City of Antioch

Local Roadway Safety Plan

07/28/2022

Final Report

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EXECUTIVE SUMMARY

The City of Antioch's Local Roadway Safety Plan (LRSP) is a comprehensive plan that implements a Safe Systems approach framework, consistent with Countywide Vision Zero adopted in September 2021, to systematically identify and analyze traffic safety related issues and recommend projects and countermeasures. The LRSP seeks to reduce or eliminate instances of fatal and severe injury collisions through a prioritized list of improvements that reduce the risk of crashes occurring along local roadways. The LRSP takes a proactive approach to addressing safety needs by urging not only a strategic and critical response to existing crash events and trends but, more importantly, reduce the risk of crashes occurring in the first place through context-sensitive, people-centric planning and design of streets and adjacent land uses. It is viewed as a guidance document that can be a source of information and ideas. It can also be a living document, one that is reviewed bi-annually and updated periodically by City staff and their safety partners to reflect evolving injury and collision trends and community needs and priorities. With the LRSP as a guide, the City will be eligible to apply for grant funds, such as the federal One Bay Area Grant (OBAG 3) and the Highway Safety Improvement Program (HSIP) Cycle 11.

Chapter 1 – Introduction

The Introduction presents the project, describes how this report is organized, summaries the vision and goals, the study area for the LRSP, details how the report is organized and introduces the safety partners.

Chapter 2 – Existing Planning Efforts

This chapter summarizes existing City and regional planning documents and projects that are relevant to the LRSP. It ensures that the recommendations of the LRSP are in line with existing goals, objectives, policies, or projects. This chapter summarized the following documents: City of Antioch General Plan, Contra Costa Countywide Bicycle and Pedestrian Plan (2018), Antioch Downtown Specific Plan (2018), Hillcrest Station Area Specific Plan, Contra Costa County Transportation Analysis Guidelines, Contra Costa Countywide Transportation Safety Policy and Implementation Guide (2021), 2017 Countywide Comprehensive Transportation Plan, Contra Costa Transportation Authority Transportation Expenditure Plan 2020, Contra Costa County General Plan 2005-2020 (2005), Transportation Baseline Report Contra Costa County General Plan (2019), City of Antioch Traffic Calming Policy (2020) and City of Antioch Five-Year Capital Improvements Program (2020-2025).

Chapter 3 – Collision Data Collection and Analysis

Reported Collisions

Collision data was obtained and analyzed for a five-year period from 2014 to 2018 from the California Highway Patrol's Statewide Integrated Traffic Records System (SWITRS) and the University of California at Berkeley SafeTREC's Transportation Injury Mapping Service (TIMS).

The collision analysis identified general trends of collisions in the City of Antioch. For collisions of all severity, including PDO collisions, 85% collisions occurred at intersections. The most common collision types occurring at intersections are broadside and rear-end collisions. The most common primary collision factor for collisions occurring at intersections is unsafe speed and improper turning. About 47 percent of rear-end collisions have occurred due to unsafe speed.

Though the total number of collisions that have occurred in the City has decreased from 2016 to 2018, only about 4% of all collisions have led to a severe or a fatal injury. Most of the "killed or severely injured" (KSI) collisions have occurred on Hillcrest Avenue, 18th Street, Lone Tree Way, A Street, West 10th Street and Deer Valley Road. Unsafe speed, traffic signals and signs, and Auto right-of-way violation have been observed to be the top primary collision factors for the collisions occurring on these streets in the City. More then 50% of these collisions have been observed to have occurred during night time conditions, in locations with or without street lights. Visibility is observed to be an issue and improving visibility for motorists as well as non-motorists will help navigate these locations better.

About 22% of KSI collisions have been vehicle-pedestrian collisions. The highest number of vehicle-pedestrian KSI collisions have been observed along the roadways Delta Fair Boulevard/Gentrytown Drive, W/E 18th Street and W 10th Street.

Community Information and Perceptions

Community members and stakeholders shared their observations and concerns regarding locations and situations where collisions are occurring but are not necessarily being reported. They shared their knowledge and experiences of locations where "near-miss" collisions were occurring. They also indicated those locations that did not "feel safe" and that despite a lack of documented crash data, a heightened risk of collisions could occur. In other words, there was a risk of a collision but that risk had yet to materialize as an actual event. This is more then a general fear of a collision occurring, but an intuitive and rational sense that a particular location was not safe.

Chapter 4 - Emphasis Areas

Emphasis areas are a focus of the LRSP. They are identified through three broad methodologies: analysis of data that identifies where various KSI collisions have occurred within the City of Antioch, analysis of actual or potential collision locations relative to context, and evaluation of social and behavioral factors that are attributable to increased risk of collisions. The nine emphasis areas for Antioch are:

- Intersection Safety
- Unsafe Speed Collisions
- Pedestrian Safety
- Hit Object Collisions
- Nighttime Collisions
- Broadside Collisions
- Traffic Signals and Signs Violations Collisions
- Driving Under the Influence
- Reduce Teenage/Younger Adult - Party at Fault

Chapter 5 – Countermeasure Identification

Engineering countermeasures were selected for each of the high-risk locations and for the emphasis areas. These were based off of approved countermeasures from the Caltrans Local Roadway Safety Manual (LRSM) used in HSIP grant calls for projects. The intention is to give the City potential countermeasures for each location that can be implemented either in future HSIP calls for projects, or using other funding sources, such as the City's Capital Improvement Program. Non-engineering countermeasures were also selected and are included with the emphasis areas.

Chapter 6 – Safety Projects

A set of ten safety projects were created for high-risk intersections and roadway segments, using HSIP approved countermeasures. These safety projects are:

- Project 1: Safety at Signalized Intersections
- Project 2: Pedestrian Safety at Signalized Intersections
- Project 3: Safety at Unsignalized Intersections
- Project 4: Safety at Signalized Intersections
- Project 5: Safety at Roadway Segments
- Project 6: Pedestrian Safety Improvements along Corridors
- Project 7: Bike Safety Improvements along Corridors
- Project 8: Pedestrian and Lighting Safety Improvements along Corridors
- Project 9: High-Friction Surface Treatments
- Project 10: Corridor Improvements

Chapter 7 – Evaluation and Implementation

The LRSP is a guidance document that is recommended to be updated every two to five years in coordination with the safety partners. The LRSP document provides engineering, education, enforcement, and emergency medical service related countermeasures that can be implemented throughout the City to reduce fatal and severe injury collisions. After implementing countermeasures, the performance measures for each emphasis area should be evaluated annually. The most important measure of success of the LRSP should be reducing fatal and severe injury collisions throughout the City. If the number of fatal and severe injury collisions does not decrease over time, then the emphasis areas and countermeasures should be re-evaluated.

1. INTRODUCTION

What is an LRSP?

A Local Roadway Safety Plan (LRSP) is a localized data-driven traffic safety plan that provides opportunities to reduce or eliminate instances of fatal and severe injury collisions. An LRSP creates a framework to systematically identify and analyze traffic safety-related issues, and recommend safety projects and countermeasures. An LRSP facilitates the development of local agency partnerships and collaboration, resulting in the development of a prioritized list of improvements that can qualify for Highway Safety Improvement Program (HSIP) funding.

An LRSP is a proactive approach to addressing safety needs and is viewed as a living document that can be constantly reviewed and revised to reflect evolving trends, and community needs and priorities.

Vision and Goals of the City of Antioch's LRSP

Vision: Antioch's LRSP is founded in the belief that our roadways will be good neighbors that create a sense of place and belonging for all. They will provide safer and more inviting opportunities for people to travel regardless of mode. They will be planned, designed, operated, and maintained such that there will be fewer deaths and serious injuries resulting from collisions.

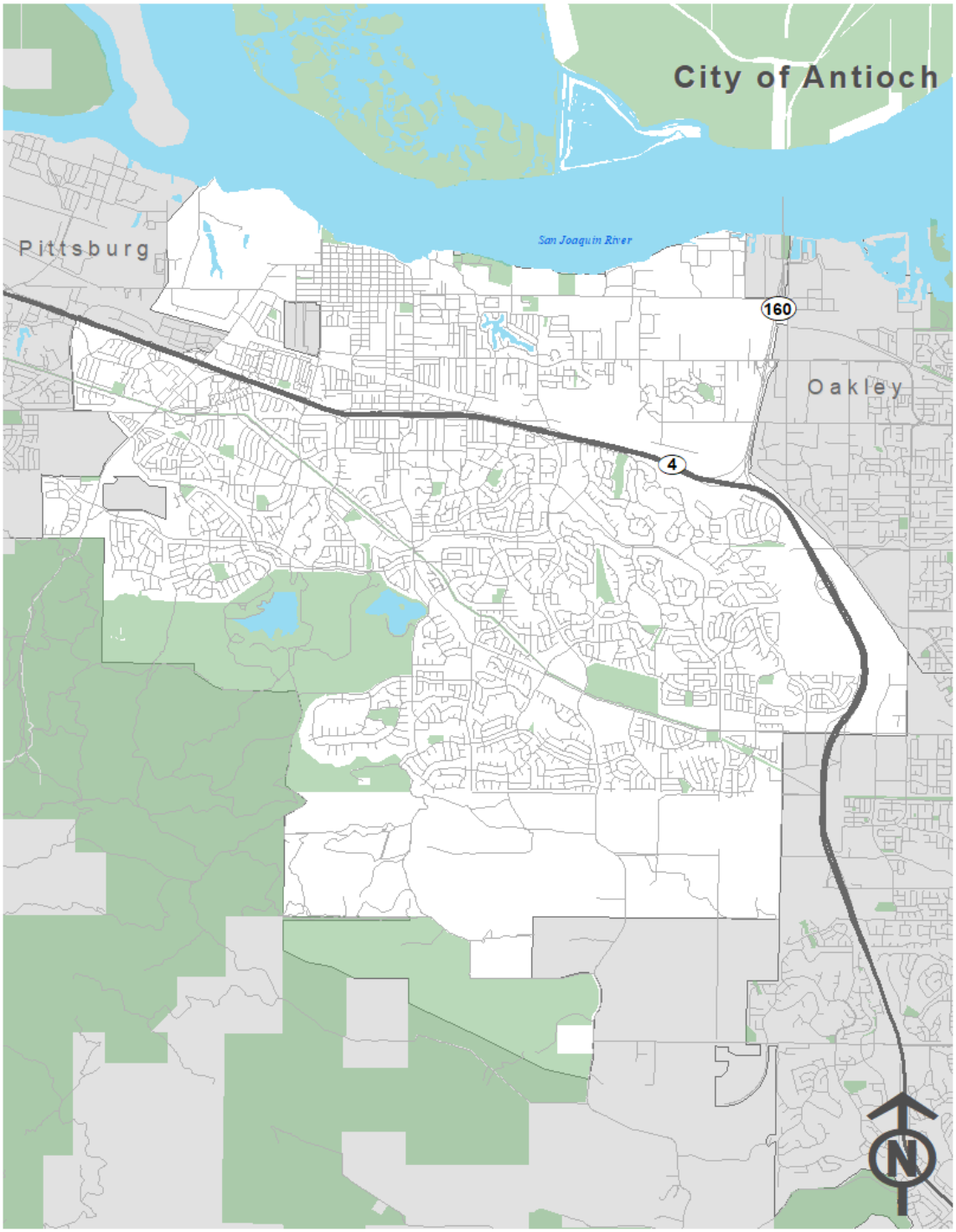
- Goal #1: Identify and analyze roadway safety issues and recommend improvements
- Goal #2: Improve the safety of all road users, especially vulnerable road users, by using proven safety countermeasures and acknowledging tradeoffs between competing interests and outcomes.
- Goal #3: Ensure coordination and response of key stakeholders (local officials, city staff and community members) to implement roadway safety improvements within Antioch
- Goal #4: Serve as a resource for staff who continually seek funding for safety improvements
- Goal #5: Recommend what, how and why safety improvements can be made in a manner that is fair and equitable for all Antioch residents considering locations or communities that have been most impacted or have seen the least investment over time.
- Goal #6: Enhance and expand community engagement and collaboration to bring more inclusivity to the LRSP process.
- Goal #7: Adopt a qualitative and quantitative data-driven approach that provides for accountability and evaluation, shared responsibility and redundancy.
- Goal #8: Employ new or innovative safety countermeasures through tactical urbanism strategies and quick-build or pilot projects.

- Goal #9: Leverage new technologies such as video analysis to identify near-miss collisions, using block chaining to integrate previously disassociated data sets, and smart city systems such as vehicle-to-infrastructure (V2I) interaction and data transfer.

Study Area

The City of Antioch is located in Contra Costa County, California in the San Francisco Bay Area, covering a total area of just under 30 square miles. It is directly south of the Sacramento-San Joaquin Delta. The City's estimated population is 111,506 (ACS 2019 1-year estimate). State Routes (SR) 4 and 160 are the major highways that connect the City of Antioch to the Antioch Bridge and other nearby cities, such as Pittsburg, Oakley, and Brentwood. **Figure 1** shows the study area.

Figure 1. City of Antioch



2. EXISTING PLANNING EFFORTS

This section summarizes the planning documents, projects underway, and studies reviewed for Antioch Local Roadway Safety Plan (LRSP). The purpose is to ensure the LRSP vision, goals, and E's strategies are aligned with prior planning efforts, planned transportation projects and non-infrastructure programs. The documents reviewed are listed below:

- City of Antioch General Plan (2003);
- Contra Costa Countywide Bicycle and Pedestrian Action Plan (2018);
- Antioch Downtown Specific Plan (2018);
- Hillcrest Station Area Specific Plan (2009);
- Contra Costa County Transportation Analysis Guidelines (2020);
- 2017 Countywide Comprehensive Transportation Plan;
- Contra Costa Transportation Authority Transportation Expenditure Plan (2020);
- Contra Costa County General Plan (2005);
- Transportation Baseline Report Contra Costa County General Plan (2019);
- City of Antioch Traffic Calming Policy (2020);
- City of Antioch 5 Year Capital Improvement Program (2020 – 2025)

The following sections include brief descriptions of these documents and how they inform the development of the LRSP. A brief document summary is listed in **Table 1**. A more detailed list of upcoming projects and relevant policies is listed in **Appendix A**.

The City is actively pursuing a number of diversity, equity and inclusion inspired efforts. Examples include the formation of a Human Rights and Racial Equity Ad Hoc Committee in May of 2022 and the establishment of a new City department. The City Council adopted an enabling ordinance, effective as of June of 2022, creating the Department of Public Safety and Community Resources. The Department will span several program areas, including the Community Engagement Division. The Community Engagement Division will proactively interface with the community to address critical public health and safety issues through events, initiatives, public forums, and panel discussions.

Table 1. Document Review Summary

Document	Highlights
City of Antioch General Plan (2003)	Circulation Element of the plan details plans for the City of Antioch including bicycle, pedestrian, vehicle and transit improvements.
Contra Costa Countywide Bicycle and Pedestrian Action Plan (2018)	Details bicycle and pedestrian improvements on County significant corridors. Also includes a collision analysis that identified Lone Tree Way as high bicycle/pedestrian collision corridor in Antioch. CCTA is also in the process of developing a Countywide Vision Zero Framework, which is a key implementation recommendation of the CBPP 2018.
Antioch Downtown Specific Plan (2018)	Details circulation and access of Downtown Antioch. Pedestrian, bicycle and transit improvements will be given high priority.
Hillcrest Station Area Specific Plan (2009)	Details compact pedestrian orientated plans for the Hillcrest Station Area. Plans include new roads, new pedestrian and bicycle facilities, including some new Class I trails.
Contra Costa County Transportation Analysis Guidelines (2020)	Aids the preparation of traffic analysis for project applicants and staff. Contra Costa County has completed a Vision Zero Plan to address severe and fatal collisions on County-owned roadways. The Plan includes a Vision Zero campaign.
Contra Costa Countywide Transportation Safety Policy and Implementation Guide (2021)	This report lays out a framework for Safety Policy and implementation in Contra Costa County. The Safe System Approach of integrating multimodal equity supports the goal of reducing or eliminating severe injuries and fatalities
2017 Countywide Comprehensive Transportation Plan	Contains a countywide transportation projects list, including a performance target to reduce injuries and fatalities from collisions.
Contra Costa Transportation Authority Transportation Expenditure Plan 2020	This is a very high-level plan that reaffirms CCTA's commitment to Complete Streets and road traffic safety.
Contra Costa County General Plan (2005)	General Plan is in the process of being updated. The most applicable policies are under 5-M Improve Safety for Bicyclists and Pedestrians which lists example countermeasures.
Transportation Baseline Report Contra Costa County General Plan (2019)	The report functions as the existing conditions report for the forthcoming Transportation and Circulation Element of the Contra Costa County General Plan, which will present policies and implementation measures to maintain and improve the county's transportation network.
City of Antioch Traffic Calming Policy (2020)	The City of Antioch's Traffic Calming Policy gives step by step instructions on how to respond to resident's concerns with speeding on residential streets.
City of Antioch 5 Year Capital Improvement Program (2020 – 2025)	This plan details the capital improvements funded through 2025. They include roadway improvements, trails and signal improvements.

City of Antioch General Plan (2003)

Adopted in 2003, the General Plan presents a consolidated framework of decisions for guiding where and how development should occur in Antioch. The General Plan recognizes that the Circulation Element is crucial to improve Antioch's perceived quality of life and economic prosperity. It emphasizes the need for safe and convenient movement of people and goods between land uses at the development intensity anticipated in the Land Use Element. The plan represents Antioch's policies governing its transportation system, including roadways and intersections; pedestrian and bicycle paths; and bus and rail transit. The goals and policies stated in the General Plan will inform the countermeasure selection and proposed safety projects for the Antioch LRSP report. It will help the LRSP in supporting the recommended safety projects along with the mobility and transportation needs of the City.

Contra Costa Countywide Bicycle and Pedestrian Plan (2018)

The Contra Costa Transportation Authority (CCTA or Authority) adopted this plan to support and encourage walking and biking countywide. This plan establishes a long-term vision for improving walking and bicycling in Contra Costa by updating the previous Bicycle and Pedestrian Master Plan that was orginally adopted in 2003 and updated again in 2009. It provides a guide for the future development of bicycle and pedestrian facilities, as well as education, enforcement, and encouragement programs for Contra Costa. The plan also provides design standards for new bikeways and pedestrian facilities. The guidelines and policies described in this plan related to Complete Streets and road geometry improvements are crucial. They will help inform the safety projects considered for the LRSP report. CCTA has developed a Countywide Vision Zero Framework, which a key implementation recommendation of the CBPP 2018. This effort continues to define a countywide high-injury network (HIN) with collision typologies, and sets forth a Vision Zero policy and implementation guide for local agencies.

Antioch Downtown Specific Plan (2018)

The Antioch Downtown Specific Plan focuses on cultivating a successful downtown, through its unique waterfront setting, historic character, streetscape design, building design and open space. Applicable recommendations in this document are based on the goal of making downtown walkable and accessible. The land uses established in this Plan are supported by a balanced transportation network that includes vehicular, transit, bicycle and pedestrian modes. Downtown benefits from existing and improving multi-modal transportation access. The Downtown Specific Plan contains a host of improvements to the multimodal transportation system, including closures of critical gaps in the network that hinder access to downtown.

Hillcrest Station Area Specific Plan

The Hillcrest Station Area Plan focuses on future transit oriented developments (TOD) adjacent to the new Antioch eBART station that opened in 2018. The 375 acre site is envisioned to be a compact pedestrian-orientated setting with both jobs and housing. The Plan provides a framework for a pedestrian and transit orientated district with tree lined streets, services and public spaces and recreational opportunities.

