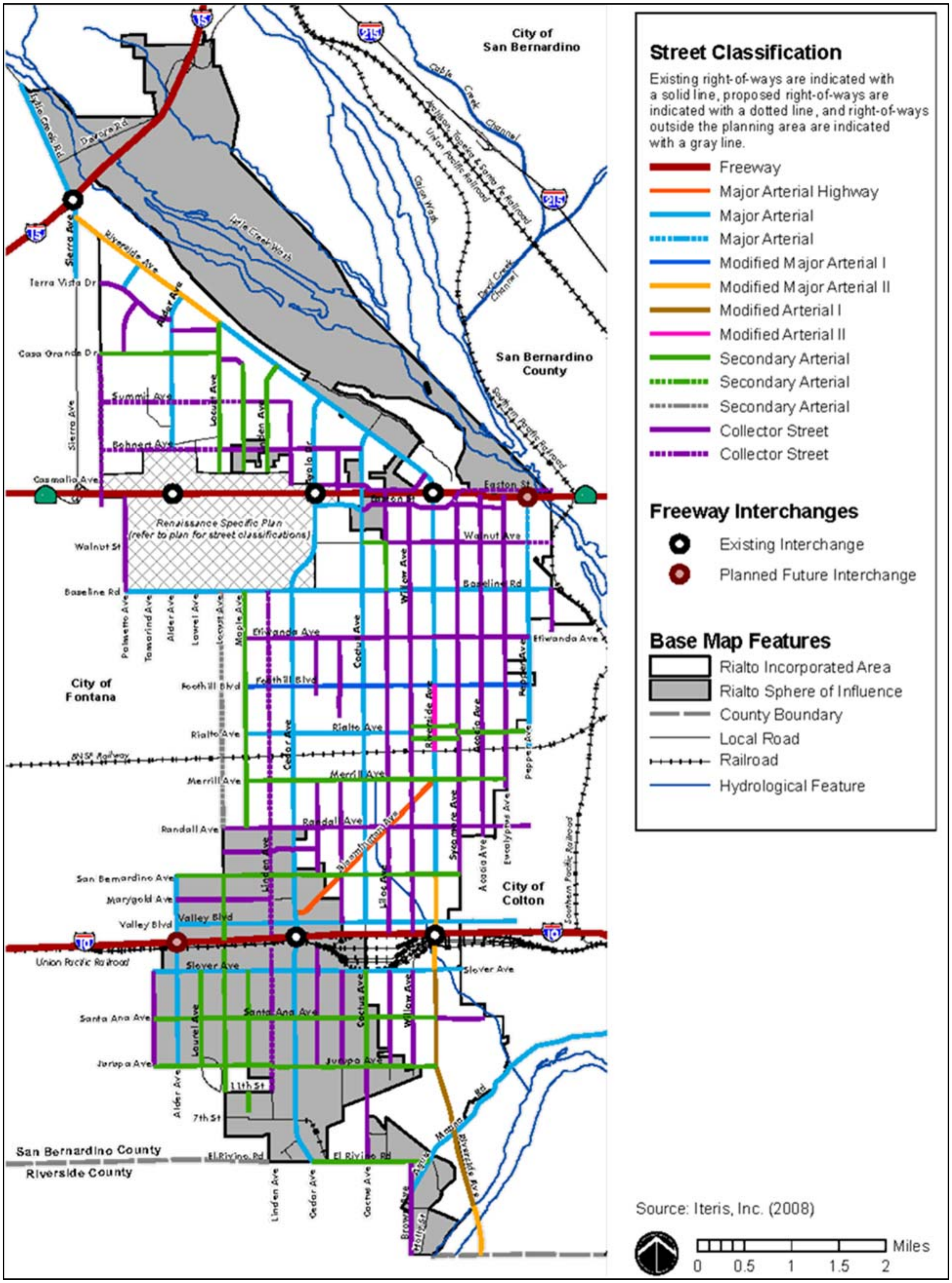
In 2016, the City of Rialto submitted an application to Caltrans District 8 for funding towards the SSARP grant. In May 2017, the DLA approved an allocation of State funds for the preliminary engineering phase. Soon after, the City of Rialto issued a Request for Proposals (RFP) for an engineering study to develop systemic traffic safety solutions. Albert Grover & Associates (AGA) was awarded the contract for the safety analysis, bringing extensive local experience in developing and implementing feasible safety solutions.

In the RFP, the following roadways are identified as areas of particular concern:

- **A** Riverside Avenue
- **B** Foothill Boulevard
- **C** Baseline Road
- **D** Cedar Avenue / Ayala Drive
- **E** Eucalyptus Avenue

Later in the study scoping process, discussions by the City Council, City staff, and the consultant also added two more corridors to the analysis: Casmalia Street and Cactus Avenue. Per the RFP and discussions with the City, high-risk intersections throughout the City were also identified for inclusion in the study.

Figure 1: City of Rialto Roadway Network



3.4. Study Data

This study synthesizes data from various sources to build a comprehensive analysis of traffic operations and safety conditions in the City, including the following:

- California Office of Traffic Safety (OTS) injury data and rankings
- City Crossroads collision database records
- Statewide Integrated Traffic Records System (SWITRS) records
- University of California Transportation Injury Mapping System (TIMS) records
- Current and historical aerial satellite imagery
- Google Street View ground-level imagery

3.5. Project Tasks

Analyze Collision Data – Four years of collision data (from January 1, 2014, to December 31, 2017) compiled in the City's Crossroads database were analyzed to identify high-risk locations and collision patterns. High-risk intersections were identified by collision frequency, traffic control type, and intersection and roadway geometrics. Collision patterns and trends were evaluated based on parameters such as collision type, primary collision factor, collision severity, time of day, and age of parties involved.

Review Field Conditions – For each study corridor and intersection selected in the RFP and data analysis, project engineers conducted on-site technical reviews of traffic patterns, intersection geometrics, traffic signal equipment, intersection and roadway signage, roadway pavement and striping conditions, adjacent land uses, and other pertinent factors not readily apparent in the data. These field reviews focused on identifying potential improvements to traffic safety as well as motorist and pedestrian awareness.

Identify Countermeasures – Based on the collision patterns and field reviews, traffic safety countermeasures were selected from Caltrans' Local Roadway Safety Manual (LRSM, June 2018). The selected countermeasures were evaluated using both a "systemic approach" and a "spot location approach", as appropriate.

Recommend Improvements – The selected traffic safety countermeasures were expanded and detailed to identify specific corridor and intersection improvement projects for City Council considerations. Of the corridor improvement projects, those with the potential for state or federal grant funding were identified. The intersection improvement recommendations were further categorized into low-cost operational improvement projects and capital improvement program projects.

4. Data Analysis Techniques

Various data sources were synthesized to form a holistic picture of traffic safety in the City of Rialto, including state data from the Office of Traffic Safety (OTS) and California Highway Patrol, City collision data collated in a Crossroads database, and private, open-source data from the University of California Transportation Injury Mapping System (TIMS) and Google Earth and Google Street View. Project engineers also spent time on the ground in the City of Rialto, familiarizing themselves with existing traffic and roadway conditions by both driving through study locations and observing them over peak traffic periods (i.e. during the AM, MD, PM and nighttime peak hours).

4.1. California Office of Traffic Safety Rankings

OTS is a State partnership with the National Highway Traffic Safety Administration (NHTSA) that identifies highway safety problems and offers countermeasures to address them. Every year, OTS ranks individual cities' traffic safety statistics with cities of similar-sized populations using data from several sources, including Caltrans, the California Highway Patrol, and the California Departments of Justice (DOJ) and of Finance (DOF). The following population groupings are used by the OTS rankings:

- Group A – population over 250,000
- Group B – population 100,001 – 250,000 (City of Rialto falls in this group)
- Group C – population 50,001 – 100,000
- Group D – population 25,001 – 50,000
- Group E – population 10,001 – 25,000
- Group F – population 2,501 – 10,000
- Group G – population 2,500

The OTS rankings are based on the number of persons killed or injured in traffic incidents of various categories, for example:

- Total Fatal and Injury – Total number of traffic collision victims with fatalities and/or injuries
- Alcohol Involved – Number of fatalities/injuries resulting from incidents involving a party (driver, pedestrian, bicyclist) classified as "Had Been Drinking"
- Motorcycles – Number of fatalities/injuries resulting from incidents involving a motorcycle
- Pedestrians – Number of fatalities/injuries resulting from incidents involving a pedestrian
- Bicycles – Number of fatalities/injuries resulting from incidents involving a bicyclist
- Speed Related – Number of fatalities/injuries resulting from incidents involving speeding
- Nighttime – Number of fatalities/injuries resulting from incidents between 9:00pm and 2:59am (prime hours for DUI, speeding, and drowsy driving)
- Hit and Run – Number of fatalities/injuries resulting from incidents where a driver left the scene

4.2. Traffic Collision Data

The Caltrans Division of Local Assistance, in conjunction with the Federal Highway Administration (FHWA) and the Safe Transportation Research and Education Center (SafeTREC), developed the Local Roadway Safety Manual (LRSM, version 1.4 released June 2018) to maximize local roadway safety by encouraging local agencies to evaluate their roadway networks. It focuses on key safety activities which should be conducted regularly to reduce the number and severity of collisions and identifies several resources for assessing roadway safety issues on roadway networks:

Formal Sources

- *Law enforcement reports and citations* – A collision report or citation is generated by the investigating officer who responds at the scene of a collision summarizing information regarding the collision.
- *State and local collision databases* – The Statewide Integrated Traffic Records System (SWITRS) is a database of collision records maintained by the California Highway Patrol (CHP).
- *Field assessments* – In-person observations conducted by project engineers provide real-world knowledge of traffic conditions and collision risk factors at study locations. These observations can be enhanced and supported by satellite and ground-level imagery.

Informal Sources

- *Historical observations* – Road maintenance crews, law enforcement, first responders, and emergency medical services can help identify problem areas. Law enforcement officers may be aware of problem areas based on citations, while maintenance crews and medical personnel keep work logs which can provide supplemental information about collisions and high collision locations.
- *Local citizen reports* – Submitted to local agencies by correspondence or at a public meeting, these reports should be corroborated by field assessments, data, and other documentation.

Traffic collision data was evaluated using the City's Crossroads Collision Database, which uses SWITRS data via a software tool for organizing traffic collision and citation records. Crossroads is widely used by many traffic engineering, public safety, and police departments.

While the Rialto Police Department has vehicular accident data in addition to what is available from SWITRS reports, it has not been included in the analysis as it did not contain the key collision data information required to be included in the HSIP analysis. At a minimum, the key accident information should include: accident location, direction of travel of each party, type of collision, severity of collision and an accurate collision plot diagram, among others. To have the vehicular accident data included in the analysis, the engineer completing the application must include all necessary data requested and certify to the accuracy of the information provided in the application.

Typically, three years of data are required for collision analysis, but using an extended study period strengthens the evaluation. As collisions occur randomly throughout any given year, using multi-year safety data smooths outlier years of high or low collision rates, identifying locations with a history of roadway collisions and their patterns. For this project, four years of collision data, from January 1, 2014 through December 31, 2017, was analyzed. Collision reports and diagrams from Crossroads are included in Section 10.

4.3. Aerial and Street View Imagery

A broad, publicly-available resource, Google Earth and Google Street View provide recent satellite and ground-level imagery around the world. In addition to current conditions, Google Earth also provides a historical perspective on roadway configuration, construction activities and land use through the review of older satellite images, often dating back several decades. Using Google Earth aerial satellite and Street View imagery, roadway and adjacent land use characteristics for each of the study corridors and intersections were initially reviewed by traffic engineers to provide an overview of the roadway layout and connectivity to the street network. Roadway data gathered by Google imagery includes roadway widths, lane capacities, posted speed limits, median types, and driveway/cross-street density. Intersection data gathered by Google imagery includes traffic signal equipment configuration, adjacent driveways, and dedicated turn lanes.

4.4. Field Investigations

Following the data analysis and a preliminary imagery review, project engineers drove along the study corridors during various hours of the day to gain a comprehensive picture of existing traffic flows, lines-of-sight, pedestrian activity, driver behavior, and other factors relevant to big-picture, corridor safety analysis. Similarly, project engineers visited the study intersections, approaching each from both a motorist and pedestrian perspective.

4.5. Intersection and Roadway Risk Factors

The collision data analysis, aerial and street view imagery review, and field assessments focused on finding roadway, traffic, environmental, and human risk factors throughout the City.

Roadway Factors

Access Control – The number and location of driveways can affect arterial traffic flow and safety, especially when vehicles slow to enter driveways or in response to traffic merging from driveways. Generally, it is an advisable traffic safety practice to restrict driveways within 250 feet of an intersection to right-turn access only, reducing potential conflicts.

Bicycle Facilities – The provision of bicycle routes, lanes, detection, and push buttons at traffic signals are key to an effective active transportation system. Bicycle lanes can have a traffic calming effect on travel speeds along a roadway by narrowing the available roadway width dedicated to vehicles.

Grades – Significant grades can impact motorist visibility, vehicle speeds, and vehicle braking performance. Generally, intersections in Rialto have relatively flat approach angles and are therefore not considered a significant contributing factor to collisions in the City.

Number of Travel Lanes – Most arterials in the City are four lanes wide—with some roadways such as Foothill Boulevard having six lanes—with left-turn pockets at intersections. Unrestricted on-street parking is provided on many arterial streets in the City. Arterials providing freeway access generally have been widened near the interchanges to facilitate access to and from the freeways.

Pavement Markings – Proper pavement markings channelize traffic and heighten motorist awareness. For example, the use of “cat- track” striping through intersections can reduce sideswipe collisions for lane shifts and double left-turns. To maintain their effectiveness, pavement markings must be renewed frequently.

Pedestrian Path of Travel – Creating and maintaining clear, unobstructed pedestrian paths compliant with the Americans with Disability Act (ADA) is key. Gaps in sidewalks or missing crosswalks can motivate pedestrians to walk in or cross the street where it is not advisable to do so. Crosswalk markings and warning signs need to be well-placed and maintained to provide clear path delineation and maximum visibility.

Raised or Painted Medians – The City has a mix of arterial medians: some are comprised of painted lines, others are raised medians, and still others are landscaped medians. While some collectors have painted centerline striping, most residential roadways have no markings. Raised and landscaped medians generally serve to reduce head-on collisions, vehicle speeds, and turning-movement conflicts.

Roadway Construction – Roadway construction can play a role in crashes where motorists lose control and run off the roadway, rear-end other vehicles, or strike objects and parked cars. Maintenance issues such as potholes, glazing, rutting, and standing water can also lead to reduced handling and braking performance.

Roadway Geometrics – Horizontal and vertical curves, especially approaching intersections, can be difficult to navigate. In Rialto, the roadway network is organized in a grid pattern with few horizontal and vertical curves.

Signage – Unnecessary, missing, or unclear signage can confuse motorists or influence them to make poor choices. For example, a “No U-turn” sign posted at signalized intersections with left-turn phasing could instead lead motorists to make unprotected mid-block U-turns. Likewise, missing warning signs for crosswalks, merging lanes, or other roadway characteristics could result in collisions.

Street and Safety Lighting – Lighting is important at night as well as during foggy and other poor-weather conditions. Signalized intersections typically have four or more safety lights to illuminate crosswalks; however, wider streets may need more to provide uniform lighting for pedestrians, cyclists, and small vehicles. Mid-block street lighting is generally designed at about half the intensity of intersection lighting.

Utilities – Intersections with underground valves and vaults may require frequent lane closures for utility workers to access facilities or perform maintenance. Overhead wires and support poles can obstruct visibility of traffic signal indications, signage, pedestrians, and cyclists.

Traffic Factors

Traffic Signal Equipment – The number and placement of vehicle indications, the use of countdown pedestrian indications, the placement of push buttons, etc., all play a role in the intersection operation.

Traffic Signal Phasing & Sequencing – Traffic signal programming (permissive, protected-permissive, or fully protected left-turn arrows; right-turn overlap arrows; opposed phasing schemes; etc.) is important for efficient traffic signal operation. A traffic signal that is programmed to maximize vehicle arrivals on green has a reduced risk of rear-end collisions.

Traffic Signal Timing – Local traffic signal timing parameters such as pedestrian, yellow, all-red, and minimum green intervals are important in the safety of a signalized intersection. Whether pedestrian indications are manually activated or automatically operated can play a role in both pedestrian and motorist behavior.

Traffic Speeds – Appropriate speed limits based on Engineering and Traffic Surveys are essential for setting traffic signal timing parameters and designing lane striping transitions. Roadways with lower travel speeds may have fewer severe injury collisions; however, arbitrarily setting low speed limits can create speed variations that may contribute to higher collision rates.

Traffic Volumes – The total volume of traffic carried by a roadway has a direct relationship to anticipated crash risk. Roadways with good traffic flow can accommodate high volumes of traffic safely; however, as congestion increases, so do stops and wait times at traffic signals, increasing as motorist frustration and distraction.

Transit – Public transit can facilitate movement in the City; however, large transit vehicles can also block visibility, accelerate/brake slowly, and make wide slow turns, disrupting traffic flow. Location of bus stops and frequency of service can also have an impact on traffic operations and pedestrian crossing activity.

Human Factors

Age – Older and younger drivers typically fall into higher risk groups. Older drivers may have reduced reaction and perception times, vision, and physical flexibility. Younger drivers typically lack experience, take more risks, and may have poor judgment. We look for elevated collision rates for younger drivers near schools, parks, and entertainment areas, and for older drivers near senior centers and medical facilities.

Aggressive Driving – Driving too fast for conditions, exceeding speed limits, not signaling while passing or turning, and risk taking can all lead to higher collision risks. Although aggressive driving is not typically indicated in collision reports, it may be a factor when speeding or merging are noted.

Driver Impairment – Driving while under the influence of medications, alcohol, marijuana, or other drugs can reduce driver attention, reaction times, and judgment. Another driver impairment often overlooked because it is difficult to assess is the effect of fatigued driving from either driving for extended periods or lack of sleep.

Driver Inattention – Distracted drivers do not give sufficient attention to driving, thus leading to crashes. In recent years, distracted driving seems to be on the rise primarily due to the proliferation of personal mobile devices as well as integrated in-vehicle entertainment and navigation technology.

Environmental Factors

Land Use – Land use can have a profound impact on traffic flows and patterns. For example, intersections adjacent to schools may have brisk activity during periods of student arrivals and departures on school days. Conversely, industrial and warehousing are generally busy during morning and early afternoon hours, but have low activity during evening peak periods and weekends.

Sun / Shadows – The rising or setting sun on the horizon can significantly reduce driver visibility of stopped or conflicting traffic, leading to increased broadside and rear-end crashes. Likewise, large trees and buildings that cast shadows on the roadway at various times of the day or months of the year can also obscure vehicles, pedestrians, and cyclists.

Weather – Southern California doesn't experience much of the extreme weather conditions that others in the country face. Although snow isn't a problem, other weather conditions such as high winds, fog, extreme heat, and occasional rain can lead to elevated crashes.

4.6. High-Risk Corridor Selection

Through the SSARP funding application process, City staff initially identified five high-risk corridors for future study. Those five corridors are Riverside Avenue, Foothill Boulevard, Baseline Road, Cedar Avenue/Ayala Drive, and Eucalyptus Avenue. In reviewing the issuance of a contract for this study, City Council also requested that Casmalia Street be specifically included as a corridor of study primarily due to a recent spike in collisions and the new and continuing development along the street. As a part of the citywide systemic analysis that was conducted by AGA a seventh corridor, Cactus Avenue, was added due to its high incidence of collisions, particularly a high frequency of broadside collisions. The corridors identified for this study are given in **Table 2**.

4.7. High-Risk Intersection Identification

From the four-year collision history (2014-2017), a list of the top 50 collision-prone intersections was compiled by number of collisions. Based on the overall collision frequency, the top ten collision-prone intersections in the City of Rialto were selected for further study. In addition, since the top ten intersections were already signalized, the Top-50 list was evaluated to identify the most collision-prone unsignalized location as well. Finally, in reviewing field conditions for the top collision-prone intersections, a twelfth location was chosen based on intersection geometry. The study intersections are given in **Table 3.**

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Table 2: Study Corridors

	Roadway	Limits	Length (mi)
1	Riverside Ave	south City limit - north City limit	12
2	Foothill Blvd	west City limit - east City limit	3.1
3	Baseline Rd	west City limit - east City limit	3.4
4	Cedar Ave / Ayala Dr	Randall Ave - Riverside Ave	4.7
5	Cactus Ave	Valley Blvd - Riverside Ave	5.2
6	Eucalyptus Ave	Rialto Ave - Easton St	2.9
7	Casmalia St	Cedar Ave - Spruce Ave	2.8

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Table 3: Study Intersections

	Intersection	No. Incidents	Reason for Selection
1	Cedar Ave @ Merrill Ave	37	Top 10 High-Frequency Collision Location
2	Pepper Ave @ Foothill Blvd (Caltrans)	28	
3	Riverside Ave @ Valley Blvd	27	
4	Riverside Ave @ I-10 (Caltrans)	25	
5	Cedar Ave @ Foothill Blvd	23	
6	Riverside Ave @ Baseline Rd	22	
7	Eucalyptus Ave @ Baseline Rd	20	
8	Foothill Blvd @ Riverside Ave	20	
9	Foothill Blvd @ Sycamore Ave	20	
10	Riverside Ave @ Easton St	20	
11	Riverside Ave @ Third St	8	Most Collisions at Unsignalized Location
12	Riverside Ave @ Merrill Ave & Bloomington Ave	17	Top-15 Location w/ Nonstandard Geometry

Data: City Crossroads database, 2014-2017

5. Data Analysis Results and Findings

5.1. Statewide Safety Ranking

Every year, the California Office of Traffic Safety (OTS) evaluates cities based on the number of persons injured or killed in traffic incidents as reported through a statewide database. The OTS data for the City of Rialto from 2011 to 2016 generally show increases in injuries and fatalities over recent years. In fact, the total number of traffic injuries and fatalities in the City has nearly doubled over this six-year period (**Figure 2**). Injuries and fatalities related to alcohol-involved incidents, speeding incidents, and nighttime incidents are also on upward trends.

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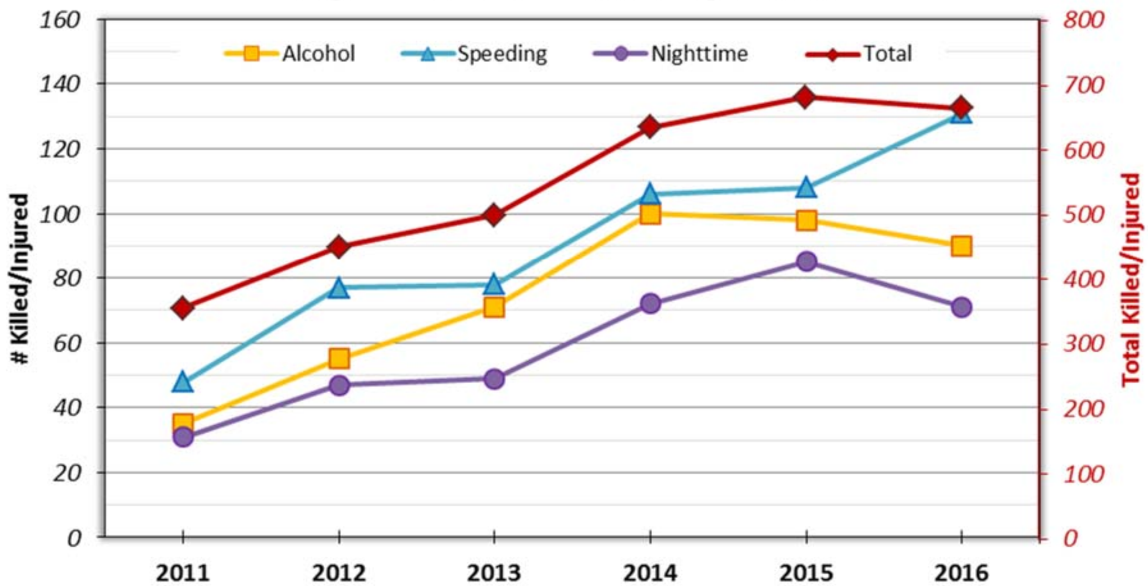
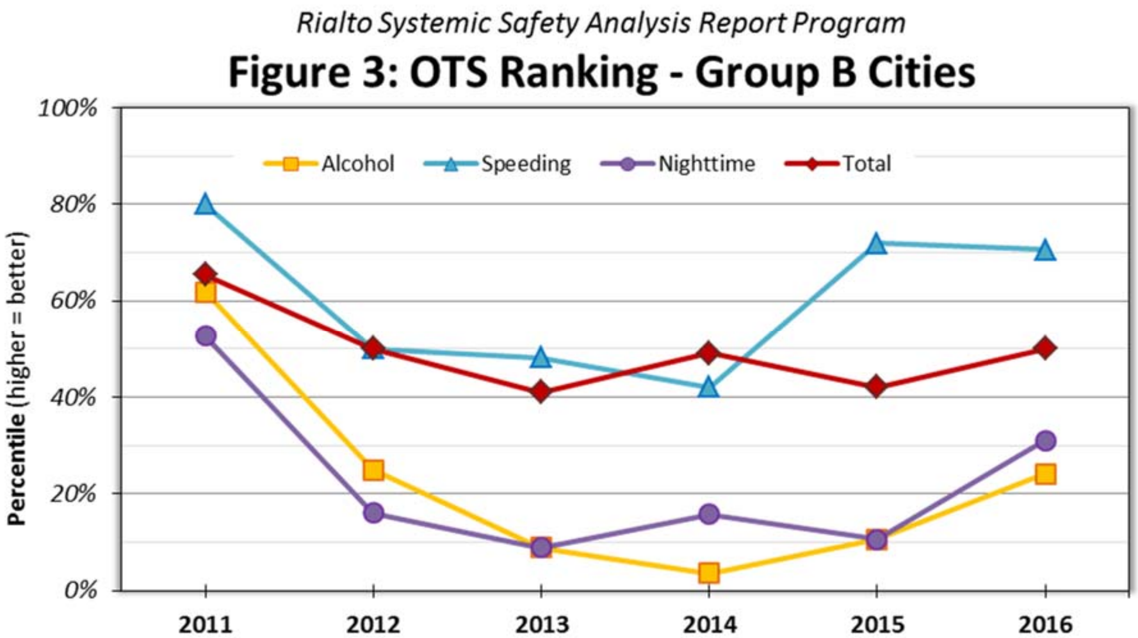
Figure 2: OTS Ranking Data



Although the overall number of persons killed or injured has been generally increasing in the last few years, the City of Rialto has maintained a ranking within the median quintile of its cohort cities (Group B populations) for the last five years (**Figure 3**). This implies that traffic injuries and fatalities may also be trending upward statewide. Although it is certainly not desirable to see more lives impacted by traffic injuries, this does indicate that the overall trend in the City of Rialto is not out of the ordinary.

Despite its average ranking in total injuries/fatalities, the City of Rialto has ranked in the bottom 30th percentile of its cohort cities for five of the last six ranked years in alcohol-related and nighttime incidents. These are likely highly correlated statistics, as a high percentage of alcohol use and alcohol-related activities occur at night. Low lighting conditions and fatigue also contribute to DUI collisions as well as speeding and drowsy-driving collisions.



5.2. Citywide Trend Analysis

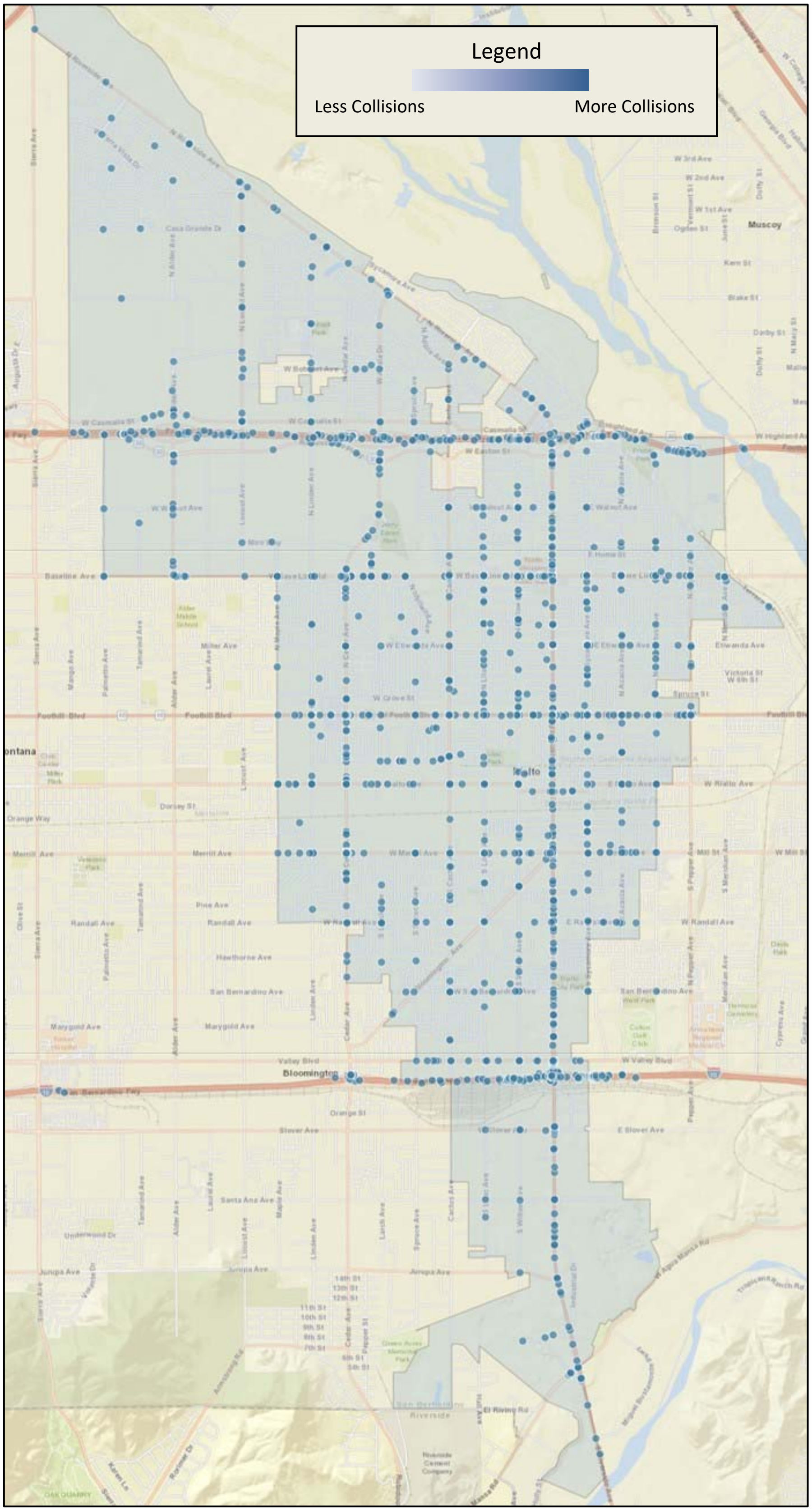
Collision patterns and trends in the citywide data were analyzed by evaluating the following collision attributes:

- Collision locations (heat map)
- Collision severity
- Collision type
- Primary collision factor
- Age demographics of parties involved

Traffic Collision Heat Map

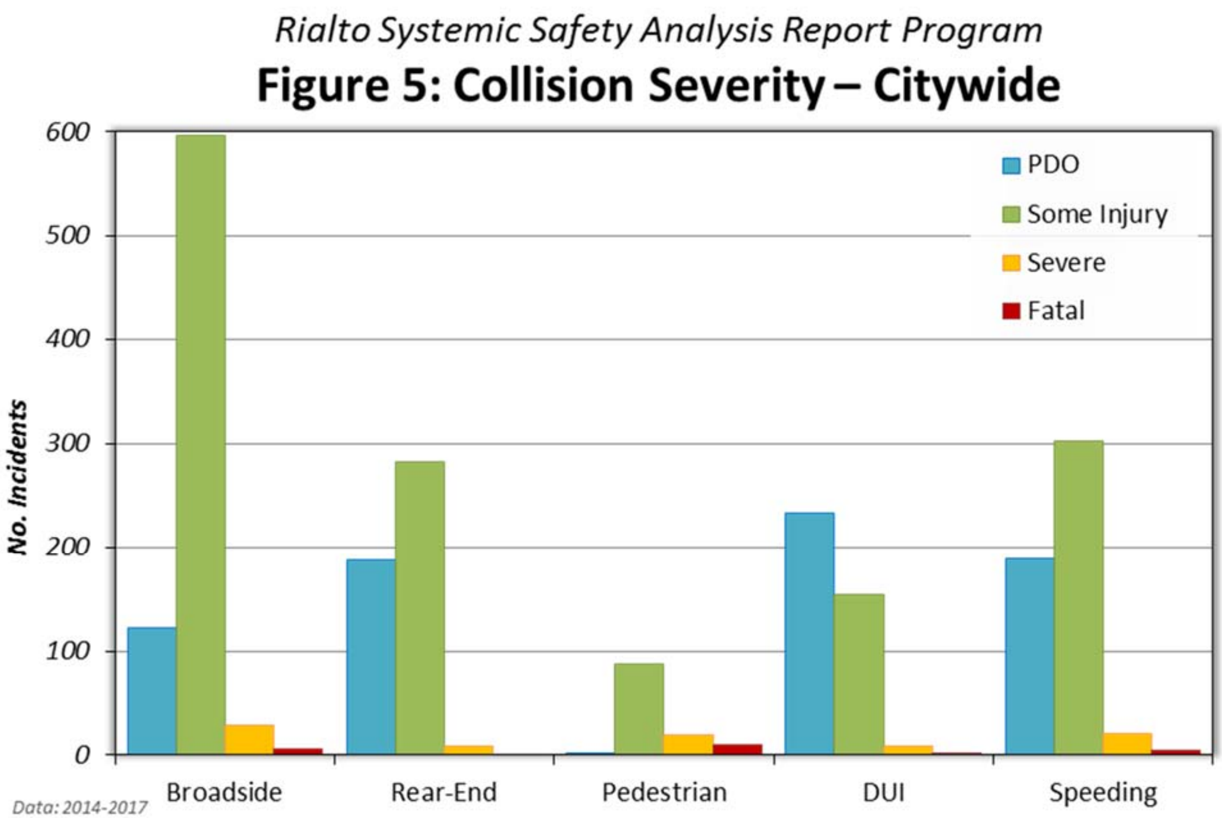
SafeTREC, in collaboration with the University of California at Berkeley, created a geocoded collision database known as the Transportation Injury Mapping System (TIMS), which is accessible online. Using recent SWITRS data, a traffic collision heat map was generated via the TIMS webtool (**Figure 4**). Traffic collision occurrence patterns in the City of Rialto follow typical traffic flow patterns, with many incidents occurring along arterial roadways such as Baseline Road, Foothill Boulevard, and Riverside Avenue, as well as a prevalence of freeway incidents on the I-210 and I-10 freeways.

Figure 4: City of Rialto Traffic Collision Heat Map (TIMS, 2014-2017 data)



Collision Severity

Generally, traffic incidents occurring in the City of Rialto are low-severity, with about 34% of reported incidents having property damage only (PDO), about 61% having minor injury or complaint of pain, and about 5% of incidents studied having severe or fatal injuries. That is, of the 2,197 incidents collected in the four-year study period, 23 involved a fatality and 24 people lost their lives. **Figure 5** shows the collision severity proportions for the top two collision types (broadsides and rear-ends) as well as for typical injury-prone incident types such as pedestrian incidents, DUI incidents, and speeding incidents.



Top Collision Types

Broadside collisions were the most common in Rialto within the four-year study period, with over 750 recorded incidents, or about 34% of all collisions. It is followed by rear-end collisions at 22% and hit-object collisions at 14%. Collisions involving pedestrians, which are often a particular safety concern, are relatively low in the City of Rialto, comprising about 5% of the data. The project team also noted that over 450 incidents were recorded as hit-and-run collisions, or nearly 22% of all collisions studied.

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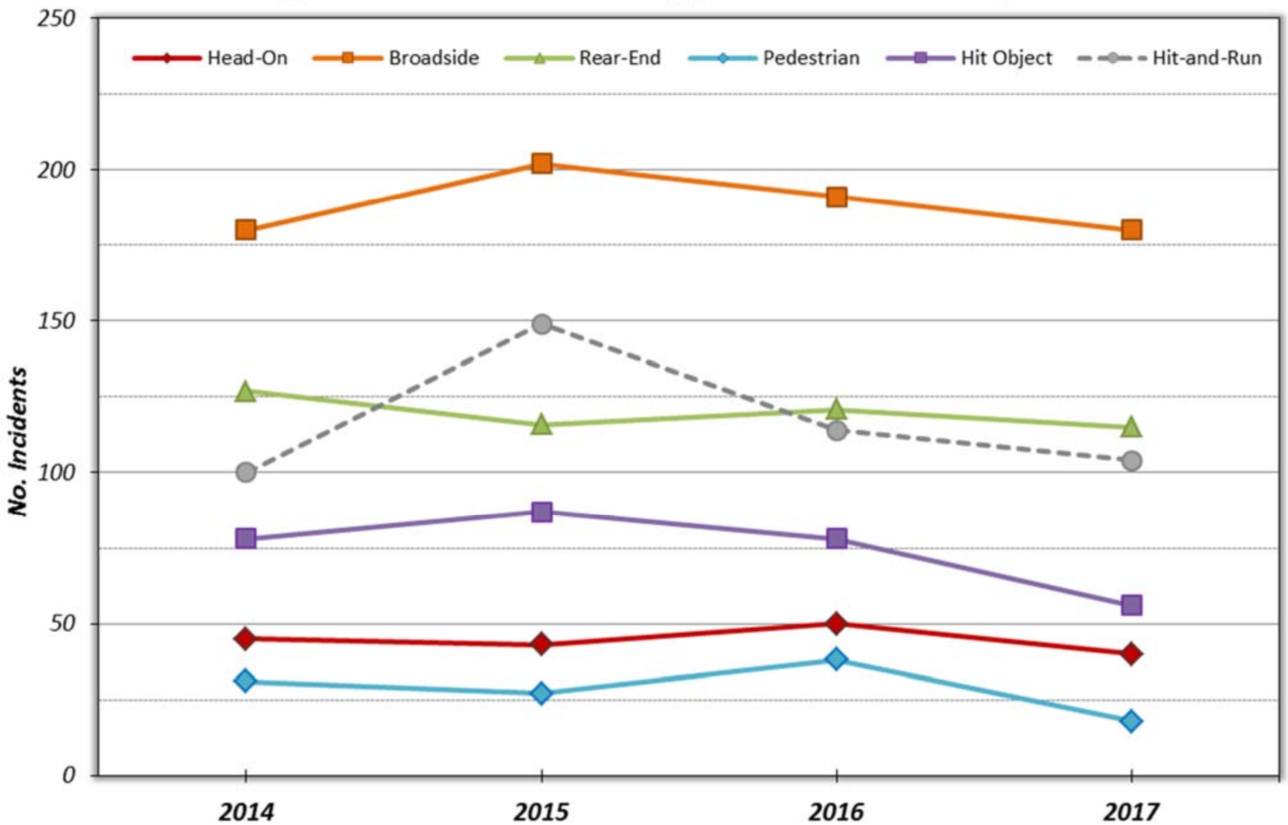
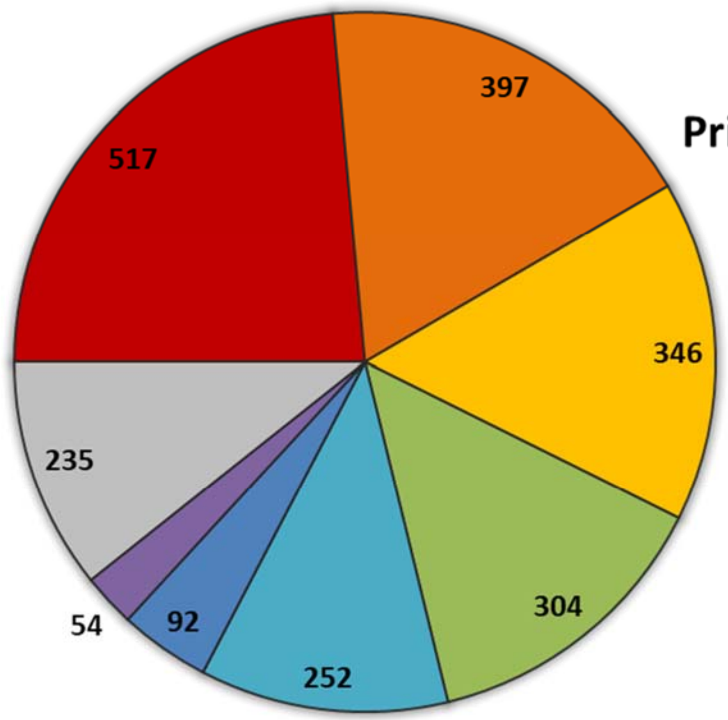
Figure 6: Collision Type Trends – Citywide



Top Primary Collision Factors

Collision records that note the primary collision factor are useful in providing insight into the causal and contributing factors to a collision. Within the study data, less than 3% of incidents were noted with an "unknown" primary collision factor, which is indicative of a commendable effort by local police officers and investigators to thoroughly assess incidents.

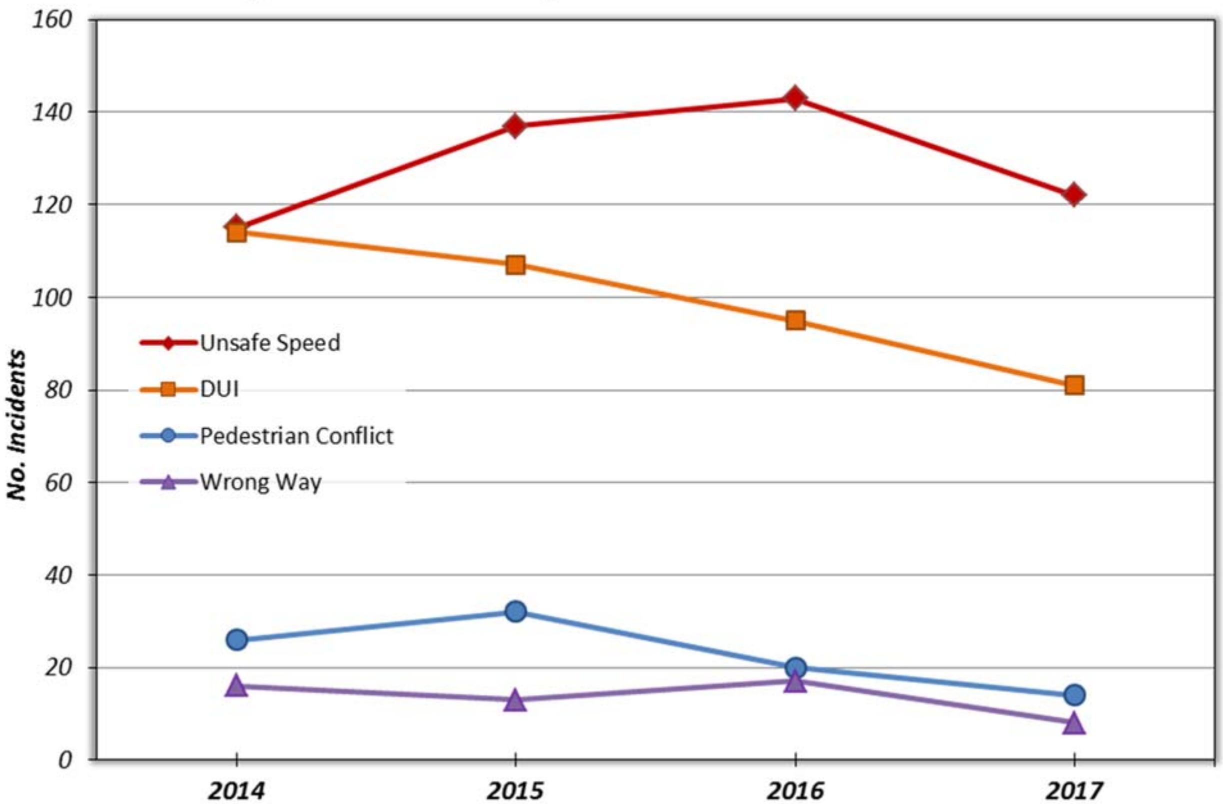
The top primary collision factor in the City of Rialto is unsafe vehicle speeds, which may often involve speeding. Unsafe speed is determined to be a speed inappropriate for the condition at the time, whether it be clear or inclement weather, free-flow or congested traffic conditions. Within the study period, over 500 collisions were recorded with speeds being the primary collision factor, or nearly 25% of collisions studied (**Figure 7**). The second-most prevalent primary collision factor was Driving Under the Influence (DUI) at 18%. However, the analysis also revealed that DUI collisions are steadily declining over time (**Figure 8**).



Rialto SSARP
Figure 7: Primary Collision Factors

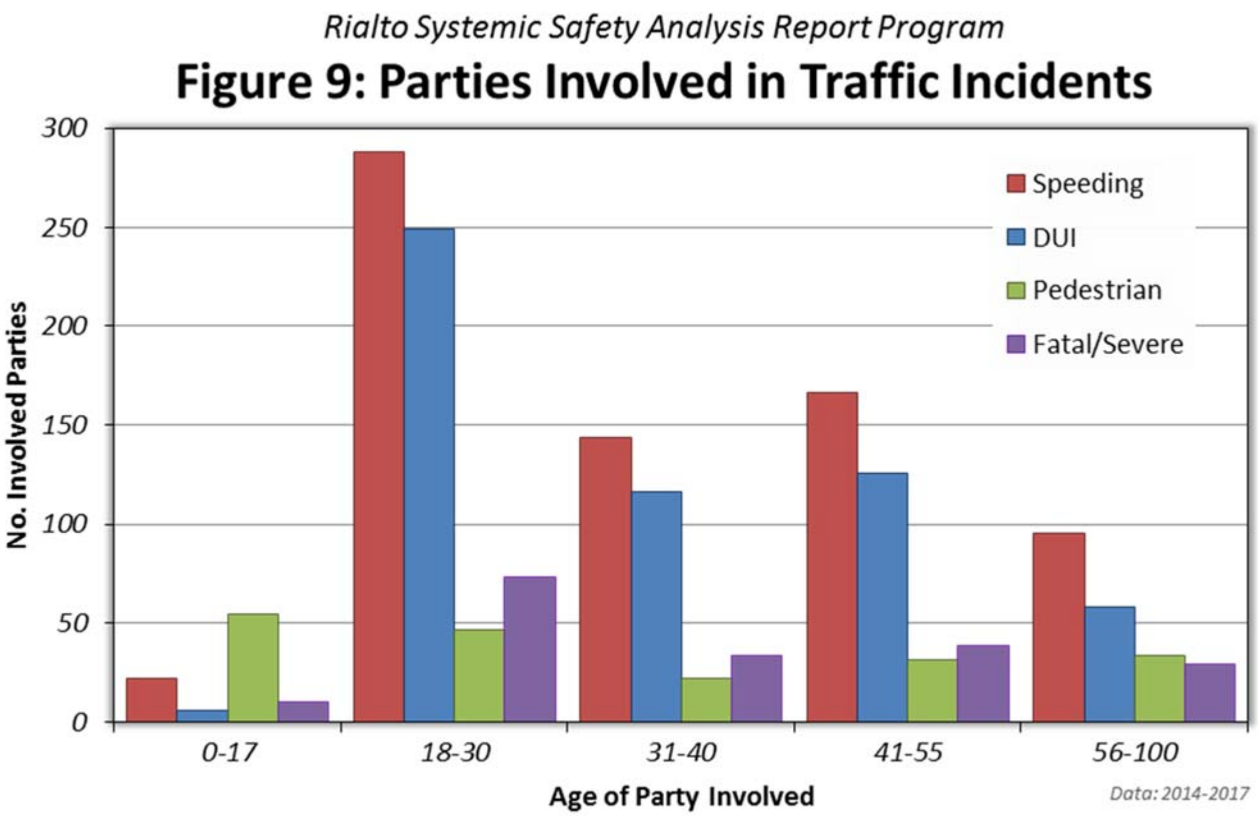
Rialto Systemic Safety Analysis Report Program

Figure 8: Primary Collision Factor Trends



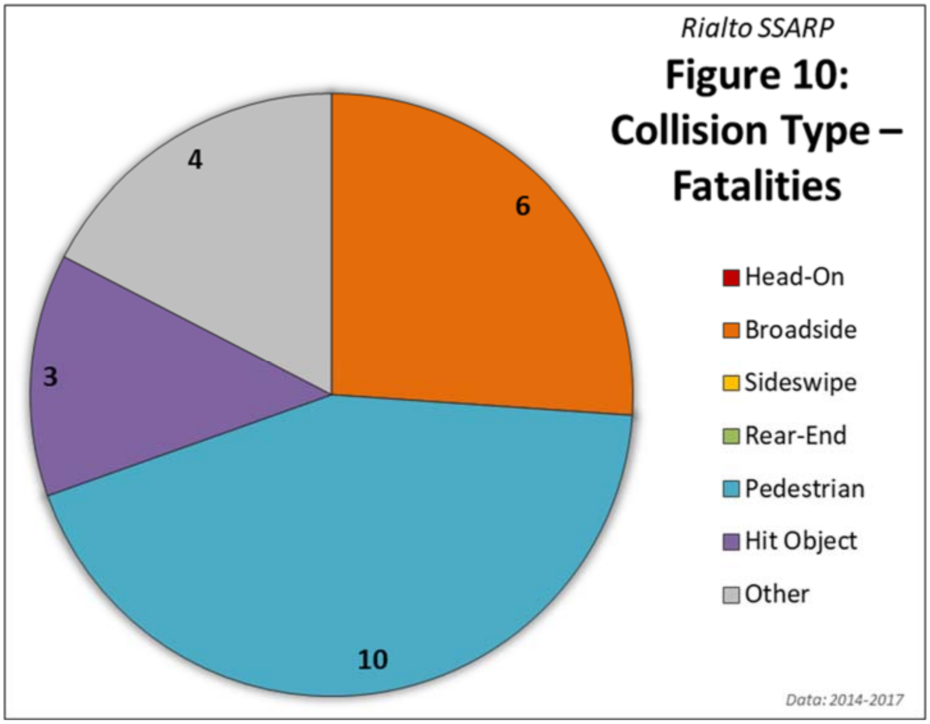
Demographics of Parties Involved

The four-year historical collision records list 3,212 parties involved in traffic incidents within the City of Rialto, or an average of 1.5 parties per incident. This number includes both at-fault and not-at-fault drivers, bicyclists, and pedestrians involved in collisions. The data analysis shows no undue safety issue affecting school-age children or minors; however, the project team did note that nearly two in five involved parties were between the ages of 18-30. This young-adult demographic would have fewer years of driving experience than middle-aged or elderly persons, and is typically associated with poor driving habits such as speeding, DUI's, drowsy driving, and recklessness. **Figure 9** illustrates the age groups studied by the types of collisions they were involved in.



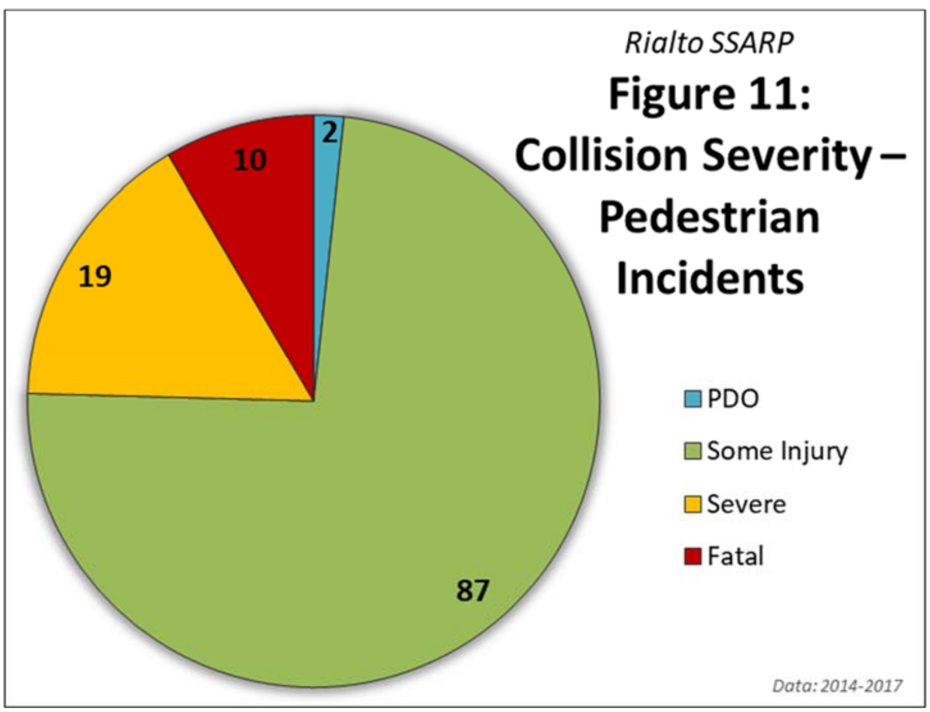
5.3. Fatalities

Within the four-year study period, 23 collisions resulted in a fatality, with 24 people losing their lives in traffic collisions. This equals an average rate of six traffic fatalities per year, or about one every other month. Of the 23 fatal collisions studied, ten were pedestrian collisions (**Figure 10**). Pedestrians (and bicyclists, for similar reasons) are some of the most vulnerable roadway users, as they have little to no protective equipment compared to motorists (i.e. airbags, seatbelts, cushioned seats, or helmets).



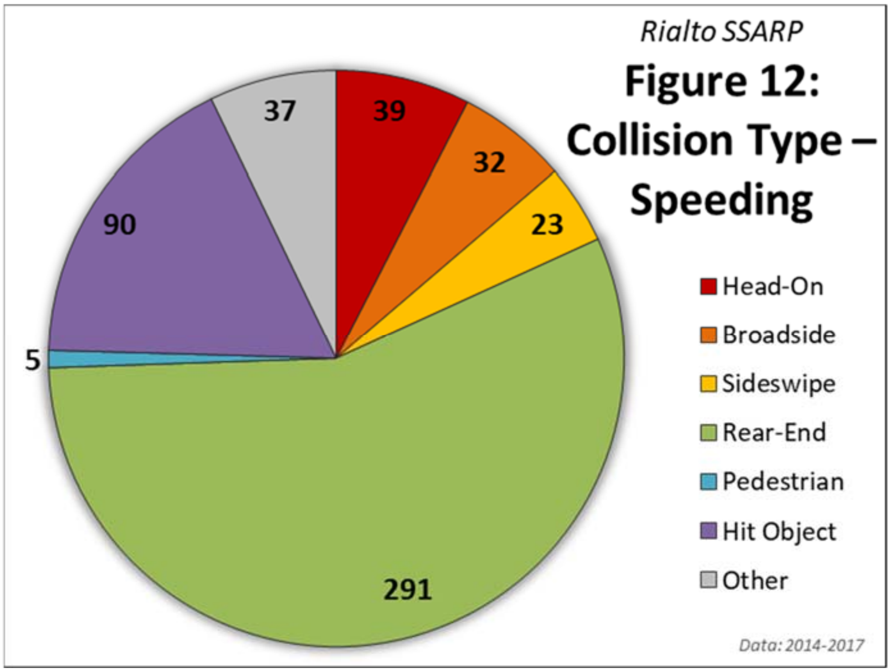
5.4. Pedestrian Collisions

Pedestrian incidents tend to occur near schools and parks, and many involve school-age children. Within the four-year study period (2014-2017), 118 collisions were recorded that involved one or more pedestrians, with 10 resulting in a fatality and 19 in severe injuries (**Figure 11**). This equals approximately thirty pedestrian collisions per year, on average, with over 75% resulting in minor injuries.

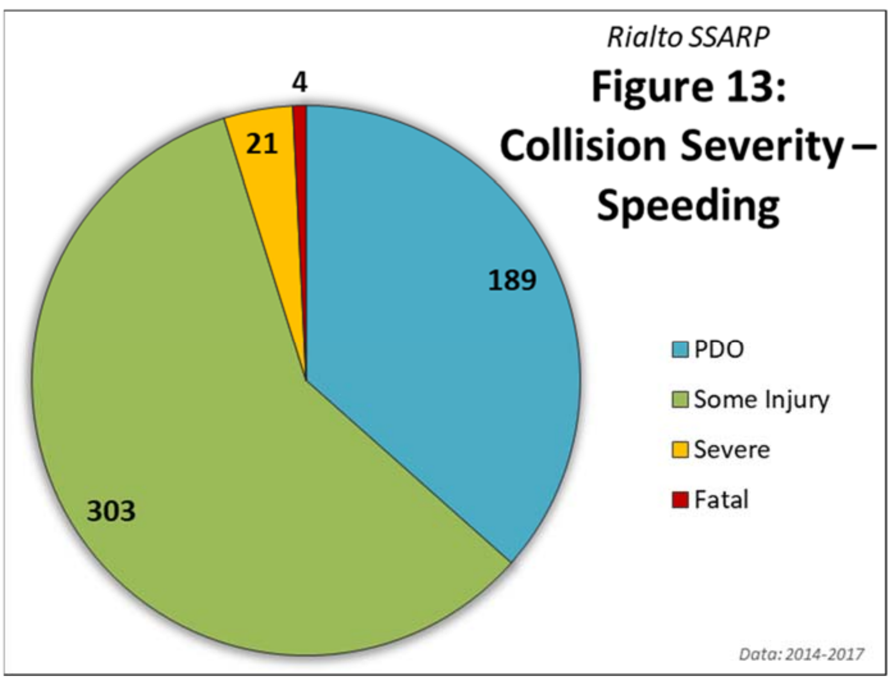


5.5. Speeding Collisions

The #1 primary collision factor within the City of Rialto, cited in over 500 collisions—or nearly 24% of incidents recorded during the four-year study period, is unsafe speeds (or speeding). Of these speed-related collisions, over half (56%) were rear-end collisions (**Figure 12**). This would seem to indicate that a majority of speeding collisions occur when a motorist is traveling faster than the general stream of traffic.

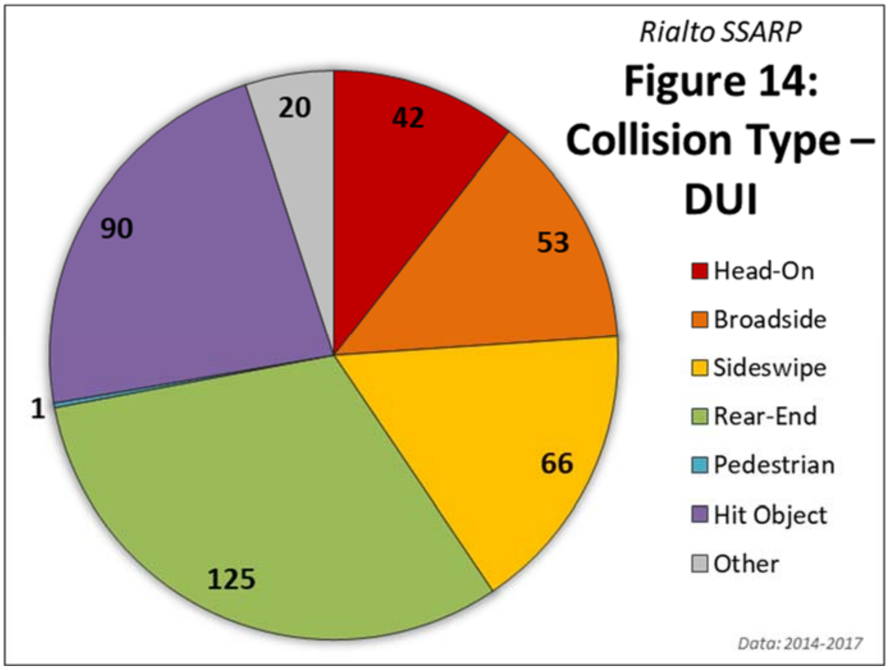


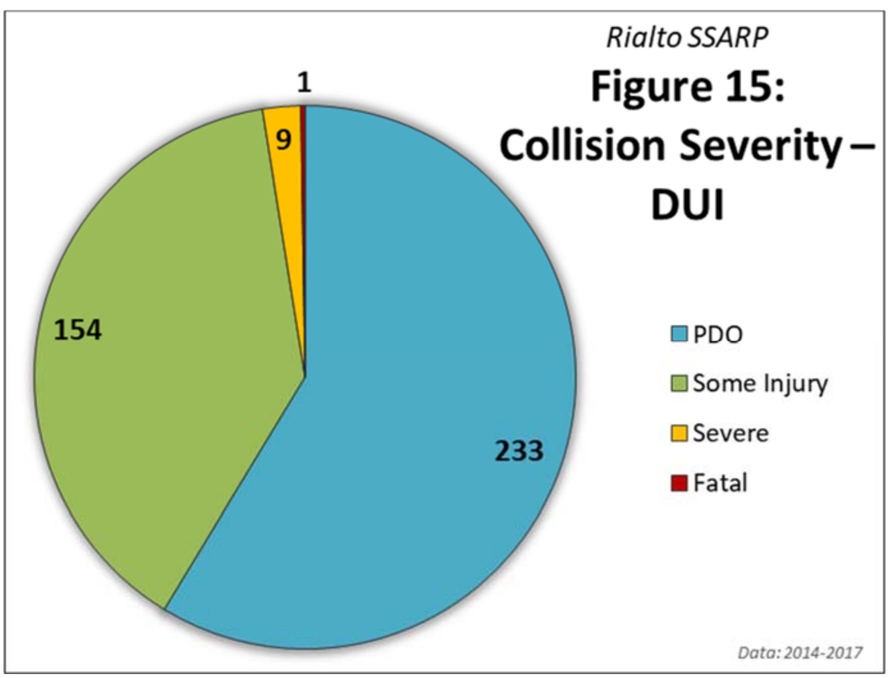
Although the vehicle travel speeds prior to a collision are generally correlated to the severity of injuries from the incident, very few speeding collisions studied (less than 5%) resulted in severe or fatal injuries (**Figure 13**).



5.6. DUI Collisions

Driving Under the Influence (DUI) applies to any driver whose perceptions, reactions, and other functions are affected by a substance taken into the body. Although most commonly referring to alcohol-inhibited drivers, this may also extend to drivers using or abusing recreational or medical drugs. In the City of Rialto, DUI was the #2 primary collision factor during the four-year study period, with nearly 400 recorded collisions (18%). These incidents were most frequently rear-end collisions (32%), followed by hit-object collisions (23%) (**Figure 14**). Of the DUI collisions recorded, less than 3% resulted in a severe or fatal injury (**Figure 15**).

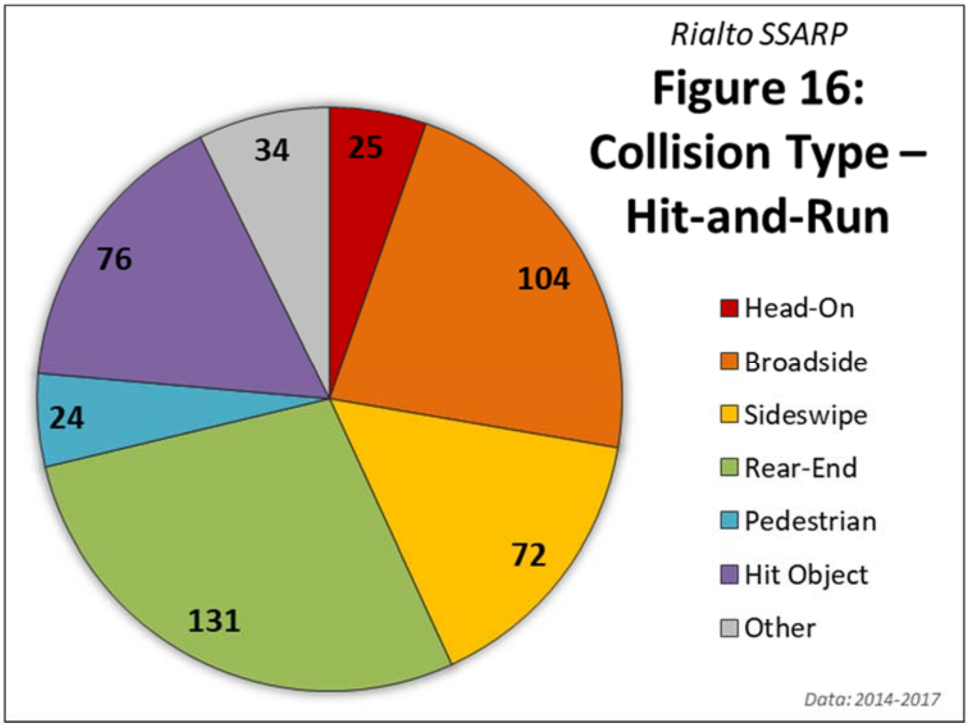




5.7. Hit-and-Run Collisions

A review of the collision data also found that over 20% of the incidents recorded in the City of Rialto during the four-year study period (2014-2017) were hit-and-run collisions, where the at-fault party who initiated or caused the incident departed the scene following the collision. Although this occurrence is not related to the contributing factors of the collision, hit-and-run incidents may lead to reckless or risky motorists driving off with possible injury or unsafe vehicle damage.

Hit-and-run incidents recorded in the study vary broadly by type, generally following Citywide collision patterns of broadsides (22%) and rear-ends (28%) prevailing (**Figure 16**). However, the study did note that 24 hit-and-run incidents involved pedestrians, who tend to sustain greater injuries in traffic collisions.



Some possible motivators for hit-and-run perpetrators may include lack of a valid license or insurance. It is important (and lawful) for all drivers to maintain both an active, valid driver's license and liability auto insurance—and carry proof of both—while operating a motor vehicle in the state of California at all times.

6. High-Risk Corridors

The City's original RFP identified five City corridors for study: two east/west corridors and three north/south corridors that travel through different sectors of the City:

- Riverside Avenue, which forms the central spine of the City and provides freeway access;
- Foothill Boulevard, which forms part of the State highway network;
- Baseline Road, a major regional arterial roadway;
- Cedar Avenue / Ayala Drive, which facilitates freeway access in the western portion of the City; and
- Eucalyptus Avenue, which has recently seen several severe collisions.