Contra Costa County Transportation Analysis Guidelines

The Contra Costa County Transportation Analysis Guidelines' (2020) main goal is to aid in the preparation of traffic analysis for project applicants and staff. The guidelines mainly pertain to CEQA and SB 743, and largely does not relate to the LRSP with the exception that the guidelines summarize existing Contra Costa County policies which include a Vision Zero Policy. The County is in the process of developing a Vision Zero Plan to address severe and fatal collisions on County-owned roadways. The Plan would develop a Vision Zero campaign that, if funding allows, can be used to engage the general public through education and encouragement.

Contra Costa Countywide Transportation Safety Policy and Implementation Guide (2021)

This report layout a framework for Safety Policy and implementation in Contra Costa County. The Safe System Approach integrating multimodal equity supports the Vision Zero goal of eliminating severe injuries and fatalities. CCTA launched their Vision Zero Framework & Systemic Safety Approach effort to serve as the basis for transportation planning, policy, design, construction, and funding throughout Contra Costa County.

2017 Countywide Comprehensive Transportation Plan

The aim of the Countywide Comprehensive Transportation Plan is to establish a long-range vision for Contra Costa's transportation system and identify projects, programs, and policies that the Authority Board hopes to pursue. The document consists of detailed policy information about allocations of future funding. The projects listed under the performance target "reduce injuries and fatalities from collisions" supports the development of traffic safety approaches for the LRSP.

Contra Costa Transportation Authority Transportation Expenditure Plan 2020

The Contra Costa Transportation Authority Transportation Expenditure Plan serves as a roadmap and itinerary that will guide transportation investment for the coming 35 years. The document consists of detailed policy information about allocations of future funding. The projects listed under the policy Road Traffic Safety and Complete Streets Policy are the most applicable to the LRSP.

Contra Costa County General Plan 2005-2020 (2005)

The purpose of the Contra Costa County General Plan is to express the broad goals and policies, and specific implementation measures, which will guide decisions on future growth, development, and the conservation of resources through the year 2020. The plan includes seven mandated elements, the most applicable to the LRSP is the Transportation and Circulation Element. The County is in the process of updating the plan, a planning effort entitled Envision Contra Costa 2040.

Transportation Baseline Report Contra Costa County General Plan (2019)

The baseline report presents a summary of the existing transportation conditions in the planning area of the Contra Costa County General Plan. The report functions as the existing conditions report for the forthcoming Transportation and Circulation Element of the Contra Costa County General Plan, which will present policies and implementation measures to maintain and improve the county's transportation network. The policies in the Transportation and Circulation Element will help to expand transportation choices, improve safety, and address transportation system effects on the environment and community quality of life.

City of Antioch Traffic Calming Policy (2020)

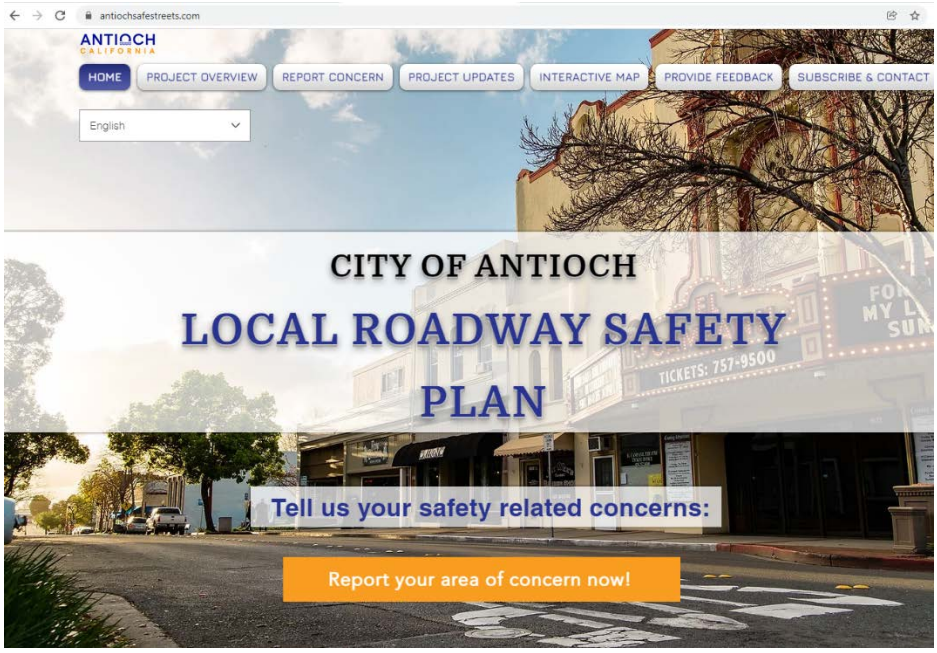
The City of Antioch's Traffic Calming Policy details a step by step process to respond to resident's complaints of speeding in residential neighborhoods. The plan concentrates on a number of countermeasures that are HSIP approved (such as striping, signage and speed feedback signs), and those that aren't (such as speed humps/cushions). The 85th percentile speeds collected as part of this policy will also be useful to the LRSP.

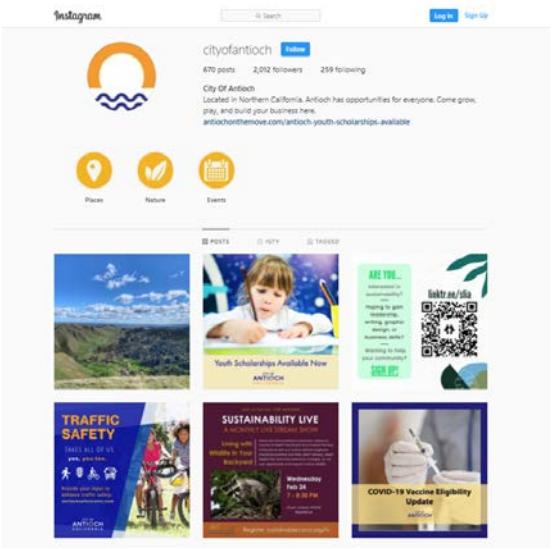
City of Antioch 5 Year Capital Improvements Program (2020-2025)

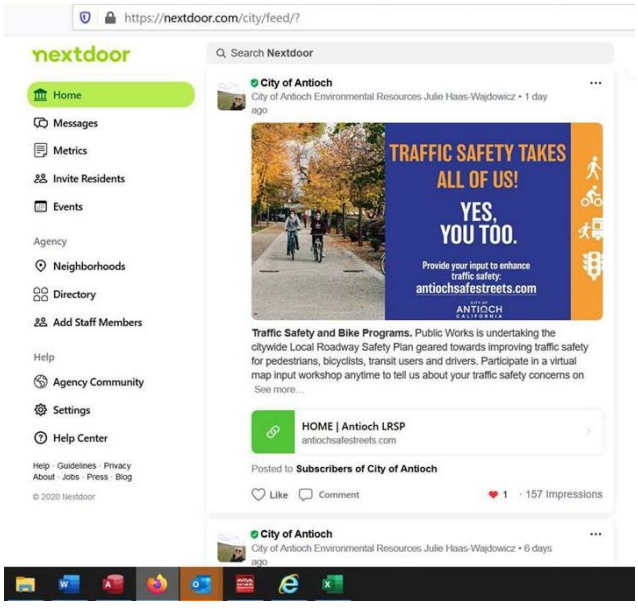
The aim of the City of Antioch's Five Year Capital Improvement Program 2020-2025 is to assist the City is achieving the broad and comprehensive goals of the General Plan. The document consists of detailed project information, funded and unfunded, across a five year period. The projects listed under the sections of roadway improvements, parks and trails, and traffic signals will help to confirm traffic safety solutions for the LRSP.

3. OUTREACH EFFORT

Safety partners are vital to the development and implementation of an LRSP. For the development of this LRSP, a list of stakeholders were identified and engaged throughout the project timeline. This stakeholder and community outreach was supplemented by a project website with an interactive map tool platform (www.antiochsafestreets.com). The project website was widely shared by the City on the City's website and social media. Below are some snapshots of posts shared across the project timeline.







Stakeholder Outreach and Engagement

For Antioch, these include Antioch Public Works, Antioch Police Department, Contra Costa County Fire Protection, Tri Delta Transit, and Contra Costa Transportation Authority. A virtual stakeholder meeting among these departments/agencies was held on May 4, 2021 to review project goals and findings, and to solicit feedback from the group.

Community Outreach

This outreach process was supplemented by a project website (www.antiochsafestreets.com), with an interactive map tool platform. The interactive map was used to solicit input from Antioch residents outside the confines of traditional meetings. The map input platform was published for community input on December 1st, 2020 and on April 20, 2021. During this period 202 public comments were submitted regarding traffic safety issues. Other responses were collected through website, email correspondence, and social media comments. The most common responses were related to the following:

- Speeding
- Intersection Safety
- Pedestrian Safety

The most common commented on traffic safety issue was speeding, with 89 comments. The most common street with speeding issues were Hillcrest Avenue, Highway 4, James Donlon Boulevard, and Rocksprings Way. Intersection safety was the second most common commented on traffic safety issues, with 39 comments. The intersections of Candlewood Way/Prewett Ranch and Hillcrest Avenue/Highway 4 was the most commented on location with intersection safety issues. Other traffic safety issues include, pedestrian safety, stop sign/red light violations, bicycle safety and donuts. **Figure 2** summarizes the public comment findings. **Appendix B** lists all the comments as received.

Figure 2. Public Comments on Traffic Safety Issues

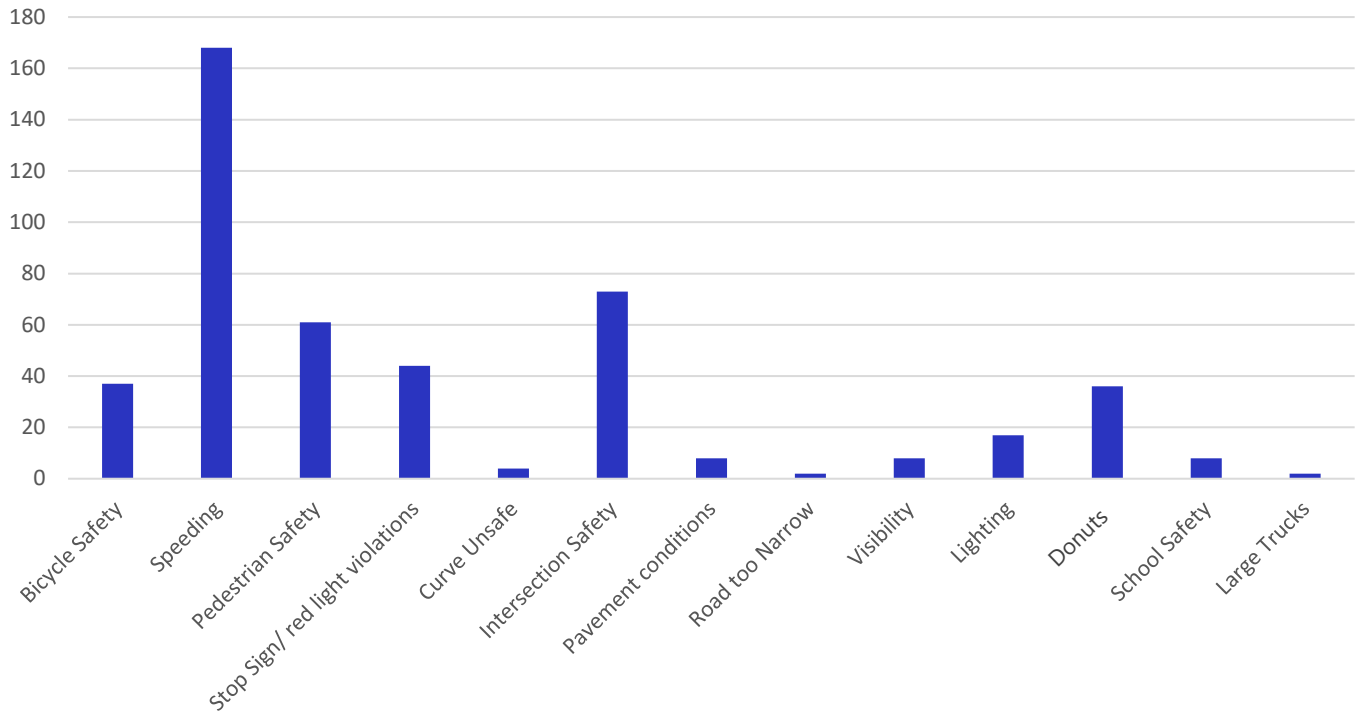


Figure 3. Map Input Responses

4. COLLISION DATA COLLECTION AND ANALYSIS

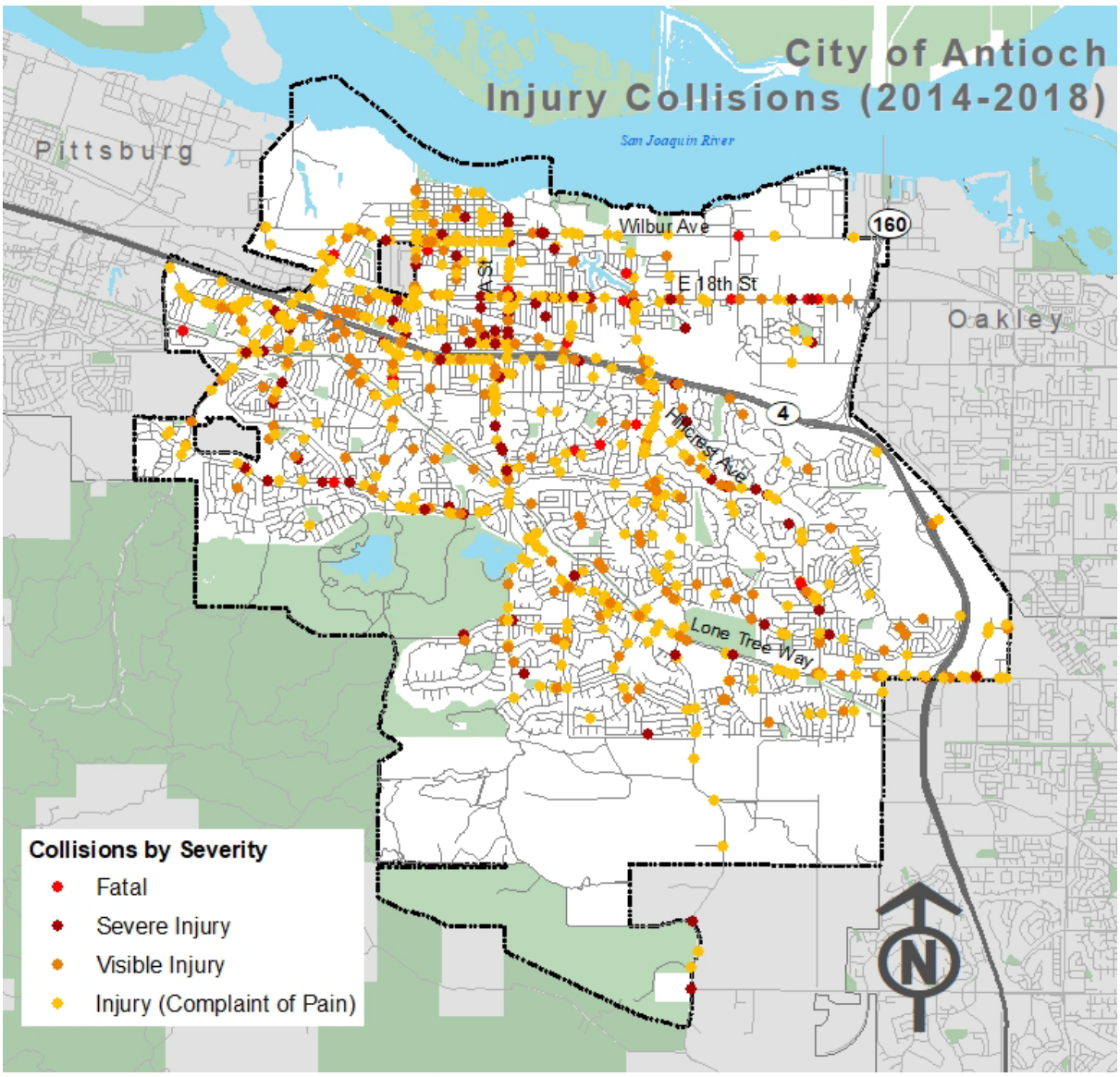
This chapter summarizes the results of a citywide collision analysis as part of the LRSP. Five years of collision data from 2014 to 2018 was analyzed. This chapter includes the following sections:

- Preliminary Collision Data Analysis
- Fatal and Severe Injury Collision Analysis
- Geographic Collision Analysis
- High Injury Network

The LRSP focuses on systematically identifying and analyzing safety issues and recommends appropriate safety improvements. The section starts with an analysis of citywide collisions of all severity, including Property Damage Only (PDO) collisions. Then, a detailed analysis was conducted for fatal and severe injury (KSI) collisions that have occurred on Antioch's roadways. The KSI collisions were then separated by facility type (i.e. based on collisions occurring on intersections and roadway segments) as the geometrics of roadway segments and intersections are different and are affected varyingly by different factors.

After this data was separated, a comprehensive evaluation was conducted based on factors such as collision severity, type of collision, primary collision factor, lighting, weather and time of the day. **Figure 4** illustrates all the injury collisions that have occurred in Antioch from 2014 to 2018.

Figure 4. All Injury Collisions on City Roadways (2014-2018)



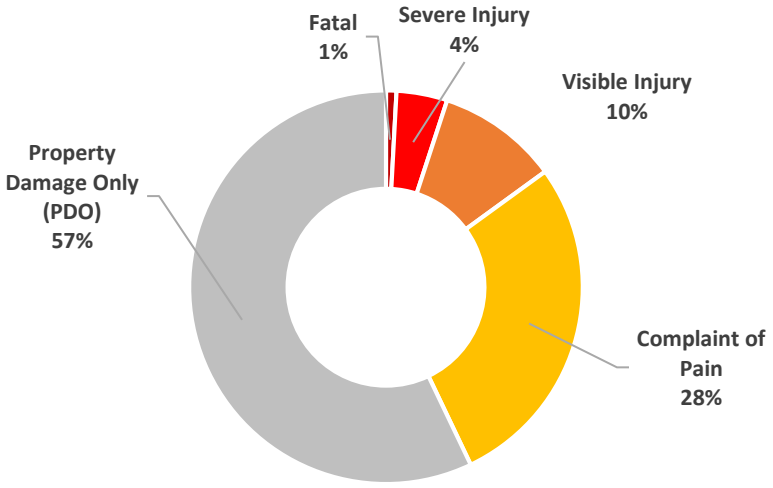
Collision data helps to understand different factors that might be influencing collision patterns and leading to collisions in a given area. For the purpose of this analysis, a five-year city-wide collision data, from 2014 to 2018 was retrieved from Transportation Injury Mapping System (TIMS) and Statewide Integrated Traffic Records System (SWITRS). The collision data was analyzed and plotted in ArcMap to identify high-risk intersections and roadways segments.

Preliminary Collision Data Analysis

Collision Classification

There were a total of 2,920 collisions reported City-wide from 2014 to 2018. Out of these 2,920 collisions, 1,667 collisions (57%) were PDO collisions, 815 collisions (28%) led to complaint of pain, and 291 collisions (10%) led to a visible injury. There were 147 KSI collisions (5% of total) out of which, 122 collisions (4%) led to a severe injury and 25 collisions (1%) led to a fatality. **Figure 5** illustrates the classification of all collisions based on severity.

Figure 5. Collisions by Severity in Antioch



The analysis first includes a comparative evaluation between all collisions and KSI collisions, based on various factors including but on limited to: collision trend, primary collision factor, collision type, facility type, motor vehicle involved with, weather, lighting, and time of the day. Following this, a comprehensive analysis is conducted for only KSI collisions. KSI collisions cause the most damage to those affected, infrastructure and the aftermath of these collisions lead to great expenses for City administration. The LRSP process thus focuses on these collision locations to proactively identify and counter their respective safety issues.

The collision data was separated by facility type, i.e. based on collisions occurring on intersections and roadway segments. For the purposes of the analysis, a collision was said to have occurred at an intersection if it occurred within 250 feet of it. The reported collisions categorized by facility type and collision severity are presented in **Table 2.**

Table 2. Collisions by Severity and Facility Type in Antioch

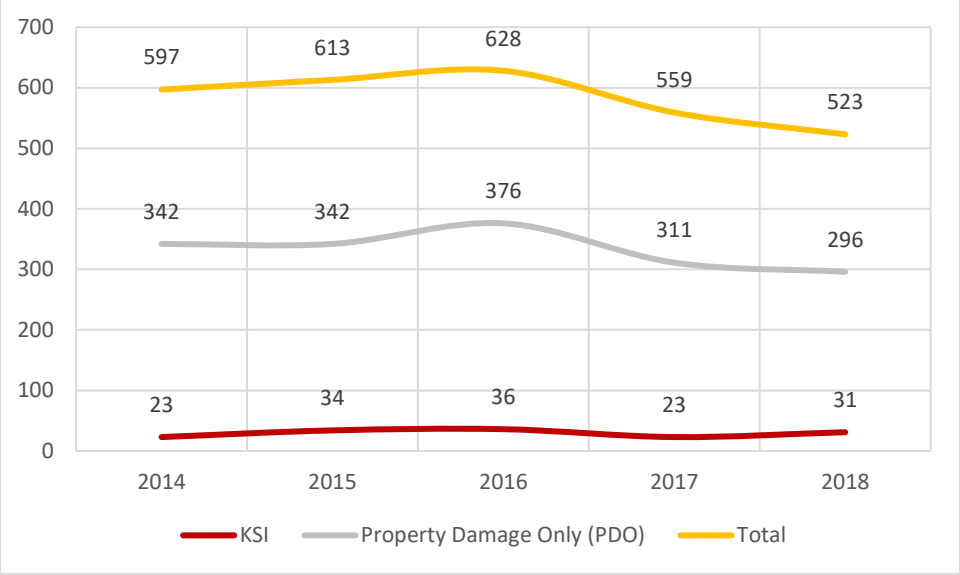
Collision Severity	Roadway Segment	Intersection	Total
Fatal	8	17	25
Severe Injury	20	102	122
Visible Injury	49	242	291
Complaint of Pain	124	691	815
Property Damage Only (PDO)	237	1,430	1,667
Total	438	2,482	2,920

Year Trend

For collisions of all severity, the number increased from 2014 to 2016 and then decreased in 2017 and 2018. The highest number of collisions (628 collisions) were observed in 2016 and the lowest number of collisions (523) were observed in 2018.

A total of 147 KSI collisions occurred in the City during the study period. They were observed to be the lowest (23 collisions) in 2014 and 2017. Overall, KSI collisions were observed to rise from 2014 to 2016, before decreasing in 2017, then increasing in 2018. The highest number of KSI collisions (36 collisions) occurred in the year 2016. **Figure 6** illustrates the five-year collision trend for all collisions, KSI collisions and also PDO collisions.

Figure 6. Five-Year Collision Trend



Intersection vs. Roadway Collisions

Considering all collisions, it was observed that 15% (438 collisions) occurred on roadway segments whereas 85% (2,482 collisions) occurred at intersections. When only KSI collisions are considered, it was observed that 19% (28 collisions) occurred on roadway segments whereas 81% (119 collisions) occurred at intersections. This classification by facility type can be observed in **Figure 7** and **Figure 8**.

Figure 7. Intersection vs. Roadway Segment Collisions – All Collisions

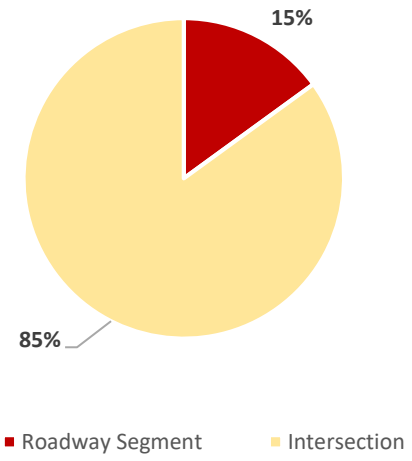
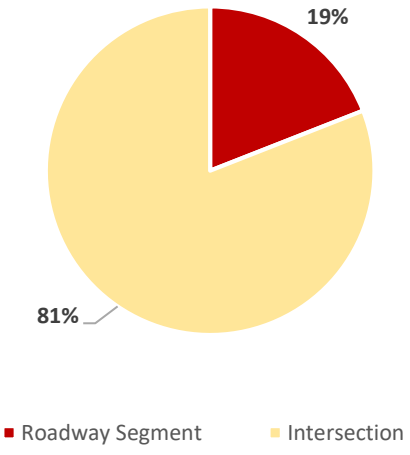


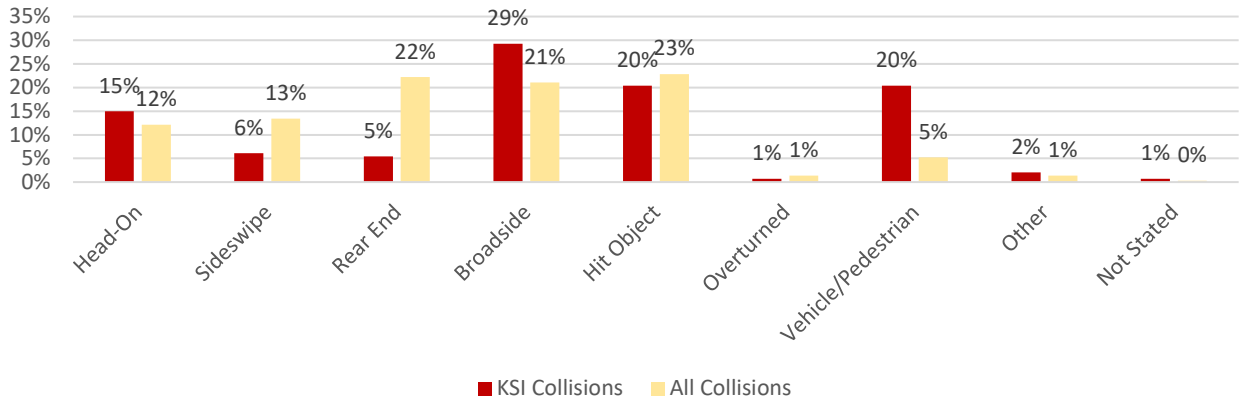
Figure 8. Intersection vs. Roadway Segment Collisions – Killed or Severe Injury Collisions



Collision Type

Considering all collisions, the most commonly occurring collision types were hit object collisions (23%), rear-end collisions (22%) and broadside collisions (21%). When only KSI collisions were considered, the most commonly occurring collision types were broadside (29%), hit object (20%) and vehicle-pedestrian (20%). **Figure 9** illustrates the collision type for all collisions as well as KSI collisions.

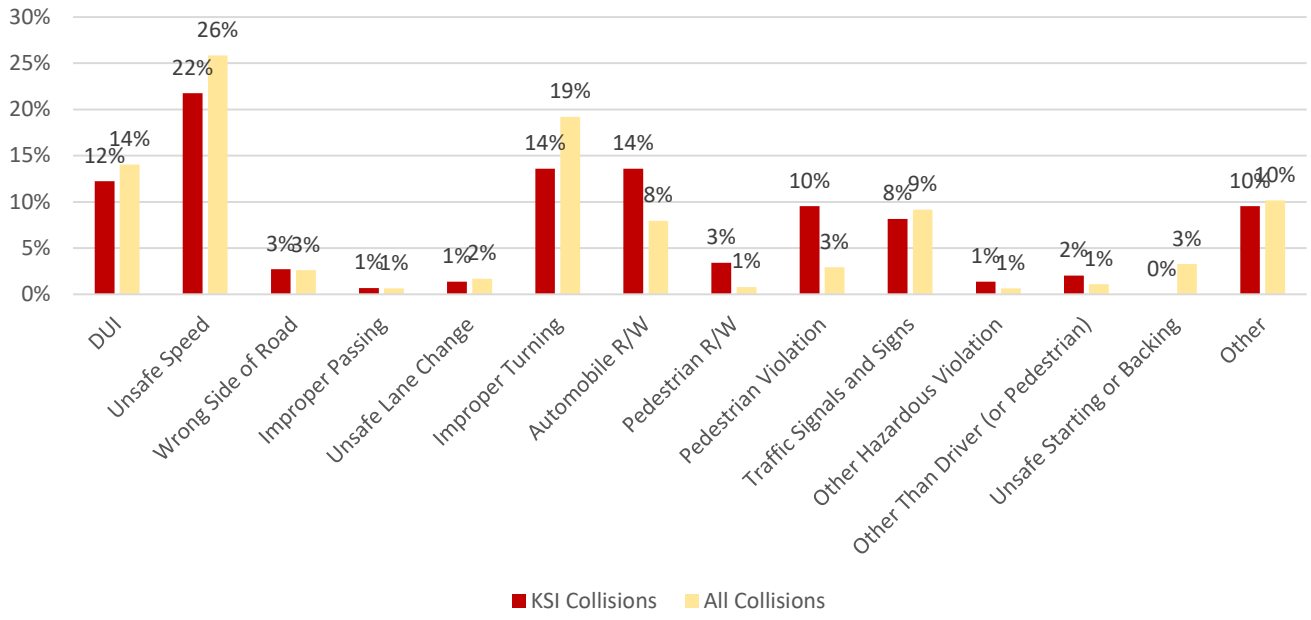
Figure 9. Collision Type: All Collisions vs. KSI Collisions



Primary Collision Factor

For all collisions, unsafe speed (26%) was the most common primary collision factor, followed by improper turning (19%) and driving under influence (14%). Similar collision factors were observed for KSI collisions. Additionally, pedestrian violation was also one of the major collision factors observed for KSI collisions. **Figure 10** illustrates the primary collision factor for all collisions and KSI collisions.

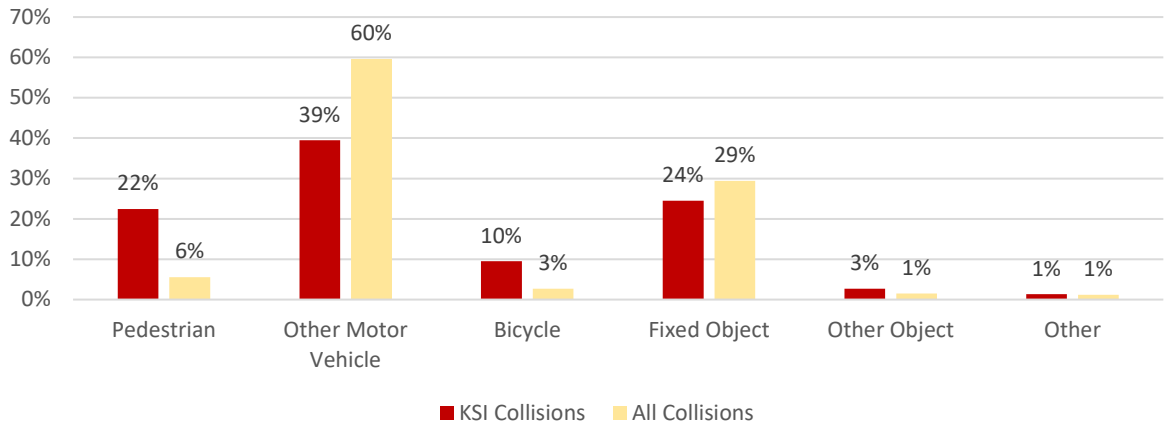
Figure 10. Primary Collision Factor: All Collisions vs. KSI Collisions



Motor Vehicle – Motor Vehicle Collisions

Considering all collisions, 60% of the collisions are motor vehicle involved with other motor vehicle collisions. The remaining collisions include motor vehicle involved with fixed object (29%), motor vehicle involved with pedestrian (6%) and motor vehicle involved with a bicyclist (3%). For KSI collisions, 36% of the collisions occurred where motor vehicles were involved with other motor vehicles, 22% of the collisions involved pedestrians, 24% of the collisions involved fixed objects and 10% of the collisions involved a bicycle. **Figure 11** illustrates the percentage for all collisions as well as KSI collisions.

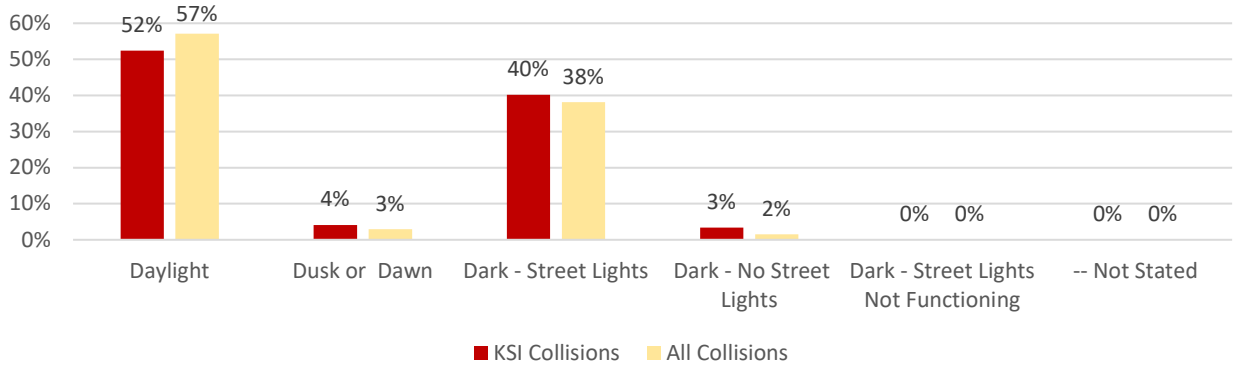
Figure 11. Motor Vehicle Involved With: All Collisions vs. KSI Collisions



Lighting

For collisions of all severity, 57% of collisions occurred in daylight and 38% of collisions occurred in the dark on streets with street lights. Similar trends were observed for KSI collisions, where 40% of collisions occurred in the dark on streets with street lights and 52% of collisions occurred in daylight. **Figure 12** illustrates the lighting condition for all collisions and KSI collisions.

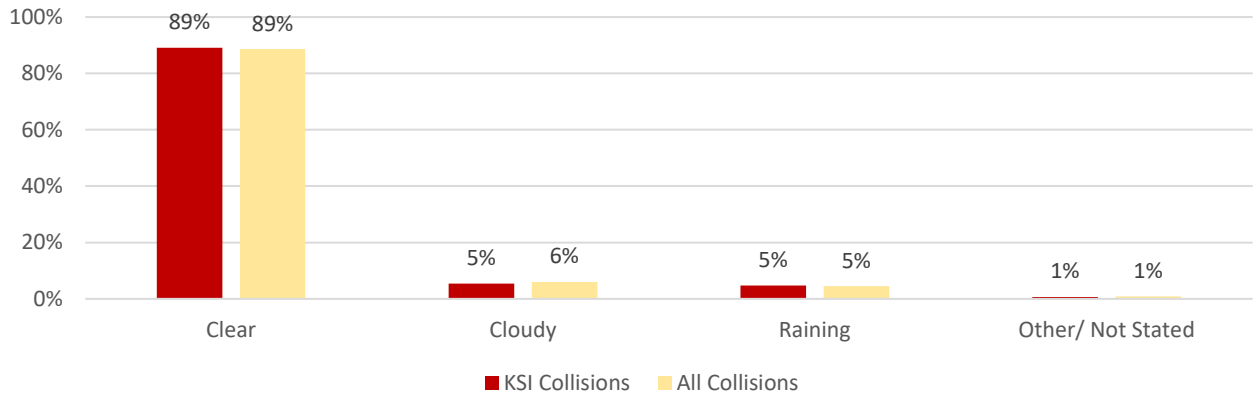
Figure 12. Lighting Conditions: All Collisions vs. KSI Collisions



Weather

89% of all collisions occurred during clear weather conditions, 6% of collisions occurred during cloudy weather conditions, and 5% occurred during rainy weather conditions. For KSI collisions, 89% of the collisions occurred during clear weather conditions, 5% of the collisions occurred in cloudy conditions and 5% occurred during rainy weather conditions. **Figure 13** illustrates the percentage distribution of weather conditions during occurrence of collisions of all severity as well as KSI collisions.

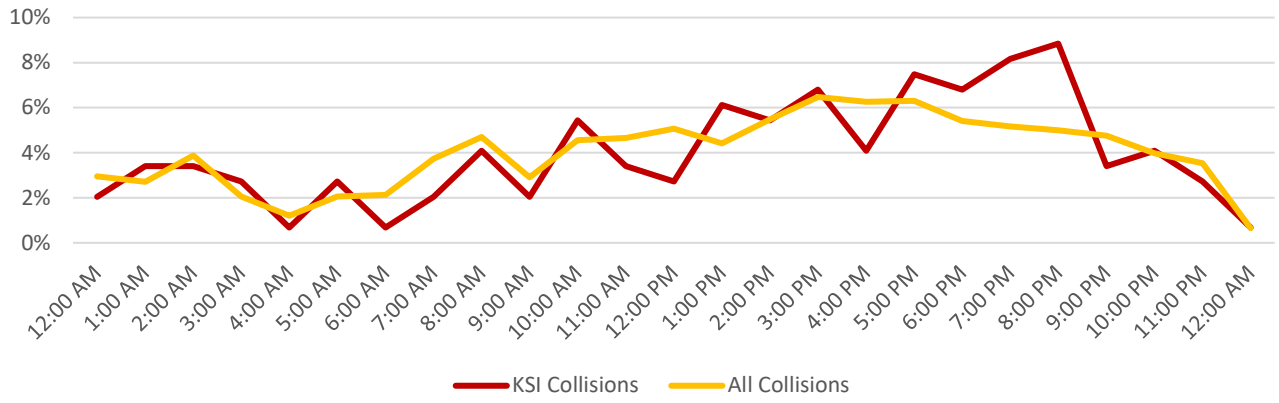
Figure 13. Weather Conditions: All Collisions vs. KSI Collisions



Time of the Day

For collisions of all severity, the highest number of collisions occurred between 3:00 p.m. to 4:00 p.m. (7%) and the lowest number of collisions occurred between 4:00 a.m. to 5:00 a.m. For all KSI collisions, maximum number (9%) of collisions occurred between 8:00 p.m. to 9:00 p.m. and the minimum number of collisions occurred between 4:00 am to 5:00 a.m. **Figure 14** illustrates the percentage of collisions occurring during the day for all collisions as well as KSI collisions.