Following the RFP, the City Council added Casmalia Street to the study in the interest of future-proofing the corridor for upcoming development projects and anticipated growth. Finally, upon initial review of the collision history data, AGA project engineers also added Cactus Avenue to the study based on collision patterns and frequency. Ultimately, seven corridors were analyzed as detailed in **Table 4** below, shown in **Figure 17**, and discussed in the following pages:

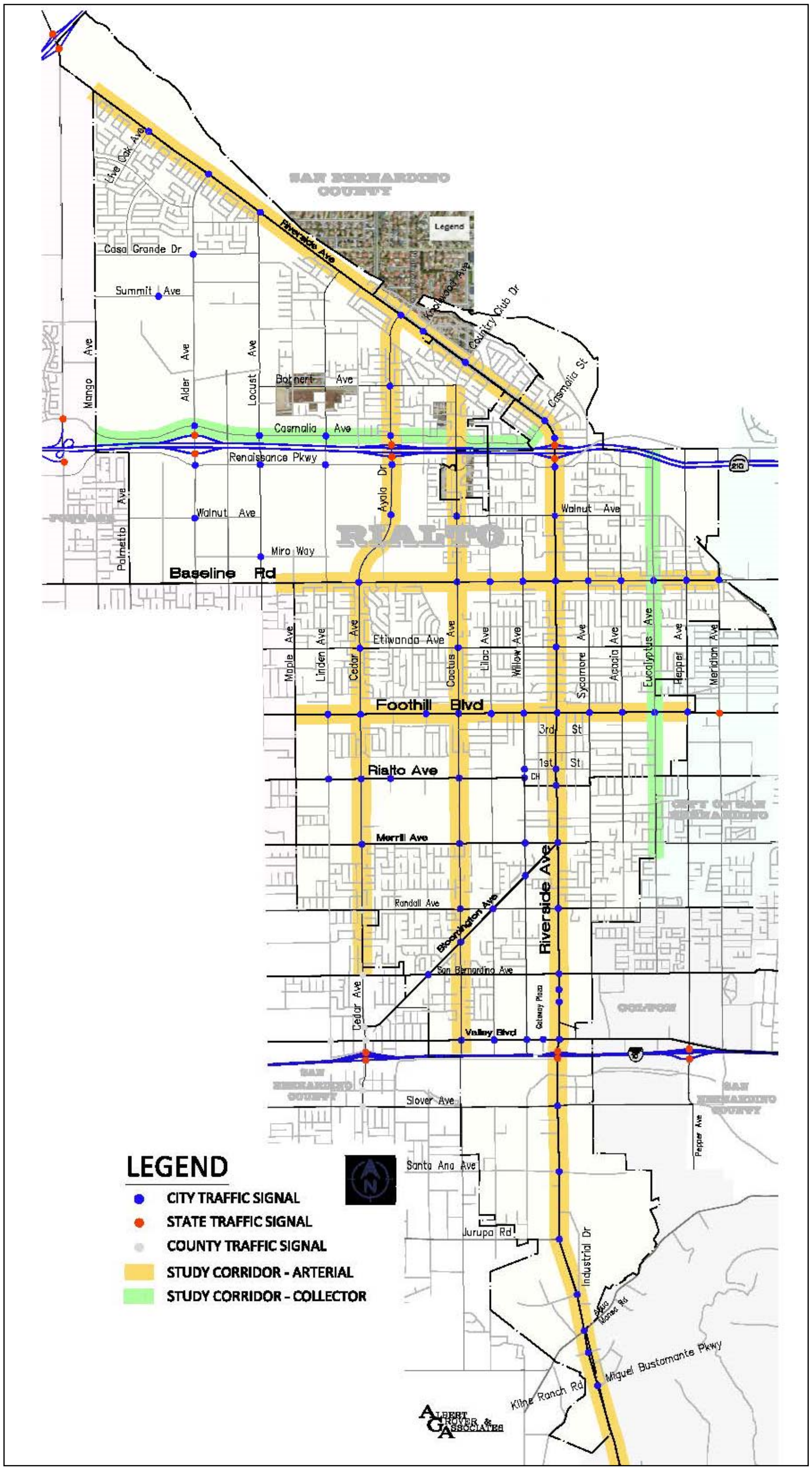
Rialto Systemic Safety Analysis Report Program

Table 4: Study Corridor Collision Rates

	Roadway	Limits			Length (mi)	Number of Incidents	Collision Rate /mi	Collision Rate /mi-yr
1	Riverside Ave	south City limit	-	north City limit	12	466	38.8	9.71
2	Foothill Blvd	west City limit	-	east City limit	3.1	277	89.4	22.3
3	Baseline Rd	west City limit	-	east City limit	3.4	226	66.5	16.6
4	Cedar Ave / Ayala Dr	Randall Ave	-	Riverside Ave	4.7	189	40.2	10.05
5	Cactus Ave	Valley Blvd	-	Riverside Ave	5.2	103	19.8	4.95
6	Eucalyptus Ave	Merrill Ave	-	Easton St	2.9	57	19.7	4.91
7	Casmalia St	Alder Ave	-	Riverside Ave	2.8	29	10.4	2.59

Data: City Crossroads database, 2014-2017

Figure 17: Study Corridors



6.1. Riverside Avenue

Number of Collisions: 466

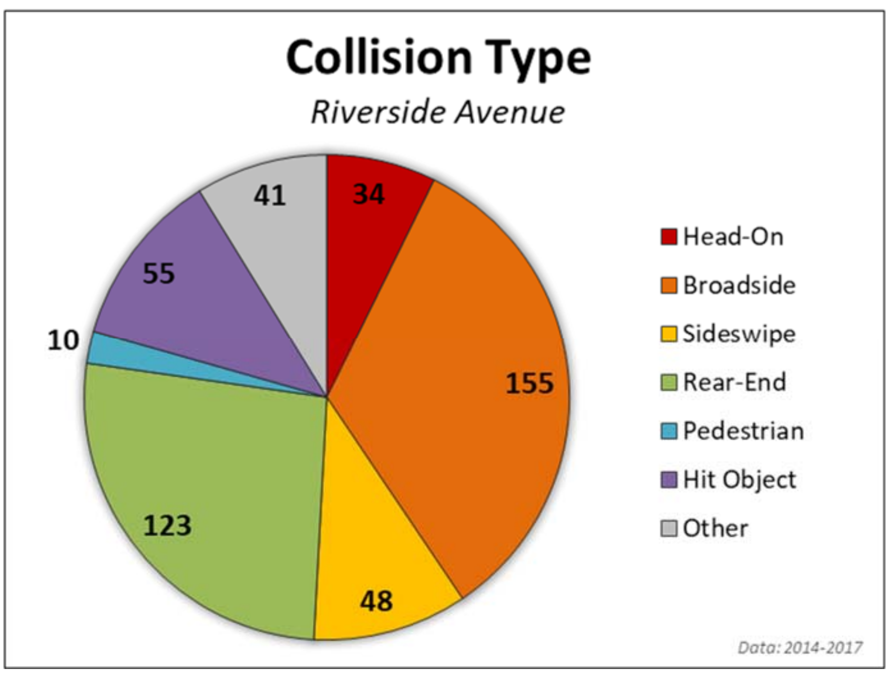
Riverside Avenue is a north/south arterial roadway classified in the City's General Plan as a Major Arterial, except for the Historic Downtown District between Foothill Boulevard and the BNSF railway just south of Rialto Avenue, where it is classified as a Modified Major Arterial II. Throughout the City, Riverside Avenue varies from two to three lanes per direction, with posted speed limits ranging from 30 mph to 55 mph. Spanning 12 miles in the City of Rialto, it terminates at Sierra Avenue to the north, while to the south it continues into the City of Colton.

As a regional roadway, Riverside Avenue provides access to the I-10, I-210, and I-15 freeways, while also featuring the historic Downtown Rialto commercial district, between Foothill Boulevard and Rialto Avenue. North of the I-210 freeway, land uses adjacent to Riverside Avenue are mostly residential, while land uses near to and south of the I-10 freeway are largely industrial.

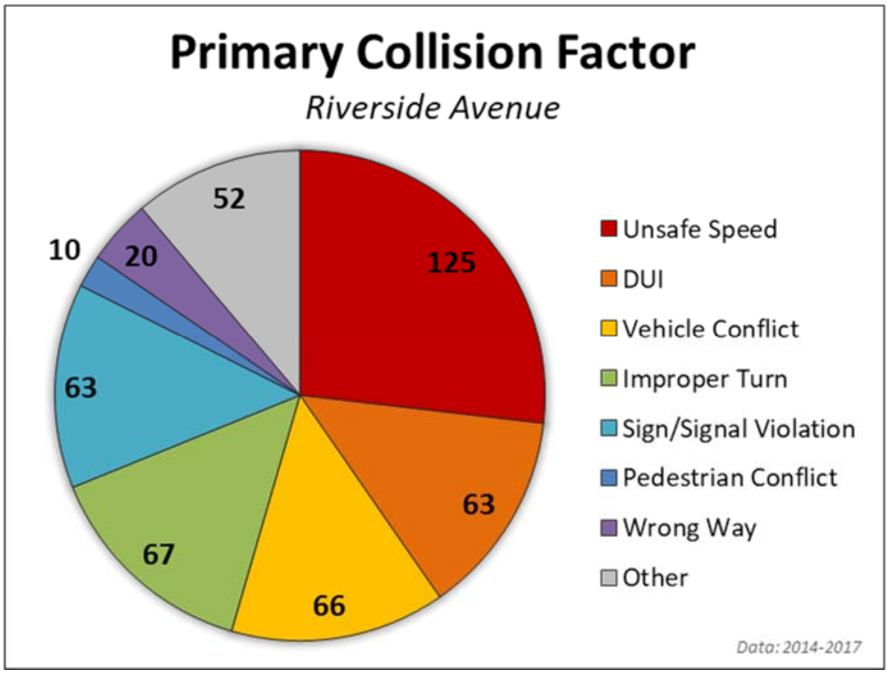
Corridor Collision Patterns

Riverside Avenue is not only the longest street in the City is it also the most collision prone, with one in five—or 20%—of all collisions in the City. Collision data over the four-year study period (2014-2017) shows a total of 466 collisions along this corridor, including intersection-related collisions. On average, this is equal to about 40 collisions per mile, or about ten collisions per mile per year.

Along Riverside Avenue, broadside collisions are the most prevalent; however, under further investigation only about 4% of those broadside crashes result in severe injuries or fatalities (see figure below, details in **Appendix C**). This trend is atypical, in that broadside crashes are generally the most violent and generate the most injuries. Additionally, we typically see higher broadside collision rates in areas where traffic signals are not equipped with left-turn arrows; however, many traffic signals along Riverside Avenue are equipped with left-turn arrows, providing the highest level of safety.



The collision pattern analysis also found a higher-than-normal percentage of collisions along Riverside Avenue happening at night, with unsafe speed being the most prevalent collision factor (see figure below, details in **Appendix C**). The second most prevalent collision type is rear-end collisions, a fairly typical pattern for a major arterial like Riverside Avenue. Another noteworthy characteristic is the low pedestrian collision rate in consideration of the prominence of the street, traffic volumes, and width of the roadway.



Segmentation

In consideration of the length of Riverside Avenue and its diverse land use and traffic characteristics, the engineering team felt it would be best to divide the corridor into the following four segments for further study:

A	Riverside Avenue south of I-10	2.6 miles
B	Riverside Avenue from I-10 to Foothill Blvd	2.0 miles
C	Riverside Avenue from Foothill Blvd to I-210	2.6 miles
D	Riverside Avenue north of I-210	4.8 miles

The four segments have very different roadway, traffic, and land use characteristics. Riverside Avenue south of the I-10 primarily serves an industrial area that is linked to the I-10 freeway. North of the I-10 up to Foothill Boulevard, the roadway is configured in a traditional grid pattern of short blocks and serves a mix of commercial, retail, and higher-density residential. This segment also includes the historic downtown with its expansive center median, store fronts, and pedestrian amenities. North of Foothill Boulevard up to the I-210 freeway, the roadway serves a more traditional suburban layout of lower-density single family home frontages with commercial shopping at major intersections. North of the I-210 freeway, the road curves from its north-south orientation to a northwest-southeast orientation and becomes a higher-speed arterial through a residential area with frontage roads, limited access, and long blocks.

By analyzing collision data for the four roadway segments separately, very different characteristics and patterns emerge. For example, segment B had the highest collision rate (nearly 25 collisions per mile per year), while in segment D the rate was 3.65 collisions per mile per year (or 85% lower). Other differences include an elevated frequency of hit-object collisions combined with a low frequency of rear-end collisions in segment A, where truck traffic is prevalent, to the opposite in segments B and C, where one in three collisions are rear-ends and there are few hit-object collisions. There were some similarities as well, such as unsafe speed being the top primary collision factor in all four segments. Collison statistics for all segments are given in **Appendix C**.

Recommendations

Based on the systemic collision analysis, the engineering team has developed the following recommendations:

1. <u>Consistent Speed Zoning:</u>

Riverside Avenue has speed limits varying from a low of 30 mph in the historic downtown to a high of 55 mph south of the I-10 freeway. Since unsafe speed is a consistent collision factor throughout the corridor, it is suggested that the City normalize speed limits by reducing the top speed limits. The engineering team does not suggest raising the speed limit in the historic downtown; rather, the speed zone segments with posted speed limits over 40 mph could be targeted for traffic calming measures. The California Vehicle Code (CVC) and Caltrans' procedures for setting speed limits severely limit the ability for cities to reduce speed limits. Since vigorous radar enforcement is a key component of any successful traffic calming strategy, it is suggested that speed reduction measures be pursued first to allow subsequent speed limit reductions.

The engineering team does not recommend arbitrarily lowering speed limits by City Council action, since that would preclude speed zone enforcement by the use of radar. Therefore, we recommend a coordinated effort to enhanced speed limit signage and markings, installation of strategically placed permanent speed feedback signs, and increased enforcement presence in an effort to calm traffic speeds. That coordinated effort should be followed by a resurveying of speed limits by an engineering firm experienced in matching roadway characteristics and posted speed limits. Hopefully, that firm will be able to recommend strategic downward speed zoning consistent with CVC and Caltrans procedures and be acceptable to the courts. Such a coordinated engineering and enforcement strategy has been successful in other cities in calming traffic speeds, lowering speed limits, and reducing crash frequencies.

2. <u>Street and Safety Lighting:</u>

Riverside Avenue segments A (south of I-10) and C (between Foothill Blvd & I-210) have higher-than-expected nighttime collision rates; therefore, these two segments may benefit from additional street and safety lights or higher wattage fixtures. South of the I-10 freeway, street lighting is inconsistent from block to block with some areas well-lit and others having the absence of street lights. Between Foothill Boulevard and I-210 freeway there are many LED street lights; however, intersection safety lighting could be enhanced. Typically, traffic signals are equipped with four safety lights; however, some older intersections in the City are equipped with only two safety lights. Some of the City's larger intersections could benefit from six or eight safety lights to provide consistent intersection lighting coverage rather than just the regular four safety lights, which could lead to sporadic lighting coverage and dark areas. It is suggested the City review street and safety lighting along Riverside Avenue, with particular attention to intersections and areas without street lights to enhance nighttime roadway lighting as a countermeasure to reduce the risk of nighttime collisions.

3. <u>Traffic Signal Operations:</u>

As a result of its design and configuration, Riverside Avenue north of the I-210 freeway (segment D) promotes fast travel speeds between the I-210 and I-15 freeways. This high-speed travel is inconsistent with the residential area and may discourage walking and biking. At this stage in its development, recommending a radical change in the street would be cost-prohibitive and unrealistic. However, changing the traffic signal operation to de-emphasize fast travel and promote calmer driving could encourage more active transportation and reduce the risk of injury and fatal collisions.

For one, the project team recommends lower traffic signal cycle lengths, which allow traffic signals to be more responsive to side-street and left-turn traffic at the decrease of long green lights for Riverside Avenue, which encourage higher travel speeds and create longer wait times for other motorists. Shorter cycle lengths introduce more cycling of the traffic signal and thus more red-light time to Riverside Avenue, slowing traffic by making it less advantageous to speed between traffic signals.

Furthermore, when there is no side-street or left-turn traffic, traffic signals typically rest in green for the main direction of travel. A traffic signal programmed for a rest-in-red operation essentially displays a red light for all approaching directions until a vehicle is detected, upon which it turns green to serve that vehicle on a first-come first-served basis. Traffic signals operating in a rest-in-red mode can be programmed to stop speeding motorists while providing motorists traveling at or below the speed limit with a green light so they don't have to stop. Operating traffic signals on Riverside Avenue in a rest-in-red mode during off-peak periods could significantly reduce travel speeds, discourage speeders by slowing travel, and improve safety for all road users.

4. Raised Median Islands with Landscaping:

Through the neighborhoods south of the historic downtown to San Bernardino Avenue, Riverside Avenue has a series of jogged and "T" intersections, essentially creating a discontinuous break of east/west streets in the gridded street network. This roadway network scheme thus concentrates vehicular turning movements on to and off of Riverside Avenue. Considering all the uncontrolled turning movements on Riverside Avenue created by the street network, it isn't much of a surprise that this section of Riverside Avenue has the highest concentration of broadside and head-on crashes in the City. It would be impractical to signalize all the jogs and "T's" in this area to control turn movements; however, it may be practical to install raised landscaped medians to concentrate conflicting left-turns at key locations by eliminating them at problematic locations. This redistribution of traffic created by the medians could not only improve safety, but reduce travel speeds along this stretch. Therefore, it is suggested that the City consider continuing the raised landscaped medians from the historic downtown area to the commercial area south of San Bernardino Avenue.

5. Riverside Avenue, Bloomington Avenue & Merrill Avenue:

The five-legged intersection of Riverside Avenue, Bloomington Avenue, & Merrill Avenue is located just south of the historic downtown, in the middle of the segment with the highest collision rate. The intersection configuration is unconventional not only because of its fifth leg but also that the fifth-leg approach is off-center from the intersection of the other four legs, creating an awkward and inefficient arrangement of traffic signal equipment and traffic movements. By reconfiguring the intersection into two separate intersections—or, alternatively, into a roundabout—safety and efficiency could be improved. Were a roundabout to be constructed, it could be a focal point in the City's roadway network, connecting the historic downtown with the residential neighborhoods and commercial centers to the south. Combined with medians and landscaping along Riverside Avenue, such a focal point could markedly calm traffic speeds, reduce conflicting left-turn movements, and improve walkability. Such changes could create a significant change in the street character, resulting in increased economic opportunity and improved traffic safety. Further details regarding collision patterns and recommended improvements at this intersection are discussed in **Section 7.12**.

6.2. Foothill Boulevard

Number of Collisions: 277

Foothill Boulevard is an east/west roadway classified in the City's General Plan as a Modified Major Arterial I. The 3.1 miles of Foothill Boulevard that traverse through the City are a part of Historic Route 66, continuing into unincorporated San Bernardino County to the east and into the City of Fontana to the west. Foothill Boulevard was originally owned, constructed, and operated by Caltrans, but was relinquished to the City of Rialto in 2009. The roadway's characteristics still remain very "State Route-ish" in that its features are very car-centric with plentiful wide travel lanes, roadside commercial, varying roadway widths, high travel speeds, and a lack of continuous curbs, gutters, and sidewalks.

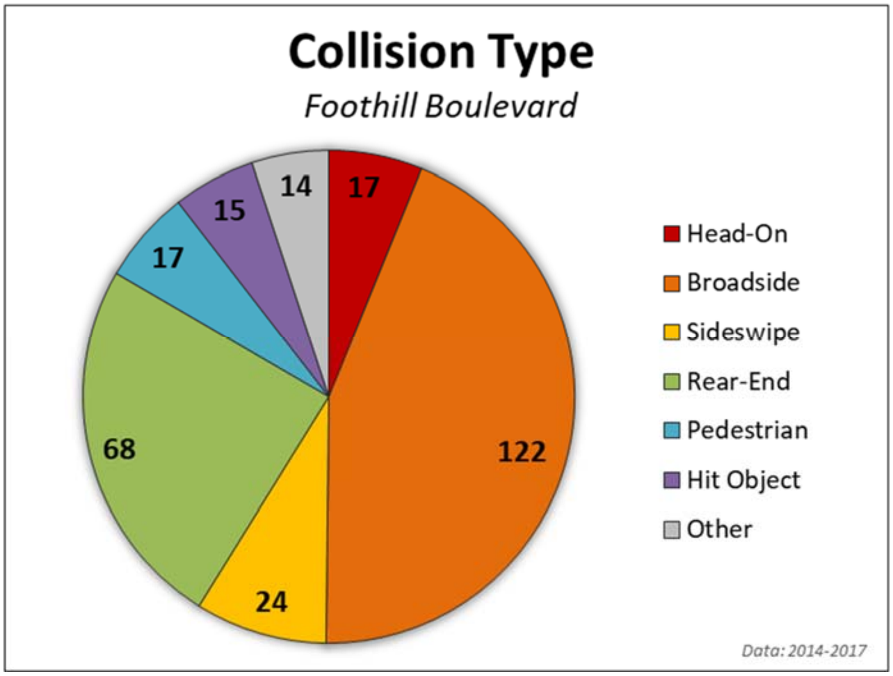
Foothill Boulevard is generally a six-lane roadway with a center two-way left-turn lane and on-street parking that has periodic lane drops around commercial properties that jut out into the right-of-way narrowing the roadway. The posted speed limit varies from 40 mph to 50 mph. Street lighting is provided, but spacing between street lights is generally greater than on most major urban arterials. Likewise, safety lights at intersections provide lower lighting levels than expected for a modern arterial. Prior to the completion of the I-210 freeway, Foothill Boulevard was a very busy regional arterial carrying more traffic than any other street in the City. However, since the construction of the I-210 freeway, traffic volumes have declined to a level typical of an arterial of its size and location.

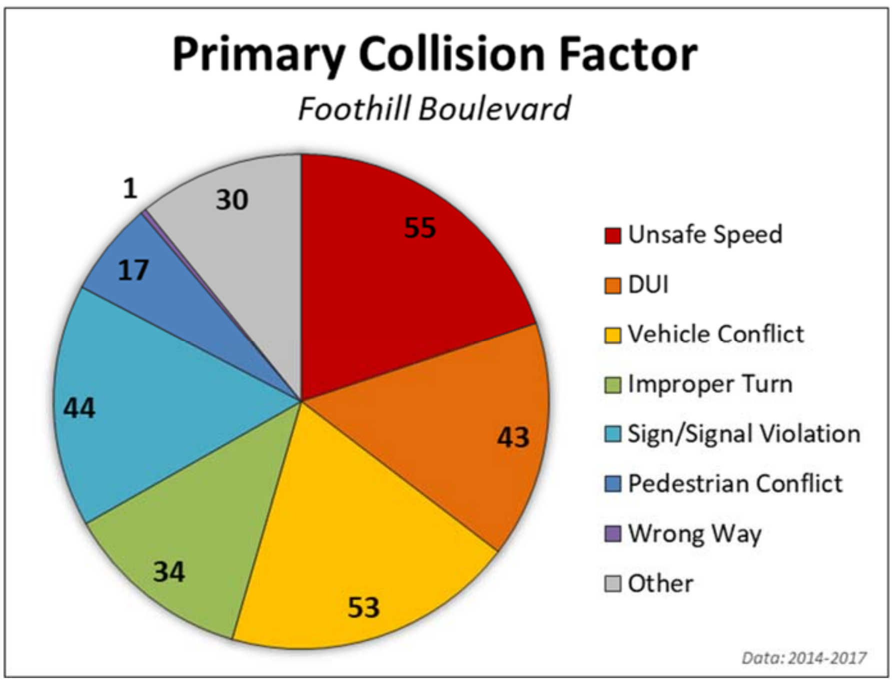
Corridor Collision Patterns

Collision data over the four-year study period (2014-2017) shows a total of 277 collisions along this corridor, including intersection-related collisions. This equals approximately 90 collisions per mile during the study period, or an average of about 22 collisions per mile per year. Four of the top ten most collision prone intersections in the City are located within the Foothill corridor. Those four intersections are located at Pepper Avenue, Cedar Avenue, Riverside Avenue, and Sycamore Avenue. The corridor has a slightly higher than expected nighttime collision rate.

The systemic analysis revealed that broadside collisions were the most prevalent type of crash at 44% of the total, followed by rear-end collisions at around 25%. The high frequency of broadside collisions is noteworthy since every traffic signal along the corridor is provided with east/west fully protected left-turn arrows, which are designed to reduce the risk of such crashes. Considering the various striping transitions, lane drops, and unfinished curbs it was remarkable that less than 15% of all crashes were classified as sideswipe or hit object crashes. As for the primary cause of collisions, there is no readily apparent dominant pattern that emerged. Six of the eight primary traffic collision cause types have double-digit frequency percentages. The two highest-ranked causes where found to be unsafe speed and right-of-way violations.

The following figures show the proportions of collision types and primary collision factors recorded along the corridor during the study period, with detailed statistics in **Appendix C**:





Recommendations

The 2010 Foothill Boulevard Specific Plan lays out a fresh vision for the roadway and the corridor. That vision includes converting the car-centric stark nature of the roadway into more of a traditional boulevard; one that would still be able to efficiently accommodate regional traffic flows while being much more visually appealing and pedestrian friendly. Many of the recommendations from that 2010 plan are still relevant today and if they were implemented could significantly change the character of the street most certainly resulting in lower collision rates. The engineering team is of the opinion that the "State Route-ish" nature of the roadway designed to move traffic as fast as possible through the corridor creates the very characteristics that are contributing to the high collision rate. Throughout the State it is the Caltrans operated State Routes traversing through urbanized areas that have not only the highest number of crashes but the highest crash frequencies. Relinquishment of Foothill Boulevard to the City of Rialto was a good first step. Conversion of the State route to a more traditional boulevard with center median islands, landscaping, sidewalks, and other pedestrian amenities is the next logical step. Therefore, the engineering team has developed the following recommendations:

1. **Foothill Boulevard Specific Plan Elements:**

   Consider strategic implementation of the roadway elements of the 2010 Foothill Boulevard Specific Plan. Creating a uniform boulevard with narrower travel lanes, the elimination of transitions and trap lanes, continuous curbs, gutters, and sidewalks, landscaped medians, improved street lighting, and modernized traffic signals will significantly change the car-centric character of the roadway, thus creating a completer street, calming traffic speeds, and improving safety.

2. **All-Red Clearance Intervals:**

   With an elevated frequency of broadside collisions, it is suggested that the City consider reviewing and extending all-red intervals for each of the traffic signals along the corridor. Typically, former Caltrans-operated State routes are relinquished with traffic signal timing providing one second all-red intervals for each movement regardless of the intersection geometry. However, broadside crashes could be reduced if additional all-red time is provided for left-turn and side street traffic to clear the extended length of Foothill Boulevard before a conflicting green interval is activated.

3. **Intersection Safety Lighting:**

   Enhanced safety lighting at signalized intersections could improve motorist visibility in the dark and address the slightly elevated night-time collision rate for the corridor. Installation of four safety lights over Foothill Boulevard (one per corner) would significantly improve lighting levels and lighting consistency across the entire intersection.

4. **Travel Lanes:**

   State routes are typically striped with freeway sized travel lanes. These wide travel lanes of 12 to 14 feet in width are designed for freeway speeds and thus they encourage higher travel speeds in the urban arterial environment. Higher freeway speeds in an arterial environment with traffic signals, driveways, parked cars, and conflicting traffic generally results in more frequent and severe crash rates. It is recommended that when the street is resurfaced that the striping be redesigned around the use of 11-foot travel lanes. An 11-foot travel lane is sufficiently wide to accommodate arterial traffic speeds up to 50 mph; however, generally motorist feel more comfortable traveling in the 40mph range, thus the restriping should calm traffic speeds and reduce the risk of severe crashes.

5. **Traffic Signal Modernization:**

   Many of the existing traffic signals are aging and are not in compliance with current safety standards. Modernization of the aging traffic signals with new traffic signal equipment, new vehicle and bicycle detection systems, enhanced safety lighting, and new control and communications systems should improve intersection safety. Since many of the traffic signals along Foothill Boulevard have higher than expected collision rates, a corridor-wide traffic signal modernization project is likely to garner full project funding through an HSIP grant application.

6.3. Baseline Road

Number of Collisions: 226

Baseline Road is an east/west arterial roadway classified in the City's General Plan as a Major Arterial. Throughout the City, Baseline Road varies from two to three lanes per direction, with posted speed limits ranging from 35 mph to 50 mph. Baseline Road is primarily a four-lane arterial roadway with a two-way left turn lanes and left-turn pockets at signalized intersections. Spanning 3.4 miles in the City of Rialto, it continues into unincorporated San Bernardino County to the east, while to the west it continues into the City of Fontana.

The 3.4 miles of Baseline Road that traverse through the City are a part of regional corridor extending some 35 miles between the City of San Dimas and the City of Highland. There are a few long blocks with raised landscaped median islands in the vicinity of Eisenhower High School and westerly thereof. At the westerly end of the corridor there are large industrial and warehouse buildings on the north side of the street and residential neighborhoods on the south side of the street. The easterly half of the corridor is dominated with fences along both sides of the street with residential neighborhoods behind. There is a large retail shopping area in the vicinity of Riverside Avenue and in that area the westbound direction is provided with three through lanes; however, the eastbound direction only has two through lanes. The posted speed limit varies from 35 mph in the retail shopping area east of Riverside Avenue to 40 mph in the residential areas on each side of the retail shopping area to 50 mph at the west end of the corridor adjacent to the industrial area. There are "25 mph speed limit when children are present" reduction signs posted in the vicinity of the high school.

Generally, continuous sidewalks are provided along both sides of the entire stretch of the corridor except on the north side of the street between Cactus Avenue and Cedar Avenue adjacent to the retention basin and vacant parcels where the roadway is not fully developed with curbs and gutters. Street lighting is inconsistent along the corridor with good coverage adjacent to new housing and commercial developments and gaps in coverage adjacent to older developments and vacant parcels.

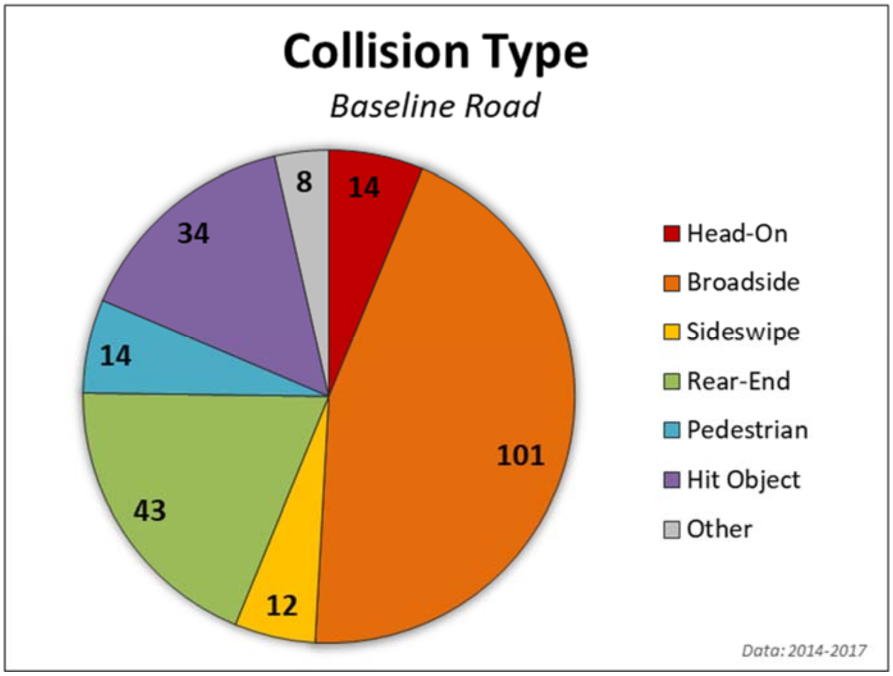
Corridor Collision Patterns

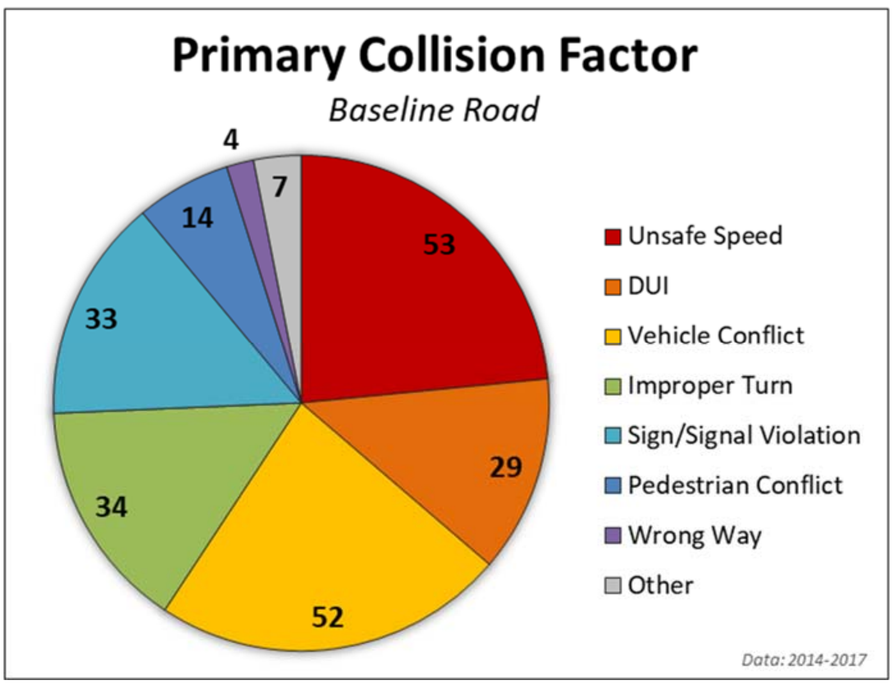
Collision data over the four-year study period (2014-2017) shows a total of 226 collisions along this corridor, including intersection-related collisions. This equals about 67 collisions per mile during the study period, or about 17 collisions per mile per year on average. The Baseline corridor ranks as the third most collision-prone corridor in the study after Riverside Avenue and Foothill Boulevard; however, the Baseline corridor has far fewer driveways, intersecting roadways, and conflicting traffic movements than the top two corridors.

As with the top two corridors, the nighttime collision rate was higher than expected along the Baseline corridor; especially considering the significant number of industrial properties on the western end of the corridor that are generally not active during the night. Two of the top-ten most collision-prone intersections in the City are located within the Baseline corridor: at Riverside Avenue and Eucalyptus Avenue.

The analysis revealed that broadside collisions were the most prevalent collision type at almost 45%, followed by rear-end collisions at 19%. The high frequency of broadside collisions is noteworthy since every traffic signal along the corridor except two are provided with east/west left-turn arrows, which should reduce the risk of such crashes. Also of note was a higher-than-expected hit-object crash rate of 15%, since the travel lanes are generally straight and there are few roadway obstructions. As for the primary cause of collisions, there is no dominant pattern in the data, with five of the eight primary collision factors having double-digit frequency percentages. The two highest-ranked causes were unsafe speed and right-of-way violations.

The following figures show the proportions of collision types and primary collision factors recorded along the corridor during the study period, with detailed statistics in **Appendix C**:





Recommendations

The City has a policy of requiring new development to provide off-site adjacent roadway improvements including curbs, gutters, sidewalks, street lighting, etc. This policy is typical of most municipalities and should, over time, complete gaps in sidewalks and street lighting as well as provide infrastructure consistency along the corridor. Assuming that future development will fill in the gaps in roadway and traffic infrastructure, the engineering team has developed the following recommendations:

1. **All-Red Clearance Intervals:**

   With such an elevated frequency of broadside collisions, it is suggested that the City consider reviewing and potentially providing or extending all-red intervals for traffic signals experiencing a high level of broadside collisions. Typically, many left-turn arrows are not provided all-red intervals; however, all-red intervals for left-turn arrows along Baseline may be warranted in consideration of truck movements and demonstrated patterns of broadside collisions.

2. **Radar Feedback Signs:**

   Baseline Road has long blocks which encourages motorists to travel at higher speeds; consequently, almost one in four collisions on the corridor is a result of unsafe speed. Therefore, it is recommended that radar speed feedback signs be installed at regular intervals—typically mid-block between traffic signals—as a traffic calming measure. Since such signs would be ineffective in the retail shopping area where the speed limit is already 35 mph, it is estimated that 12 to 14 such signs would be needed to cover the remaining extended stretches of the corridor. The systemic deployment of such signs should send a clear message to the public that speeding is not acceptable.

3. **Baseline Road & Eucalyptus Avenue:**

   This intersection is one of the top ten collision prone intersections in the City. As outlined in Recommended Intersection Improvements; this intersection should be fully modernized with new traffic signal equipment, left-turn arrows, enhanced safety lighting, and “dilemma zone” detection. This intersection has one of only two traffic signals along the corridor that has yet to be modernized and provided with east/west left-turn arrows.

   As part of the HSIP Cycle 8 grant funding received by the City, the traffic signal system at this intersection is being upgraded to include new traffic signal equipment for an 8-phase signal operation, enhanced safety lighting, emergency vehicle preemption (EVP) system, left-turn phasing for the E/W movement, video detection and appropriate signing and striping upgrades, among others.

4. **Baseline Road & Sycamore Avenue:**

   This intersection has one of only two traffic signals along the corridor that has yet to be modernized and provided with east/west left-turn arrows. Consider fully modernizing the traffic signal at the intersection with new traffic signal equipment, left-turn arrows, enhanced safety lighting, and “dilemma zone” detection. Completion of such a project will create a more uniform traffic control scheme for the street and should reduce crash rates at the intersection.