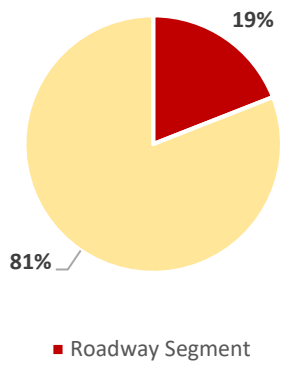
Figure 14. Time of the Day: All Collisions vs. KSI Collisions



Killed or Severe Injury (KSI) Collision Analysis

This section describes a detailed collision analysis performed for KSI collisions occurring at roadway segments and intersections in the City of Antioch. Of the total 147 KSI collisions that occurred in the City, 119 collisions (81%) occurred at intersections and 28 collisions (19%) occurred at roadway segment locations. This distribution is illustrated in **Figure 15.**

Figure 15. KSI Collisions: Roadway Segments and Intersections



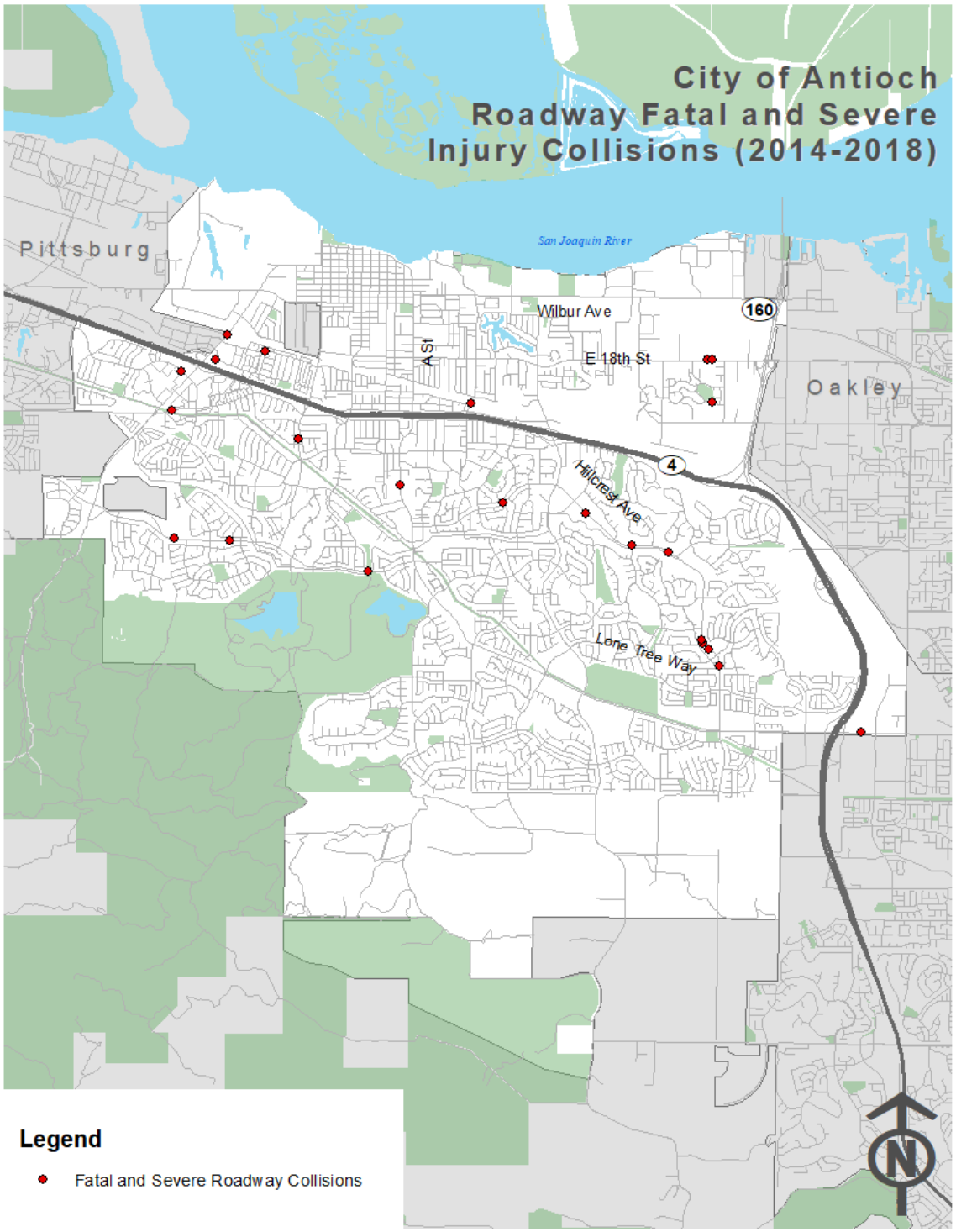
The detailed collision analysis is effective for identifying high-risk locations by evaluating a shorter list of collisions that have led to a fatality or a severe injury. Collisions have been segregated by facility type and further analyzed taking into account the following five collision attributes:

- Violation Category
- Collision Type
- Lighting Conditions
- Weather Conditions
- Time of the Day

Roadway Segment Analysis

A total of 28 KSI collisions occurred on roadway segments between 2014 and 2018. **Figure 16** illustrates the roadway segment collisions that occurred in the City from 2014 to 2018.

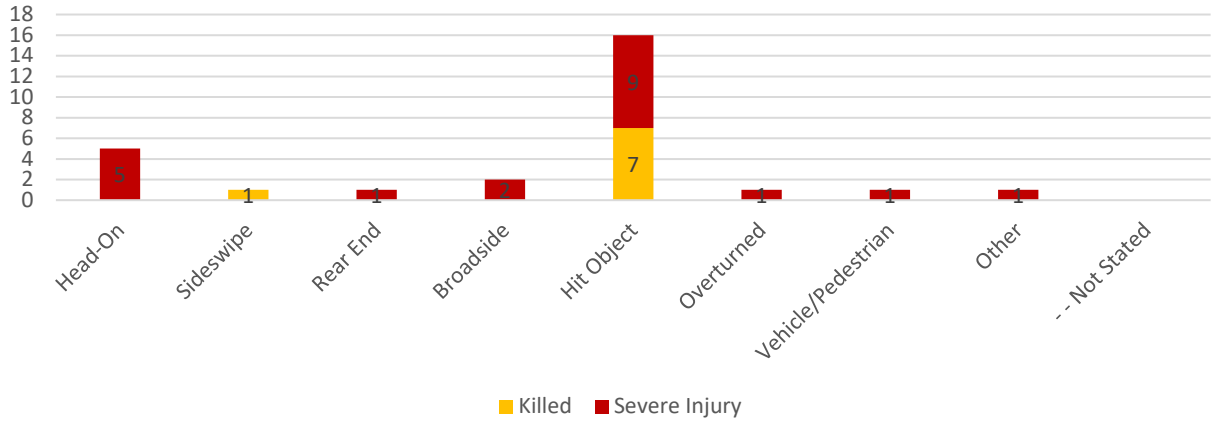
Figure 16. Roadway KSI Collisions



Collision Type and Severity

For all the roadway segment collisions that led to a fatality or severe injury, there were 16 hit object collisions (57%), five head-on collisions (18%) and two broadside collisions (7%). **Figure 17** illustrates the type of collision as well as the resulting severity for KSI collisions on roadway segments.

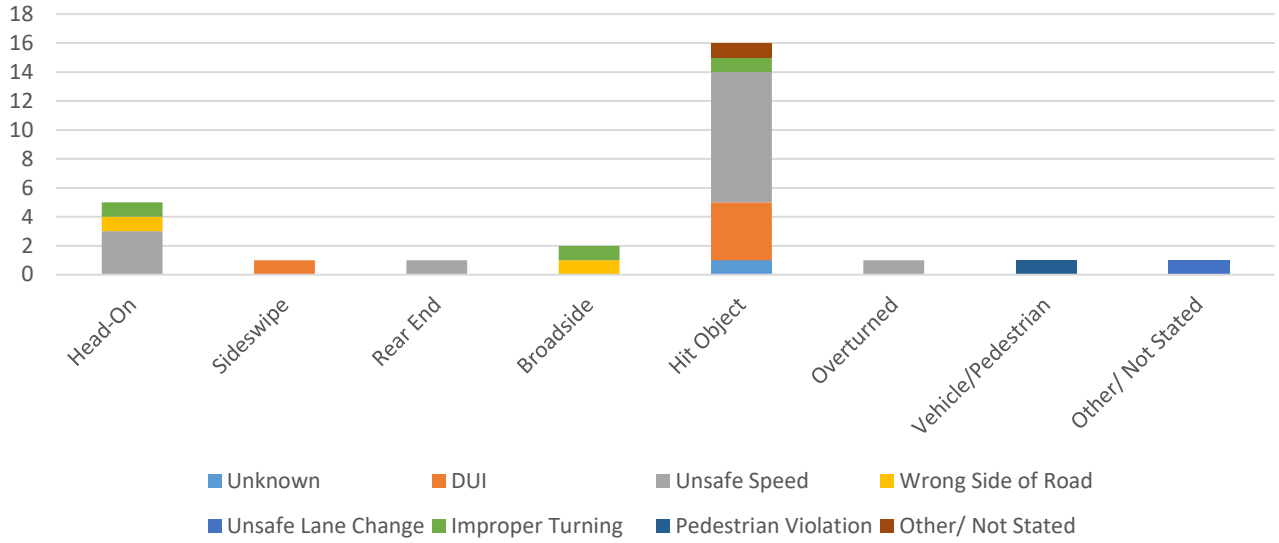
Figure 17. Collision Type for KSI Collisions on Roadway Segments



Violation Category and Collision Type

For all the roadway segment collisions that led to a fatality or severe injury, there were 14 unsafe speed collisions (50%), five DUI collisions (18%) and three improper turning collisions (11%). The results, with collision type, are shown in **Figure 18.**

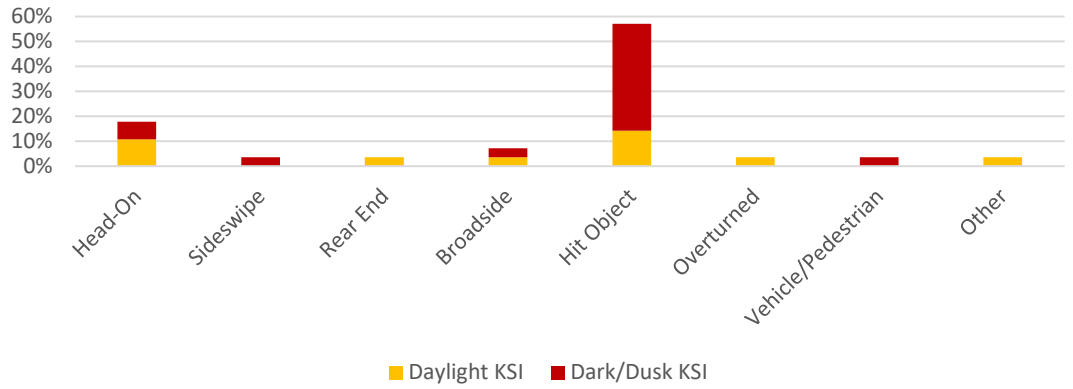
Figure 18. Distribution of Violation Categories for KSI Collisions on Roadway Segments



Lighting Condition and Collision Type

For all KSI collisions occurring at roadway segments, 12 (43%) of them occurred during nighttime or dusk and was a hit object collision. Three collisions resulted in a fatal or severe collisions occurred during the daylight and was a head-on collision. **Figure 19** illustrates the lighting condition and the collision type as observed for KSI collisions occurring on roadway segments.

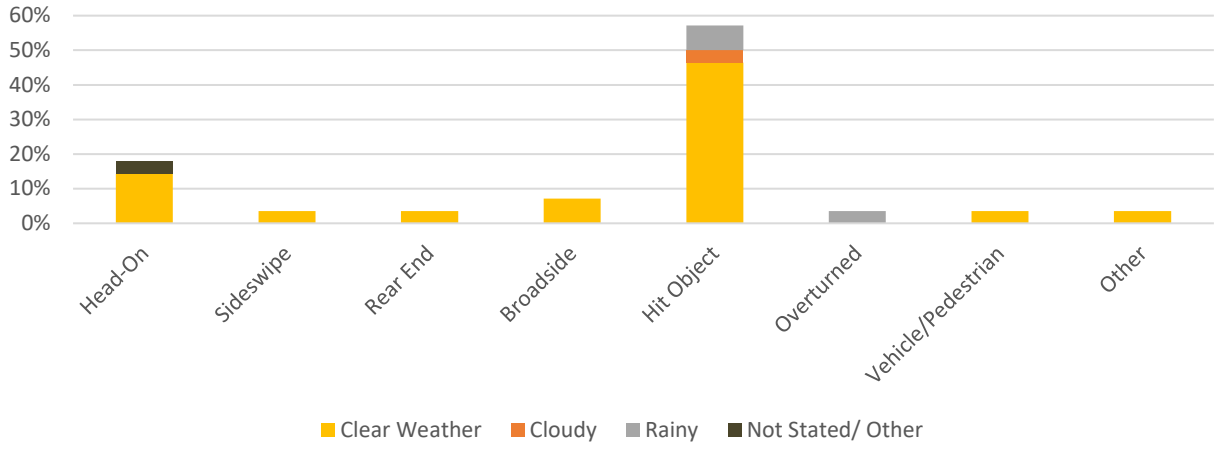
Figure 19. Lighting Conditions for KSI Collisions on Roadway Segments



Weather Condition and Collision Type

For all KSI collisions occurring at roadway segments, 23 (82%) of them occurred during clear weather conditions. The weather conditions for the rest of the collisions were rainy, cloudy or not stated. **Figure 20** illustrates the weather condition and the type of collision for all fatal and severe injury collisions that occurred on roadway segments.

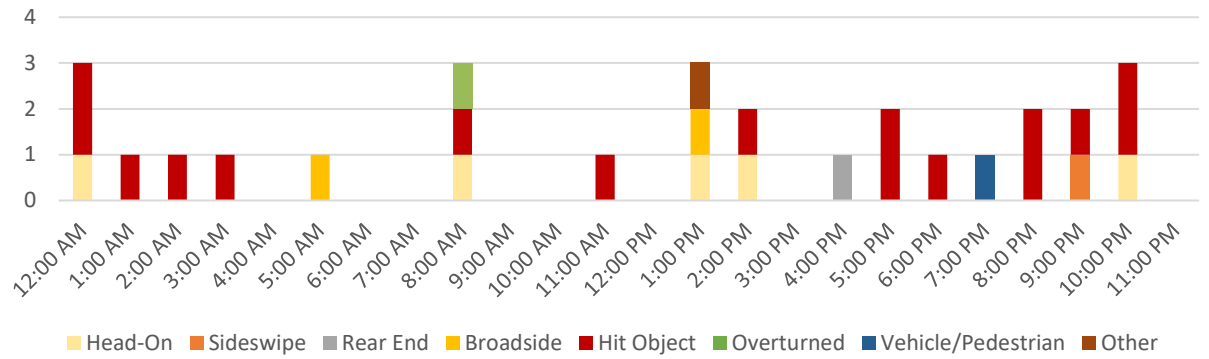
Figure 20. Weather Conditions for KSI Collisions on Roadway Segments



Time of the Day and Collision Type

For all the KSI collisions that occurred on roadway segments, 16 of them were hit object collisions, that occurred primarily in the early morning (prior to 4:00 a.m.) and at night after 5:00 p.m. **Figure 21** illustrates the collision type by the time of the day for all roadway segment collisions.

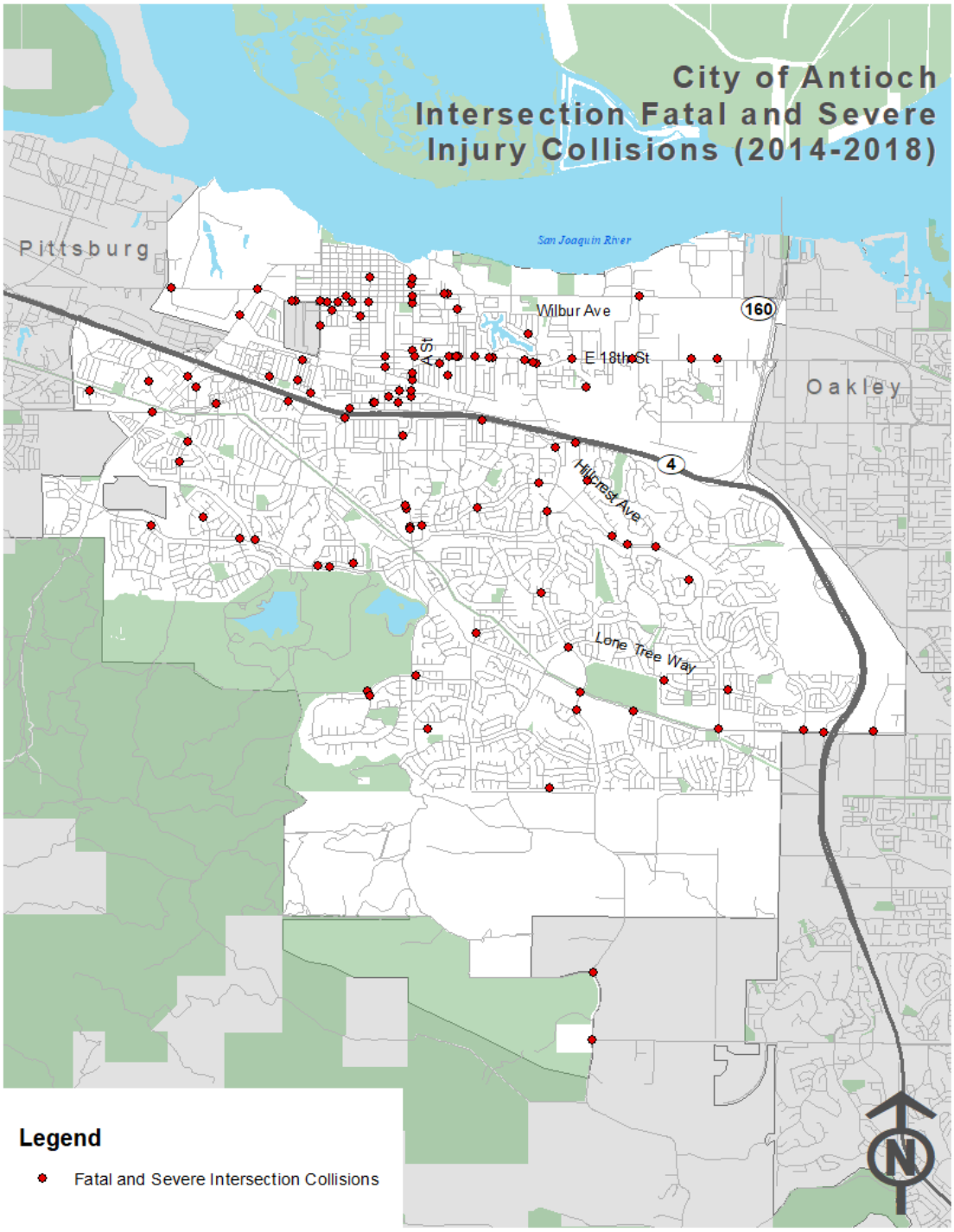
Figure 21. KSI Collisions on Roadway Segments by Time of the Day



Intersection Analysis

There were a total of 119 KSI Collisions that occurred at intersections. **Figure 22** illustrates all the KSI collisions that have occurred at intersections in the City during the study period.