   As part of the HSIP Cycle 8 grant funding received by the City, the traffic signal system at this intersection is likewise being upgraded to include new traffic signal equipment for an 8-phase signal operation, enhanced safety lighting, emergency vehicle preemption (EVP) system, left-turn phasing for the E/W movement, video detection and appropriate signing and striping upgrades, among others.

6.4. Cedar Avenue / Ayala Drive

Number of Collisions: 189

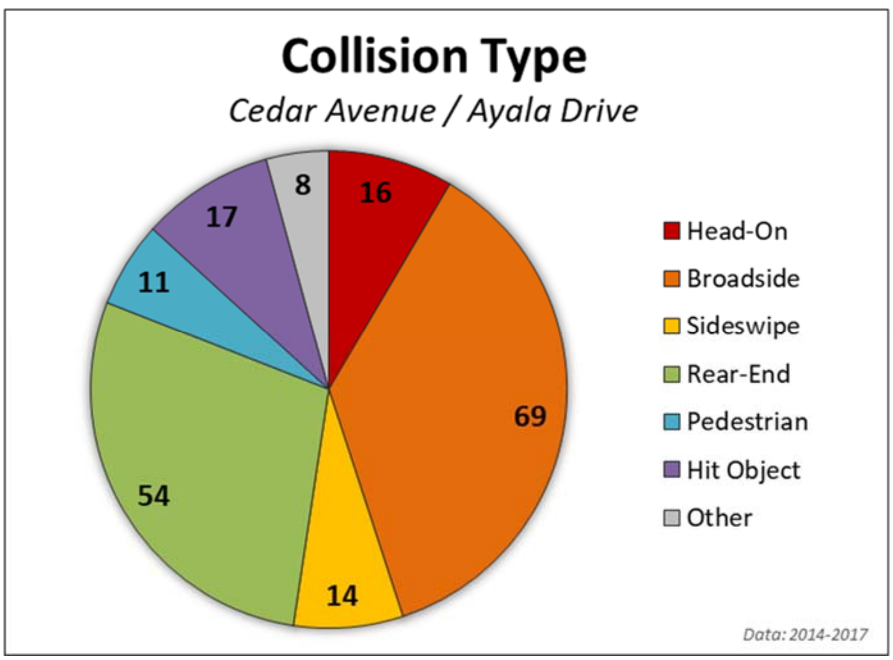
Cedar Avenue and Ayala Drive combine to form a single arterial roadway corridor classified in the City's General Plan as a Major Arterial. The Cedar/Ayala corridor is a four-lane arterial roadway with bicycle lanes and a two-way left-turn median lane that opens up to provide left-turn pockets at signalized intersections. Posted speed limits vary from 45 mph to 50 mph. Spanning a combined 4.7 miles in this study, the Cedar/Ayala corridor runs from Randall Avenue in the south in the Bloomington community to Riverside Avenue in the north. Further south, Cedar Avenue continues through the I-10 freeway interchange to Riverside County.

Besides Riverside Avenue, the Cedar/Ayala corridor is the only other north/south corridor in the City with access to both the I-210 and I-10 freeways. Land use along the corridor is a mix of industrial, warehousing, retail shopping centers, and residential. Traffic flow along the corridor can be brisk, as it is used by commuters and truckers as an alternative to Riverside Avenue for those using either of the two east/west freeways.

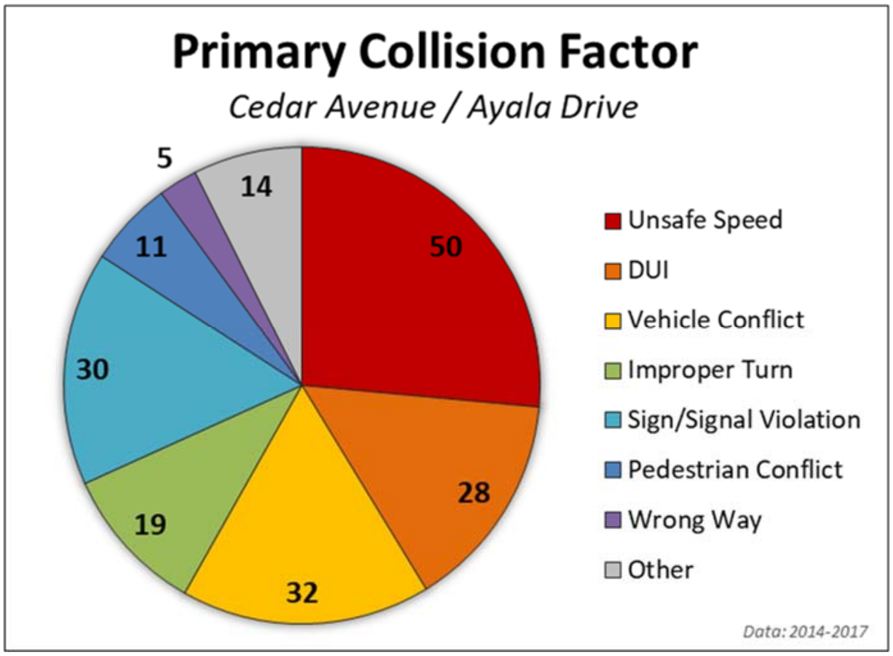
Corridor Collision Patterns

Collision data over the four-year study period (2014-2017) shows a total of 189 crashes along this corridor, including intersection-related collisions. This equals approximately forty collisions per mile, or an average of about ten collisions per mile per year. The analysis revealed that almost 92% of all collisions on the corridor occur at or in the immediate vicinity of intersections, and the vast majority of those at signalized intersections. The intersection with the highest number of crashes in the City, Cedar Avenue and Merrill Avenue, is on this corridor, along with four others in the top twenty collision-prone intersections: at Foothill Boulevard, Etiwanda Avenue, Rialto Avenue, and Baseline Road. It is expected that most corridor collisions occur at intersections; however, such a high percentage suggests traffic signal operations could be a contributing factor.

The following figures show the proportions of collision types and primary collision factors recorded along the corridor during the study period, with detailed statistics in **Appendix C**:



At almost 37% of all collisions, broadside crashes are the most prevalent type of collision, followed closely at almost 29% by rear-end crashes. Although unsafe speed is the primary cause of approximately 27% of all crashes there appears to be no discernable pattern to the causes of crashes since DUI's, vehicle right-of-way violations, improper turns, and traffic signal violations all were of significance with double-digit percentages. It is also interesting to note that the corridor has a higher-than-expected nighttime collision rate with more than 40% of all crashes occurring after dark.



Recommendations

Based on the layout of the Cedar/Ayala corridor in the City's street network and the recent developments near the I-210 freeway, it is expected that traffic along the corridor will continue to grow as the City also does. It is therefore recommended that the City's focus for this corridor be on the safe, orderly, and efficient movement of north/south traffic through traditional operational and management strategies of a vehicle-centric arterial corridor. As such, the engineering team has developed the following recommendations:

1. **Safety Lighting:**

   Since an elevated proportion of crashes on the corridor occur at night in the vicinity of intersections, a safety lighting assessment might be prudent. Such an assessment would identify areas of dim lighting that could be corrected with additional safety lights and/or more powerful fixtures.

2. **Corridor Traffic Signal Timing:**

   It is suggested that a consultant be retained every three years to review and recommend adjustments to the traffic signal timing for the ten City traffic signals along the corridor. This is especially important as the developments in the northern part of the City become fully developed and occupied. Since there is such a high percentage of broadside crashes along the corridor, it is suggested that the City may want to provide a consistent corridor wide all-red intervals including such intervals at the conclusion of the protected north/south left-turn intervals. It is also suggested that the traffic signals be timed to provide a north/south progression speed of 40 or 45 miles per hour as to reward those motorists traveling at or below the speed limit with a green light.

3. **Pedestrian Facilities:**

   There are a number of blocks in the commercial areas were sidewalks are not provided. Although there are very few pedestrian-related collisions during the study period, it is suggested the sidewalk network be completed to pre-empt and prevent pedestrians being tempted to walk in the street. Completing the corridor's sidewalks could also reduce future risk of crashes as traffic grows in the future.

4. **Strategic Access Control:**

   There are a number of minor "T" intersections, jogged intersections, and driveways along the corridor. Each of those locations creates an uncontrolled, conflicting turn opportunity that contributes to higher risks of crashes. It is suggested that the strategic use of raised medians, especially within 250 feet of signalized intersections, could reduce conflicting movements and increase overall corridor safety.

5. **Cedar Avenue & Merrill Avenue:**

   This signalized intersection is the most collision-prone intersection in the City. As detailed in Section 7.1, there are a number of operational improvements that can be made to the traffic signal, both physical and programmable, to reduce the risk of collisions at this intersection.

6. **Cedar Avenue & Etiwanda Avenue:**

   This intersection is the 16th-most collision-prone intersection in the City and the only traffic signal in the corridor with north/south permissive left-turns. Consider modernizing the traffic signal at the intersection to provide additional street lighting and north/south left-turn arrows.

6.5. Cactus Avenue

Number of Collisions: 103

Cactus Avenue is a north/south arterial roadway classified in the City's General Plan as a Major Arterial. It is a four-lane arterial roadway, with a two-way left-turn median lane. The southern half of the street is posted with a 45 mph speed limit while the northern half is posted with a 40 mph speed limit. Spanning 5.2 miles and in the City of Rialto, it terminates at Riverside Avenue to the north and just before the I-10 freeway to the south. This continuous portion of Cactus Avenue is contained entirely within the City of Rialto, and is not connected to the arterial roadway of the same name in Riverside County to the south.

Cactus Avenue is primarily a residential arterial, providing access to neighborhoods, schools, churches, and commercial employment. Most adjacent properties back up to the street; thus, the roadway is lined with backyard fences. Likewise, in the industrial area midway along its length, commercial properties have security fences and buildings located away from the roadway. The fence-lined frontage, combined with the painted median, creates a wide-open view for motorists, encouraging higher travel speeds. Cactus Avenue has a bridge over the I-210 freeway; however, there are no on-ramps or off-ramps. Although the street is an arterial with traffic signal control at major intersections, there are three all-way stops at the northern end of the corridor.

Corridor Collision Patterns

Collision data over the four-year study period (2014-2017) shows a total of 103 collisions along this corridor, including intersection-related collisions. On average, this is equal to about twenty collisions per mile, or about five collisions per mile per year. The collision data shows that about 50% of all collisions along the corridor are broadsides, while 25% collisions are either head-on or hit-object collisions. Such a pattern of collisions suggests that motorists are making poor decisions when judging gaps in traffic and/or the speed of approaching traffic. Although unsafe speed was cited as a primary collision factor in less than 15% of all crashes, the higher-than-expected incidence of head-on and hit-object collisions suggests that motorists may be traveling faster than what is considered appropriate for the conditions and losing control of their vehicles.

The figures on the following page show the proportions of collision types and primary collision factors recorded along the corridor during the study period, with detailed statistics in **Appendix C**.

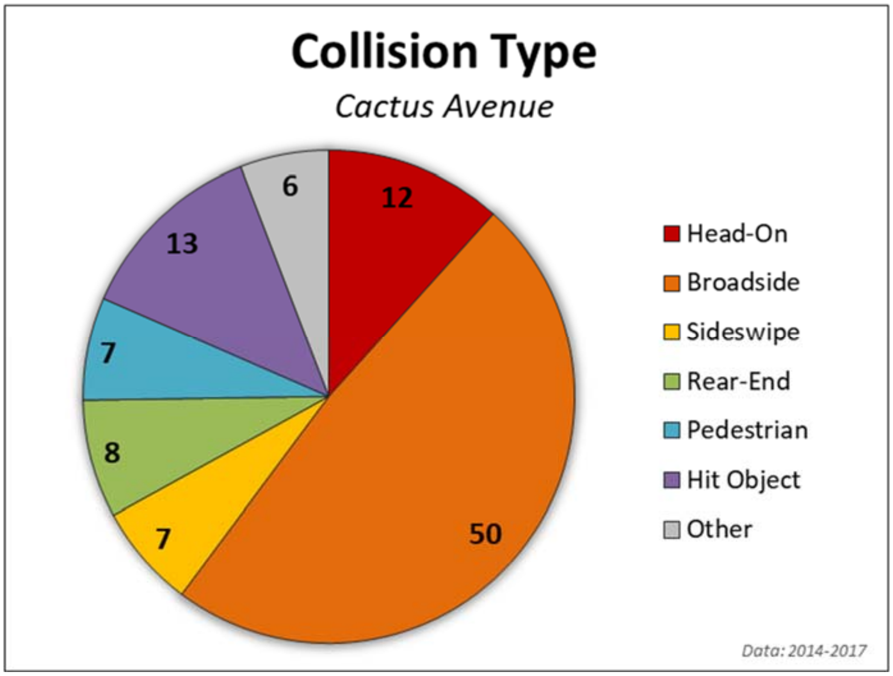
Recommendations

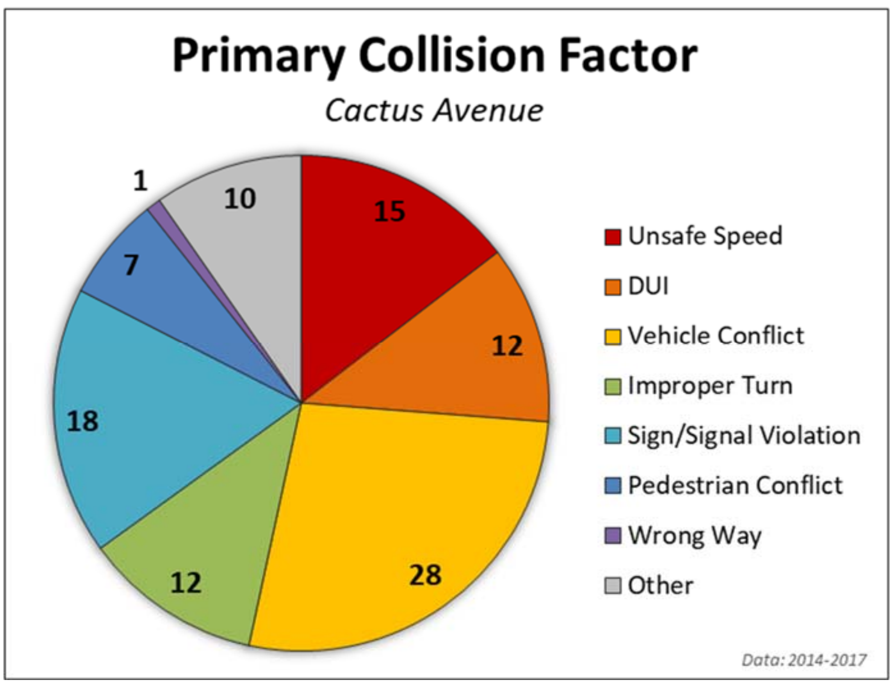
Although not on the original list of study corridors, the engineering team also decided to assess Cactus Avenue due to its size, location, and high percentage of broadside collisions. Based on the systemic analysis, the engineering team has developed the following recommendations:

1. **Complete Street Project:**
   Based on field observations of traffic demand and travel patterns, Cactus Avenue may be a good candidate for a road diet with protected bike lanes and a landscaped median island. Cactus Avenue could become a "spine" of active transportation connecting residents to schools, parks, and local retail. The commercial/industrial area between Merrill Avenue and just north of Rialto Avenue could remain four lanes to accommodate trucks and business access; however, commercial traffic could be discouraged north and south of those blocks. Converting to a complete street could help reduce the elevated broadside collision rate and the traffic calming effect could be successful in reducing the head-on, hit object, sideswipe, and pedestrian crashes that amount to about 40% of all crashes along the roadway.

2. **Traffic Signal Installation:**

It is suggested that the three all-way stops on Cactus Avenue at Easton Street, Cactus Avenue at Casmalia Street, and Cactus Avenue at Bohnert Avenue/Apple Avenue be converted to traffic signals, which will better accommodate peak traffic flows, improve safety through positive right-of-way assignment, and improve walkability. Should a road diet be implemented, it will be necessary to signalize the all-way stops to avoid extended vehicle queues during school arrival and dismissal periods and other peak traffic flows.





6.6. Eucalyptus Avenue

Number of Collisions: 57

Eucalyptus Avenue is a north/south roadway in the northeast part of the City, classified in the City's General Plan as a Collector Street. Throughout the City, Eucalyptus Avenue is a two-lane roadway, with a yellow centerline and frequent on-street parking. The posted speed limit is 35mph south of Rialto Avenue and 40mph north of Rialto Avenue. Spanning 2.9 miles in the City of Rialto, Eucalyptus Avenue terminates at Easton Street just south of the I-210 freeway in the north and extends south over two miles to just south of Merrill Avenue / Mills Street at Rialto High School before continuing on into the Cities of San Bernardino and Colton. It forms part of the City's eastern border with the City of San Bernardino.

Although Eucalyptus Avenue is a residential street, it also provides direct access to four schools, a park, a church, and other commercial establishments at key intersections. Traffic controls include two-way stops, four-way stops, traffic signals, and school crosswalks.

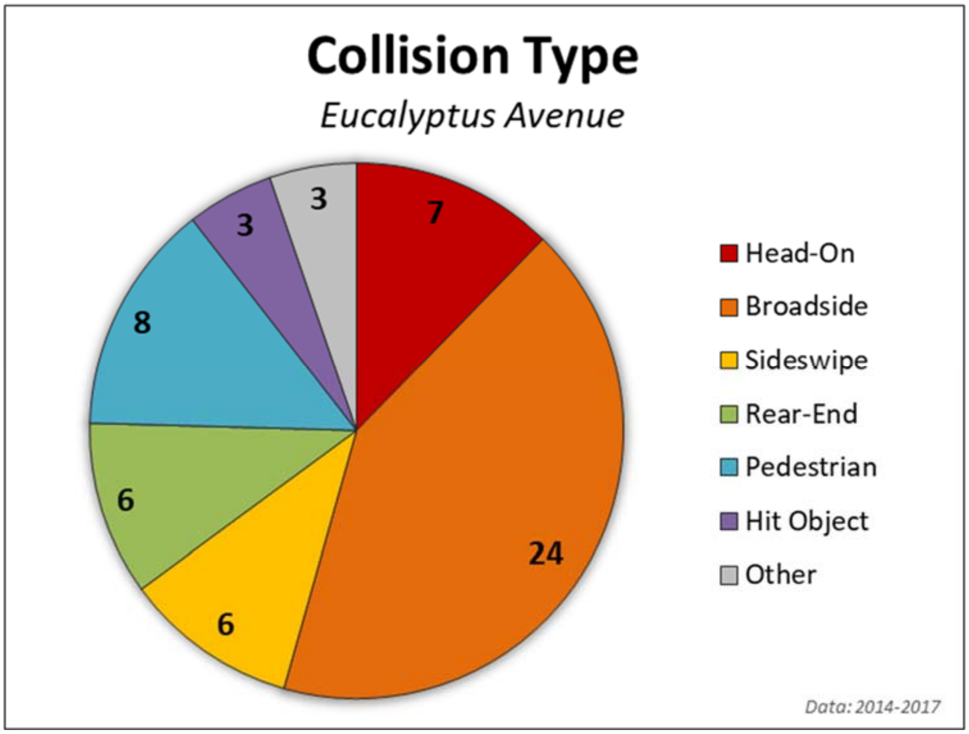
Corridor Collision Patterns

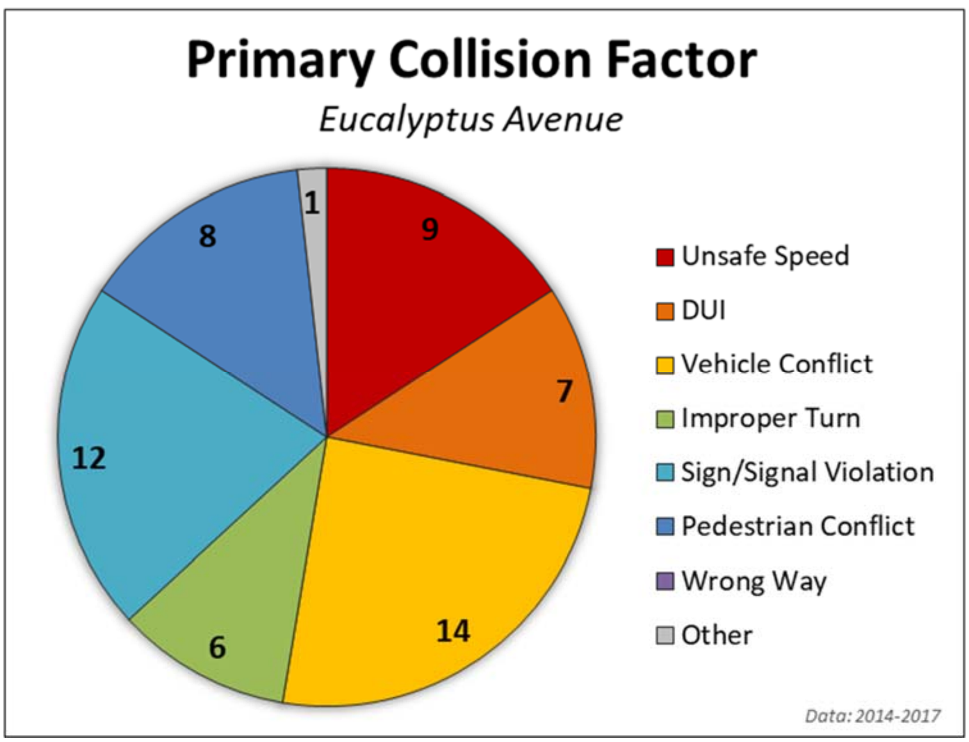
Collision data over the four-year study period (2014-2017) shows a total of 57 collisions along this corridor, including intersection-related collisions. This equals a collision rate of approximately twenty collisions per mile, or about five collisions per mile per year on average. Eucalyptus Avenue is the second best-performing corridor studied; however, it has a higher-than-expected injury rate and three reported fatalities over the study period. Such a high percentage of injury collisions is abnormal for a low-volume, residential collector street.

With four schools being served by the corridor, it was initially thought that perhaps school-related traffic may be a contributing factor to the collision frequency; however, the systemic analysis revealed that less than one-third of the crashes occurred on school days during daylight hours. However, the analysis did reveal that persons under the age of 25 were involved in more than a half of all crashes for which age data was available.

The analysis revealed that broadside crashes were the most prevalent (42%) followed by head-on, rear-end, sideswipe, and pedestrian crashes each in the 10%–15% range. The pattern of collision types found isn't unusual for a low-volume, residential collector serving schools. The prevailing primary causes of the collisions were found to be right-of-way violations and failure to observe traffic controls, amounting to approximately 45% of all collisions, with unsafe speed cited in about 16% of collisions and pedestrians violations accounting for another 14%. The pattern of primary collision factors is again not unusual for a low-volume, residential collector serving schools.

The following figures show the proportions of collision types and primary collision factors recorded along the corridor during the study period, with detailed statistics in **Appendix C**.


Collision Type
Eucalyptus Avenue
7
24
6
6
8
3
3
Head-On
Broadside
Sideswipe
Rear-End
Pedestrian
Hit Object
Other
Data: 2014-2017


Primary Collision Factor
Eucalyptus Avenue
1
9
7
14
6
12
8
Unsafe Speed
DUI
Vehicle Conflict
Improper Turn
Sign/Signal Violation
Pedestrian Conflict
Wrong Way
Other
Data: 2014-2017

Recommendations

Based on the review of field conditions and the systemic analysis, the engineering team felt that the key to improving safety along the corridor was to address the age-related crash rate and reduce travel speeds on this key school access route. As such, the engineering team has developed the following recommendations:

1. **<u>Downward Speed Zoning:</u>**

   The current speed zoning along the corridor varies from a low of 35 mph to a high of 40 mph, with school-zone signing lowering the speed limit to 25 mph when children are present. Although the speed zones have been set in accordance with Caltrans procedures and State law; a 40 mph limit is an unreasonable speed limit for a two-lane residential collector street especially considering that most drivers feel that they can exceed the speed limit by up to 10 mph without fear of citation. It is recommended that the City target the corridor for a 30 mph speed limit and implement strategies geared toward reducing the speed limit. Such strategies could include establishing a safety corridor, decertifying existing speed limits, use of prima fascia speed zones, deployment of speed feedback signs, increased enforcement, and resurveying the speed limit.

2. **<u>School Outreach Program:</u>**

   Since persons under the age of 25 are involved in more than 50% of all crashes along the corridor, it is suggested that the City work with the schools along the corridor to create a school outreach program to educate students, parents, and young drivers on the dangers of speeding, distracted driving, and violating traffic laws. The outreach program could be centered around a theme of "keeping us all safe" and could include public outreach regarding "slowing down" and the need for downward speed zoning.

3. **<u>No Parking Zones:</u>**

   Most of the stop controlled intersections along the corridor are not afforded with red zones that prohibit parking near corners. Vehicles parked near corners block visibility of traffic controls, conflicting traffic, pedestrians, and bicyclists. It is suggested that on a strategic basis that intersection red zones of 20 feet on the approach to an intersection and 10 feet on the departure from an intersection be established, where feasible, to improve sight distance of conflicting traffic and pedestrians and reduce the risk of collisions.

4. **<u>School Zone Signage and Markings:</u>**

   Although only about 30% of collisions occur during the daytime hours on school days, a review of school zone traffic controls—with an eye toward modernization—for the four schools within the corridor could be beneficial in reducing collisions. School zone signage and markings could be enhanced with high visibility crosswalks, larger signs, and additional signs and pavement markings. These improvements along with the establishment of additional no parking zones at intersection corners around schools, parks, and churches could help address the corridor's pedestrian collision rate.

5. **<u>Eucalyptus Avenue & Baseline Road:</u>**

   Two of the three fatal crashes recorded along this corridor occurred at this intersection. As detailed in the recommended intersection improvements, it is recommended that this older traffic signal be fully modernized with new traffic signal equipment, safety lighting, left-turn arrows, and detection systems. The new traffic signal is expected to improve efficiency and safety at the intersection.

   As part of the HSIP Cycle 8 grant funding received by the City, the traffic signal system at this intersection is being upgraded. Refer to Baseline Road recommendations in Section 6.3.

6.7. Casmalia Street

Number of Collisions: 29

Casmalia Street is an east/west roadway classified in the City's General Plan as a Collector Street. Throughout the City, Casmalia Street varies from one to two lanes per direction, with posted speed limits ranging from 25 mph to 55 mph. Spanning 2.8 miles in the City of Rialto, it terminates at Riverside Avenue to the east, while to the west it continues into the City of Fontana as Sierra Lakes Parkway.

Casmalia Street runs just north of the I-210 freeway, providing indirect freeway access via its proximity to the freeway interchanges at Alder Avenue, Ayala Drive, and Riverside Avenue. West of Ayala Drive, it is largely surrounded by recent commercial developments and large undeveloped lots. As Casmalia nears the border with the City of Fontana it widens to become a multi-lane arterial roadway with traffic signals and a 55mph speed limit. During the engineering team's field visits there were new commercial developments and ongoing construction activities along the western part of the roadway. East of Ayala Drive, however, Casmalia Street takes on a decidedly neighborly nature, becoming an undivided two-lane residential street with a 25 mph posted speed limit, residential frontages and driveways, as well as on-street parking. Currently, Casmalia Street has just five traffic signals: at Alder Avenue, Locust Avenue, Linden Avenue, Ayala Drive, and Riverside Avenue.

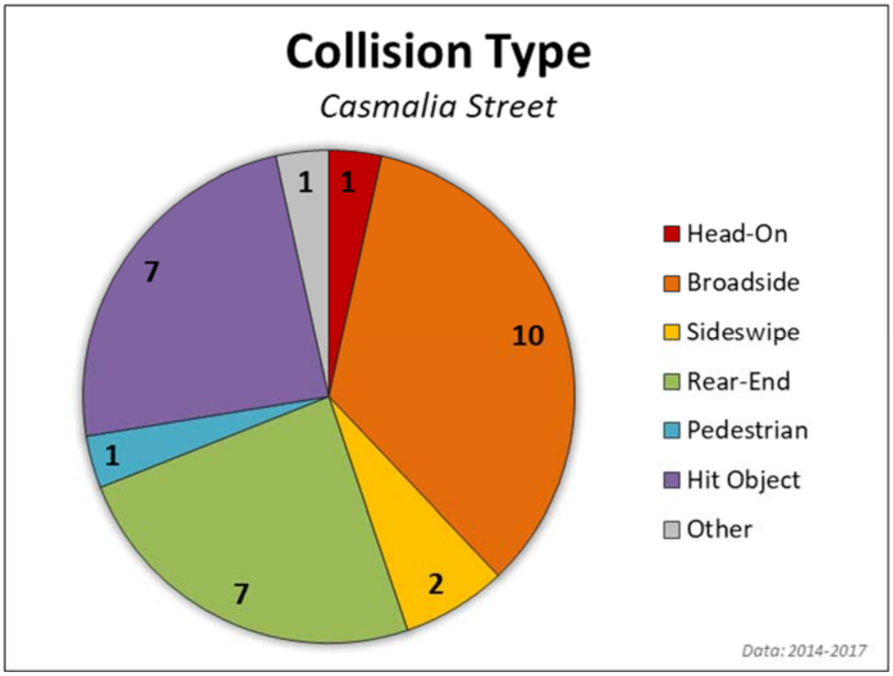
Casmalia Street features prominently in future development plans for the northwest sector of the City, providing primary access for several undeveloped and under-development parcels. Traffic flow on the roadway is generally light today; however, it is expected that traffic demands will increase significantly in future years as commercial development continues alongside the I-210 freeway both in the City of Rialto and the City of Fontana. Although the roadway provides a fairly direct connection between the I-210 freeway ramps at Riverside Avenue and Ayala Drive that section of the roadway is through a residential neighborhood. The City Council expressly requested that the engineering team review this corridor; in consideration of its potential future growth in traffic along its western reach and make recommendations for the City to consider in their future street improvement plans.

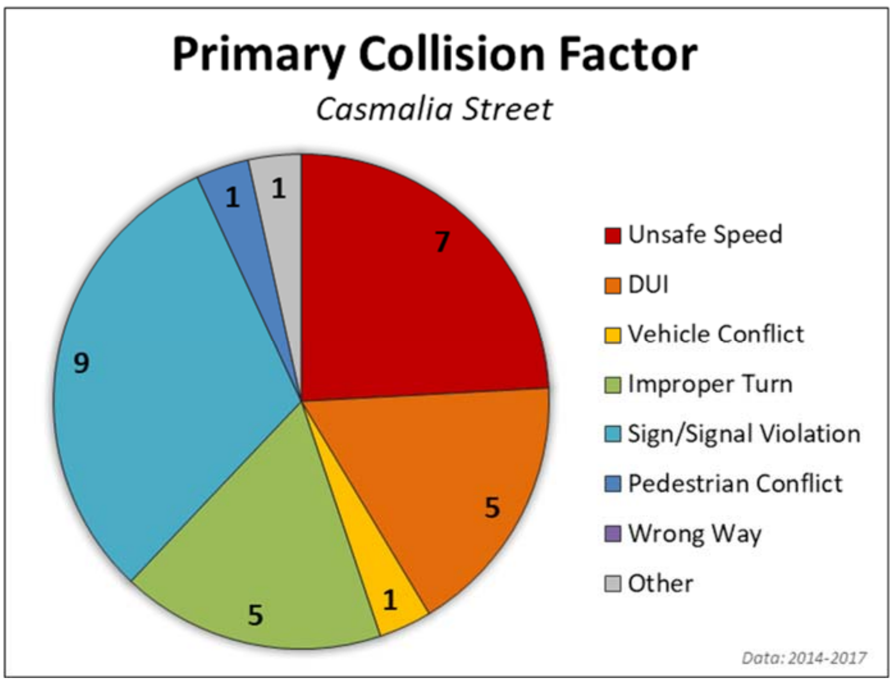
Corridor Collision Patterns

Collision data over the four-year study period (2014-2017) shows a total of 29 collisions along this corridor, including intersection-related collisions. This is equal to a collision rate of about ten collisions per mile, or nearly three collisions per mile per year on average.

The Casmalia corridor is the best-performing corridor studied and generally there are too few crashes to draw significant conclusions; especially in light of the diversity of the land use and traffic patterns between the western commercial area and the eastern residential area. That being said, the systemic analysis did reveal that broadside crashes were the most prevalent followed closely by rear-end and hit-object crashes. The primary cause of the reported collisions was traffic signal and stop sign violations followed by unsafe speed.

The following figures show the proportions of collision types and primary collision factors recorded along the corridor during the study period, with detailed statistics in **Appendix C**:





Recommendations

This corridor was selected for study by the City Council: not necessarily for its current collision rates, but to recommend strategies to lower the future risk of collisions. It is clear that the traffic characteristics of high-capacity, high-speed, wide streets needed in the commercial area to the west are not necessarily compatible with the low-volume, low-speed characteristics of a residential street on the eastern end of the corridor. Therefore, the engineering team felt that the primary goal of our recommendations should be to protect the residential community from cut-through commuter and commercial traffic between Ayala Drive and Riverside Avenue. Therefore, the engineering team has developed the following recommendations:

1. **Consistent Speed Zoning:**

   The current speed zoning along the corridor varies from a low of 25 mph in the residential neighborhoods to a high of 55 mph at the border with the City of Fontana. It is recommended that the speed limit east of Ayala in the residential neighborhood remain 25 mph and that additional speed limit signs be installed along that stretch to advise motorists thereof. For the commercial stretch of the roadway west of Ayala Drive it is suggested that a target speed limit of 40 mph be pursued. Speed limits over 40 mph are not bicycle friendly and they can create speed differentials between faster cars and slower trucks that will be serving the area. In order to attain an enforceable 40 mph speed limit, the City will have to employ speed reduction features such as speed feedback signs, raised medians, traffic signal timing strategies, and focused enforcement.

2. **Casmalia Street west of Ayala Drive:**

   It is suggested that the commercial portion of Casmalia Street ultimately be improved to be a consistent street width with similar amenities from Ayala Drive to the western City border with the City of Fontana. It is suggested that the street be developed to have sufficient through and turning lanes, left-turn pockets at each intersection, that all intersections be signalized, a center raised median installed, street lighting, parking/stopping prohibitions, and continuous bike lanes provided with a four foot striped buffer. A consistent well-lit and controlled commercial street should provide the capacity needed to support business traffic yet provide the level of safety expected of a modern collector road.

3. **Casmalia Street & Cactus Avenue:**

   As outlined in the recommendations for Cactus Avenue; it is recommended that this all-way stop controlled intersection be upgraded to a traffic signal. A traffic signal will improve right-of-way assignment, efficiency of traffic movements, and will improve pedestrians and bicyclists connectivity across Cactus Avenue. Furthermore, the traffic signal could encourage a more active lifestyle for students attending the two schools in the area since crossing Cactus Avenue will be easier and safer.

4. **Casmalia Street & Lilac Avenue:**

   This residential intersection is overly large and there are no sidewalks for about 500 feet east of it on either the north or south side of Casmalia Street. Sidewalks are also not present on Lilac Avenue north of the intersection; however, that roadway is a discontinuous local street. It is recommended that the intersection be reconfigured as a roundabout with median landscaping, pedestrian crosswalks, and sidewalks along Casmalia Street. Such a project would reduce travel speeds and discourage commercial traffic on the collector street while also serving as a neighborhood aesthetic improvement.

5. **Casmalia Street & Ayala Drive:**

   If eastbound traffic picks up along Casmalia Street east of Ayala Drive, we recommend considering modifying the traffic signal operation and/or other traffic calming measures to minimize non-local traffic intrusions into the neighborhood.

7. High-Risk Intersections

From the City of Rialto Crossroads collision database, the study identified the fifty intersections with the most recorded incidents over the four-year study period (2014-2017). From this list, twelve specific locations were identified for focused analysis in this study via the following criteria:

- ✓ The top ten intersections were prioritized for study, to maximize the impact of safety improvements.
- ✓ The vast majority of intersection-related collisions occur at traffic signals; for further investigation, the unsignalized intersection with the highest collision occurrence (Riverside Avenue at Third Street) was also identified for study.
- ✓ Within the top fifteen locations, one stood out for its location along the longest arterial corridor as well as its unusual geometry: Riverside Avenue at Merrill Avenue and Bloomington Avenue.

Rialto Systemic Safety Analysis Report Program

Table 5: Study Intersection Collision Rates

	Intersection	No. Incidents	Collisions per Year (Avg)	Notes
1	Cedar Ave @ Merrill Ave	37	9.25	- top head-on (5) - top DUI (6)
2	Pepper Ave @ Foothill Blvd (Caltrans)	28	7	
3	Riverside Ave @ Valley Blvd	27	6.75	- top rear-end (14) - top speeding (12) - top hit-and-run (11)
4	Riverside Ave @ I-10 (Caltrans)	25	6.25	
5	Cedar Ave @ Foothill Blvd	23	5.75	- top DUI (6)
6	Riverside Ave @ Baseline Rd	22	5.5	
7	Eucalyptus Ave @ Baseline Rd	20	5.0	- 2 fatalities
8	Foothill Blvd @ Riverside Ave	20	5.0	
9	Foothill Blvd @ Sycamore Ave	20	5.0	
10	Riverside Ave @ Easton St	20	5.0	- top sideswipe (5)
11	Riverside Ave @ Third St	8	2.0	- top unsignalized location
12	Riverside Ave @ Merrill Ave & Bloomington Ave	17	4.3	- five-legged intersection

Data: City Crossroads database, 2014-2017

Collision trends, field conditions, and potential improvement opportunities were reviewed for all of the above locations, the details of which are given in the following pages.

7.1. Cedar Avenue at Merrill Avenue

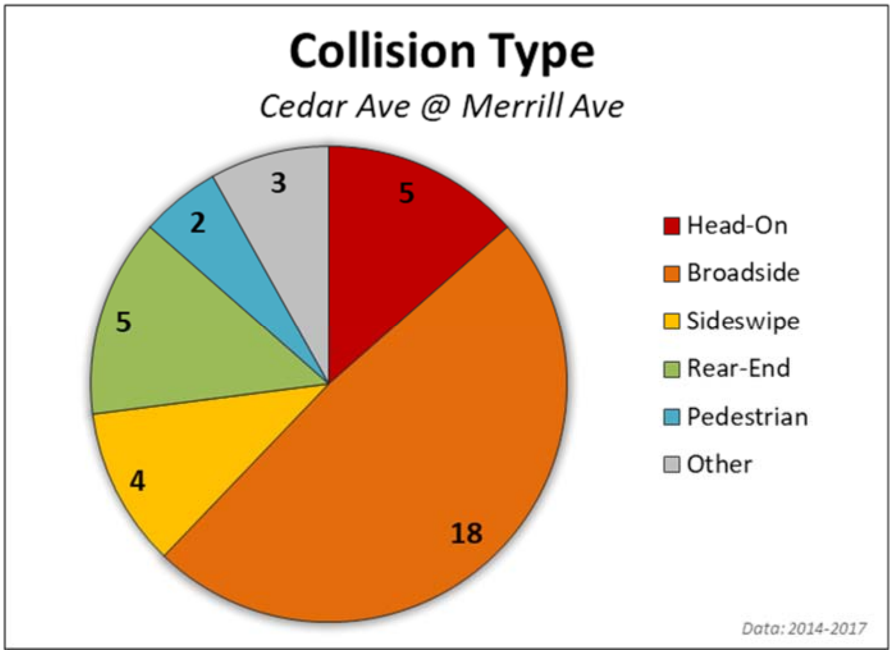
Number of Collisions: 37

This intersection is located in the southwest sector of the city, next to several industrial and commercial properties. Per the City of Rialto General Plan, Cedar Avenue is classified as a Major Arterial, while Merrill Avenue is classified as a Secondary Arterial. At this location, both Cedar Avenue and Merrill Avenue are four-lane arterial roadways with posted speed limits of 45 mph and dedicated left-turn pockets at the intersection. A gated commercial building sits on the northwest corner, a Chevron gas station on the northeast corner, a walled-off residential neighborhood on the southeast corner, and a church—Calvary Chapel Rialto—on the southwest corner.

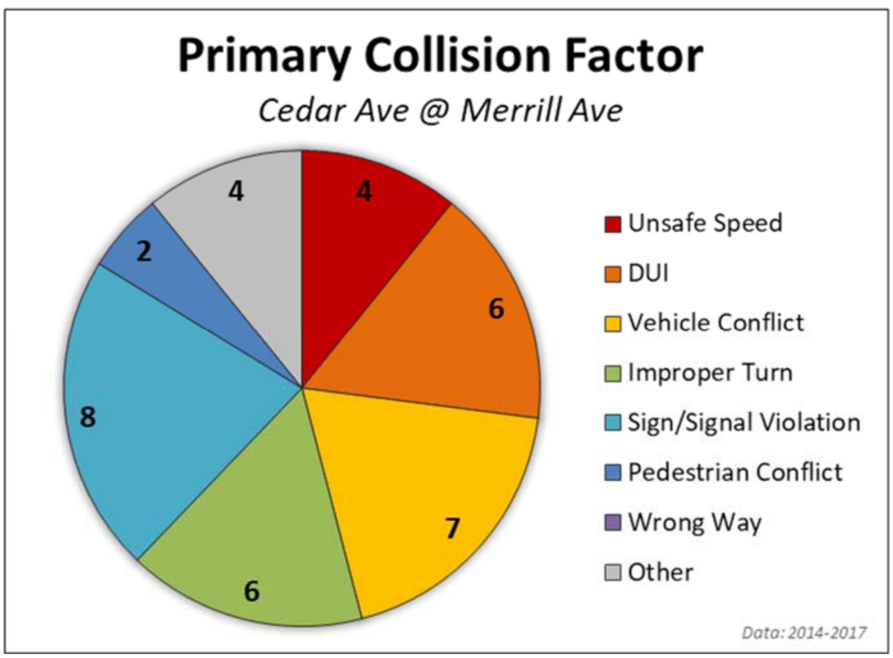
The intersection is controlled by a traffic signal, with left-turn arrows provided for the northbound and southbound approaches on Cedar Avenue. The northbound and southbound left-turn arrows currently operate on protected lead/lag phasing, where one direction receives the left-turn green arrow concurrent with the beginning of the through phase and the other direction receives a left-turn green arrow at the end of the through phase. Pedestrian crossings are provided across all approaches.

Intersection Collision Patterns

This intersection is the most collision-prone intersection in the city. Over the four-year study period (2014-2017), a total of 37 collisions were documented at this intersection, or about nine per year on average. Of these incidents, 24 (65%) involved parties aged 18-30, 18 (49%) were broadside collisions, 15 (41%) occurred at night, five (14%) were head-on collisions, and six (16%) involved a DUI. These data rank this location as #1 in total collisions, young-adult collisions, nighttime collisions, broadside collisions, head-on collisions, and DUI-involved collisions within the study. The following figures show the collision types and primary collision factors at this location, with detailed statistics in **Appendix C**.



At 49%, the most prevalent collision type at this intersection is broadsides. Traffic signals are designed to prevent broadside collisions—resulting from right-of-way confusions and conflicting movements—so such a high percentage is unusual for a signalized location. Therefore, the field review took care to note any potential impairments to driver awareness for conflicting vehicle movements.



The prevalence of vehicle conflict, improper turn, and signal violation factors at this location are congruent with the finding of a large percentage of broadside collisions.

Recommendations

In order to address the elevated broadside collision rate at this location, it is recommended the City increase all-red time for the northbound and southbound approaches by 0.5 seconds to provide an additional margin of time for vehicles to completely clear the intersection. It is further recommended the City convert the northbound/southbound left-turn lead/lag phasing operation to leading-only left turns. This would more clearly separate the left-turning traffic from through traffic, with the added benefit of an all-red clearance interval in between the left-turn arrow and through green phases.

The estimated cost of these recommended capital improvements is approximately $195,500.

Operational / Low-Cost Recommendations:

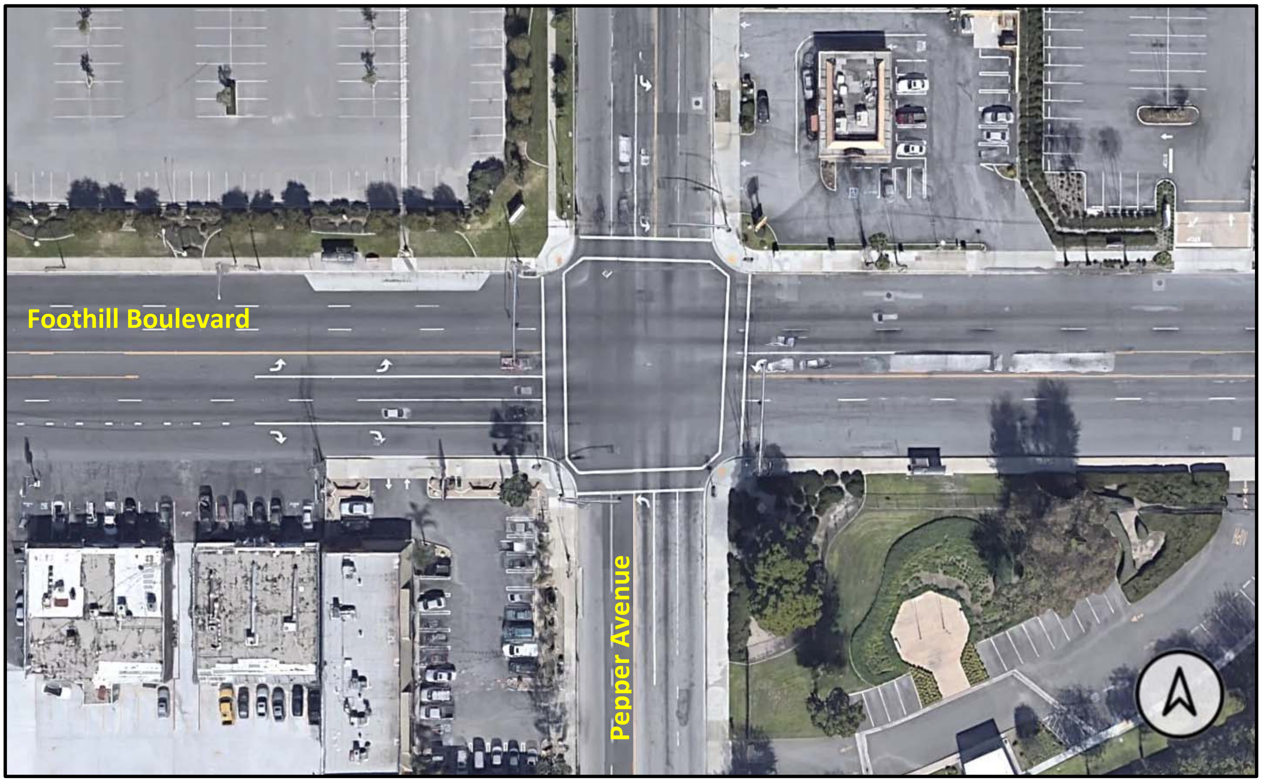
- Extend NB/SB all-red clearance interval by 0.5 seconds
- Provide 1-second all-red clearance interval for NB/SB left-turn movements
- Convert NB/SB left-turn arrow lead/lag operation to lead/lead
- Program advance loops for dilemma zone detection

Capital Improvement Recommendations:

- Upgrade existing vehicle detection to video detection system
- Install EB/WB Protected-Permissive Left-Turn (PPLT) arrows
- Add limit lines for all approaches

7.2. Pepper Avenue at Foothill Boulevard (State owned and operated)

Number of Collisions: 28



This intersection is located on the eastern edge of the city, along the city border with the City of Colton, surrounded by commercial properties. Per the City of Rialto General Plan, Pepper Avenue is classified as a Major Arterial, while Foothill Boulevard is classified as a Modified Major Arterial I. At this location, Pepper Avenue is a four-lane arterial roadway included in the City's truck route network with a 45 mph posted speed limit. West of Pepper Avenue, Foothill Boulevard is a six-lane arterial roadway with a 40 mph posted speed limit. East of Pepper Avenue, Foothill Boulevard is a four-lane arterial roadway under Caltrans' jurisdiction with a 50 mph posted speed limit. All four approaches have two-way left-turn median lanes, which open up to provide dedicated left-turn pockets at the intersection. The County of San Bernardino Department of Health Services sits on the northwest corner, a Church's Chicken with drive-through on the northeast corner, a Southern California Edison facility on the southeast corner, and a commercial center on the southwest corner.

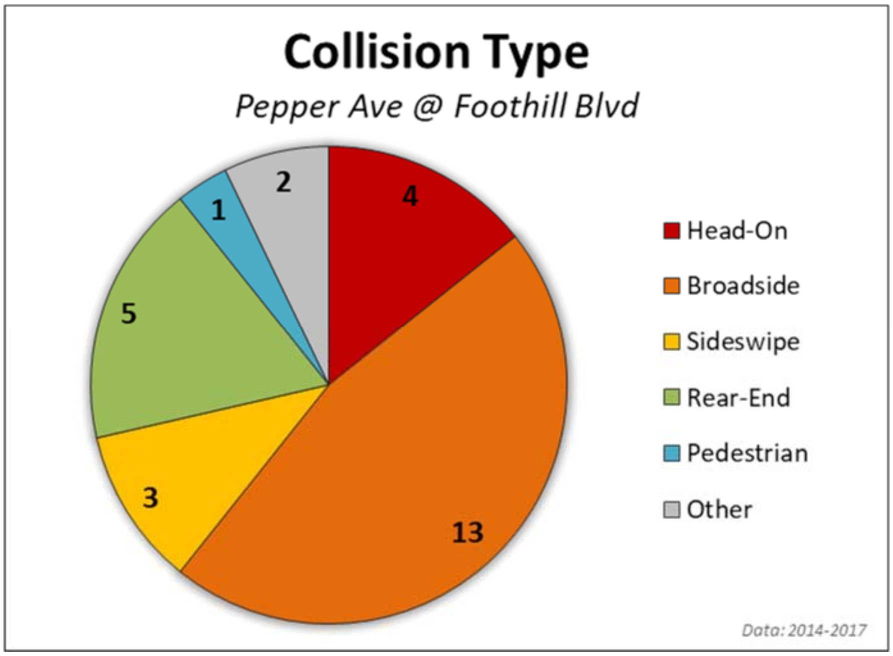
The intersection is controlled by a traffic signal, with left-turn arrows provided for the eastbound and westbound approaches on Foothill Boulevard. Near-side signal indications are provided on all approaches, which provide advance information to improve motorist awareness. Pedestrian crossings are provided across all approaches.

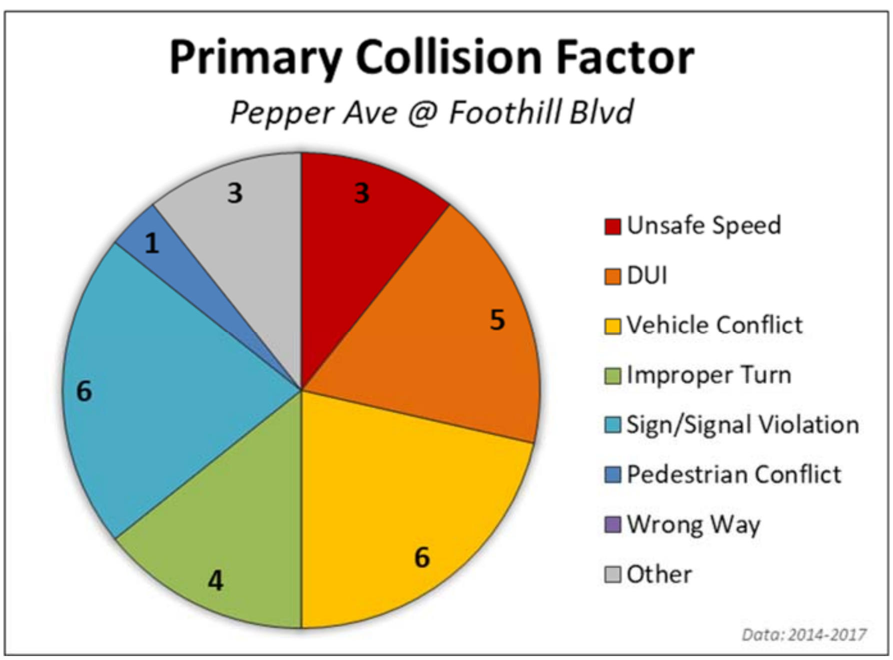
Intersection Collision Patterns

Collision data over the four-year study period (2014-2017) shows a total of 28 collisions at this intersection, or about seven per year on average. Of these incidents, 11 (39%) occurred on weekends, 13 (46%) occurred at night, 15 (54%) involved parties aged 18-30, five (18%) involved a DUI, and 13 (46%) were broadside collisions. These data rank this location as #1 in weekend collisions, #2 in nighttime collisions, and #3 in both young-adult and DUI-involved collisions within the study.

Typically, about one-third of collisions at an intersection would occur at night. In addition to lighting-related concerns, these collisions involve a prevalence of DUI, speeding, and drowsy driving risk factors. At this location, 46% of recorded incidents occurred at night, which is slightly higher than expected.

The following figures show the collision types and primary collision factors at this location, with detailed statistics in **Appendix C**.





At 46%, the most prevalent collision type at this intersection is broadsides. Traffic signals are essentially designed to prevent broadside collisions—which typically result from right-of-way confusions and conflicting movements—so such a high percentage is unusual for a signalized location. Therefore, the field review took care to note any potential impairments to driver awareness for conflicting vehicle movements.

The prevalence of vehicle conflict, improper turn, and signal violation factors at this location are congruent with the finding of a large percentage of broadside collisions.

Finally, the collision patterns at this location showed that seven (25%) of the 28 incidents involved the northbound left-turn movement, which is currently allowed to proceed permissively through the intersection, concurrent with the north- and southbound through movements. Therefore, it is expected that improving traffic safety for the northbound left turn at this location would reduce collision frequency overall.

Recommendations

In order to improve driver awareness and nighttime intersection visibility, it is recommended the City prioritize this location for repainting and refreshing the existing lane and crosswalk striping, as it was observed to be worn and/or faded in several places. It is further recommended to improve the signing and striping regarding the dedicated eastbound right-turn lane by installing additional "Right Turn Must Turn Right" (R3-7) signage and an additional right-turn arrow pavement marking at the west leg limit line. Additionally, it is recommended to improve the northbound left-turn safety condition by providing a northbound left-turn arrow, which we propose to be operated as a Protected-Permissive Left-Turn (PPLT). Finally, the City may consider widening the northbound approach on the east side to provide a new right-turn pocket, which could improve curb alignments through the intersection.

The estimated cost of these recommended capital improvements is approximately $250,000.

Operational / Low-Cost Recommendations:

- Renew and refresh existing intersection striping
- Paint additional EB right-turn arrow pavement marking at limit line
- Install additional EB near-side "Right Lane Must Turn Right" (R3-7) sign at limit line
- Consider installing EB eastbound far-side "Right Lane Must Turn Right" (R3-7) sign at east leg crosswalk

Capital Improvement Recommendations:

- Install NB Protected-Permissive Left-Turn (PPLT) arrow
- Consider widening NB approach to provide new right-turn pocket lane

7.3. Riverside Avenue at Valley Boulevard

Number of Collisions: 27

This intersection is located in the southern part of the city, just north of the I-10 freeway, surrounded by commercial properties. Per the City of Rialto General Plan, Valley Boulevard is classified as a Major Arterial, while at this location Riverside Avenue is classified as a Modified Major Arterial II. At this location, Valley Boulevard is a four-lane arterial roadway with a 40 mph posted speed limit west of the intersection and a 45 mph posted speed limit east of it, while Riverside Avenue is a six-lane arterial roadway with a 40 mph posted speed limit. All four approaches have raised concrete center medians which narrow down to provide dedicated left-turn pockets at the intersection.

At the intersection, a Burger King with drive-through sits on the northwest corner, a Coco's restaurant on the northeast corner, and gas stations on the southeast and southwest corners. It was observed that this location carries heavy traffic flows to and from the I-10 freeway, with frequent queuing in the dedicated eastbound right-turn lane.

The intersection is controlled by a traffic signal, with left-turn arrows provided for all approaches. Southbound U-turns are prohibited during the AM and PM weekday peak periods. Near-side signal indications are also provided on all approaches, which provide advance information to improve motorist awareness. Pedestrian crossings are provided across all four approaches.

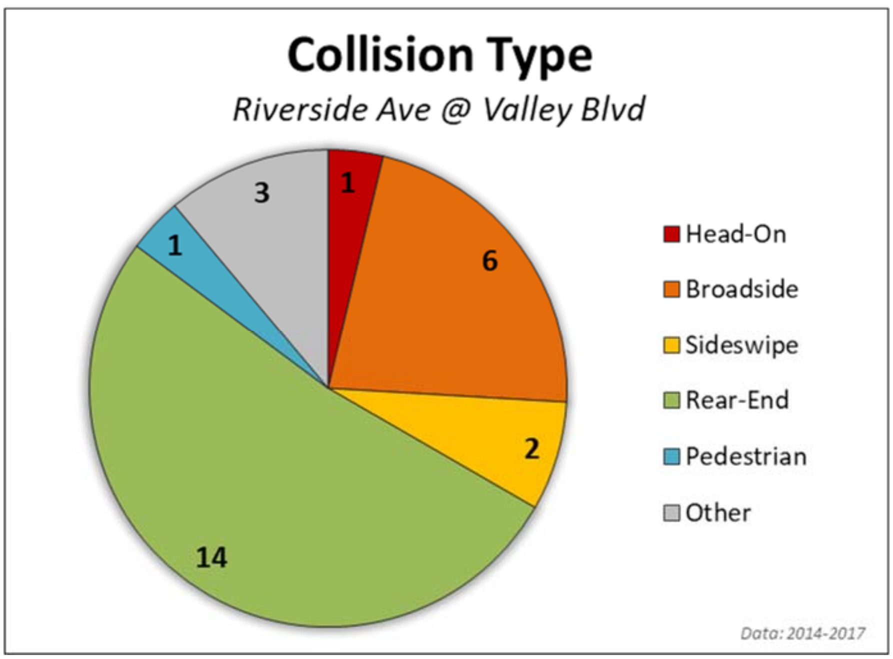
Intersection Collision Patterns

Collision data over the four-year study period (2014-2017) shows a total of 27 collisions at this intersection, or about seven per year on average. Of these incidents, 14 (52%) were rear-end collisions, 12 (44%) involved unsafe speeds, 11 (41%) were hit-and-runs collisions, 17 (63%) involved parties aged 18-30, and 12 (44%) occurred at night. These data rank this location as #1 in rear-end, speeding, and hit-and-run collisions and #2 in nighttime and young-adult collisions within the study.

Nearly 80% of the rear-end collisions at this location involved northbound or southbound vehicles traveling on Riverside Avenue. Per satellite aerial imagery and field observations, it was noted that the adjacent traffic signal at the I-10 westbound ramps is located a short distance away, less than 500 feet to the south.

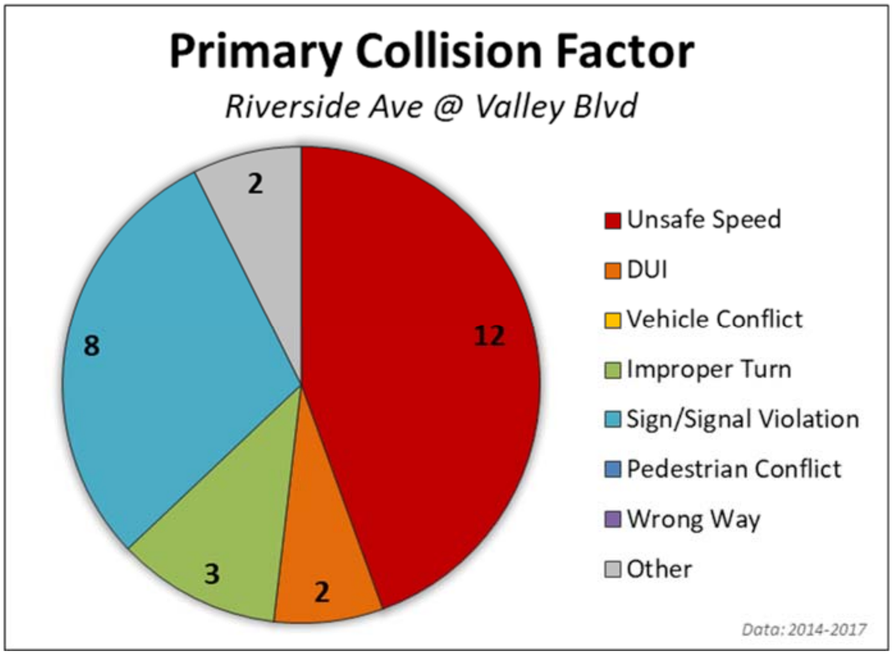
Typically, about one-third of collisions at an intersection would occur at night. In addition to lighting-related concerns, these collisions involve a prevalence of DUI, speeding, and drowsy driving risk factors. At this location, 44% of recorded incidents occurred at night, which is slightly higher than expected.

The following figures show the collision types and primary collision factors at this location, with detailed statistics in **Appendix C**.



At 52%, the most prevalent collision type at this intersection is rear-end collisions, which typically involve drivers distracted by nearby downstream signal indications, congested stop-and-go conditions, or unsafe speeds. Therefore, the field review focused on potential improvements to motorist awareness and traffic signal indications.

The prevailing primary collision factor at this location is unsafe vehicle speeds, at 44% of all recorded incidents. This corresponds to the high proportion of collisions involving young adults (63%) and elevated incidence of nighttime collisions (44%).



Recommendations

In order to improve driver awareness and nighttime intersection visibility, it is recommended the City prioritize this location for repainting and refreshing the existing lane and crosswalk striping, as it was observed to be worn and/or faded in several places. It is further recommended to reduce potential vehicle conflicts at this busy intersection by permanently restricting northbound and southbound U-turns on Riverside Avenue, which is a common practice near freeway interchanges. Additionally, it is recommended to improve the eastbound right-turn traffic flow by providing a right-turn overlap arrow, to be operated concurrent with the northbound left-turn arrow. Finally, the City may consider widening the southbound approach to provide a new dedicated right-turn lane.

The estimated cost of these recommended capital improvements is approximately $200,000.

Operational / Low-Cost Recommendations:

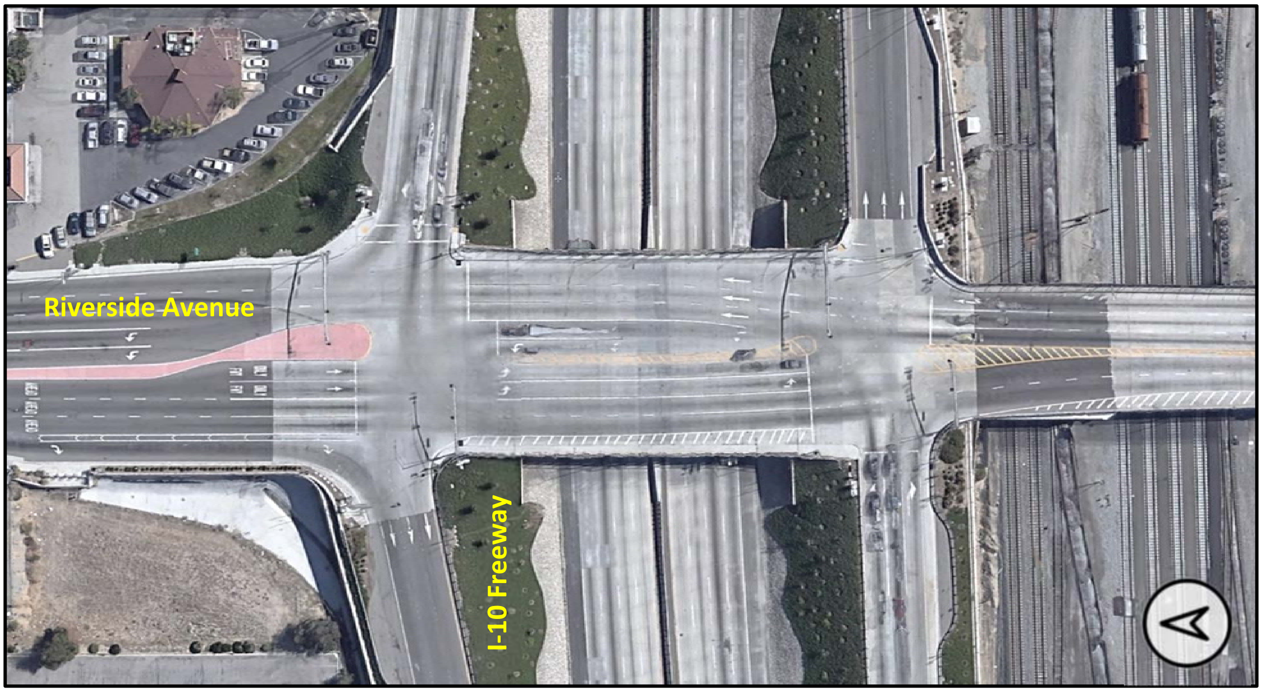
- Renew and refresh existing intersection striping
- Install NB "No U-Turn" (R3-4) signage
- Replace existing SB time-limited "No U-Turn" sign with permanent "No U-Turn" (R3-4) sign

Capital Improvement Recommendations:

- Install additional NB/SB mast-arm signal indications
- Install EB right-turn overlap arrow
- Install additional safety lighting on NW and SE corners
- Consider widening SB approach to provide new dedicated right-turn pocket lane

7.4. Riverside Avenue at Interstate 10 Freeway Interchange (State owned and operated)

Number of Collisions: 25



Due to the geographical tagging of the collision history database used in this study, incidents recorded along Riverside Avenue at the Interstate 1- (I-10) freeway interchange were inconclusive as to be distinguished between the eastbound or westbound ramp signal. Therefore, the two traffic signals were treated as one study location. The similar geometries and traffic signal operations—as well as their close proximity—provide for a comprehensive assessment of the interchange as a whole.

This study location is in the southern part of the city, connecting the City of Rialto to the Interstate 10 (I-10) freeway, a regional thoroughfare. At this location, Riverside Avenue is a six-lane arterial roadway classified as a Modified Major Arterial II under the City's General Plan. Dual dedicated left-turn pockets are provided on Riverside Avenue for traffic entering the freeway.

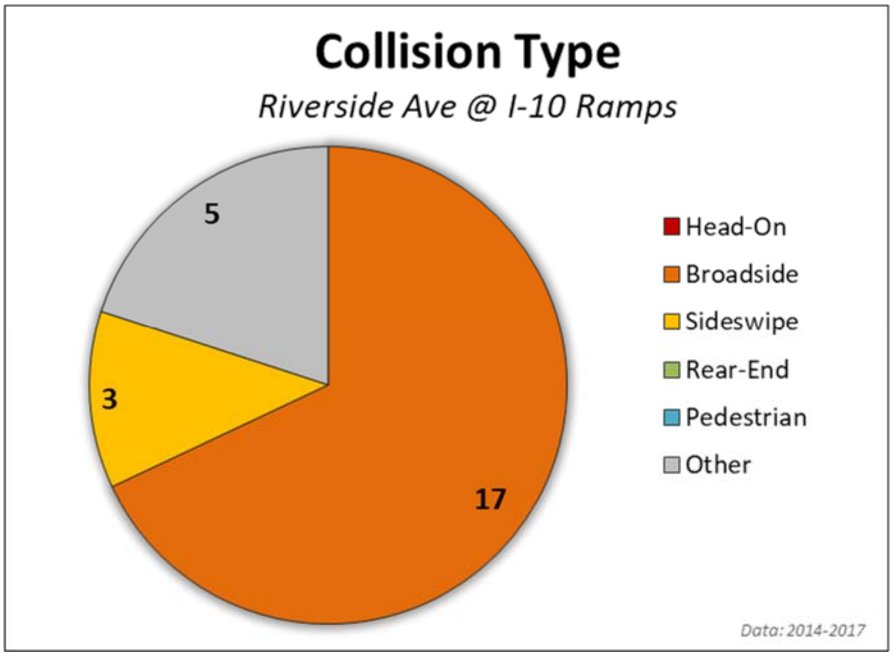
Both the eastbound and westbound ramps interchange intersections are controlled by traffic signals, with left-turn arrows provided for the northbound and southbound approaches on Riverside Avenue, as appropriate. Near-side signal indications are provided on all approaches, which provide advance information to improve motorist awareness. Pedestrian crossings are provided along Riverside Avenue only, with sidewalks on both sides of the freeway overpass. Pedestrian crossing is prohibited across Riverside Avenue.