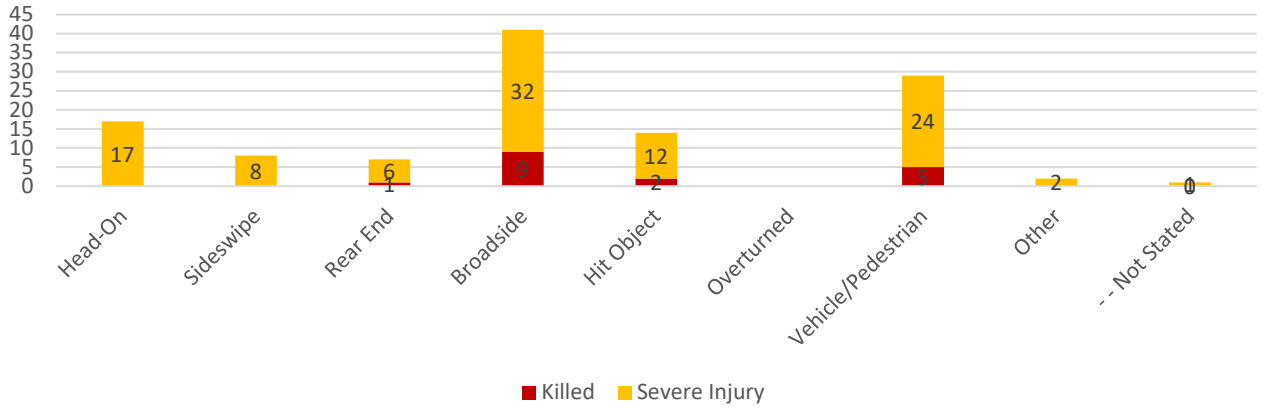
Figure 22. Intersection KSI Collisions



Collision Type and Severity

Examining which collision types led to KSI collisions at intersections can help to identify the appropriate countermeasures. Broadside collisions and vehicle pedestrian collisions were the most prominent collision types that led to KSI collisions, as shown in **Figure 23.** Hit-object, vehicle-pedestrian, broadside and rear-end collisions have led to fatal collisions.

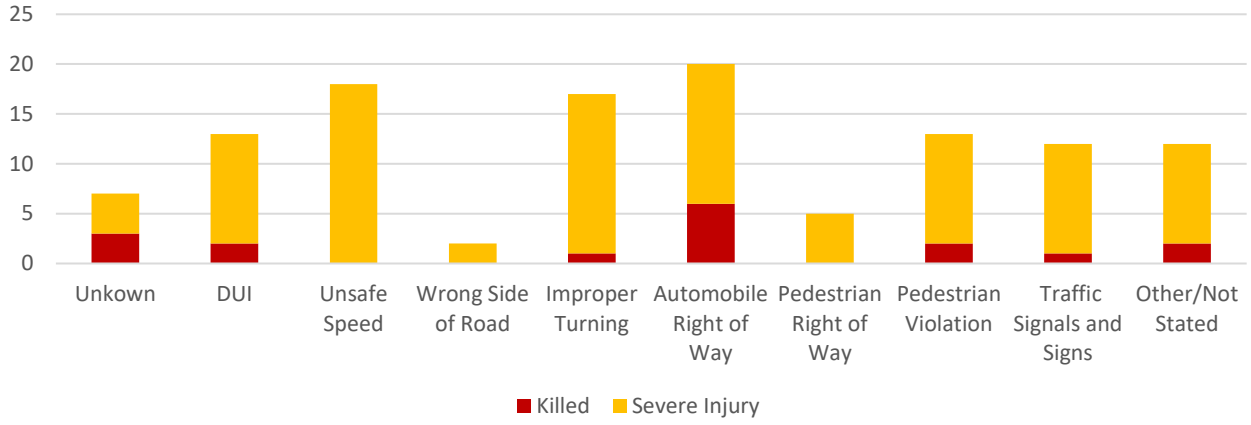
Figure 23. Collision Type with Severity for KSI Collisions at Intersections



Violation Category and Collision Type

Examining the violation category in combination with the collision type can help to understand the factors that lead to certain collision types; and identify which countermeasures are most appropriate. The violation category that caused the highest number of fatal and severe injury collisions at intersections was auto right-of-way violation followed by unsafe speed and improper turning. The results are shown in **Figure 24**.

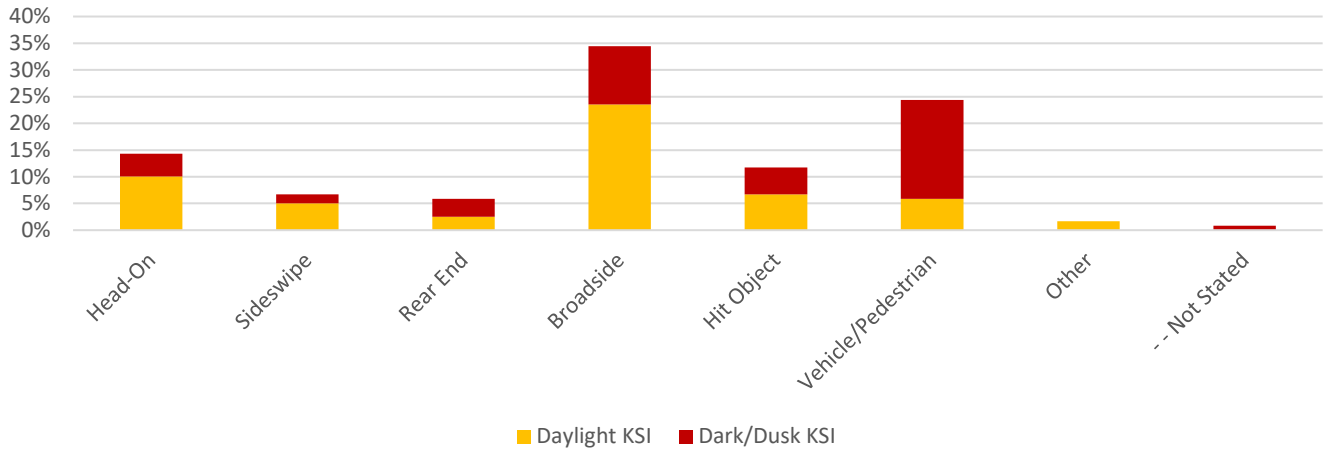
Figure 24. Violation Categories for KSI Collisions at Intersections



Lighting Condition and Collision Type

Lighting conditions affect the visibility at intersections for approaching vehicles. For all KSI collisions at intersections, 55% occurred during daylight and 45% occurred in the dark or dusk/dawn. The most commonly occurring collision type, broadside, occurred during the daylight. **Figure 25** represents the distribution of collision type according to the lighting conditions present.

Figure 25. Lighting Conditions for KSI Collisions at Intersections

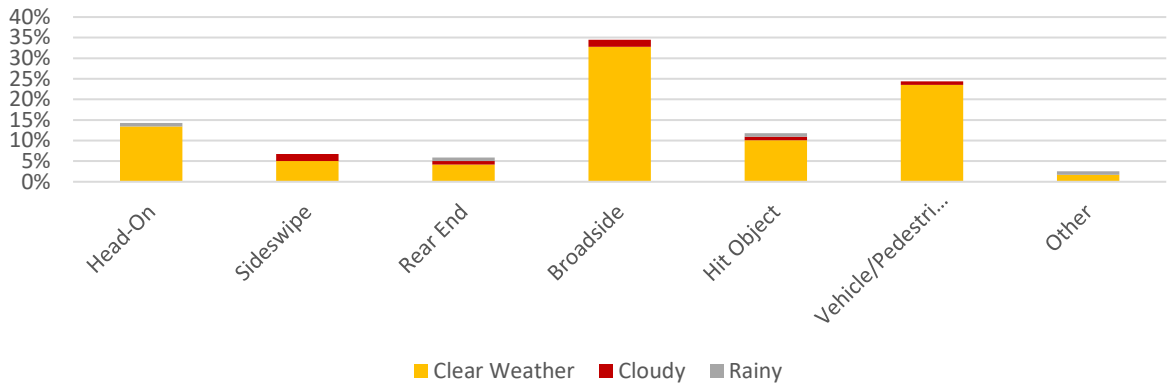


It's worth noting that vehicle/pedestrian collisions occurred in the dark at locations with functioning and non-functioning streetlights when visibility of the object or pedestrian may have been obscured. While it cannot be known if the fact the streetlights were not functioning contributed to a specific collision; however, the importance of proper maintenance of street lighting cannot be overstated.

Weather Condition and Collision Type

A total of 91% of collisions occurred during clear weather conditions, 6% of collisions occurred during cloudy weather, and 3% collisions occurred during rainy weather conditions, for intersection collisions that resulted in a fatality or severe injury, as shown in **Figure 26**.

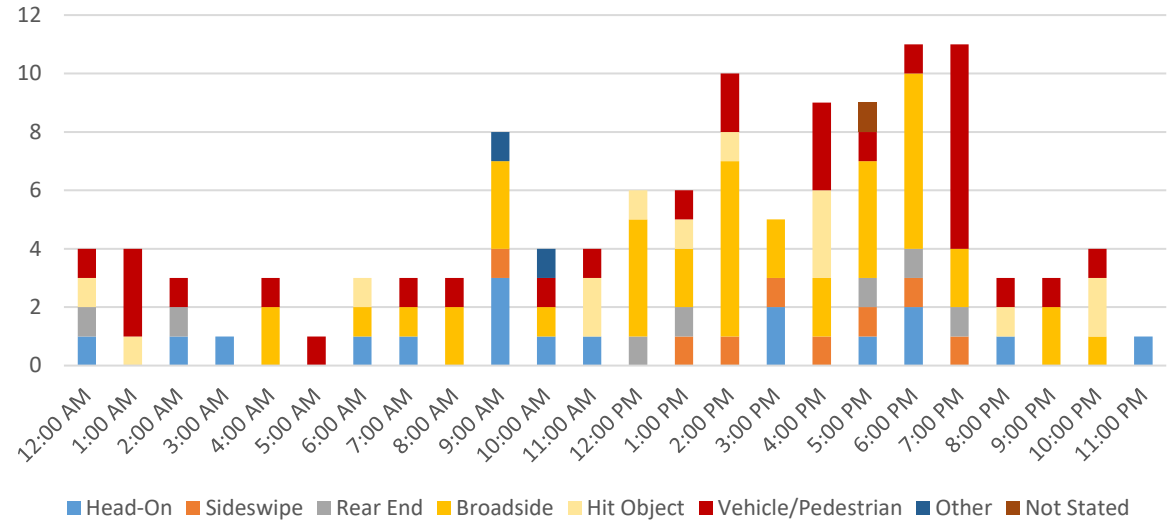
Figure 26. Weather Conditions for KSI Collisions at Intersections



Time of the Day and Collision Type

The most prominent time period for KSI collisions at intersections was observed to be between 6:00 p.m. to 8:00 p.m. (18%) as shown in **Figure 27**. Other prominent collision times were between 2:00 p.m. to 3:00 p.m. (8%) and 9:00 a.m. to 10:00 a.m. (7%). Broadside and vehicle-pedestrian were the most prominently observed collision type during hours when maximum number of collisions occurred. About 46% crashes have occurred between 2:00 p.m. to 8:00 p.m. in the evening.

Figure 27. KSI Collisions at Intersections by Time of Day



Geographic Collision Analysis

This section describes a detailed geographic collision analysis performed for injury collisions occurring at roadway segments and intersections in the City of Antioch. The above collision analysis was used to identify five main collision factors that highlight the top trends among collisions in Antioch. These five collision factors were identified to be unsafe speed collisions, pedestrian collisions, broadside collisions, hit object collisions and night time conditions collisions.

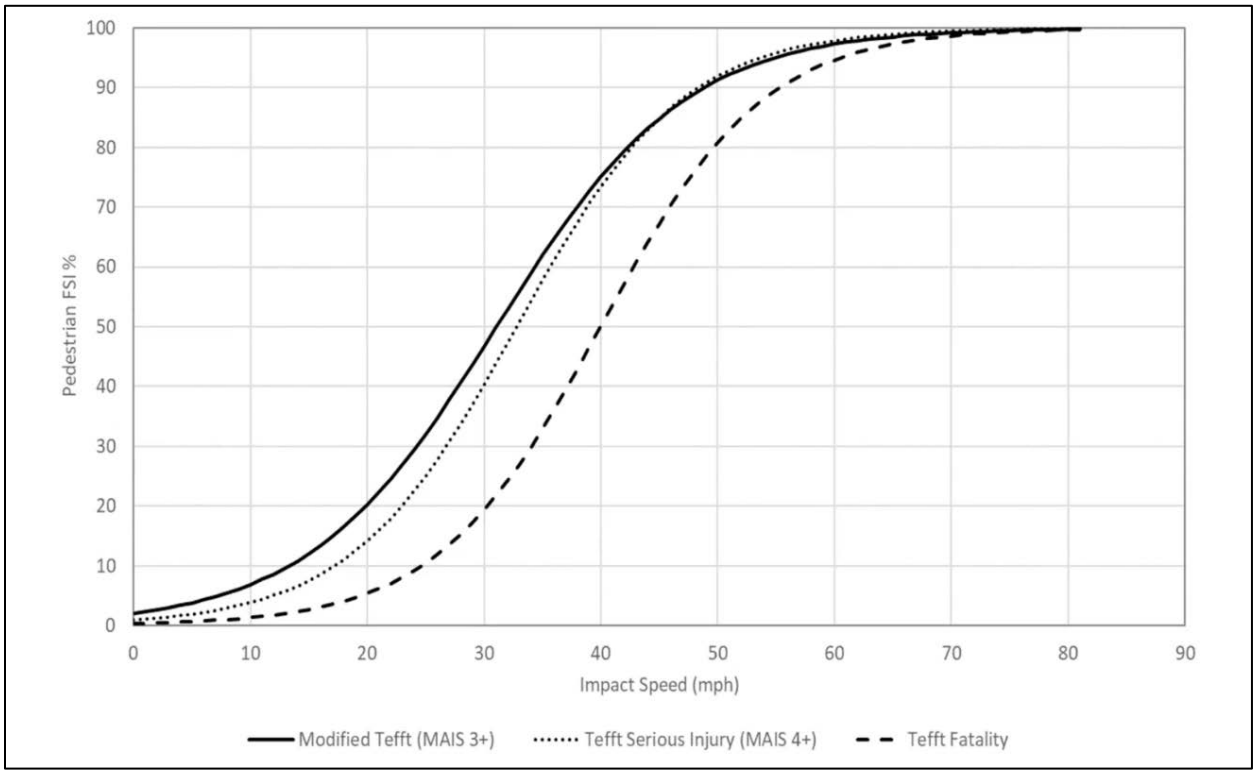
Unsafe Speed Collisions

For all injury collisions in Antioch, 26% were unsafe speed collisions. **Figure 28** shows the distribution of unsafe speed collisions throughout Antioch between 2014 and 2018. Lone Tree Way, James Donlon Boulevard, and Hillcrest Avenue have a higher concentration of unsafe speed collisions, compared to other Antioch roads.

Pedestrian Collisions

Figure 29 shows the probability of an auto-pedestrian crash being fatal or imparting serious or severe injuries to the pedestrian. The values for children and the elderly are higher. The term "Tefft" refers to the 2011 technical report "Impact Speed and a Pedestrian's Risk of Severe Injury or Death" authored by Brian C. Tefft for the AAA Foundation for Traffic Safety. The term MAIS refers to Maximum Abbreviated Injury Scale, a globally accepted and widely used trauma scale used by medical professionals. It provides an objective and reliable basis for data collection and international comparisons. The injury score is determined at the hospital with the help of a detailed classification key. A MAIS score of 1 is considered minor injuries treatable by first aid or a minor emergency clinic. A MAIS score of 2 is considered moderate injuries requiring emergency room treatment but not requiring hospitalization for full recovery. A MAIS of 3 is considered serious and described as reversible injuries with hospitalization required. A MAIS of 4 is considered severe and life threatening and not fully recoverable without care. A MAIS of 5 is critical and described as non-reversible injuries and not fully recoverable even with medical care. A MAIS score of 6 is considered virtually unsurvivable and fatal.

Figure 28. Auto-Pedestrian Crash: Probability of Pedestrian Suffering Serious Injury or Death (Federal Highway Administration)



The collision data revealed that 22% of KSI collisions involved a pedestrian, compared to just 6% of all collisions. **Figure 30** shows the distribution of pedestrian collisions throughout Antioch between 2014 and 2018. West 18th Street, near Antioch High School, West 10th Street, Lone Tree Way, and Somersville Road have a higher concentration of pedestrian collisions, compared to other Antioch roads.

Broadside Collisions

For KSI collisions in Antioch, 29% were broadside collisions. **Figure 31** shows the distribution of broadside collisions throughout Antioch between 2014 and 2018. East 18th Street, Lone Tree Way, and Country Hills Drive have a higher concentration of broadside collisions, compared to other Antioch roads.

Hit-Object Collisions

For all injury collisions in Antioch, 23% of collisions were hit-object collisions. **Figure 32** shows the distribution of hit object collisions throughout Antioch between 2014 and 2018. Hillcrest Avenue and James Donlon Boulevard have a higher concentration of hit-object collisions, compared to other Antioch roads.

Nighttime Collisions

The data analysis showed that 44% of KSI collisions occurred during nighttime. **Figure 33** shows the distribution of nighttime collisions throughout Antioch between 2014 and 2018. The Office of Traffic Safety ranked Antioch 31st out of 58 similar California cities with high levels of nighttime collisions (one being the highest, or worst)[1].

[1] Year 2019 Annual Ranking, https://www.ots.ca.gov/media-and-research/crash-rankings-results/?wpv-wpcf-year=2019&wpv-wpcf-city_county=Antioch&wpv_filter_submit=Submit, accessed on April 22, 2022

Figure 29. Unsafe Speed Collisions

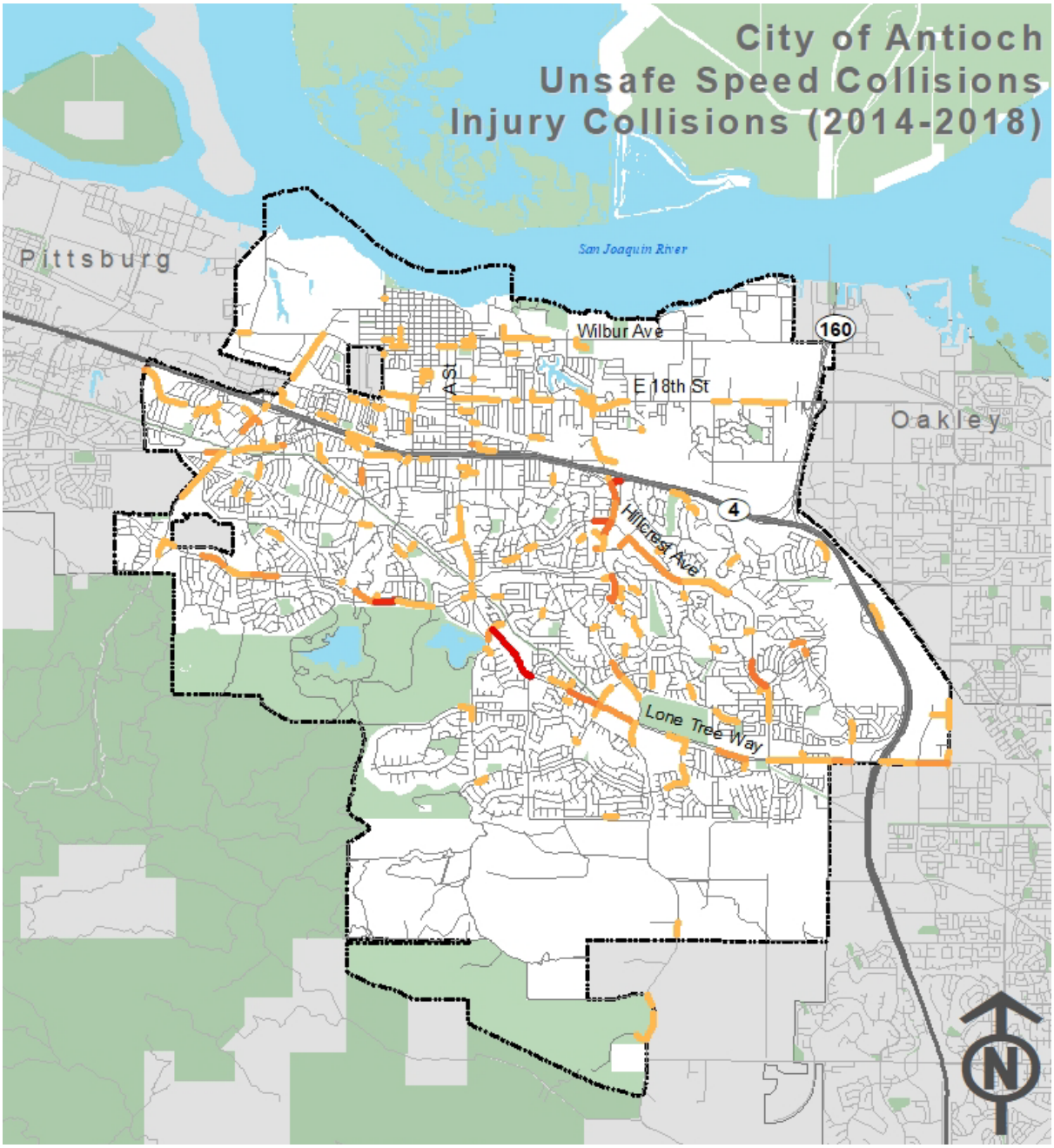


Figure 30. Pedestrian Collisions

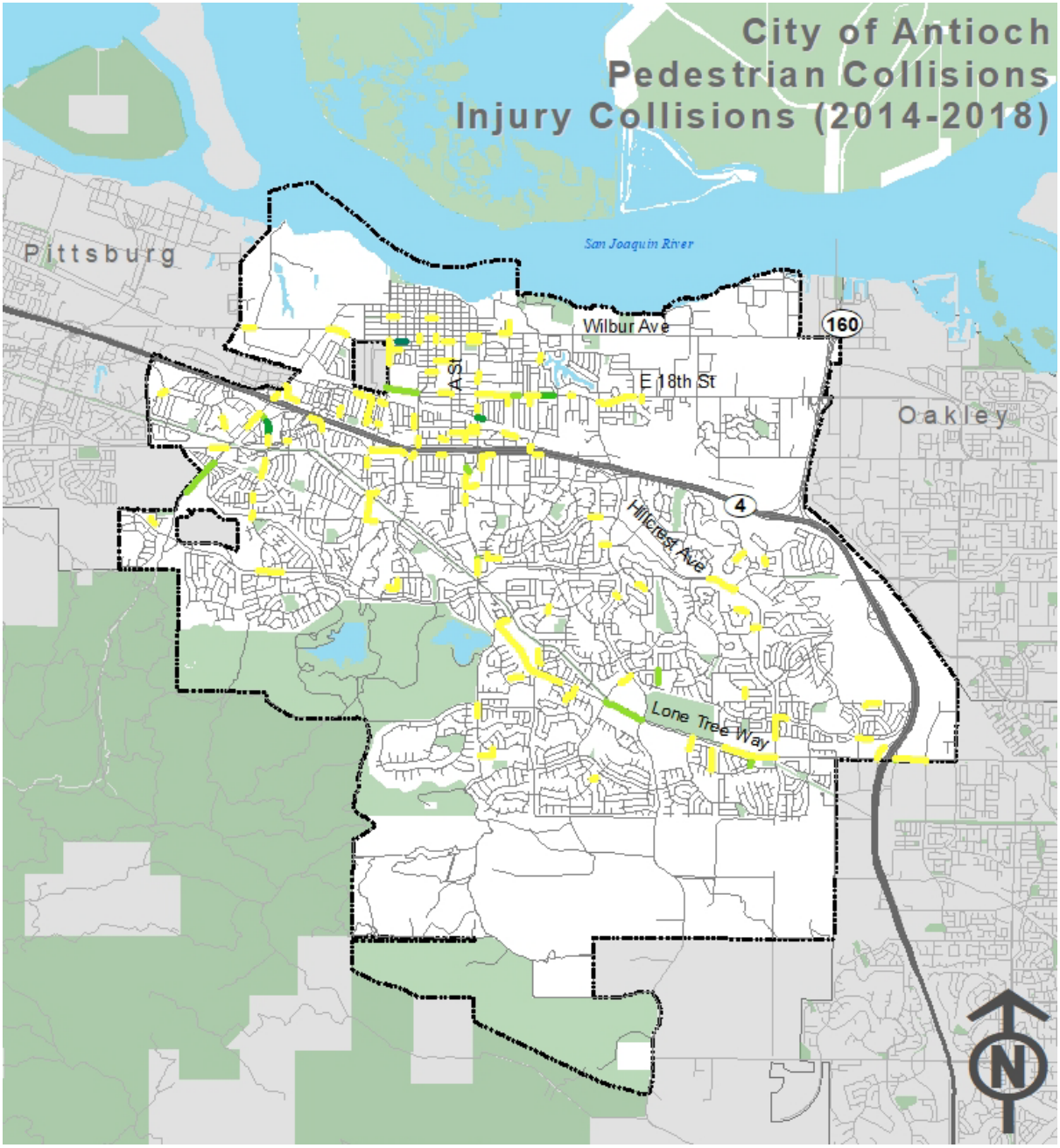


Figure 311. Broadside Collisions

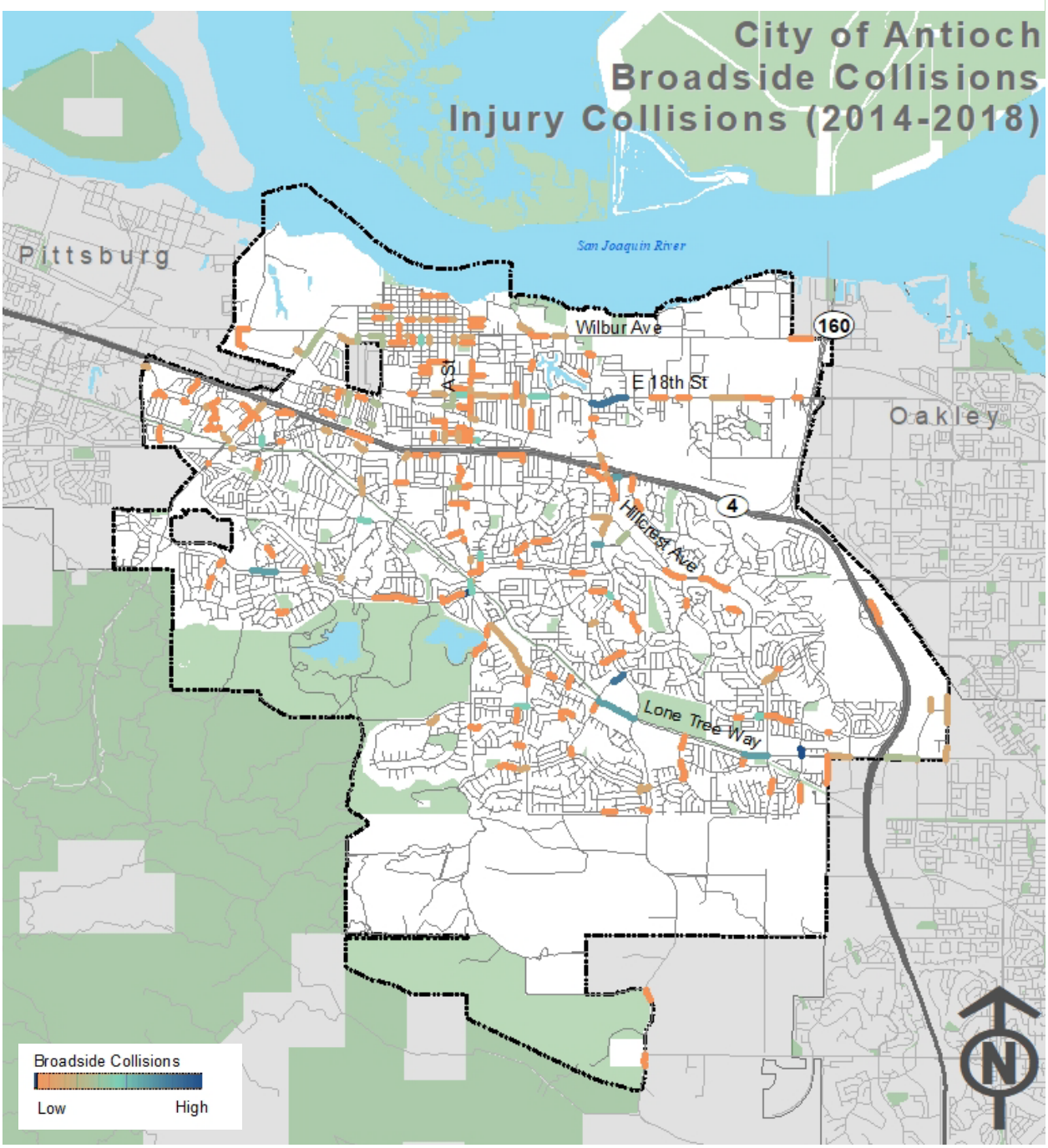


Figure 32. Hit Object Collisions

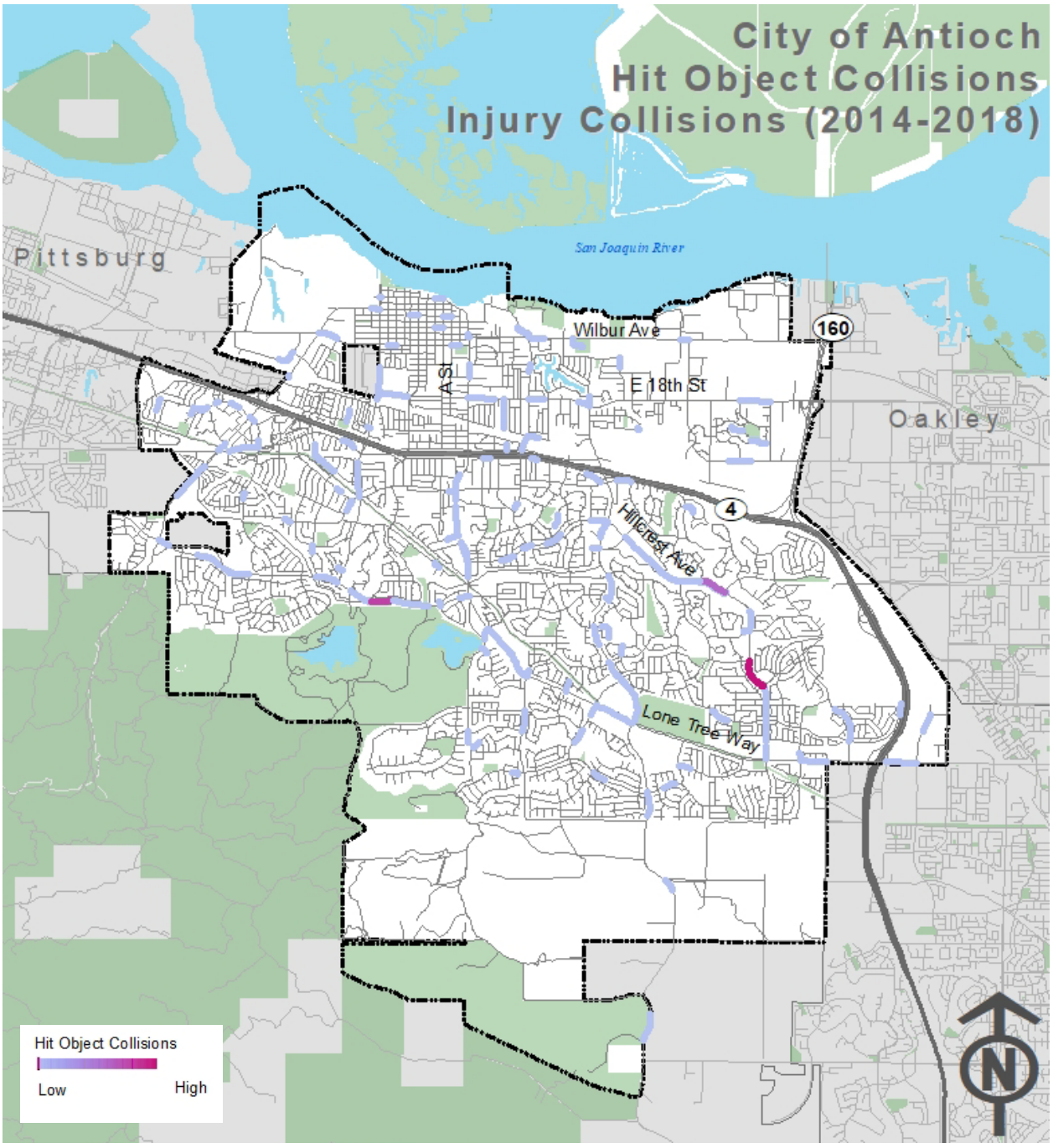
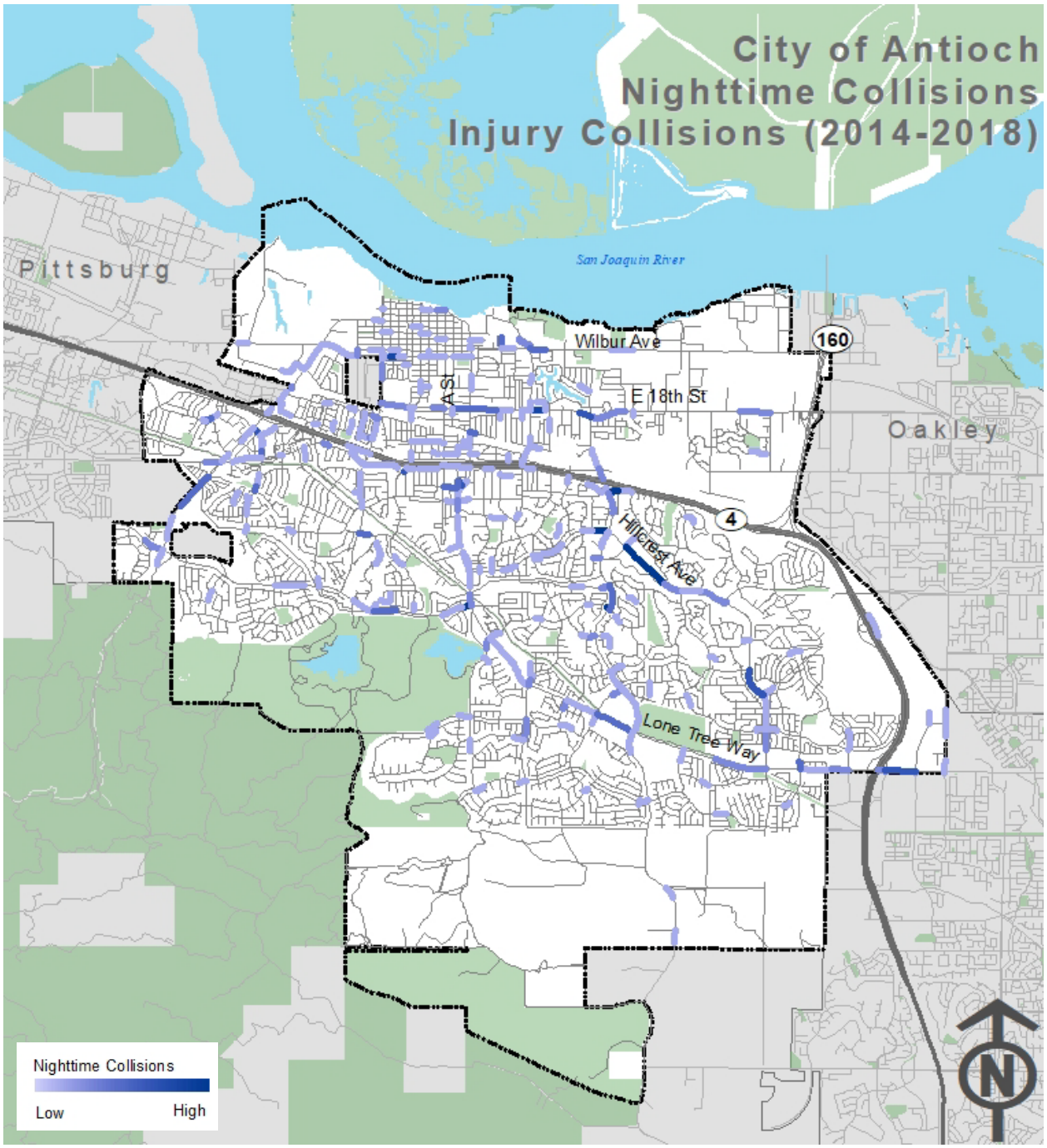


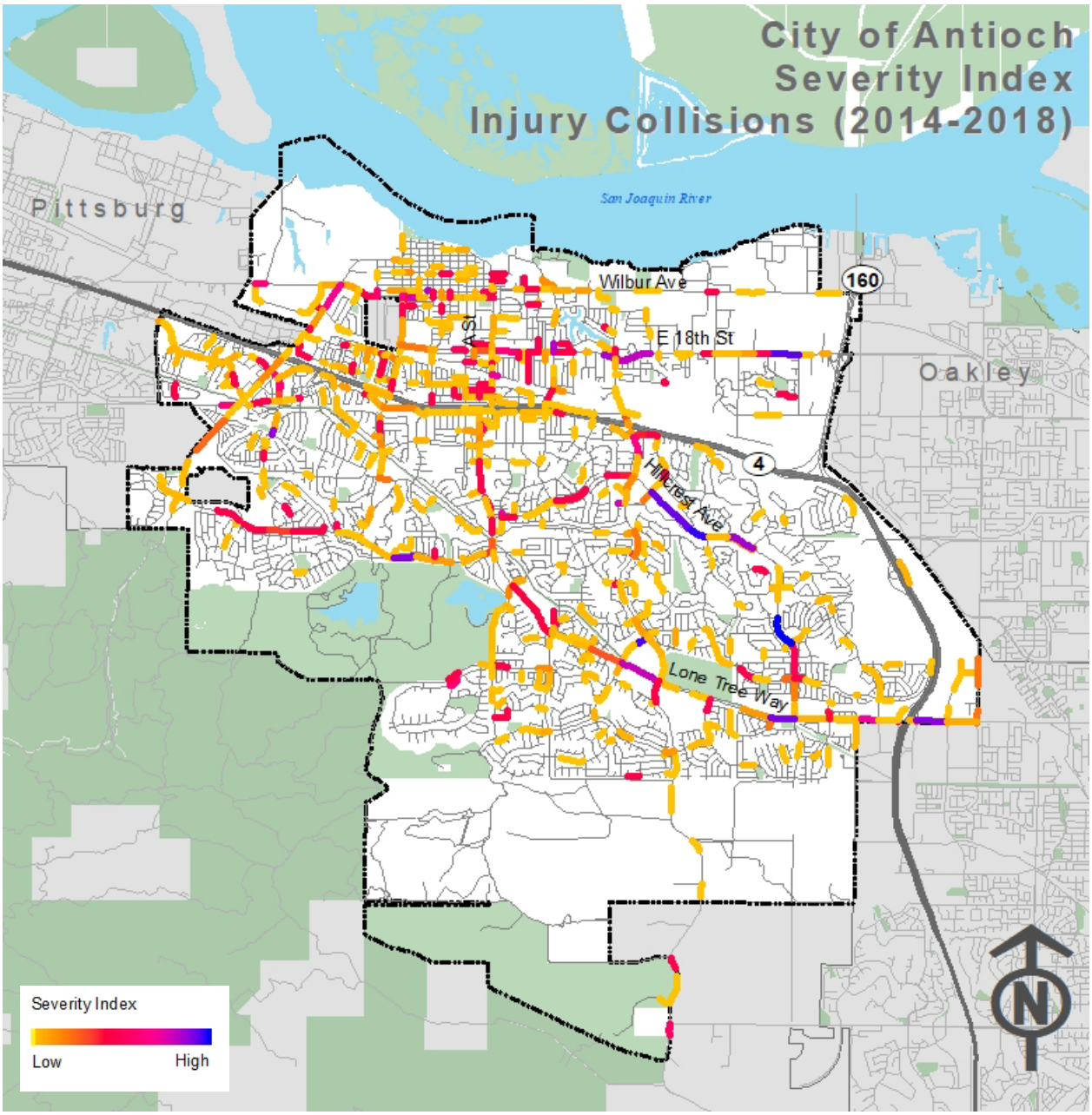
Figure 323. Nighttime Collisions



Collision Severity Index

A collision severity index was used to identify the high severity collision network, using the Equivalent Property Damage Only (EPDO) method. The EPDO method accounts for both the severity and frequency of collisions by converting each collision to an equivalent number of property damage only (PDO) collisions. The EPDO method assigns a crash cost and score to each collision according to the severity of the crash weighted by the comprehensive crash cost. These EPDO scores are calculated using the comprehensive crash costs used in the HSIP Cycle 10 application. The EPDO scores for all collisions can then be aggregated in a variety of ways to identify collision patterns, such as location hot-spots. **Figure 34** shows the results of the EPDO method for the City of Antioch.