Intersection Collision Patterns

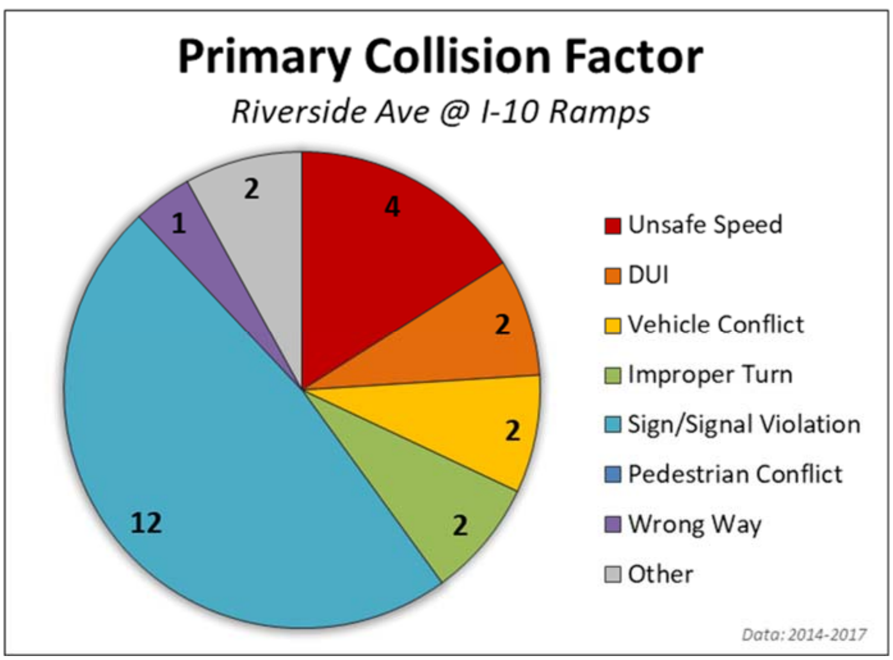
Collision data over the four-year study period (2014-2017) shows a total of 25 collisions at this location, or about six per year on average. Of these incidents, 17 (68%) were broadside collisions and 11 (44%) occurred at night. These data rank this location as #2 in broadside collisions within the study.

Typically, about one-third of collisions at an intersection would occur at night. In addition to lighting-related concerns, these collisions involve a prevalence of DUI, speeding, and drowsy driving risk factors. At this location, 44% of recorded incidents occurred at night, which is slightly higher than expected.

The following figures show the collision types and primary collision factors at this location, with detailed statistics in **Appendix C**.



At 68%, the most prevalent collision type at this intersection is broadsides. Traffic signals are essentially designed to prevent broadside collisions—which typically result from right-of-way confusions and conflicting movements—so such a high percentage is unusual for any signalized location.



The prevalence (48%) of signal violation as a primary collision factor at this location is congruent with the finding of a large percentage of broadside collisions. Furthermore, it may be that the proximity of the two adjacent freeway ramp signals, and/or the tendency of motorists to be distracted or in a hurry at freeway entrances and exits, contribute to risky driving patterns that factor into these collisions.

Finally, the collision patterns at this location showed that thirteen (52%) of the 25 incidents involved left-turn movements: four collisions each involving the southbound left turn toward the eastbound on-ramp, eastbound left turn from off-ramp, and westbound left turn from the off-ramp; and one collision involving the northbound left turn toward the westbound on-ramp.

Recommendations

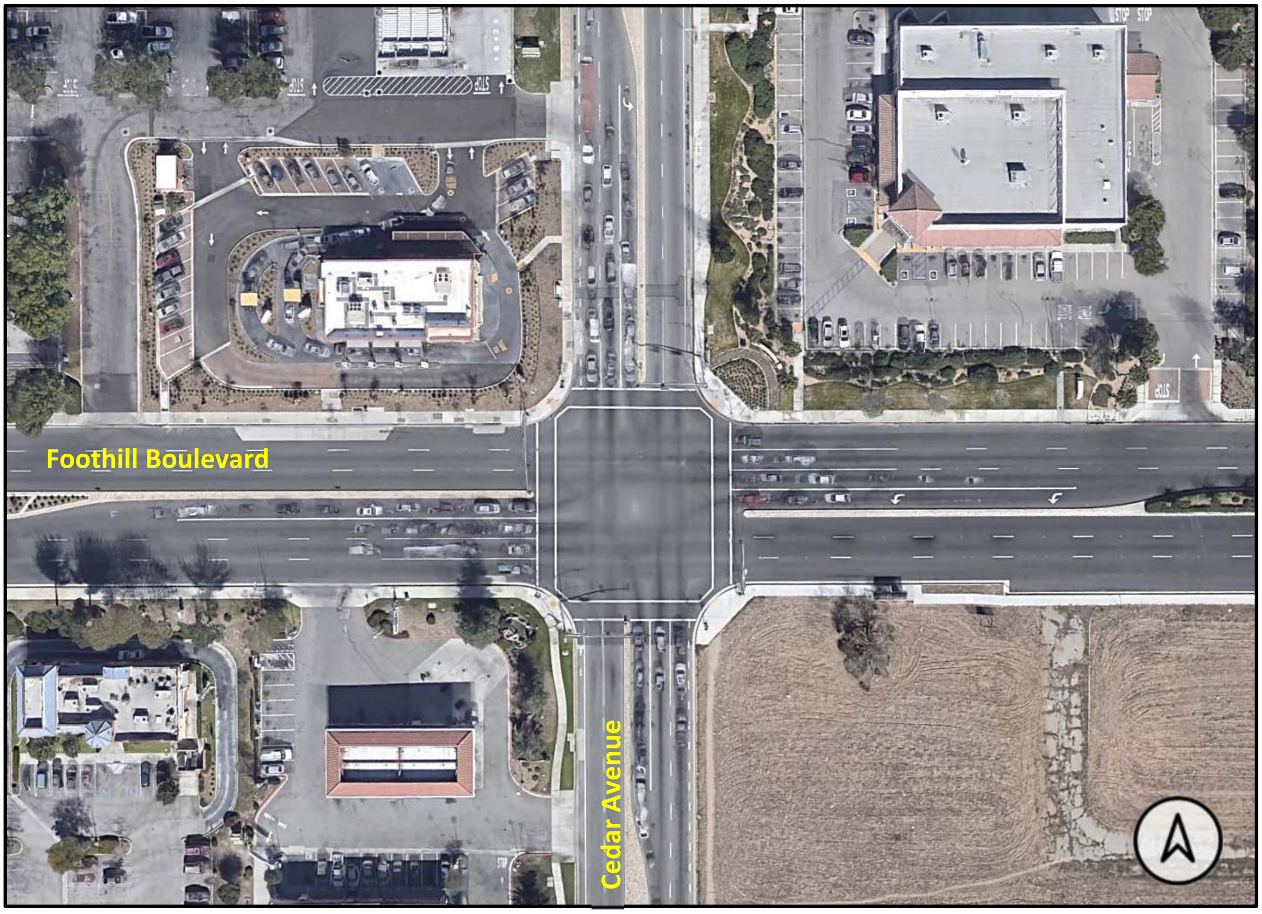
As freeway interchanges fall under the jurisdiction of Caltrans, it is recommended the City of Rialto request Caltrans to implement several safety enhancements (increase all-red clearance time and install additional mast-arm-mounted traffic signal indications) as well as conduct a detailed traffic safety evaluation at this location and incorporate its findings into future improvement projects.

Operational / Low-Cost Recommendations:

- Request that Caltrans increase all-red clearance interval for all phases
- Request that Caltrans install additional NB/SB mast-arm indications for Riverside Avenue
- Request that Caltrans conduct a detailed traffic safety evaluation and incorporate its findings into future improvement projects

7.5. Cedar Avenue at Foothill Boulevard

Number of Collisions: 23



This intersection is located in the western part of the city, surrounded by commercial properties. Per the City of Rialto General Plan, Cedar Avenue is classified as a Major Arterial, while Foothill Boulevard is classified as a Modified Major Arterial I. At this location, Cedar Avenue is a four-lane arterial roadway with a 50 mph posted speed limit north of the intersection and a 45 mph posted speed limit south of it, while Foothill Boulevard is a six-lane arterial roadway with a 50 mph posted speed limit. All four approaches have raised concrete center medians which narrow down to provide dedicated left-turn pockets at the intersection. A McDonald's fast-food restaurant with drive-through sits on the northwest corner, a Walgreens pharmacy on the northeast corner, and a Chevron gas station on the southwest corner, while the southeast corner currently lies vacant.

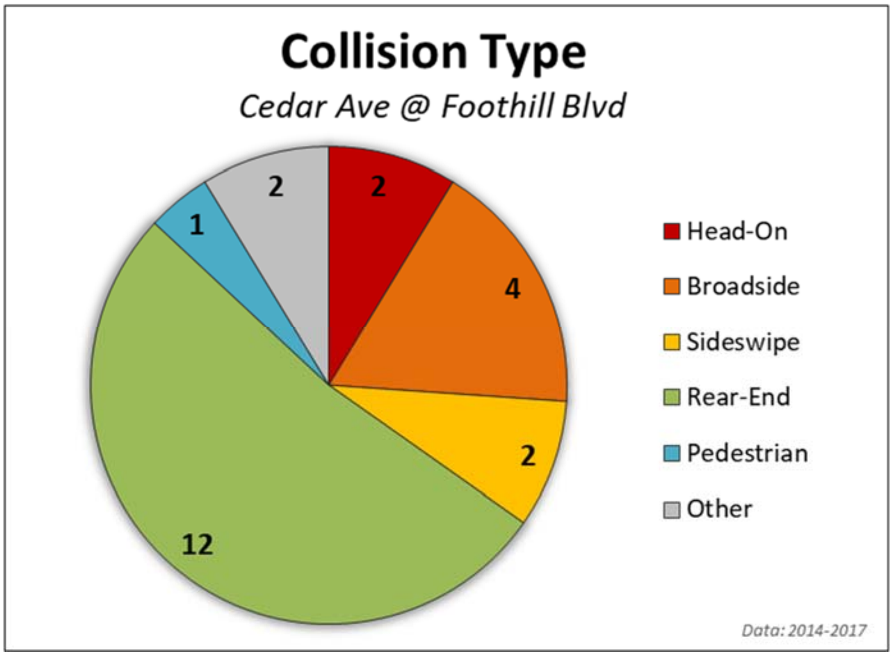
The intersection is controlled by a traffic signal, with left-turn arrows provided for all approaches. Near-side signal indications, which provide advance information to improve motorist awareness, are provided for the northbound and southbound approaches only. Pedestrian crossings are provided across all four approaches.

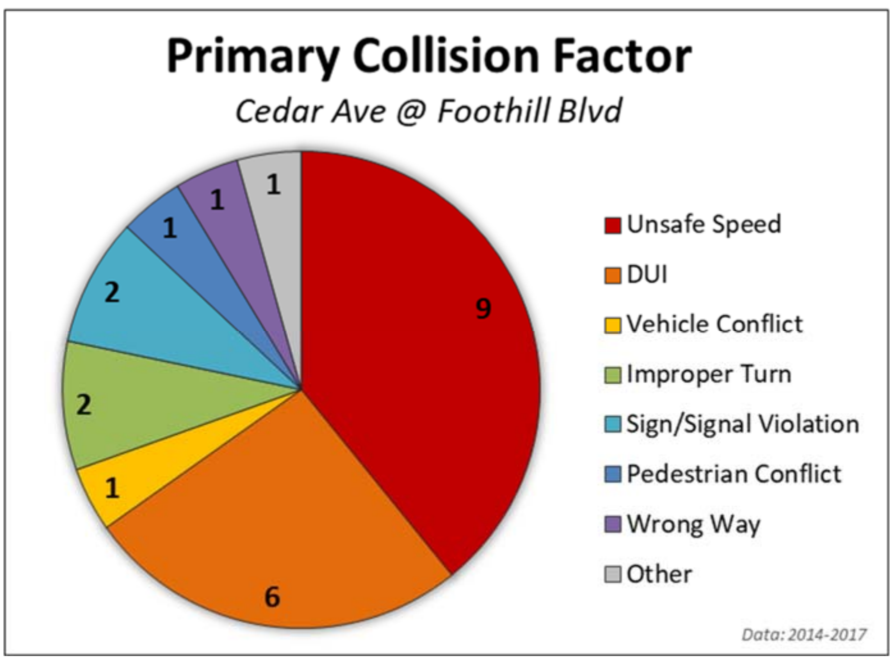
Intersection Collision Patterns

Collision data over the four-year study period (2014-2017) shows a total of 23 collisions at this intersection, or about six per year on average. Of these incidents, 12 (52%) were rear-end collisions, nine (39%) involved unsafe speeds, and six (26%) involved a DUI. These data rank this location as #1 in DUI collisions, #2 in rear-end collisions, and #3 in speeding collisions within the study.

Although an elevated number of DUI collisions occurred at this intersection, most of them (5 of 6, or 83%) were rear-end collisions, which are typically low-severity incidents. In fact, no severe-injury or fatal collisions were recorded at this location, including the DUI incidents.

The following figures show the collision types and primary collision factors at this location, with detailed statistics in **Appendix C**.





At 52%, the most prevalent collision type at this intersection is rear-end collisions, which typically involve drivers distracted by nearby downstream signal indications, congested stop-and-go conditions, or unsafe speeds. Therefore, the field review focused on potential improvements to motorist awareness and traffic signal indications.

The prevailing primary collision factor at this location is unsafe vehicle speeds, at 39% of all recorded incidents, with DUI's being the second, at 26%.

Recommendations

As DUI's tend to occur at night, one potential improvement to separate conflicting traffic at night is to increase all-red clearance intervals. To increase motorist awareness, it is recommended the City install additional traffic signal indications for the eastbound and westbound movements on Foothill Boulevard.

The estimated cost of these recommended capital improvements is approximately $10,000.

Operational / Low-Cost Recommendations:

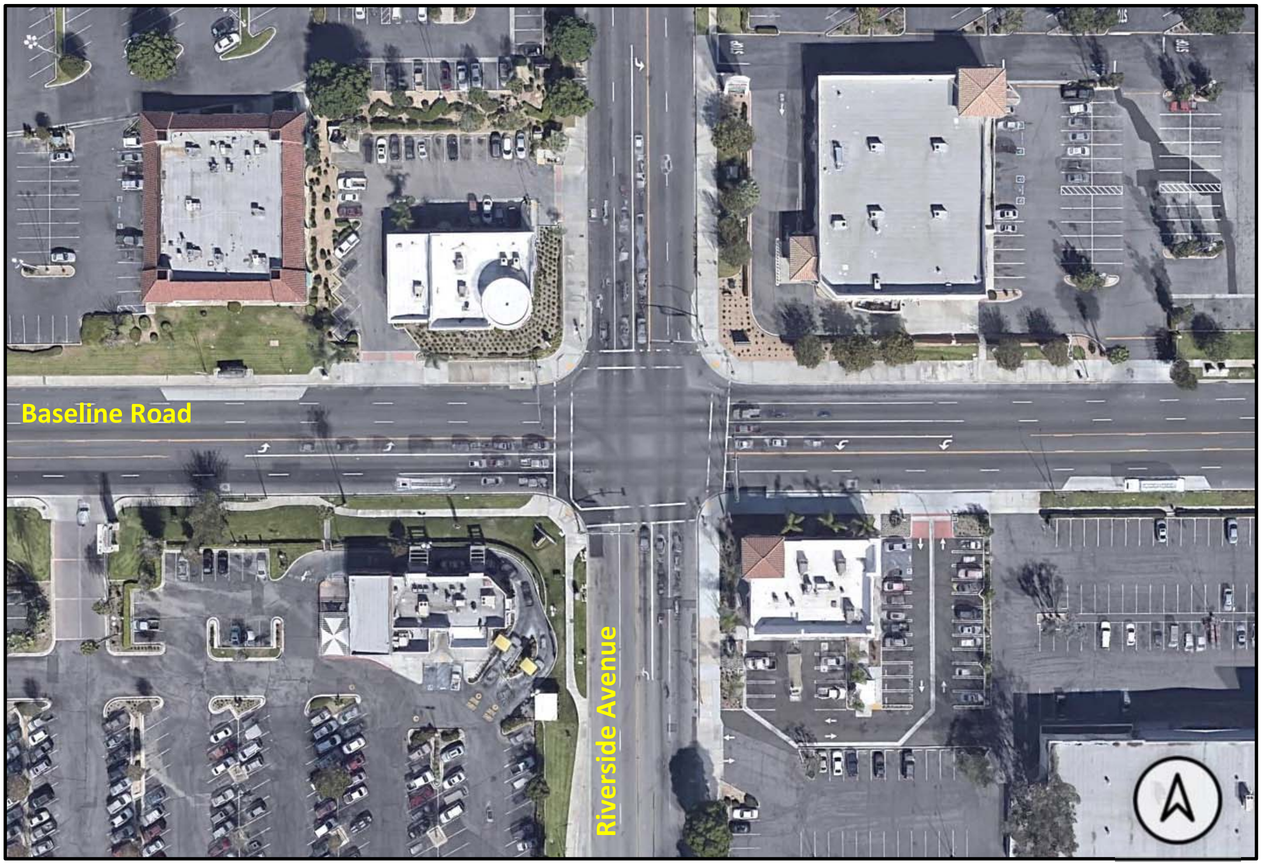
- Consider increasing all-red clearance interval at night

Capital Improvement Recommendations:

- Install EB/WB near-side signal indications
- Install additional EB/WB mast-arm signal indications

7.6. Riverside Avenue at Baseline Road

Number of Collisions: 22



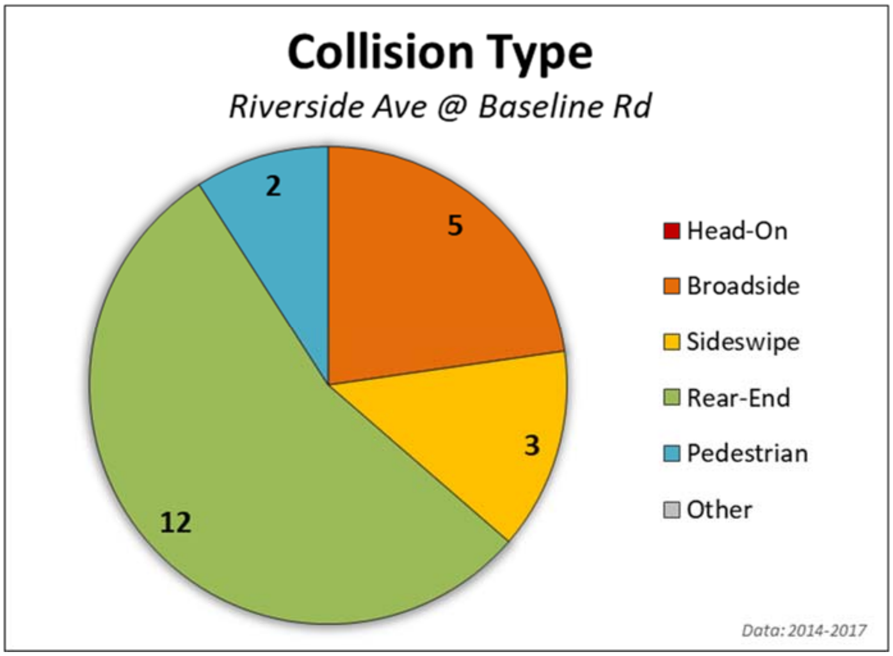
This intersection is located in the heart of the city, surrounded by commercial properties. Per the City of Rialto General Plan, at this location both Riverside Avenue and Baseline Road are classified as Major Arterials. At this location, Riverside Avenue is a four-lane arterial roadway with a 50 mph posted speed limit north of the intersection and a 40 mph posted speed limit south of it, while Baseline Road is a five-lane arterial roadway with a 35 mph posted speed limit. All four approaches have dedicated two-way left-turn median lanes which open up to provide dedicated left-turn pockets at the intersection. A multi-tenant commercial building sits on the northwest corner, a Walgreens pharmacy on the northeast corner, a Tacos El Gavilan restaurant on the southeast corner, and a McDonald’s restaurant with drive-through on the southwest corner.

The intersection is controlled by a traffic signal, with left-turn arrows provided for all approaches. Westbound U-turns are prohibited at all times. Near-side signal indications, which provide advance information to improve motorist awareness, are provided for eastbound vehicles only. Pedestrian crossings are provided across all four approaches.

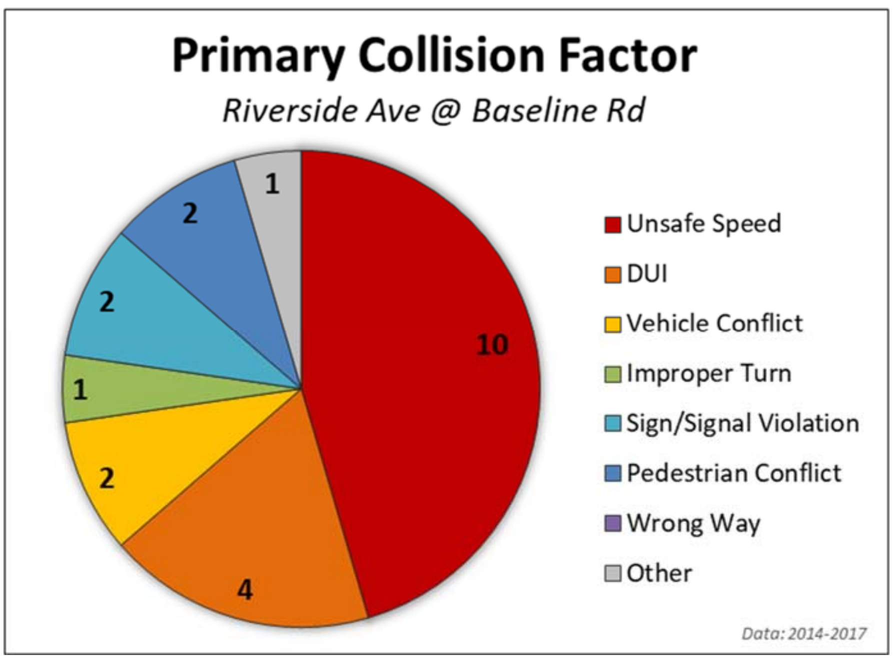
Intersection Collision Patterns

Collision data over the four-year study period (2014-2017) shows a total of 22 collisions at this intersection, or about six per year on average. Of these incidents, 12 (55%) were rear-end collisions and 10 (44%) involved unsafe speeds. These data rank this location as #2 in rear-end and speeding collisions within the study.

The following figures show the collision types and primary collision factors at this location, with detailed statistics in **Appendix C**.



At 55%, the most prevalent collision type at this intersection is rear-end collisions, which typically involve drivers distracted by nearby downstream signal indications, congested stop-and-go conditions, or unsafe speeds. Furthermore, two-thirds of the rear-end collisions at this location involved vehicles traveling on Riverside Avenue. Therefore, the field review focused on potential improvements to motorist awareness and traffic signal indications, particularly for the northbound and southbound approaches.



The prevailing primary collision factor at this location is unsafe vehicle speeds, at 44% of all recorded incidents, with DUI’s being the second, at 18%.

Recommendations

In order to improve driver awareness, it is recommended the existing westbound left-turn lane assignment sign be replaced with a “No U-Turn” (R3-4) sign; additional near-side traffic signal indications be installed for the northbound, southbound, and westbound approaches; and the westbound mast-arm left-turn signal indication be replaced with left-turn arrows.

The estimated cost of these recommended capital improvements is approximately $37,500.

Operational / Low-Cost Recommendations:

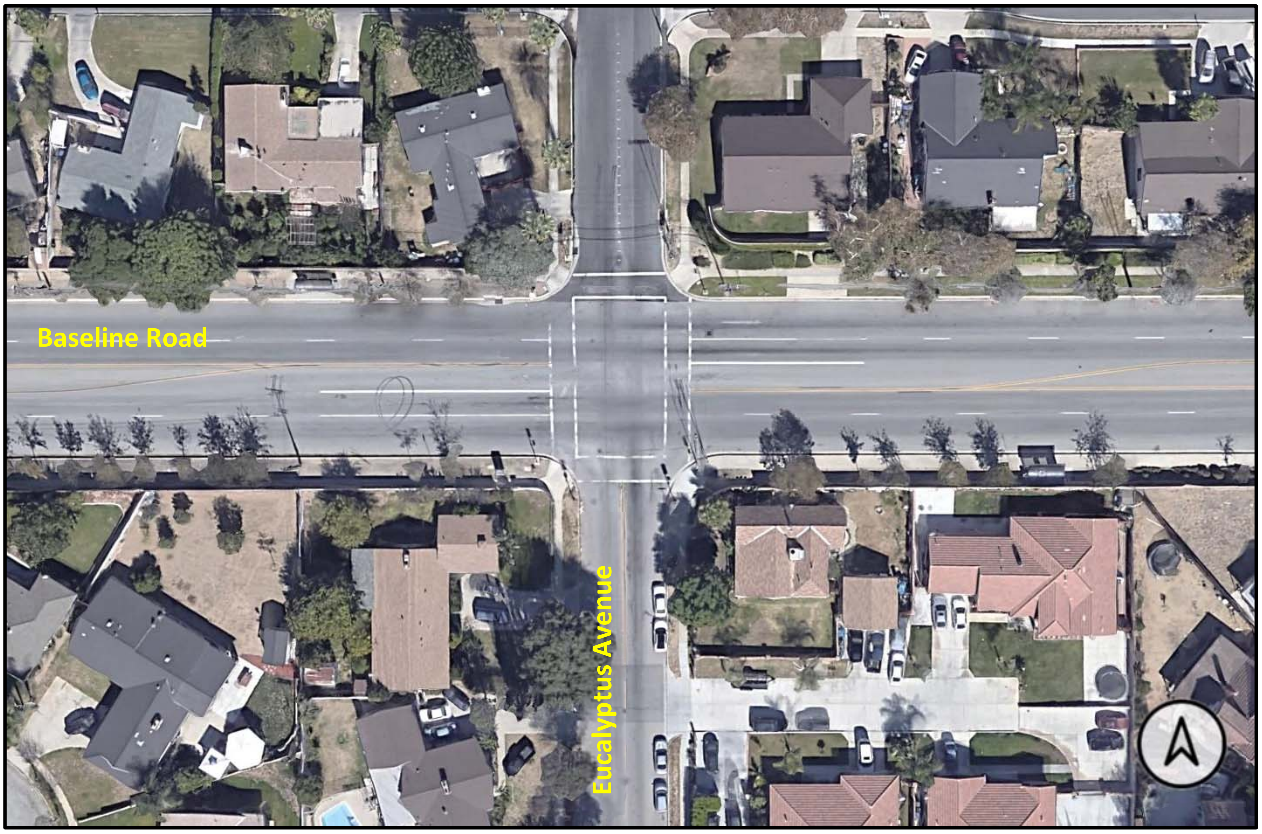
- Replace existing WB mast-arm lane assignment sign with permanent “No U-Turn” (R3-4) sign

Capital Improvement Recommendations:

- Install NB, SB, WB near-side signal indications
- Install bigger pole at NW corner to accommodate 45’ mast arm.
- Replace WB left-turn programmed-visibility (PV) signal head with left-turn arrow signal indications.

7.7. Eucalyptus Avenue at Baseline Road

Number of Collisions: 20



This intersection is located in the heart of the city, surrounded by residential neighborhoods. Per the City of Rialto General Plan, Baseline Road is classified as a Major Arterial, while Eucalyptus Avenue is classified as a Collector Street. At this location, Baseline Road is a four-lane arterial roadway with a 40 mph posted speed limit and a painted median lane, which narrows to provide dedicated left-turn pockets at the intersection. In contrast, Eucalyptus Avenue is a two-lane, undivided residential collector roadway with a 40 mph posted speed limit and on-street parking.

The intersection is controlled by a traffic signal, with pedestrian crossings provided across all approaches. The signal operation is controlled by semi-actuation, with vehicle detection on Eucalyptus Avenue.

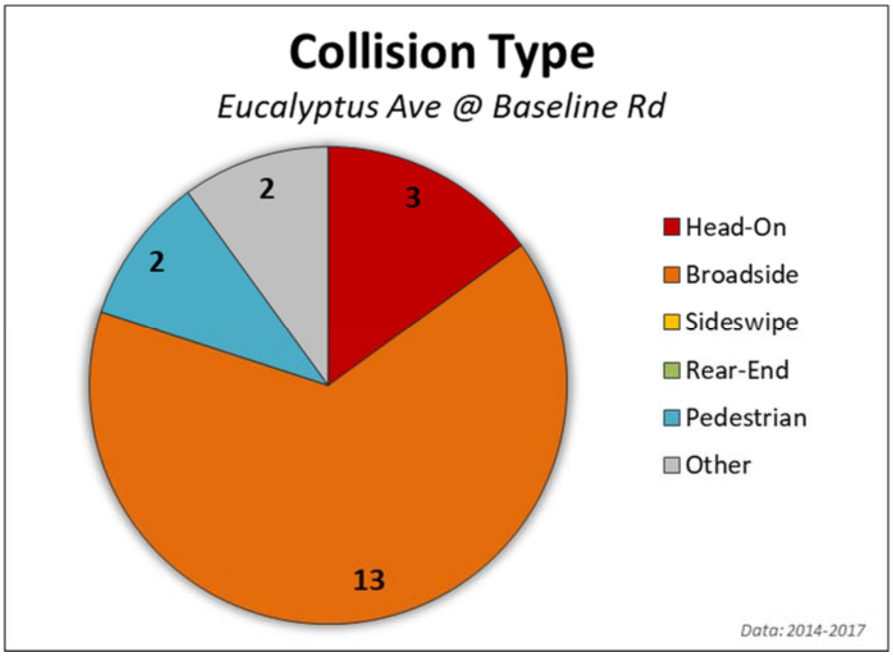
Intersection Collision Patterns

Collision data over the four-year study period (2014-2017) shows a total of 20 collisions at this intersection, or about five per year on average. Of these incidents, 13 (65%) were broadside collisions and nine (45%) occurred at night. These data rank this location as #3 in broadside collisions within the study.

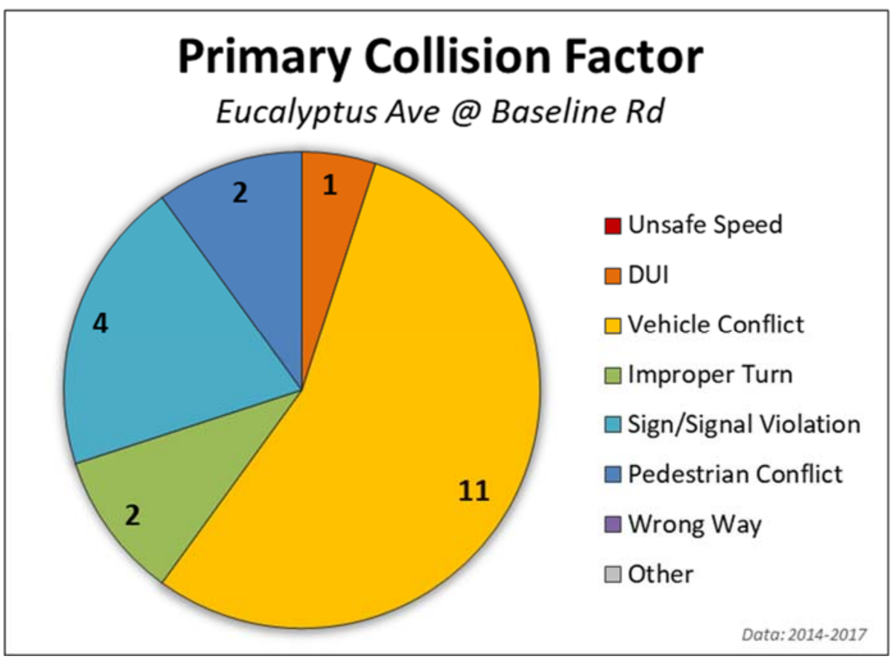
Typically, about one-third of collisions at an intersection would occur at night. In addition to lighting-related concerns, these collisions tend to involve DUI, speeding, and drowsy driving risk factors. At this location, 45% of recorded incidents occurred at night, which is higher than expected.

Furthermore, two fatalities occurred at this location, both of which were broadside collisions occurring during daylight hours with traffic signal violation being the primary collision factor.

The following figures show the collision types and primary collision factors at this location, with detailed statistics in **Appendix C**.



At 65%, the most prevalent collision type at this intersection is broadsides. Traffic signals are essentially designed to prevent broadside collisions—which typically result from right-of-way confusions and conflicting movements—so such a high percentage is unusual for a signalized location. Therefore, the field review took care to note any potential impairments to driver awareness for conflicting vehicle movements.



The prevalence of vehicle conflict and signal violation factors at this location is congruent with the finding of a large percentage of broadside collisions.

Recommendations

Due to the occurrence of severe and fatal injuries at this location, it is a prime candidate for grant funding to modernize the entire traffic signal by updating traffic signal equipment, installing additional detection, upgrading intersection safety lighting, and installing left-turn arrows for the eastbound and westbound approaches on Baseline Road.

This traffic signal upgrade and modernization is estimated to cost approximately $250,000.

Capital Improvement Recommendations:

- Modernize and upgrade existing traffic signal
    - Replace or upgrade existing traffic signal equipment
    - Upgrade EB/WB signal pole and indications on Baseline Road
    - Provide signal poles with mast arms for NB/SB approaches
    - Install additional safety lighting
    - Install EB/WB "dilemma zone" detection
    - Install EB/WB Protected Left-Turn operation

7.8. Riverside Avenue at Foothill Boulevard

Number of Collisions: 20

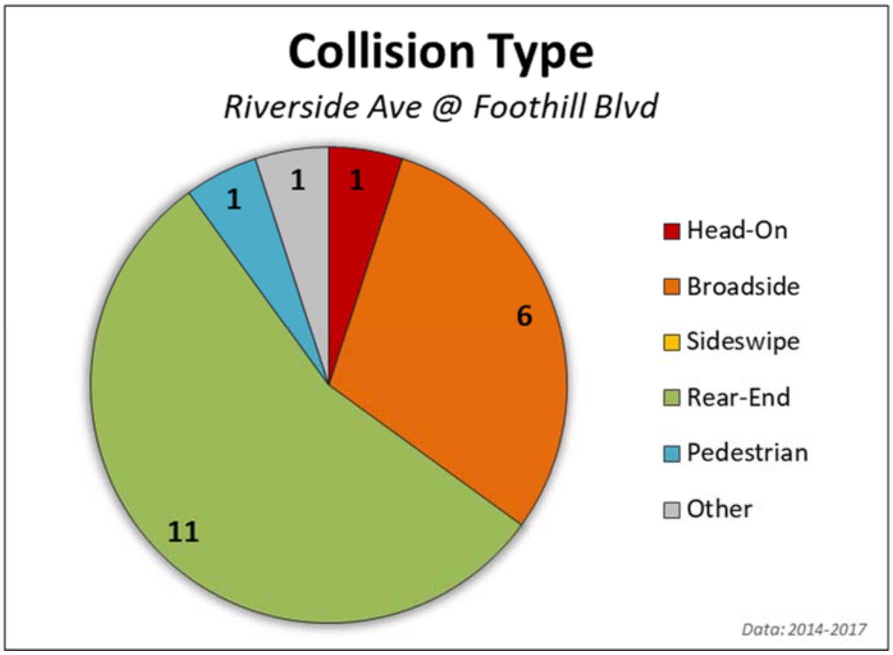
This intersection, which serves as the northern "gateway" to the Downtown Rialto area, is located in the heart of the city and surrounded by a mix of commercial properties and residential lots. Per the City of Rialto General Plan, Foothill Boulevard is classified as a Modified Major Arterial I, while at this location Riverside Avenue is classified as a Major Arterial north of the intersection and a Modified Major Arterial II south of it. At this location, Foothill Boulevard is a six-lane arterial roadway with a 40 mph posted speed limit and a two-way left-turn median lane, while Riverside Avenue is a four-lane arterial roadway with a raised, landscaped center median south of the intersection. All four approaches have dedicated left-turn pockets, with a dedicated right-turn pocket also provided for the northbound approach. A commercial building sits on the northwest corner, a Chase bank on the southeast corner, and gas stations on the northeast and southwest corners.

The intersection is controlled by a traffic signal, with left-turn arrows provided for all approaches. Pedestrian crossings are provided across all four approaches.

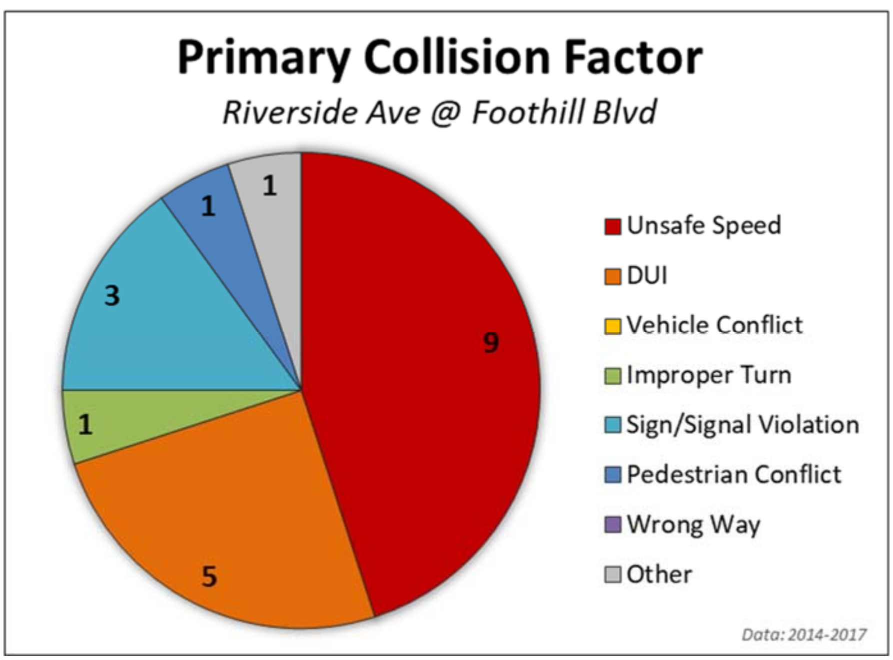
Intersection Collision Patterns

Collision data over the four-year study period (2014-2017) shows a total of 20 collisions at this intersection, or about five per year on average. Of these incidents, 11 (55%) were rear-end collisions, nine (45%) involved unsafe speeds, and five (25%) involved a DUI. These data rank this location as #2 in speeding collisions and #3 in DUI collisions within the study.

The following figures show the collision types and primary collision factors at this location, with detailed statistics in **Appendix C**.



At 55%, the most prevalent collision type at this intersection is rear-end collisions, which typically involve drivers distracted by nearby downstream signal indications, congested stop-and-go conditions, or unsafe speeds. Therefore, the field review focused on potential improvements to motorist awareness and traffic signal indications.



The prevailing primary collision factor at this location is unsafe vehicle speeds, at 45% of all recorded incidents.

Recommendations

In order to increase visibility at the intersection and reduce potential conflicts with driveway traffic, it is recommended the City restrict stopping for 150 feet north of the intersection along both sides of the north leg. Furthermore, it is recommended to install near-side traffic signal indications for the northbound and southbound approaches. Finally, it is recommended to facilitate the northbound right-turn movement by installing a right-turn overlap arrow and restricting westbound U-turns.

The estimated cost of these recommended improvements is approximately $22,000.

Operational / Low-Cost Recommendations:

- Prohibit stopping for 150 ft. north of the intersection on both sides of north leg (SB approach/NB departure)
- Install WB “No U-Turn” (R3-4) signs

Capital Improvement Recommendations:

- Install NB/SB near-side signal indications
- Install additional safety light on southeast corner
- Install NB right-turn overlap arrow

7.9. Foothill Boulevard at Sycamore Avenue

Number of Collisions: 20

This intersection is located on the eastern edge of the city, surrounded by commercial properties. Per the City of Rialto General Plan, Foothill Boulevard is classified as a Modified Major Arterial I, while Sycamore Avenue is classified as a Collector Street. At this location, Pepper Avenue is a four-lane arterial roadway included in the City's truck route network with a 45 mph posted speed limit. West of Pepper Avenue, Foothill Boulevard is a six-lane arterial roadway with a 40 mph posted speed limit. East of Pepper Avenue, Foothill Boulevard is a four-lane arterial roadway under Caltrans' jurisdiction with a 50 mph posted speed limit. All four approaches have two-way left-turn median lanes which open up to provide dedicated left-turn pockets at the intersection. The County of San Bernardino Department of Health Services sits on the northwest corner, a Church's Chicken with drive-through on the northeast corner, a Southern California Edison facility on the southeast corner, and a commercial center on the southwest corner.

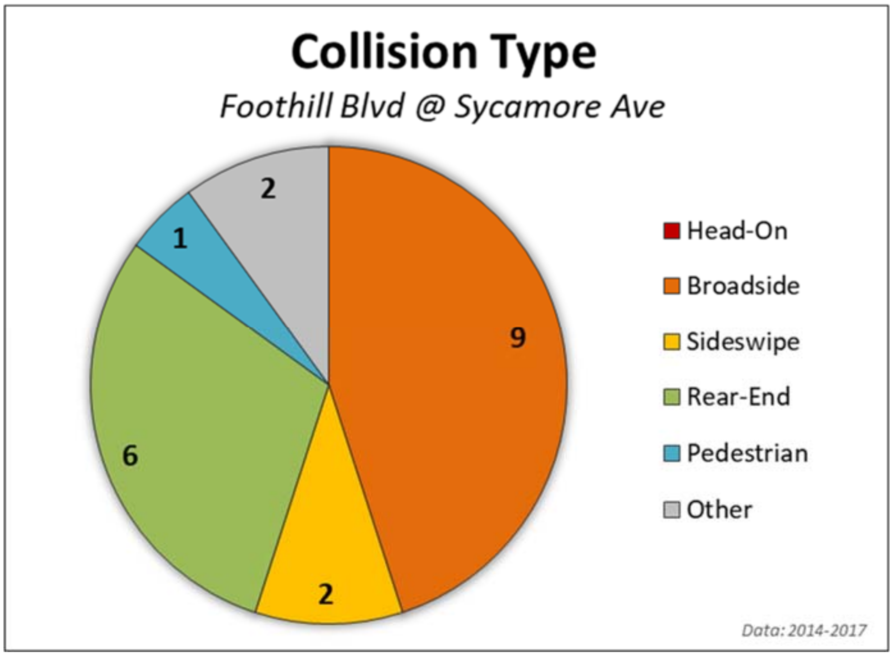
The intersection is controlled by a traffic signal, with left-turn arrows provided for the eastbound and westbound approaches on Foothill Boulevard. Near-side signal indications are provided on all approaches, which provide advance information to improve motorist awareness. Pedestrian crossings are provided across all approaches.

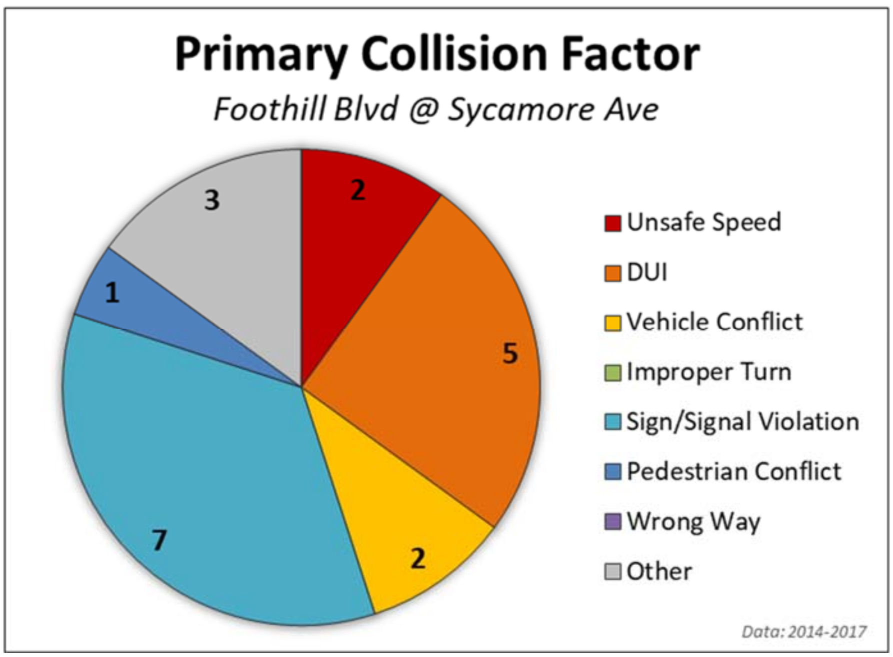
Intersection Collision Patterns

Collision data over the four-year study period (2014-2017) shows a total of 20 collisions at this intersection, or about five per year on average. Of these incidents, five (25%) involved a DUI and nine (45%) occurred at night. These data rank this location as #3 in DUI-involved collisions within the study.

Typically, about one-third of collisions at an intersection would occur at night. In addition to lighting-related concerns, these collisions involve a prevalence of DUI, speeding, and drowsy driving risk factors. At this location, 45% of recorded incidents occurred at night, which is slightly higher than expected.

The following figures show the collision types and primary collision factors at this location, with detailed statistics in **Appendix C**.





At 45%, the most prevalent collision type at this intersection is broadsides. Traffic signals are designed to prevent broadside collisions—resulting from right-of-way confusions and conflicting movements—so such a high percentage is unusual for a signalized location. Therefore, the field review took care to note any potential impairments to driver awareness for conflicting vehicle movements.

The prevalence of vehicle conflict and signal violation factors at this location is congruent with the finding of a large percentage of broadside collisions.

Finally, the collision patterns at this location showed that seven (25%) of the 28 incidents involved the northbound left-turn movement, which is currently allowed to proceed permissively through the intersection, concurrent with the north- and southbound through movements. Therefore, it is expected that improving traffic safety for the northbound left turn at this location would reduce collision frequency overall.

Recommendations

In order to improve driver awareness and nighttime intersection visibility, it is recommended the City prioritize this location for repainting and refreshing the existing lane and crosswalk striping, as it was observed to be worn and/or faded in several places. It is further recommended to improve the alignment of the dedicated eastbound right-turn lane by installing painted median striping to provide channelization and separation from the through lanes. Additionally, traffic signal equipment upgrade is recommended for the northbound and southbound approaches with new traffic signal poles, mast arms, and indications. Finally, it is recommended to improve the northbound and southbound left-turn safety condition by providing dedicated left-turn pockets to separate turning traffic from through traffic.

The estimated cost of these recommended improvements is approximately $115,000.

Operational / Low-Cost Recommendations:

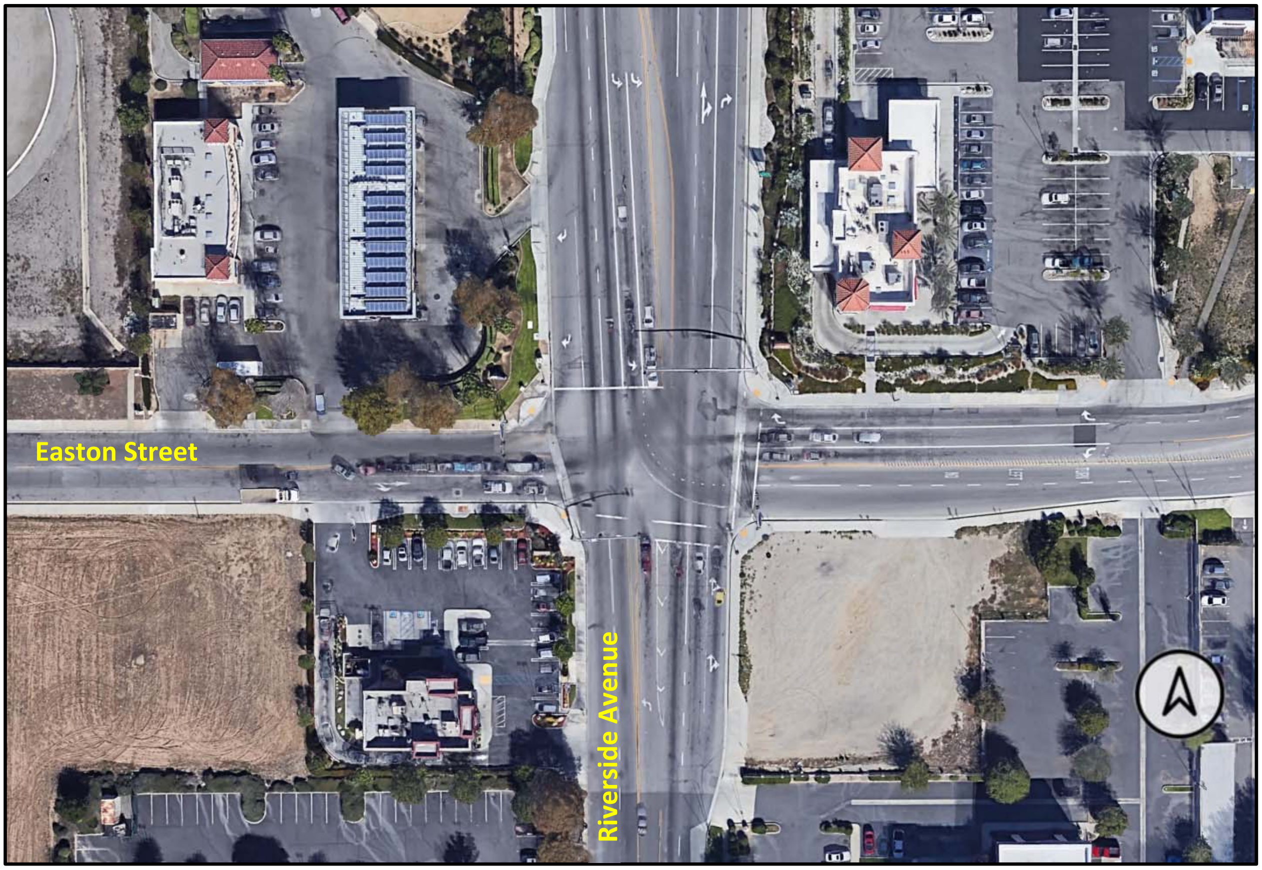
- Renew and refresh existing intersection striping

Capital Improvement Recommendations:

- Improve EB right-turn trap lane channelization with painted median
- Install new traffic signal poles for NB/SB approaches with mast arms and indications
- Restripe NB/SB approaches to provide dedicated left-turn pockets

7.10. Riverside Avenue at Easton Street

Number of Collisions: 20



This intersection is located in the northern part of the city, just south of the I-210 freeway, surrounded by commercial properties. At this location, per the City of Rialto General Plan, Riverside Avenue is classified as a Major Arterial, while Easton Street is classified as a Collector Street. At this location, Valley Boulevard is a four-lane arterial roadway with a 40 mph posted speed limit west of the intersection and a 45 mph posted speed limit east of it, while Riverside Avenue is a six-lane arterial roadway with a 40 mph posted speed limit. All four approaches have dedicated left-turn pockets: the southbound approach has two dedicated left-turn lanes, while the other approaches have a single left-turn lane. An Arco gas station sits on the northwest corner, an In-N-Out restaurant on the northeast corner, a Coffee Bean and Tea Leaf café with drive-through on the southeast corner, and a Jack-in-the-Box restaurant with drive-through on the southwest corner.

The intersection is controlled by a traffic signal, with left-turn arrows provided for all approaches. U-turns are prohibited at all times. Near-side signal indications are also provided on all approaches, which provide advance information to improve motorist awareness. Pedestrian crossings are provided across all approaches except the north leg (southbound approach).

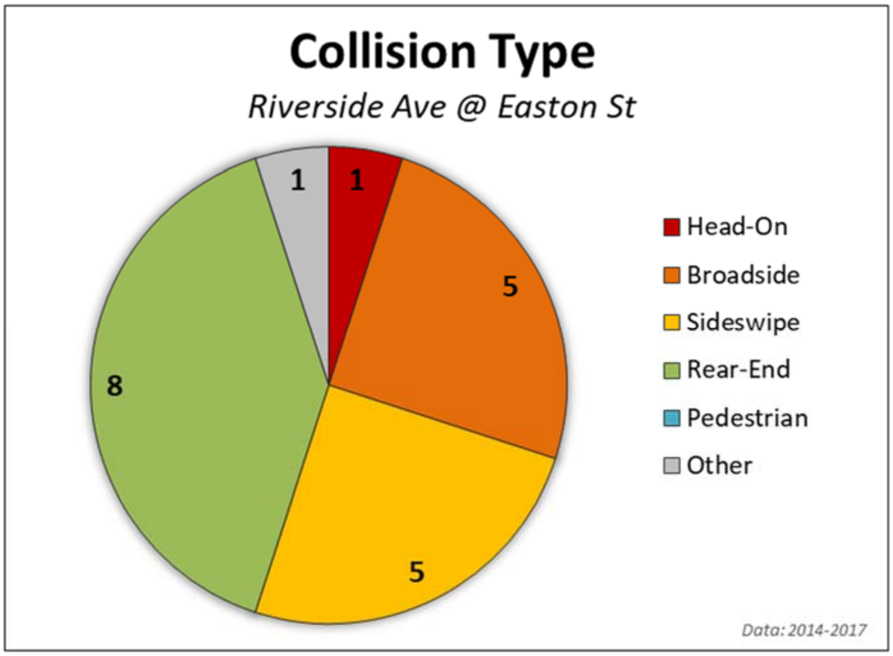
Intersection Collision Patterns

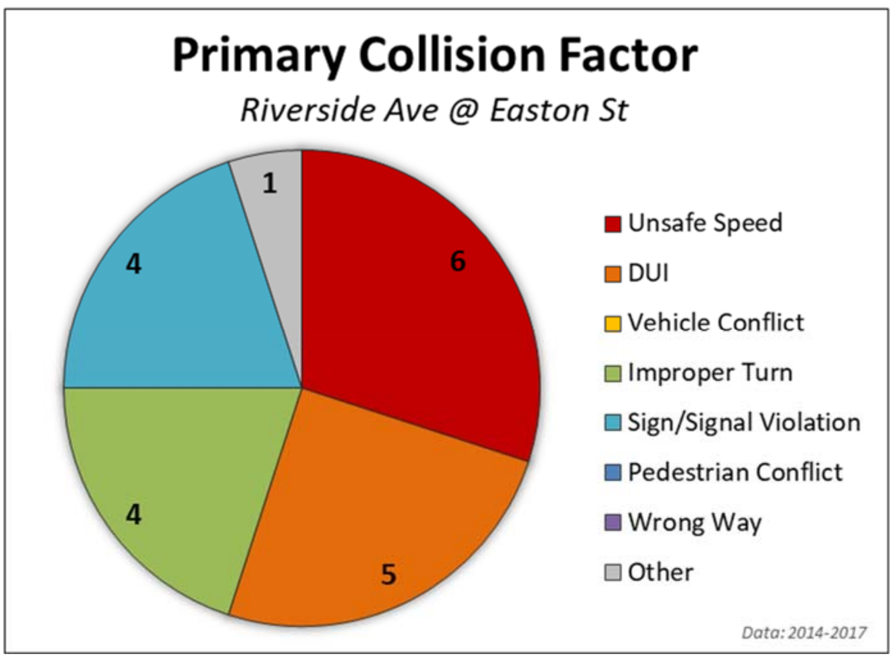
Collision data over the four-year study period (2014-2017) shows a total of 20 collisions were documented at this intersection, or about five per year on average. Of these incidents, 13 (65%) occurred at night, five (20%)

were sideswipe collisions, and five (20%) involved DUI's. These data rank this location as #1 in sideswipe collisions, #2 in nighttime collisions, and #3 in DUI collisions within the study.

Typically, about one-third of collisions at an intersection would occur at night. In addition to lighting-related concerns, these collisions involve a prevalence of DUI, speeding, and drowsy driving risk factors. At this location, 65% of recorded incidents occurred at night, which is higher than expected.

The following figures show the collision types and primary collision factors at this location, with detailed statistics in **Appendix C**.





At 40%, the most prevalent collision type at this intersection is rear-end collisions, which typically involve drivers distracted by nearby downstream signal indications, congested stop-and-go conditions, or unsafe speeds. All of the rear-end collisions at this location involved northbound or southbound vehicles traveling on Riverside Avenue. Per satellite aerial imagery and field observations, it was noted that the adjacent traffic signal at the I-210 eastbound ramps is located a short distance away, less than 500 feet to the north.

The prevailing primary collision factor at this location is unsafe vehicle speeds, at 30% of all recorded incidents, with DUI's a close second, at 20%.

Recommendations

In order to improve motorist awareness, it is recommended that the City install additional mast-arm traffic signal indications for the northbound and southbound approaches as well as upgrade the eastbound-traffic-facing mast arm to better align the signal indications to the lane geometry. Finally, it is recommended to facilitate the westbound right turn by installing a right-turn overlap arrow.

The estimated cost of these recommended improvements is approximately $40,000.

Capital Improvement Recommendations:

- Install WB and SB right-turn overlap arrows
- Install additional NB/SB mast-arm signal indications
- Replace EB mast arm with longer mast arm to better align indications

7.11. Riverside Avenue at Third Street (Downtown Rialto)

Number of Collisions: 8

This intersection is located in the heart of the city, within the historic Downtown Rialto district, surrounded by a mix of commercial and residential properties. At this location, Riverside Avenue is a four-lane arterial roadway classified as a Modified Major Arterial II with a raised, landscaped center median and a mph posted speed limit. In contrast, Third Street is a two-lane local street with a 50 mph posted speed limit.

The intersection is unsignalized, with two-way stop-controls for the eastbound and westbound approaches on Third Street. Pedestrian crossings are provided across all approaches.

During the field review, it was noted that the adjacent intersection of Riverside Avenue and Second Street, approximately 600 feet south of this intersection, has very similar characteristics.

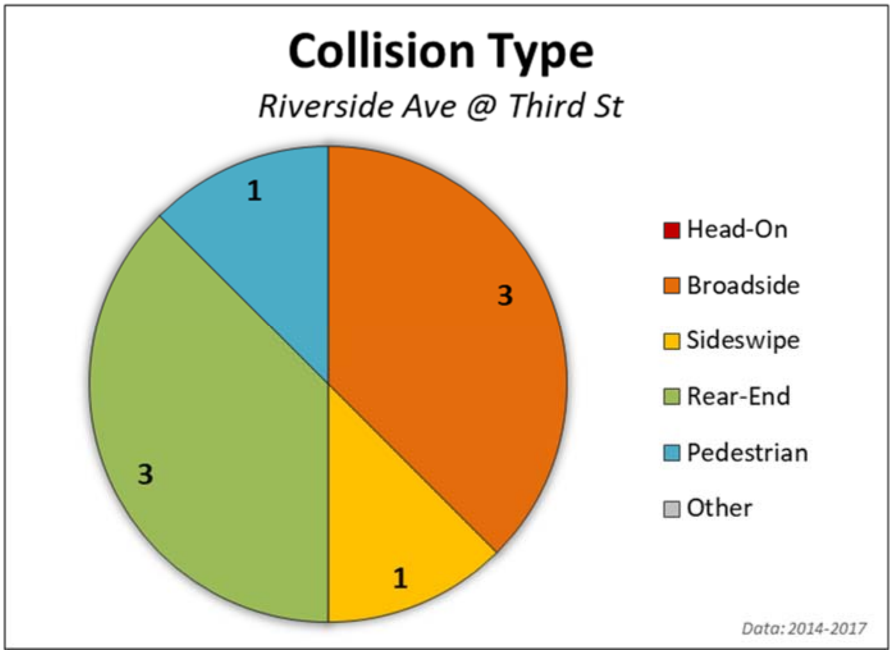
Intersection Collision Patterns

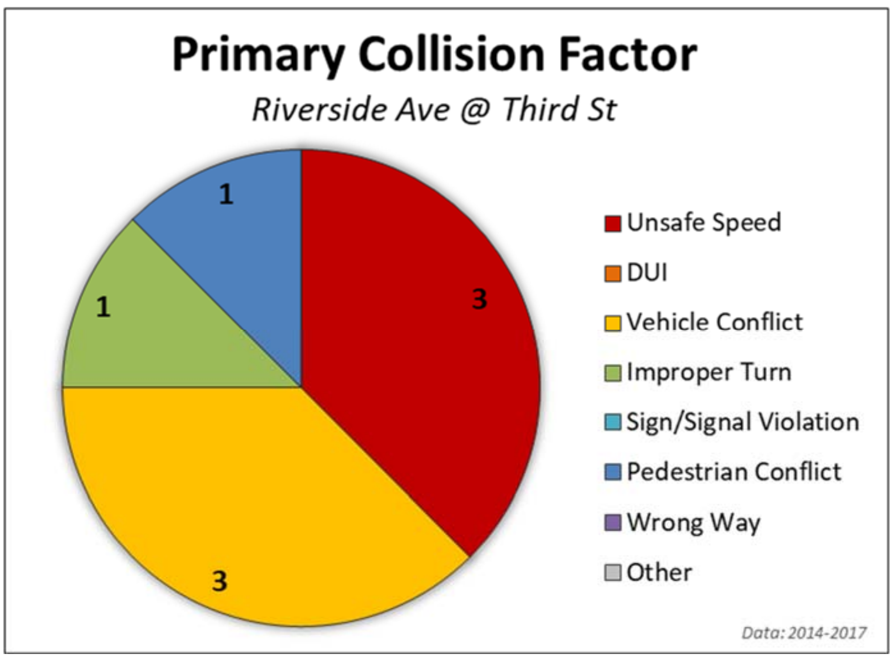
Riverside Avenue and Third Street is the most collision-prone unsignalized intersection in the city. Over the four-year study period (2014-2017), a total of eight collisions were documented at this intersection, or about two per year on average. Of these incidents, three (38%) were broadside collisions, three (38%) were rear-end collisions, and three (38%) involved unsafe speeds.

At 38% each, the most prevalent collision types at this intersection are broadsides and rear-ends. Traffic signals are essentially designed to prevent broadside collisions, which typically result from right-of-way confusions and conflicting movements.

Although it has very similar geometric and traffic characteristics, just one collision was documented at the intersection of Riverside Avenue and Second Street during the study period. Even so, it is included in the study recommendations to provide a consistent roadway design within the Historic Downtown District.

The following figures show the collision types and primary collision factors at the intersection of Riverside Avenue and Third Street, with detailed statistics in **Appendix C**.





Recommendations

Based on the data analysis and field review, the project team recommends the City of Rialto prioritize the pedestrian experience and motorist awareness within the Downtown Rialto area. In this case, it is recommended that the City concentrate pedestrian crossings at both Third Street and Second Street by providing a single, high-visibility crosswalk across Riverside Avenue per intersection. This would require removing one of the existing crosswalks across Riverside Avenue, but would reduce potential conflict points.

For increased visibility and safety, it is also recommended that each intersection have high-visibility "saw-tooth" advance markings and Rectangular Rapid Flashing Beacon (RRFB) warning lights for the crosswalks across Riverside Avenue.

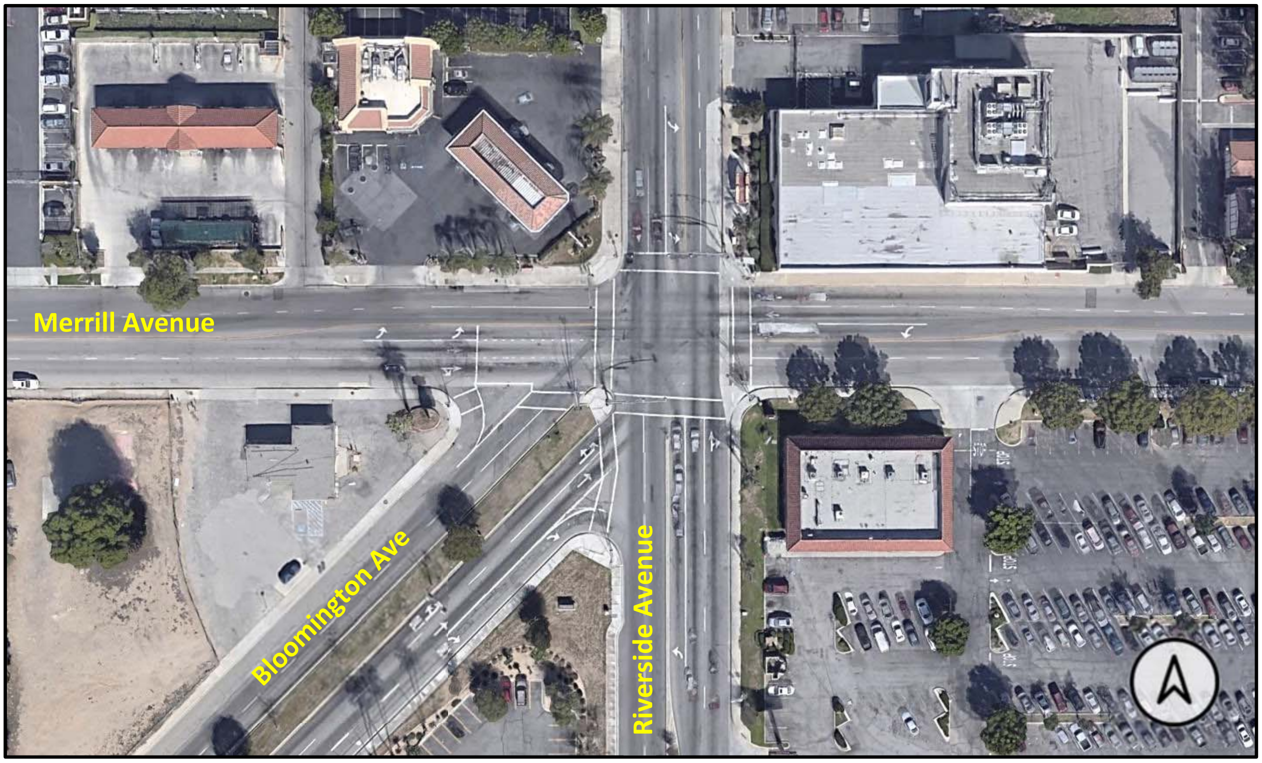
The estimated cost of these recommended improvements is approximately $36,500 per intersection, for a total of about $73,000 for two locations.

Capital Improvement Recommendations:

- Concentrate pedestrian crossings at a single, high-visibility crosswalk per intersection
- Install "saw-tooth" yield markings in advance of crosswalks
- Install double-posted rectangular rapid flashing beacons (RRFB)

7.12. Riverside Avenue at Merrill Avenue and Bloomington Avenue

Number of Collisions: 17



This intersection is located in the southern part of the city, surrounded by commercial properties. Per the City of Rialto General Plan, at this location Bloomington Avenue is classified as a Major Arterial Highway, Riverside Avenue as a Major Arterial, and Merrill Avenue as a Secondary Arterial. Valley Boulevard is a four-lane arterial roadway with a 40 mph posted speed limit west of the intersection and a 45 mph posted speed limit east of it, while Riverside Avenue is a six-lane arterial roadway with a 40 mph posted speed limit. All four approaches have dedicated raised concrete center medians which narrow down to provide dedicated left-turn pockets at the intersection: the northbound approach has two dedicated left-turn lanes, while the other approaches have a single left-turn lane. A Burger King with drive-through sits on the northwest corner, a Coco's restaurant on the northeast corner, and gas stations on the southeast and southwest corners.

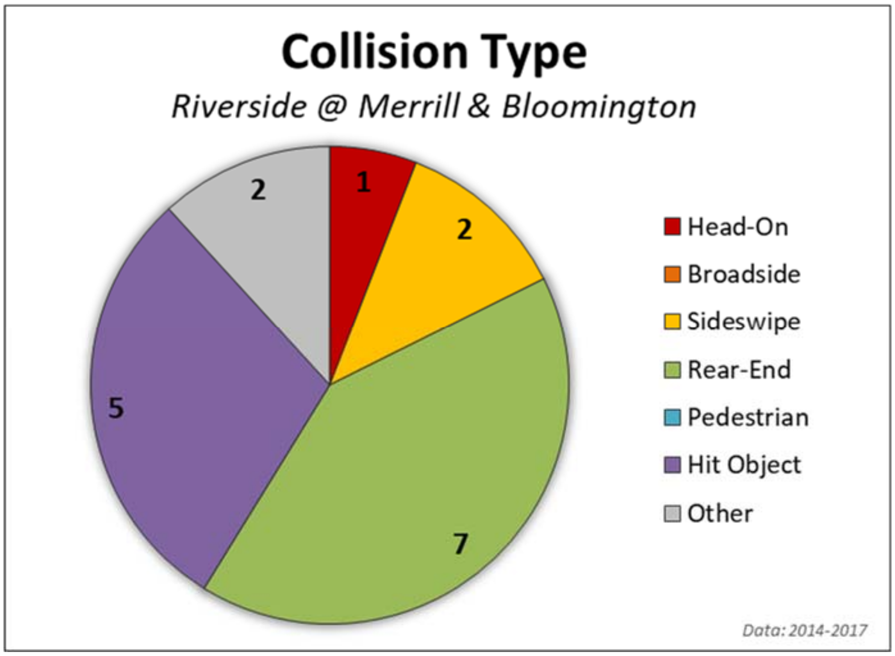
The intersection is controlled by a traffic signal, with left-turn arrows provided for all approaches. Southbound U-turns are prohibited during the AM and PM weekday peak periods. Near-side signal indications, which provide advance information to improve motorist awareness, are also provided on all approaches. Pedestrian crossings are provided across all approaches.