Figure 334. Severity Index Score

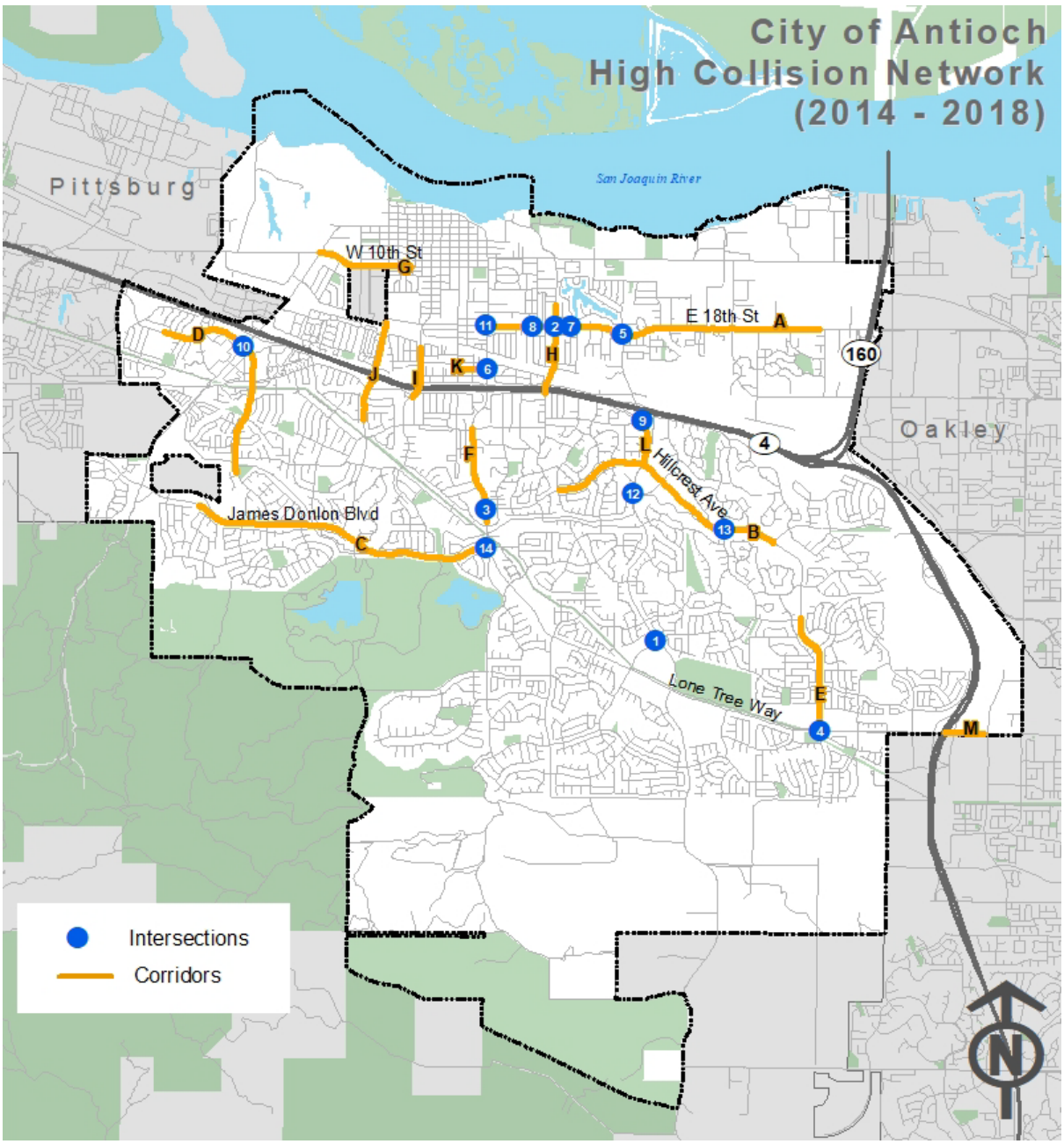


High-Collision Network

Following the detailed collision analysis, the next step was to identify the high-collision roadway segments and intersections using the EPDO method. **Figure 35** shows the top 13 high-collision roadway segments, and top 14 high-collision intersections in the City of Antioch. This high collision network has a total of 333 injury collisions and 77 KSI collisions, which represents 27% of injury collisions and 50% of KSI collisions, while covering only 3% of the City of Antioch street network.

For the purposes of the high collision network analysis, intersections include collisions that occurred within 250 feet of it and roadways include all collisions that occurred along the roadway except for collisions that occurred occur directly at an intersection, or collisions that are assigned a 0 value in distance from intersection value column in SWITRS.

Figure 34. High Collision Network



High-Risk Intersections

14 intersections were identified as high collision intersections. There were a total of 22 KSI collisions that occurred at these intersections. Out of the 22 collisions, two led to fatalities and 20 led to severe injury collisions. The intersection of Country Hills Drive and Deer Valley Road had the highest number of KSI collisions.

Table 3 lists the collision rate of the top 14 identified high-risk intersections along with their collision rate and the number of KSI collisions.

Table 3. High-collision Intersections

ID	Intersection	Total	KSI	Bike	Ped	Severity Weight
		Collisions				
1	Country Hills Dr and Deer Valley Rd	14	3	0	2	541
2	18th St and Cavallo Rd	33	2	1	3	437
3	Davison Dr and Lone Tree Wy	21	2	0	3	408
4	Lone Tree Wy and Hillcrest Ave	19	2	2	1	390
5	18th St and Hillcrest Ave	16	2	0	0	379
6	A St and Rossi Ave	17	2	1	2	366
7	18th St and Amber Dr	4	2	0	1	362
8	18th St and Crestwood Dr	7	2	0	1	356
9	Hillcrest and Larkspur Dr and East Tregallas Rd	37	1	2	0	301
10	Delta Fair Blvd and Somersville Rd	37	1	1	3	262
11	E/W 18th St and A St	11	1	2	2	234
12	Deer Valley Rd and Wildflower Dr	12	1	0	1	250
13	Hillcrest Ave and Via Dora Dr	5	1	2	0	208
14	James Donlon Blvd and Lone Tree Wy	18	0	1	0	123

High-Risk Corridors

13 corridors were identified as high collision corridors. There was a total 57 KSI collisions on these corridors. Out of the 57 collisions, 18 led to fatalities and 39 led to severe injury collisions. The corridor of W/E 18th Street from A Street to Phillips Lane had the heights number of KSI collisions, while the corridor of G Street had the highest number of KSI collisions per mile. **Table 4** lists the collision rate of the top 13 identified high-collision corridors along with the number of KSI collisions, total collisions, collision attributes, and severity weight.

Table 4. High-collision Corridors

ID	Intersection	Total	KSI	Ped	Unsafe Speed	Night	Broad-side	Length (miles)	Severity Weight
		Collisions							
A	W/E 18th St: A St to Phillips Ln	41	13	5	10	16	12	3.23	2395
B	Hillcrest Ave/ Davison Dr: Ashburton Dr/ Burwood Wy to Wildhorse Rd	30	9	2	9	12	1	1.9	1677
C	James Donlon Blvd: Hummingbird Dr to Lone Tree Wy	25	6	0	12	6	3	2.19	1143
D	Delta Fair Blvd/ Gentrytown Dr: School St to Curtis Dr	28	5	7	8	13	6	1.6	1013
E	Hillcrest Ave: Deerfield Dr to Lone Tree Wy	13	5	1	4	7	0	0.7	918
F	Lone Tree Wy: Putnam St/ Worrell Rd to Clayburn Rd	13	4	3	3	8	0	0.74	740
G	W 10th St: Auto Center Dr to Diamond St	14	3	6	1	8	3	0.72	598
H	Cavallo Rd: Amber Dr to E Tregallas Rd	7	3	0	1	1	2	0.65	531
I	G St: Minta Ln to Newbury Ave	4	3	2	0	3	2	0.38	513
J	L St/ Contra Loma Blvd: W 18th St to San Jose Dr	7	2	0	2	3	0	0.7	383
K	Rossi Ave: D St to A St	2	2	2	0	0	0	0.22	338
L	Hillcrest Ave: Davison Dr/Deer Valley Rd to Larkspur Dr/ E Tregallas Rd	8	1	0	5	2	1	0.3	211
M	Lone Tree Wy: Canada Valley to Emprie Ave	5	1	1	2	4	1	0.3	198

5. EMPHASIS AREAS

Emphasis areas are focus areas that are identified through analyzing the characteristics of collisions that have occurred in the City of Antioch within the study period (2014-2018).

Emphasis areas help in identifying appropriate safety strategies and countermeasures that have the greatest potential to reduce collisions occurring at roadway segments and intersections. This chapter summarizes nine emphasis areas identified for the City of Antioch. These emphasis areas were derived by focusing on the collisions that have occurred on the high-injury network, previously identified for the City. A summary of the collision data used for the emphasis areas is presented in **Appendix C**.

There are a number of different approaches to traffic safety studies. Some methodologies focus more on a reactive and responsive approach, while others focus on a more proactive systemic approach to traffic safety data. A reactive approach to road safety is based on the analysis of existing crash data. Road safety improvements proposed are considered in reaction to identified safety problems brought to light by crashes that have occurred after the road has been designed, and built, and opened. Traditional reactive road safety engineering processes include such activities as information collection and management (crash information systems), identification of problem locations on the road network, analysis, development and implementation of countermeasures. The Hazard Elimination Program or a high crash location list are examples of reactive approaches to crash frequency and/or severity reduction.

A proactive approach focuses on the evolving "Science of Safety", that is, what is known about the evolving specific safety implications of highway design and operations decisions. The proactive approach applies this knowledge to the roadway design process or to the implementation of improvement plans on existing roads to diminish the potential of crashes occurring prior to the road being built or reconstructed. The Empirical Bayes method is an example of such proactive traffic safety approach that attempts to predict future crashes based on roadway typologies. Most methodologies use a balance of both reactive and proactive approaches. Emphasis areas are a tool used by this analysis to identify areas that lead to fatal and severe injury collisions to systematically identify traffic safety issues in the City of Antioch.

Based on the systematic safety analysis that helped identified high-injury intersections and roadway segments, the top risk factors and emphasis areas determined are as follows:

- Intersection safety
- Unsafe speed collisions
- Pedestrian safety
- Hit object collisions

- Nighttime collisions
- Broadside collisions
- Traffic signals and signs violation
- Driving Under Influence (DUI) collisions
- Teenage/Young Adult - Party at Fault

The Four E's of Traffic Safety

LRSP utilizes a comprehensive approach to safety incorporating "4 E's of traffic safety": **E**ngineering, **E**nforcement, **E**ducation and **E**mergency Medical Services. This approach recognizes that not all locations can be addressed solely by infrastructure improvements. Incorporating the 4 E's of traffic safety is often required to ensure successful implementation of significant safety improvements and reduce the severity and frequency of collisions throughout a jurisdiction.

Some of the common violation types that may require a comprehensive approach are speeding, failure-to-yield to pedestrians, red light running, aggressive driving, failure to wear safety belts, distracted driving, and driving while impaired. When locations are identified as having these types of violations, coordination with the appropriate law enforcement agencies is needed to arrange visible targeted enforcement to reduce the potential for future driving violations and related crashes and injuries.

To improve safety, education efforts can also be used to supplement and improve the efficiency of enforcement, and vice versa. Education can also be employed in the short-term to address high crash locations until the recommended infrastructure project can be implemented, addressed under Engineering improvements and countermeasures. Similarly, Emergency Medical Services entails strategies around supporting organizations that provide rapid response and care when responding to collisions causing injury, by stabilizing victims and transporting then to facilities.

Existing Traffic Safety Efforts in the City of Antioch

The City of Antioch already has implemented safety strategies corresponding to the 4 E's of traffic safety. The strategies detailed in this chapter can supplement these existing programs and concentrate them on high injury collision locations and crash types. These initiatives are summarized in the **Table 5** below:

Table 5. City of Antioch Existing Programs Summary

Document/Program	Description	E's Addressed
City of Antioch Traffic Calming Policy (2020)	The City of Antioch's Traffic Calming Policy details a step by step process to respond to resident's complaints of speeding in residential neighborhoods. The plan concentrates on speed humps/cushions, striping, signage and speed feedback signs	Engineering, Enforcement
Speed Hump Application	Application that requests the installation or removal of speed humps or speed cushions on a residential street	Engineering
Street Smarts Diablo Region and 511 Contra Costa Programs	Street Smarts Diablo delivers bicycle and pedestrian safety programs at no cost to qualifying public schools in Central and East Contra Costa County. 511 Contra Costa is a county-wide program that strives to reduce traffic congestion and improve air quality by providing the public with information, resources, and tools that promote mobility options beyond driving alone which includes bike and pedestrian safety resources	Education
Contra Costa County Vision Zero	CCTA developed a Countywide Vision Zero Framework, which was a key implementation recommendation of the Countywide Bike/Ped Plan adopted by the CCTA Board in July 2018. This effort is focused on bicycle/pedestrian safety and developed a countywide "high-injury network (HIN)" [of common countywide collision corridors, known as "Countywide Safety Priority Locations" per 2008 through 2017 SWITRS data; the LRSP can designate "Local Safety Priority Locations" and a local priority project list for CCTA CBPP consideration RE: countywide significance], collision typologies, and a Vision Zero Transportation Safety Policy and Implementation Guide for Local Agencies. This Guide (Appendix) also includes a Toolbox to improve the safety of people walking and biking.	Engineering, Education, Enforcement, EMS
City of Antioch Police Department Child Safety Programs	City program that focuses on child safety including child safety seat inspections and motorized scooter tips.	Education

Factors Considered in the Determination of Emphasis Areas

This section presents collision data analysis of collision type, collision factors, facility type, roadway geometries, analyzed for the various emphasized areas. Emphasis areas were determined by factors that led to the highest amount of injury collisions, with a specific emphasis on killed and severe (KSI) injury collisions. This section also presents comprehensive programs, policies and countermeasures to reduce collisions in specific emphasis areas.

Emphasis Area 1: Intersection Safety

Emphasis Area 1: Intersection Safety				
Objectives			**Success Indicator**	
Reduce the number of fatal and severe injury collisions at intersections.			A reduction in the number of fatal and severe injury collisions at high-risk intersections.	
	Action	**Target Output**	**Performance Measure**	**Monitoring and Evaluation**
Education	Conduct public information and education campaign for intersection safety laws regarding traffic lights, stop signs, and turning left or right.	Awareness of traffic safety laws to be followed at intersections.	Number of education campaigns	Online or print survey of public response.
Enforcement	Targeted enforcement at high-risk intersections to monitor traffic law violations right-of-way violations, pedestrian intersection laws and speed limit laws.	Reduction in intersection collisions due to traffic law violations, right-of-way violations, and speed limits.	Number of tickets issued.	Number of intersection collisions related to traffic law violations, right-of-way violations, pedestrian violations and speeding compared to the previous year.
Engineering	• S02, Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number • S03, Improve signal timing (coordination, phases, red, yellow, or operation) • S09, Install raised pavement markers and striping (Through Intersection) • S16 Convert intersection to roundabout • S21PB, Modify signal phasing to implement a Leading Pedestrian Interval (LPI) • NS06, Install/upgrade larger or additional stop signs or other intersection warning/regulatory signs • NS07, Upgrade intersection pavement markings (NS.I.) • NS21PB, Install/upgrade pedestrian crossing (with enhanced safety features) • R22, Install/Upgrade signs with new fluorescent sheeting (regulatory or warning) • R27, Install delineators, reflectors and/or object markers	Reduction of traffic movement conflicts at intersections.	Number of intersections improved.	Number of intersection crashes related to traffic movement compared to the previous year
EMS	S05, Install emergency vehicle pre-emption systems	Decreased response time to intersection collisions.	EMS vehicle response time.	Response time compared to the previous year.