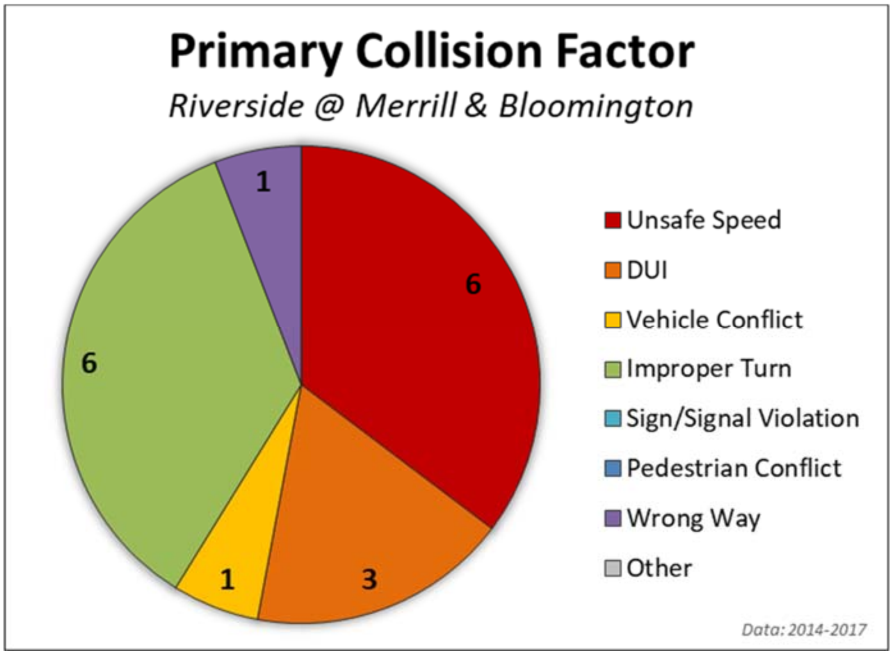
Intersection Collision Patterns

Collision data over the four-year study period (2014-2017) shows a total of 17 collisions at this intersection, or about four per year on average. Of these incidents, seven (41%) were rear-end collisions, five (44%) involved vehicles hitting fixed objects, and seven (41%) occurred at night. These data rank this location as #1 in hit-object collision and #3 in hit-and-run collisions within the study.

Typically, about one-third of collisions at an intersection would occur at night. In addition to lighting-related concerns, these collisions involve a prevalence of DUI, speeding, and drowsy driving risk factors. At this location, 41% of recorded incidents occurred at night, which is slightly higher than expected.

The following figures show the collision types and primary collision factors at this location, with detailed statistics in **Appendix C**.





At 41%, the most prevalent collision type at this intersection is rear-end collisions, which typically involve drivers distracted by nearby downstream signal indications, congested stop-and-go conditions, or unsafe speeds. Over 70% of the rear-end collisions at this location involved northbound or southbound vehicles traveling on Riverside Avenue. Therefore, the field review focused on potential improvements to motorist awareness and traffic signal indications, especially for vehicles on Riverside Avenue.

The prevailing primary collision factors at this location are unsafe vehicle speeds and improper turns, each at 35% of all recorded incidents.

Recommendations

As discussed briefly in the recommendations for the Riverside Avenue corridor, the unusual geometry of this intersection requires an awkward arrangement of traffic signal equipment and inefficient traffic signal operation. The project team has explored two alternatives for re-adapting this intersection to improve traffic signal optimization and reduce potential vehicle conflicts: the first, to reconfigure the intersection into two, closely-spaced, adjacent signalized intersections; the second, to reconfigure the intersection as a roundabout, which could additionally serve as a signature focal point for the City of Rialto along this regional corridor.

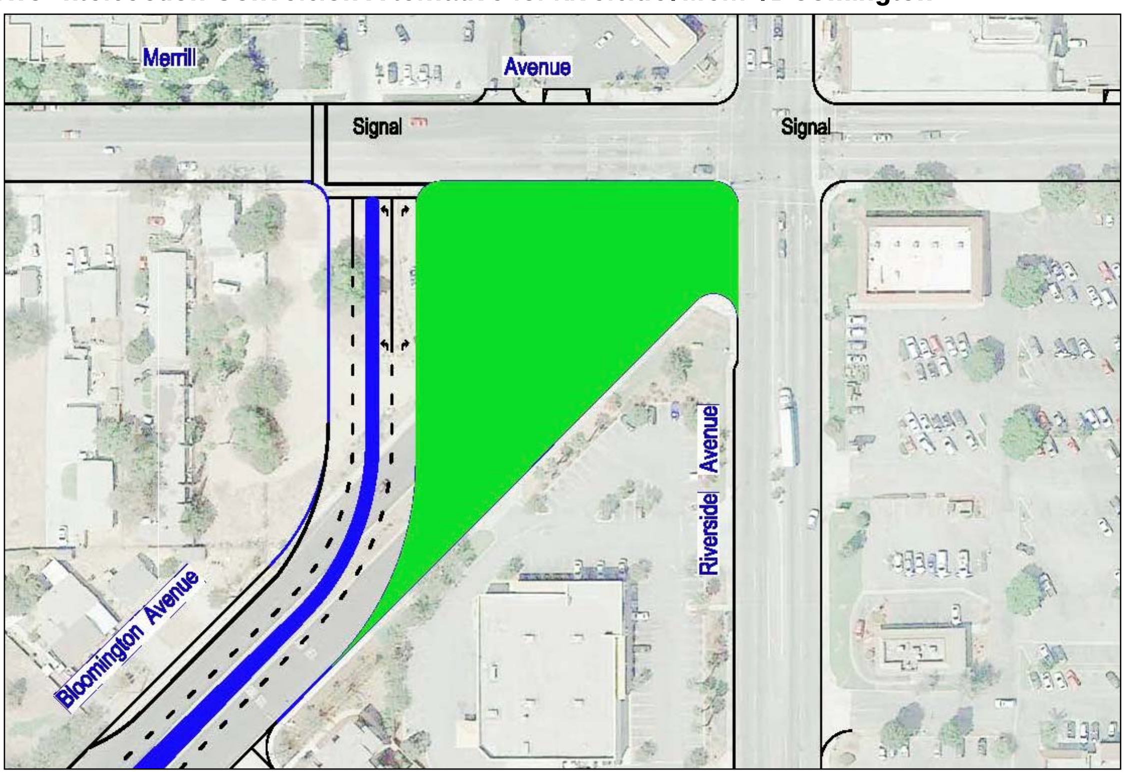
Recommendations Outside of Reconfiguring Intersection:

- Renew and reconfigure striping to better define intersection
- Install cat-track striping for vehicles exiting Bloomington Avenue
- Consider widening Riverside Avenue north leg to provide dedicated southbound right-turn pocket lane

The estimated cost of these recommended improvements is approximately $197,500.

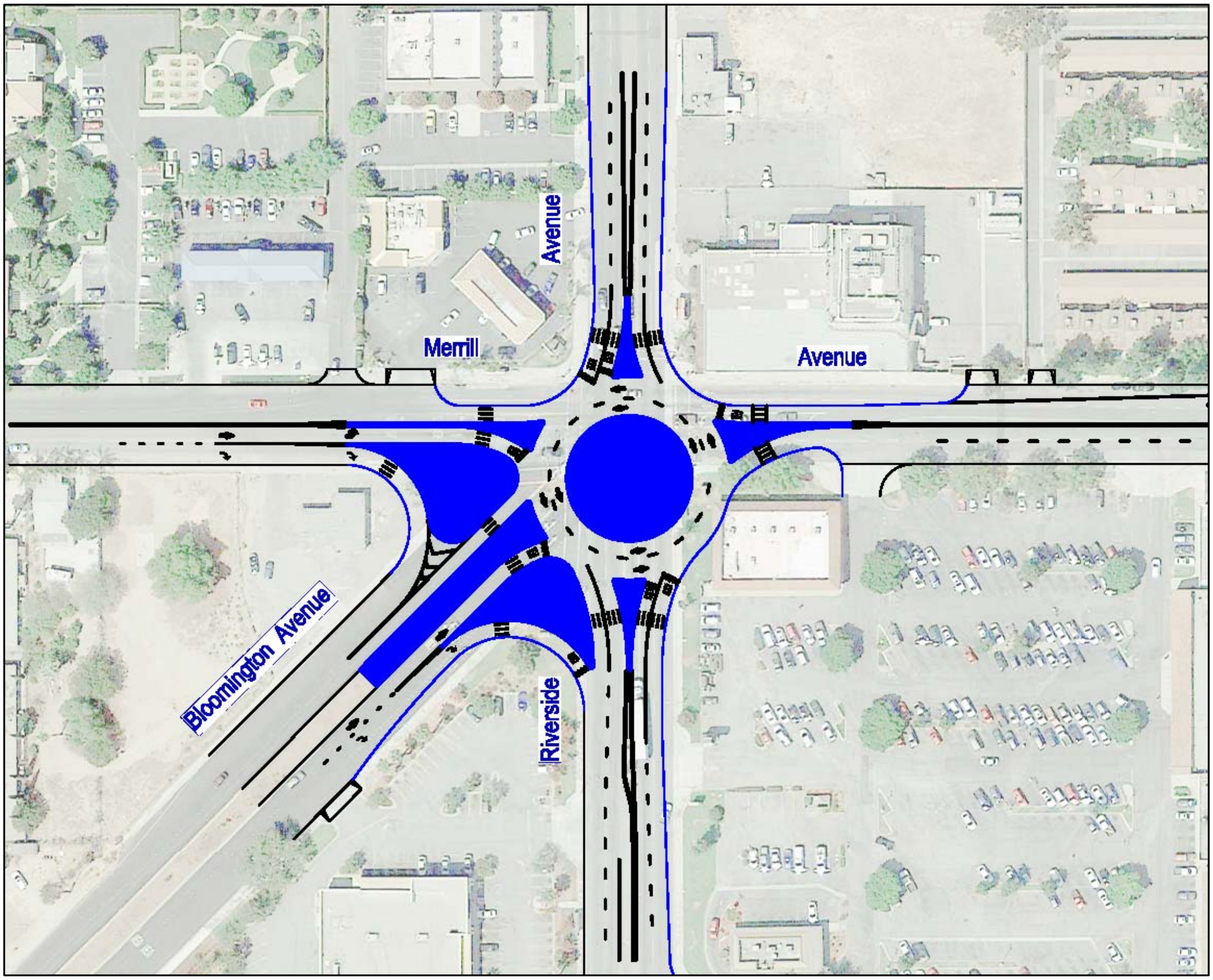
Two-Intersection Alternative:

Figure: Two-Intersection Conversion Alternative for Riverside/Merrill/Bloomington



Roundabout Alternative:

Figure: Roundabout Conversion Alternative for Riverside/Merrill/Bloomington



8. Countermeasures Identified to Address the Safety Issues

8.1. Non-Engineering Countermeasures

Traditionally, the approach to improving roadway safety is composed of what is commonly known as "The Three E's of Traffic Safety," i.e., Engineering, Enforcement, and Education. The Engineering countermeasures available to the City have already been addressed, but engineering countermeasures will not solve every safety issue identified in the City. The California Strategic Highway Safety Plan (SHSP) discusses these as "challenge areas," elements that when addressed can help improve the overall safety of roadways in the City.

Challenge areas that have been identified as of particular concern to the City of Rialto include:

- Unsafe speed or speeding
- Driving Under the Influence (DUI) of drugs or alcohol

Speeding and Aggressive Driving: The Highway Safety Plan reports that 18 percent of traffic related fatalities and injuries in California between 2012 and 2015 involved speeding. The definition for "unsafe speed" is not only "exceeding the posted speed limit," but also *"driving too fast for conditions."* VC 22350 states "No person shall drive a vehicle upon a highway at a speed greater than is reasonable or prudent, having due regard for weather, visibility, the traffic on, and the surface and width of the highway, and in no event at a speed which endangers the safety of persons or property."

Per the California Vehicle Code (CVC), a posted speed limit is required for enforcement of a maximum speed limit below 55mph. To determine and post a speed limit, an Engineering and Traffic Survey must be conducted to determine the maximum safe speed for the roadway. Once the Engineering Survey has been performed, a speed limit can be determined and approved by the jurisdiction with the authority over that roadway, and the *approved speed limit* can then be enforced. Any reductions in vehicle speeds rely on the combination of engineering design and mitigations, traffic enforcement and driver education. To address the enforcement and education aspects of the 3 E's, some strategies discussed in the highway safety plan are as follows:

- Providing high-profile speed enforcement at high-visibility locations
- Increasing the use of radar speed units to aid speed measurement
- Conducting an outreach campaign to educate drivers on the risks associated with speeding

Based on our knowledge of the City, past experience, and professional traffic engineering judgement, additional measures that can be considered, which have proven useful for cities like Rialto, are as follows:

- The utilization of lower profile, selective/focused enforcement – a technique that is highly effective near schools, parks and along roadways with high pedestrian and bicycle usage.
- Conducting safety campaigns that make use of public notices, including lawn signs and banners, to encourage traffic safety in a more personal way. This technique addresses community road users, "asking" them to be more mindful of their speed due to the presence of children, pedestrians, bicyclists, etc.
- Utilizing City-supported functions and events to emphasize traffic safety within the community. This can include booths dedicated to traffic safety, banners, publications, etc.

Driving Under the Influence (DUI) of Drugs or Alcohol: The Highway Safety Plan reports that 32 percent of traffic related fatalities and severe injuries in California between 2012 and 2015 involved an impaired person. Collisions involving DUI are usually not readily addressed using engineering countermeasures. Under HSIP, collisions involving DUI are not allowed to be considered in the calculation of benefit/cost ratios. The Highway Safety Plan includes strategies to reduce DUI-related collisions through a combination of enforcement and education measures with increased treatment programs for repeat or high-blood alcohol content offenders. The California Office of Traffic Safety (OTS) provides grants to local law enforcement agencies for increased enforcement activities such as high-profile DUI checkpoints and officer training for roadside detection of impaired drivers. The California Department of Alcohol Beverage Control offers grants to expand efforts for treatment of alcohol-related problems. **Table 6** provides potential funding sources available to assist municipalities in acquiring important non-engineering speed enforcement and education resources.

Table 6: Enforcement Funding Grants

Funding Source	Description	Website
California Department of Alcoholic Beverage Control	Education and training of officers from local law enforcement agencies	*abc.ca.gov*
Community Oriented Policing Services	Advancing the practice of community policing through information and grant resources	*cops.usdoj.gov*
California Office of Traffic Safety	Making available grants for programs of traffic law enforcement and education	*ots.ca.gov*
Grant Assistance Program	Resource for Police Department and Law Enforcement grant assistance	*policegrantshelp.com*

By utilizing grant-assisted programs, the City can address the non-engineering countermeasure of increased enforcement**.** To address education**,** the third “E” of traffic safety, the City may use community support through programs such as “Every 15 Minutes” – a two-day program provided by the CHP that focuses on high-school juniors and seniors, “challenging them to have a better understanding of drinking, driving and personal safety.” Student assemblies, community events, classes that offer follow-up video and reading materials addressing the issues of driving under the influence (DUI) are also effective. In addition, community-led groups such as Mothers Against Drunk Drivers (MADD) can also be partners in this effort. For example, in 2019 the City of Rialto hosted the Walk Like MADD charity walkathon and 5K race, in which over 500 people participated and over $25,000 was raised for drunk-driving awareness and prevention programs.

8.2. Engineering Countermeasures

Engineering countermeasures are individual elements that can help improve the overall safety of a specific location based on the types of collisions experienced and existing road characteristics. The selection of improper engineering countermeasures can sometimes result in more harm than benefit, so proposed safety improvements must be reviewed to ensure that they will help reduce the likelihood of future collisions.

In an effort to optimize highway safety funding, local transportation agencies are encouraged to identify and implement the optimal combination of countermeasures to achieve the greatest benefits. The Caltrans Local Roadway Safety Manual (LRSM) provides countermeasures for signalized intersections, unsignalized intersections, and roadway segments. The following pages give examples of applicable countermeasures for the City of Rialto as well as a comprehensive list of the countermeasures found in the LRSM.

Signalized Intersection Countermeasures

- Improve signal hardware – lenses, retro-reflective back-plates, mounting, size and number
- Provide protected left-turn phase
- Install flashing beacons as advance warning.
- Install pedestrian countdown signal heads.

Non-Signalized Intersection Countermeasures

- Add intersection lighting.
- Install/upgrade larger or additional stop signs or other intersection warning/regulatory signs
- Install flashing beacons as advance warning
- Install enhanced pedestrian crossing features (e.g. signs/markings, rapid rectangular flashing beacon, curb extensions, enhanced safety features, etc.)

Roadway Countermeasures

- Road diet
- Upgrade pavement markings and signing
- Install bike lanes
- Install sidewalk/pathway

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Table 7: Countermeasures for Signalized Intersections

No.	Type	Countermeasure Name	Crash Type	CRF	Expected Life (yrs)	Federal Funding Eligibility	Systemic Approach Opportunity
S1	Lighting	Add intersection lighting (S.I.)	Night	40%	20	100%	Medium
S2	Signal Mod	Improve signal hardware: lenses, number, size, mounting, retroreflective back-plates	All	15%	10	100%	Very High
S3	Signal Mod	Improve signal timing (coordination, phases, red, yellow, operation)	All	15%	10	50%	Very High
S4	Signal Mod	Provide Advanced Dilemma Zone Detection for high-speed approaches	All	40%	10	100%	High
S5	Signal Mod	Install emergency vehicle pre-emption (EVP) systems	Emergency Vehicle	70%	10	100%	High
S6	Signal Mod	Provide protected left-turn phase (existing left-turn lane)	All	30%	20	100%	High
S7	Signal Mod	Convert signal to mast arm (from pedestal-mounted)	All	30%	20	100%	Medium
S8	Operation/Warning	Install raised pavement markers & striping through intersection	All	10%	10	100%	Very High
S9	Operation/Warning	Install flashing beacons as advance warning (S.I.)	All	30%	10	100%	Medium
S11	Operation/Warning	Improve pavement friction (High Friction Surface Treatment)	All	40%	10	100%	Medium
S12	Geometric Mod	Install raised median on approaches (S.I.)	All	25%	20	90%	Medium
S13	Geometric Mod	Create directional median openings to allow (& restrict) left turns & U-turns (S.I.)	All	50%	20	90%	Medium
S17	Geometric Mod	Install left-turn lane & add turn phase (no left-turn lane or phase exists)	All	55%	20	90%	Low
S18	Geometric Mod	Convert intersection to roundabout (from signal)	All	Varies	20	100%	Low
S19	Ped/Bike	Install pedestrian countdown heads	P/B	25%	20	100%	Very High
S20	Ped/Bike	Install pedestrian crossing (S.I.)	P/B	25%	20	100%	High
S21	Ped/Bike	Install advance stop bar before crosswalk	P/B	15%	10	100%	Very High
S22	Ped/Bike	Modify signal phasing to implement Leading Pedestrian Interval (LPI)	P/B	60%	10	100%	Very High
S23	Geometric Mod	Install pedestrian median fencing	P/B	35%	20	90%	Low

Source: Caltrans Local Roadway Safety Manual(v1.4), June 2018

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Table 8: Countermeasures for Non-Signalized Intersections

No.	Type	Countermeasure Name	Crash Type	CRF	Expected Life (yrs)	Federal Funding Eligibility	Systemic Approach Opportunity
NS1	Lighting	Add intersection lighting (NS.I.)	Night	40%	20	100%	Medium
NS2	Control	Convert to all-way stop control (from 2-way stop or yield control)	All	50%	10	100%	High
NS3	Control	Install signals	All	25%	20	100%	Low
NS4A	Control	Convert intersection to roundabout (from all-way stop)	All	Varies	20	100%	Low
NS4B	Control	Convert intersection to roundabout (from 2-way stop or yield control)	All	Varies	20	100%	Low
NS5	Operation/Warning	Install larger/additional stop or other warning/regulatory signs	All	15%	10	100%	Very High
NS6	Operation/Warning	Upgrade intersection pavement markings (NS.I.)	All	25%	10	100%	Very High
NS7	Operation/Warning	Install flashing beacons at stop-controlled intersections	All	10%	10	100%	High
NS8	Operation/Warning	Install flashing beacons as advance warning (NS.I.)	All	30%	10	100%	High
NS9	Operation/Warning	Install transverse rumble strips on approaches	All	20%	10	90%	High
NS10	Operation/Warning	Improve sight distance to intersection (Clear Sight Triangles)	All	20%	10	90%	High
NS11	Geometric Mod	Install splitter-islands on minor-road approaches	All	40%	20	90%	Medium
NS12	Geometric Mod	Install raised median on approaches (NS.I.)	All	25%	20	90%	Medium
NS13	Geometric Mod	Create directional median openings to allow (& restrict) left- & U-turns (NS.I.)	All	50%	20	90%	Medium
NS14	Geometric Mod	Install right-turn lane (NS.I.)	All	20%	20	90%	Low
NS15	Geometric Mod	Install left-turn lane (no left-turn lane exists)	All	35%	20	90%	Low
NS16	Ped/Bike	Install raised medians / refuge islands (NS.I.)	P/B	45%	20	90%	Medium
NS17	Ped/Bike	Install pedestrian xing at uncontrolled locations (new signs & markings only)	P/B	25%	10	100%	High
NS18	Ped/Bike	Install pedestrian xing at uncontrolled locations (enhanced safety features)	P/B	35%	20	100%	Medium
NS19	Ped/Bike	Install pedestrian signal (incl. pedestrian hybrid beacon (HAWK))	P/B	55%	20	100%	Low
NS20	Operation/Warning	Improve pavement friction (High-Friction Surface Treatment)	All	40%	10	100%	Medium

Source: Caltrans Local Roadway Safety Manual(v1.4), June 2018

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Table 9: Countermeasures for Roadways

1/2

No.	Type	Countermeasure Name	Crash Type	CRF	Expected Life (yrs)	Federal Funding Eligibility	Systemic Approach Opportunity
R1	Lighting	Add segment lighting	Night	35%	20	100%	Medium
R2	Mitigate Obstacles	Remove/relocate fixed objects outside Clear Recovery Zone	All	35%	20	90%	High
R3	Mitigate Obstacles	Install median barrier	All	25%	20	100%	Medium
R4	Mitigate Obstacles	Install guardrail	All	25%	20	100%	High
R5	Mitigate Obstacles	Install impact attenuators	All	25%	10	100%	High
R6	Mitigate Obstacles	Flatten side slopes	All	30%	20	90%	Medium
R7	Mitigate Obstacles	Flatten side slopes & remove guardrail	All	40%	20	90%	Medium
R9	Geometric Mod	Install raised median	All	25%	20	90%	Medium
R10	Geometric Mod	Install median (flush)	All	15%	20	90%	Medium
R11	Geometric Mod	Install acceleration/deceleration lanes	All	25%	20	90%	Low
R13	Geometric Mod	Widen lane (initially < 10 ft)	All	25%	20	90%	Medium
R14	Geometric Mod	Add two-way left-turn lane (without reducing travel lanes)	All	30%	20	90%	Medium
R15	Geometric Mod	Road diet (reduce travel lanes from 4 to 3 & add two-way left-turn, bike lanes)	All	30%	20	90%	Medium
R16	Geometric Mod	Widen shoulder (paved)	All	30%	20	90%	Medium
R17	Geometric Mod	Widen shoulder (unpaved)	All	20%	20	90%	Medium
R18	Geometric Mod	Pave existing shoulder	All	15%	20	90%	Medium
R19	Geometric Mod	Improve horizontal alignment (flatten curves)	All	50%	20	90%	Low
R20	Geometric Mod	Flatten crest vertical curve	All	25%	20	90%	Low
R21	Geometric Mod	Improve horizontal & vertical alignments	All	60%	20	90%	Low
R22	Geometric Mod	Improve curve superelevation	All	45%	20	90%	Medium
R23	Geometric Mod	Convert from 2-way to 1-way traffic	All	35%	20	90%	Medium
R24	Geometric Mod	Improve pavement friction (High Friction Surface Treatment)	All	40%	10	100%	High
R26	Operation/Warning	Install/upgrade regulatory/warning signs with fluorescent sheeting	All	15%	10	100%	Very High
R27	Operation/Warning	Install chevron signs on horizontal curves	All	40%	10	100%	Very High
R28	Operation/Warning	Install curve advance warning signs	All	25%	10	100%	Very High
R29	Operation/Warning	Install curve advance warning signs (flashing beacon)	All	30%	10	100%	High

Source: Caltrans Local Roadway Safety Manual(v1.4), June 2018

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Table 9: Countermeasures for Roadways

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No.	Type	Countermeasure Name	Crash Type	CRF	Expected Life (yrs)	Federal Funding Eligibility	Systemic Approach Opportunity
R30	Operation/Warning	Install dynamic/variable speed warning signs	All	30%	10	100%	High
R31	Operation/Warning	Install delineators, reflectors, and/or object markers	All	15%	10	100%	Very High
R32	Operation/Warning	Install edgelines & centerlines	All	25%	10	100%	Very High
R33	Operation/Warning	Install no-passing line	All	45%	10	100%	Very High
R34	Operation/Warning	Install centerline rumble strips/stripes	All	20%	10	100%	High
R35	Operation/Warning	Install edgeline rumble strips/stripes	All	15%	10	100%	High
R36	Ped/Bike	Install bike lanes	P/B	35%	20	90%	High
R37	Ped/Bike	Install sidewalk/pathway (to reduce walking along roadway)	P/B	80%	20	90%	Medium
R38	Ped/Bike	Install pedestrian crossing (enhanced safety features)	P/B	30%	10	90%	Medium
R39	Ped/Bike	Install raised pedestrian crossing	P/B	35%	10	90%	Medium
R40	Animal	Install animal fencing	Animal	80%	20	90%	Medium
R42	Geometric Mod	Install pedestrian median fencing	P/B	35%	20	90%	Low

Source: Caltrans Local Roadway Safety Manual(v1.4), June 2018

9. Viable Project Scopes and Prioritized List of Safety Projects

9.1. Recommendations to Improve Intersection Safety

From the collision analysis and field reviews, various improvements are recommended for the twelve study intersections, ranging from low-cost operational improvements such as increasing all-red clearance intervals to large-scale improvements such as a full traffic signal modernization. Furthermore, concepts were developed for the intersection of Riverside Avenue, Merrill Avenue, and Bloomington Avenue to convert the existing intersection, with its unusual geometry, to either two adjacent signalized intersections or a roundabout.

The intersection improvement recommendations are categorized into operational improvements, which could be implemented within the City's operations and maintenance programs, and capital improvement projects, which could be implemented within the City's CIP programs or by applying for HSIP funding. The total estimated cost for the recommended intersection improvements is approximately **$2.2 million** (**Table 10**).

9.2. Recommendations to Improve Corridor Safety

From the collision analysis and field reviews, various improvements are recommended along the study corridors, ranging from low-cost improvements such as modified traffic signal cycle lengths and rest-in-red traffic signal operations to larger-scale improvements such as new landscaped medians or the assessment of new traffic signal installations. Other corridor safety recommendations include updating roadway and roadside safety lighting and the strategic use of raised medians with left-turn pockets to concentrate and control turning movements. Based on the character of the street and its adjacent land uses, Cactus Avenue was also identified as a potential candidate for a Complete Streets project to promote active transportation and reduce vehicle speeds.

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Table 10: Recommended Intersection Improvements

1/2

	Location	Recommendations	Counter-measure	Estimated Cost*	Subtotal
1	Cedar Ave @ Merrill Ave	1. Provide 1-second all-red clearance interval for N/S left-turns	S3	OP	$195,500
		2. Extend NB/SB all-red clearance interval by 0.5 seconds	S3		
		3. Convert NB/SB lead/lag left-turn arrows to all-time leading operation	S3		
		4. Upgrade vehicle detection to video detection system		$ 40,000	
		5. Install EB/WB Protected-Permissive Left-Turn (PPLT) arrow	S6	$ 150,000	
		6. Add advance limit lines for all approaches		$ 5,500	
2	Foothill Blvd @ Pepper Ave	1. Renew existing intersection striping		OP	$250,000
		2. Add EB right-turn arrow pavement marking at limit line			
		3. Install EB near-side "Right Lane Must Turn Right" (R3-7) sign			
		4. Install NB Protected-Permissive Left-Turn (PPLT) arrow	S6	$ 75,000	
		5. Consider widening NB approach to provide new right-turn pocket		$ 175,000	

** OP: it is assumed that these operational improvements can be implemented within existing operating budgets*

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Table 10: Recommended Intersection Improvements

2/2

	Location	Recommendations	Counter-measure	Estimated Cost*	Subtotal
3	Riverside Ave @ Valley Blvd	1. Renew existing intersection striping		OP	$200,000
		2. Install NB "No U-Turn" (R3-4) sign			
		3. Install additional NB/SB mast-arm indications	S2	$ 5,000	
		4. Install EB right-turn overlap arrow		$ 10,000	
		5. Install additional safety lighting on NW & SE corners	S1	$ 10,000	
		6. Consider widening SB approach to provide new right-turn pocket		$ 175,000	
4	Riverside Ave @ I-10 Ramps	1. Request that Caltrans provide and/or increase all-red time	S3	Caltrans Responsibility	
		2. Request that Caltrans install additional NB & SB mast-arm indications	S2		
		3. Request that Caltrans conduct a detailed traffic safety study			
5	Foothill Blvd @ Cedar Ave	1. Consider increasing all-red time at night	S3	OP	$10,000
		2. Install EB & WB near-side indications	S2	$ 5,000	
		3. Install additional EB & WB mast-arm indications	S2	$ 5,000	
6	Riverside Ave @ Baseline Rd	1. Replace WB mast-arm lane assignment sign w/ "No U-Turn" (R3-4) sign		OP	$37,500
		2. Install NB, SB, & WB near-side indications	S2	$ 7,500	
		3. Upgrade mast arm pole on NW corner of intersection	S2	$ 30,000	
		Install bigger signal pole to accommodate 45' mast arm.			
		Replace programmed visibility (PV) head with left-turn arrow indication			
7	Eucalyptus Ave @ Baseline Rd	1. Full modernization of traffic signal	S7	$ 250,000	$250,000
		Replace/upgrade traffic signal equipment	S2		
		Install additional safety lighting	S1		
		Install EB & WB "dilemma zone" detection	S4		
		Install EB & WB Protected-Permissive Left-Turn (PPLT) arrows	S6		
8	Foothill Blvd @ Riverside Ave	1. Prohibit stopping for 150' on north leg (SB approach/NB departure)		OP	$22,000
		2. Install WB "No U-Turn" (R3-4) signs			
		3. Install NB & SB near-side indications	S2	$ 5,000	
		4. Install additional safety light on SE corner	S1	$ 7,000	
		5. Install NB right-turn overlap arrows		$ 10,000	
9	Foothill Blvd @ Sycamore Ave	1. Renew existing intersection striping		OP	$115,000
		2. Improve EB right-turn trap lane channelization with painted median		$ 15,000	
		3. Install new NB & SB poles with mast-arms and indications	S2	$ 85,000	
		4. Restripe NB & SB approaches to provide left-turn pockets		$ 15,000	
10	Riverside Ave @ Easton St	1. Install WB right-turn overlap arrows		$ 10,000	$40,000
		2. Install additional NB & SB mast-arm indications	S2	$ 5,000	
		3. Replace EB mast arm with longer mast arm to better align indications	S2	$ 25,000	
11	Downtown Rialto (Riverside Ave @ 2nd/3rd St)	1. Concentrate pedestrian crossings at a single high visiblity crosswalk		$ 15,000	$73,000
		2. Install "saw tooth" yield markings at median	NS6	$ 1,500	
		3. Install double-posted rectangular rapid flashing beacons (RRFB)	NS8	$ 20,000	
12	Riverside Ave @ Merrill Ave & Bloomington Ave	1. Reconfigure striping to better define intersection		$ 20,000	$197,500
		2. Add cat-tracking for Bloomington Ave movements		$ 2,500	
		3. Consider widening SB approach to provide new right-turn pocket		$ 175,000	
			Construction Subtotal:	**$1,433,998**	
			Construction Contingency (20%):	**$286,800**	
			Environmental (5%):	**$71,700**	
			Design (20%):	**$286,800**	
			Construction Engineering: (10%):	**$143,400**	
		Total Estimated Cost of Recommended Improvements		**$2,222,697**	

** OP: it is assumed that these operational improvements can be implemented within existing operating budgets*

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Table 11: Recommended Corridor Improvements

Corridor	Recommendations	Counter-measure(s)	Estimated Cost[1]	HSIP[2] Candidate
1 Riverside Avenue	1. Strive for consistent speed zoning		LOW	
	2. Improve street and safety lighting	R1, S1, NS1	MEDIUM	
	3. Modify traffic signal operations		MEDIUM	
	4. Install raised median islands with landscaping	R9	HIGH	✓
	5. Target improvements at Riverside/Merrill/Bloomington*		HIGH	✓
2 Foothill Boulevard	1. Convert State Route into boulevard		HIGH	✓
	2. Consider extending all-red clearance intervals		LOW	
	3. Improve safety lighting at signalized intersections	S1	MEDIUM	
	4. Narrow travel lanes		LOW	
	5. Modernize traffic signals		HIGH	✓
3 Baseline Road	1. Install radar feedback signs	R30	LOW	
	2. Consider extending all-red clearance intervals		LOW	
	3. Target improvements at Baseline/Eucalyptus*	S1, S2, S4, S6, S7	MEDIUM	✓
	4. Target improvements at Baseline/Sycamore		MEDIUM	
4 Cedar Avenue / Ayala Drive	1. Upgrade safety lighting	R37, S1, NS1	MEDIUM	
	2. Review traffic signal timing		LOW	
	3. Complete pedestrian facilities		MEDIUM	
	4. Control access strategically		MEDIUM	
	5. Target improvements at Cedar/Merrill*	S3, S6	MEDIUM	
	6. Target improvements at Cedar/Etiwanda		MEDIUM	
5 Cactus Avenue	1. Develop and implement Complete Street project	R15, R36	HIGH	✓
	2. Consider new traffic signal installations (3)*	NS3	MEDIUM	
6 Eucalyptus Avenue	1. Implement traffic calming strategies		LOW	
	2. Establish a school outreach program		LOW	✓
	3. Establish "No Parking" zones		LOW	
	4. Upgrade "School Zone" signage and markings		LOW	
	5. Target improvements at Eucalyptus/Baseline*	S1, S2, S4, S6, S7	MEDIUM	✓
7 Casmalia Street	1. Strive for consistent speed zoning		LOW	
	2. Develop western portion for future growth		LOW	
	3. Target improvements at Casmalia/Ayala		MEDIUM	
	4. Target improvements at Casmalia/Cactus*		MEDIUM	
	5. Target improvements at Casmalia/Lilac		MEDIUM	

[1] *Estimated costs are ranked as follows: LOW = less than $150k; MEDIUM = $150k - $1M; HIGH = over $1M*
[2] *Recommended improvements with medium-to-high estimated costs & potentially high effectiveness may be eligible for Highway Safety Im*
* *Note: this recommendation is also discussed within another corridor analysis and/or the intersection analyses.*

10. Attachments and Supporting Documentation

This section provides supporting documents referred to throughout the report. The information below is divided into the following subsections:

10.1. Appendix A – Office of Traffic Safety Data

10.2. Appendix B – Citywide Collision History Data

10.3. Appendix C – Corridor Collision History Data

10.4. Appendix D – Intersection Collision History Data