Emphasis Area 2: Unsafe Speed Collisions

Emphasis Area 2: Unsafe Speed Collisions				
Objectives			**Success Indicator**	
Reduce the number of collisions due to unsafe speeding.			Reduction in the number of fatal and severe injury collisions due to unsafe speeding on all City roads.	
	Action	**Target Output**	**Performance Measure**	**Monitoring and Evaluation**
Education	Conduct public education and outreach activities that elevate the awareness of the dangers of speeding.	Awareness about the dangers of speeding.	Number of public outreach events.	Number of attendees of public outreach events and the number of speeding/ education campaign lawn signs distributed.
Enforcement	• Targeted enforcement at locations with most speeding violations and implement strict penalties for such violations. • Deploy a mobile radar trailer to high risk corridors where unsafe speed collisions occur.	Reduce the number of unsafe speeding violations.	Number of citations issued for unsafe speeding.	Number of citations issued for unsafe speeding, compared to the previous year.
Engineering	• S03, Improve signal timing (coordination, phases, red, yellow, or operation) • S04, Provide Advanced Dilemma-Zone Detection for high speed approaches • S05, Install left turn and add turn phase (signal has no left-turn lane or phase before) • S11, Improve pavement friction (High Friction Surface Treatments) • S12, Install raised median on approaches (S.I.) • S14, Create directional median openings to allow and restrict left turns and U turns • S16, Convert intersection to roundabout • NS06, Install/upgrade larger or additional stop signs or other intersection warning/regulatory signs • NS07, Upgrade intersection pavement markings (NS.I.) • NS11, Improve sight distance to intersection (Clear Sight Triangles) • R14, Road diet • R26, Install dynamic/variable speed warning signs • Decrease width of travel lanes • Simplify turn configurations • Decrease curb radius of intersections.	Reduce the number of fatal and severe injury collisions resulted from unsafe speeding.	Number of fatal and severe injury collisions resulted from unsafe speeding.	Number of fatal and severe injury collisions resulted from unsafe speeding, compared to the previous year.
EMS	Improve resource deployment for emergency responses at collision sites.	Decrease response time.	EMS vehicle response time.	Response time compared to the previous year.

Emphasis Area 3: Pedestrian Safety

Emphasis Area 3: Pedestrian Safety				
Objectives			**Success Indicator**	
Improve pedestrian network and develop safe walking environment for pedestrians			Reduction in the number of pedestrian-related collisions within the City.	
	Action	**Target Output**	**Performance Measure**	**Monitoring and Evaluation**
Education	• Pedestrian safety campaigns and outreach to raise their awareness of pedestrian safety needs through media outlets and public events. • Create a simple pocket guide of pedestrian laws for Antioch.	Increase awareness for pedestrian safety.	Number of outreach events for pedestrian safety campaigns.	Number of attendees and responses for pedestrian safety campaigns.
Enforcement	• Continue to place a high priority on enforcement of motorist and pedestrian violations that most frequently cause injuries and fatalities among pedestrians.	Reduction in pedestrian right-of-way violation and vehicle-pedestrian conflict.	Number of citations issued for violating pedestrian right-of-way.	Number of citations issues for violating pedestrian right-of-way compared to the previous year.
Engineering	• S19PB, Pedestrian Scramble • S21PB, Modify signal phasing to implement a Leading Pedestrian Interval (LPI) • NS07, Upgrade intersection pavement markings (NS.I.) • NS19PB, Install raised medians (refuge islands) • NS21PB/R35PB, Install/upgrade pedestrian crossing (with enhanced safety features) • R36PB, Install raised pedestrian crossing • R37PB, Install Rectangular Rapid Flashing Beacons (RRFB) • High-visibility ladder crosswalks • Mid-block curb extension • Pedestrian crossing flags • Yield sign for pedestrian crossing at crosswalk	Safe walking environment for pedestrians by reducing the number of pedestrian-related collisions.	Number of pedestrian-related collisions.	Number of pedestrian-related collisions compared to the previous year.
EMS	Improve resource deployment for emergency responses at collision sites.	Decrease response time.	Number of pedestrian collision-related casualty dealt by EMS.	Number of pedestrian collision-related casualty dealt by EMS compared to the previous year.

Emphasis Area 4: Hit Object Collisions

Emphasis Area 4 – Hit Object Collisions				
Objectives			**Success Indicator**	
Reduce the number of collisions due to unsafe speeding and impaired driving that result in hit object collisions.			Reduction in the number of fatal and severe injury collisions due to unsafe speeding and impaired driving on all City roads.	
	Action	**Target Output**	**Performance Measure**	**Monitoring and Evaluation**
Educatio	Conduct public education and outreach activities that elevate the awareness of the dangers of speeding and impaired driving.	Awareness about the dangers of speeding and impaired driving.	Number of public outreach events.	Number of attendees of public outreach events.
Enforcemen	• Increase the number of sobriety checkpoints and saturation patrol to increase visibility of enforcement. • Increase penalties for repeat offenders.	Reduce the number of unsafe speeding violations.	Number of citations issued for unsafe speeding.	Number of citations issued for unsafe speeding, compared to the previous year.
Engineering	• S09, Install raised pavement markers and striping (Through Intersection) • S11, Improve pavement friction (High Friction Surface Treatments) • S12, Install raised median on approaches (S.I.) • NS06, Install/upgrade larger or additional stop signs or other intersection warning/regulatory signs • NS11, Improve sight distance to intersection (Clear Sight Triangles) • NS12, Improve pavement friction (High Friction Surface Treatments) • R05, Install impact attenuators • R22, Install/Upgrade signs with new fluorescent sheeting (regulatory or warning) • R27, Install delineators, reflectors and/or object markers • Simplify turn configurations. • Decrease curb radius of intersections.	Reduce the number of fatal and severe injury collisions resulted from hit object collisions.	Number of fatal and severe injury collisions resulted from hit object collisions.	Number of fatal and severe injury collisions resulted from hit object collisions, compared to the previous year.
EMS	Improve resource deployment for emergency responses at collision sites.	Decrease response time.	EMS vehicle response time.	Response time compared to the previous year.

Emphasis Area 5: Nighttime collisions

Emphasis Area 5 - Nighttime Collisions				
Objectives		**Success Indicator**		
Reduce the number of fatal and severe injury collisions occurring at night (no natural light).		Reduction in the number of fatal and severe injury collisions at various roadway segments and intersections, at nighttime (no natural light).		
	Action	**Target Output**	**Performance Measure**	**Monitoring and Evaluation**
Education	Develop awareness program to inform residents of high-risk collision locations, the most common violations and collision types occurring at night.	Awareness regarding night-time collision types and traffic law violations.	Number of awareness program related events.	Online or print survey of public response.
Enforcement	Increase patrolling at locations where nighttime collisions are higher.	Reduction in night-time collisions caused due to traffic violations.	Number of tickets for violators at night.	Number of nighttime collisions at high-risk locations compared to the previous year.
Engineering	• S02, Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number • S09, Install raised pavement markers and striping (Through Intersection) • NS06, Install/upgrade larger or additional stop signs or other intersection warning/regulatory signs • NS07, Upgrade intersection pavement markings (NS.I.) • R01, Add segment lighting • R22, Install/Upgrade signs with new fluorescent sheeting (regulatory or warning) • R27, Install delineators, reflectors and/or object markers • Reflective paint on roadside objects, guard walls and poles • Pedestrian scale lighting	Reduction in fatal and severe injury collisions at night.	Number of locations improved to mitigate nighttime collisions.	Number of fatal and severe injury collisions at night compared to the previous year.
EMS	Improve resource deployment at night for emergency responses at collision sites.	Decrease response time at night.	EMS vehicle response time at night.	Response time at night compared to the previous year.

Emphasis Area 6: Broadside Collisions

Emphasis Area 6 - Broadside Collisions				
Objectives		**Success Indicator**		
Reduce the number of broadside collisions.		Reduction in the number of broadside collisions on arterials and collectors within the City.		
	Action	**Target Output**	**Performance Measure**	**Monitoring and Evaluation**
Education	Distribute brochures/fliers with basic red light running and stop sign violations and yielding laws and illustrations at public events.	Educate drivers about running red lights and stop signs rules and penalties associated.	Number of brochures/fliers, with response survey, distributed each year.	Number of survey responses received.
Enforcement	Targeted enforcement at locations with most red light running and stop sign violations, and implement strict penalties for such violations.	Reduction in the number of red light running and stop sign violations.	Number of citations issued for red light running and stop sign violations.	Number of citations issued for red light running and stop sign violations, compared to the previous year.
Engineering	• S02, Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number • S03, Improve signal timing (coordination, phases, red, yellow, or operation) • S08, Convert signal to mast arm (from pedestal-mounted) • S09, Install raised pavement markers and striping (Through Intersection) • NS02, Convert to all-way STOP control (from 2-way or Yield control) • NS03, Install signals • NS06, Install/upgrade larger or additional stop signs or other intersection warning/regulatory signs • NS07, Upgrade intersection pavement markings (NS.I.) • NS08, Install flashing beacons at stop controlled intersections • NS11, Improve sight distance to intersection (Clear Sight Triangles) • Bicycling crossing intersection pavement markings.	Reduction in the number of traffic signal and sign violations leading to broadside collisions.	Number of traffic signal and signs violations leading to broadside and side swipe collisions.	Number of traffic signals and signs violations leading to broadside and sideswipe collisions, compared to the previous year.
EMS	S05, Install emergency vehicle pre-emption systems	Decrease response time.	EMS vehicle response time.	Response time compared to the previous year.

Emphasis Area 7: Traffic Signals and Signs Violation

Emphasis Area 7: Traffic Signals and Signs Violations Collisions				
Objectives			**Success Indicator**	
Reduce the number of traffic signals and signs violations that lead to broadside and head on collisions.			Reduction in the number of traffic signals and signs violations collisions on arterials and collectors within the City.	
	Action	**Target Output**	**Performance Measure**	**Monitoring and Evaluation**
Education	Distribute brochures/fliers with basic red light running and stop sign violations and illustrations at public events.	Educate drivers about running red lights and stop signs rules and penalties associated.	Number of brochures/fliers, with response survey, distributed each year.	Number of survey responses received.
Enforcement	Targeted enforcement at locations with most red light running and stop sign violations, and implement strict penalties for such violations.	Reduction in the number of red light running and stop sign violations.	Number of citations issued for red light running and stop sign violations.	Number of citations issued for red light running and stop sign violations, compared to the previous year.
Engineering	• S02, Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number • S03, Improve signal timing (coordination, phases, red, yellow, or operation) • S08, Convert signal to mast arm (from pedestal-mounted) • S09, Install raised pavement markers and striping (Through Intersection) • S16/NS04/NS05, Convert intersection to roundabout • NS02, Convert to all-way STOP control (from 2-way or Yield control) • NS03, Install signals • NS06, Install/upgrade larger or additional stop signs or other intersection warning/regulatory signs • NS07, Upgrade intersection pavement markings (NS.I.) • NS08, Install flashing beacons at stop controlled intersections • NS11, Improve sight distance to intersection (Clear Sight Triangles)	Reduction in the number of traffic signal and sign violations leading to broadside and head on collisions.	Number of traffic signal and signs violations leading to broadside and head on collisions.	Number of traffic signals and signs violations leading to broadside and head on collisions, compared to the previous year.
EMS	S05, Install emergency vehicle pre-emption systems	Decrease response time.	EMS vehicle response time.	Response time compared to the previous year.

Emphasis Area 8: Driving Under Influence (DUI) Collisions

Emphasis Area 8: Driving Under Influence (DUI) Collisions				
Objectives			**Success Indicator**	
Reduce the number of DUI collisions.			Reduction in the number of DUI collisions within the City.	
	Action	**Target Output**	**Performance Measure**	**Monitoring and Evaluation**
Education	Distribute brochures/fliers with DUI information at public events. Conduct public information campaigns (billboards, TV commercials, etc). Seek partnerships with Transportation Network Companies (TNCs) e.g. Lyft, Uber, etc.	Educate drivers about DUI collisions and penalties associated.	Number of brochures/fliers, with response survey, distributed each year.	Number of survey responses received.
Enforcement	Targeted enforcement at locations with most DUI collisions during the nighttime, and implement strict penalties for such violations. DUI checkpoints at night.	Reduction in the number of DUI violations.	Number of citations issued for DUI violations.	Number of citations issued for DUI violations, compared to the previous year.
Engineering	• S02, Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number • S08, Convert signal to mast arm (from pedestal-mounted) • NS06, Install/upgrade larger or additional stop signs or other intersection warning/regulatory signs	Reduction in the number of DUI violations.	Number of DUI violations collisions.	Number of DUI violations collisions, compared to the previous year.
EMS	S05, Install emergency vehicle pre-emption systems	Decrease response time.	EMS vehicle response time.	Response time compared to the previous year.

Emphasis Area 9: Teenage/Young Adult - Party at Fault

Emphasis Area 9: Teenage/Young Adult - Party at Fault				
Objectives			**Success Indicator**	
Reduce teenager/young adult KSI collisions, especially male			Reduction in the number of fatal collisions involving male and teenage/young adults.	
	Action	**Target Output**	**Performance Measure**	**Monitoring and Evaluation**
Education	Target education programs for young adults. Distribute brochures/fliers with basic red light running, speeding, distracted driving, aggressive driving and stop sign violations information at high schoolers and driver training programs. Include statistics of male and young adult larger risks of fatalities. Expand the use of web-based social media resources such as YouTube, Facebook and Twitter for teens and young adults	Educate younger male drivers about running red lights, aggressive driving, distracted driving, speeding and stop signs rules and consequences associated.	Number of brochures/fliers, with response survey, distributed each year, number of collisions involving young adults.	Number of educational materials distributed.

5. COUNTERMEASURE IDENTIFICATION

This chapter identifies and prioritizes safety strategies targeted to address identified collision trends and motorist behavior. The process involves input from community and a thorough analysis of collisions.

Identification of Countermeasures

In 2008, the Federal Highway Administration (FHWA) published a list of proven safety countermeasures (PSC) that local agencies could consider in their efforts to reduce or eliminate KSI collisions. Beginning with nine countermeasures, in 2021 the list was expanded to 28 PSC. Similarly, California Department of Transportation (Caltrans) developed the Local Roadway Safety Manual (LRSM). The goal of this manual is to "*maximize the safety benefits for local roadways by encouraging all local agencies to proactively identify and analyze their safety issues and to position themselves to compete effectively in Caltrans' statewide, data-driven call-for-projects*."[2]

Although, the LRSM identifies all of California's local roadway safety issues and the countermeasures that address them, this document only highlights the issues and countermeasures relevant to the local roads of the City of Antioch. This section identifies the different solutions for the City from HSIP-qualified and HSIP-unqualified countermeasures. It also provides a brief description along with their corresponding crash reduction factors (CRF), expected life, baseline cost and countermeasure toolbox (**Appendix D**). The countermeasure toolbox for the City of Antioch in **Appendix E** details the draft countermeasures for each high-risk location and Emphasis Area, separated by intersections and roadway segments.

The countermeasures have been divided into four categories:

- Signalized (S) – countermeasures only applicable for signalized intersections;
- Non-Signalized (NS) – countermeasures only applicable to stop-controlled, or uncontrolled intersections;
- Roadway Segment (RS) – countermeasures only applicable to roadway segments; and
- Other (O) – countermeasures that do not qualify for HSIP funding.

[2] https://dot.ca.gov/-/media/dot-media/programs/local-assistance/documents/hsip/2020/lrsm2020.pdf

Signalized Intersections Countermeasures

S02 – Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number. Signalized intersections with a high frequency of right-angle and rear-end crashes occurring because drivers are unable to see traffic signals sufficiently in advance to safely negotiate the intersection being approached.

- Crash Reduction Factor – 15%
- Expected Life – 10 years
- Baseline Cost – Approximately $40,000 per intersection

S03 – Improve signal timing (coordination, phasing, all-red and yellow clearance intervals, or operations). Locations that have a crash history at multiple signalized intersections. Signalization improvements may include adding phases, lengthening clearance intervals, eliminating or restricting higher-risk movements, and coordinating signals at multiple locations. Understanding the corridor or roadway's crash history can provide insight into the most appropriate strategy for improving safety.

- Crash Reduction Factor – 15%
- Expected Life – 10 years
- Baseline Cost – Approximately $50,000 per intersection

S04 – Provide Advanced Dilemma Zone Detection for high speed approaches. The Advanced Dilemma-Zone

Detection system enhances safety at signalized intersections by modifying traffic control signal timing to reduce the number of drivers that may have difficulty deciding whether to stop or proceed during a yellow phase

- Crash Reduction Factor – 40%
- Expected Life – 10 years
- Baseline Cost – Approximately $40,000 per intersection

S09 - Install raised pavement markers and striping (Through Intersection). Intersections where the lane designations are not clearly visible to approaching motorists and/or intersections noted as being complex and experiencing crashes that could be attributed to a driver's unsuccessful attempt to navigate the intersection. Driver confusion can exist in regard to choosing the proper turn path or where through-lanes do not line up.

- Crash Reduction Factor – 10%
- Expected Life – 10 years
- Baseline Cost – Approximately $2,000 per intersection

S12 - Install raised median on approaches (S.I.)

Raised medians next to left-turn lanes at intersections offer a cost-effective means for reducing crashes and improving operations at higher volume intersections. The raised medians

- Crash Reduction Factor – 25%
- Expected Life – 20 years
- Baseline Cost – Approximately $100,000 per intersection

prohibit left turns into and out of driveways that may be located too close to the functional area of the intersection.

S16 - Convert intersection to roundabout (from signal) Signalized intersections that have a significant crash problem and the only alternative is to change the nature of the intersection itself. Roundabouts can also be very effective at intersections with complex geometry and intersections with frequent left-turn movements.

- Crash Reduction Factor – Varies
- Expected Life – 20 years
- Baseline Cost – Approximately $800,000 per intersection

S21PB - Modify signal phasing to implement a Leading Pedestrian Interval (LPI). A leading pedestrian interval (LPI) gives pedestrians the opportunity to enter an intersection 3-7 seconds before vehicles are given a green indication. With this head start, pedestrians can better establish their presence in the crosswalk before vehicles have priority to turn left.

- Crash Reduction Factor – 15%
- Expected Life – 10 years
- Baseline Cost – Approximately $4,000 per intersection

Non-Signalized Intersections Countermeasures

NS06 – Install/upgrade larger or additional stop signs or other intersection warning/regulatory signs. The visibility of intersections and, thus, the ability of approaching drivers to perceive them can be enhanced by installing larger regulatory and warning signs at or prior to intersections. A key to success in applying this strategy is to select a combination of regulatory and warning sign techniques appropriate for the conditions on a particular unsignalized intersection approach.

- Crash Reduction Factor – 15%
- Expected Life – 10 years
- Baseline Cost – Approximately $4,200 per intersection

NS07 – Upgrade intersection pavement markings (NS.I.). Unsignalized intersections that are not clearly visible to approaching motorists, particularly approaching motorists on the major road. The strategy is particularly appropriate for intersections with patterns of rear-end, right-angle, or turning crashes related to lack of driver awareness of the presence of the intersection

- Crash Reduction Factor – 25%
- Expected Life – 10 years
- Baseline Cost – Approximately $900 per intersection

NS14 – Install Raised Medians on Approaches. Where related or nearby turning movements affect the safety and operation of an intersection. Effective access management is key to improving safety at, and adjacent to, intersections. The number of intersection access points coupled with the speed

- Crash Reduction Factor – 25%
- Expected Life – 20 years
- Baseline Cost – Approximately $100,000

differential between vehicles traveling along the roadway often contributes to crashes.

Roadway Countermeasures

R01 – Add segment lighting. Providing roadway lighting improves the safety during nighttime conditions by (1) making drivers more aware of the surroundings, which improves drivers' perception-reaction times, (2) enhancing drivers' available sight distances to perceive roadway characteristic in advance of the change, and (3) improving non-motorist's visibility and navigation.

- Crash Reduction Factor – 35%
- Expected Life – 20 years
- Baseline Cost – Approximately $100,000

R14 – Roadway Reapportionment aka "Road Diet" (Reduce total number of vehicular travel lanes and reapportion to other functionalities (e.g., two-way left turn lane, raised median, bike facilities, transit facilities, etc.). The throughput of a corridor is not based on the number of lanes but rather the efficiency of the intersections. Similarly, the inside lanes of two way roadways with an even number of lanes tend to function as de facto left turn lanes, further reducing throughput. Thus, to reapportion the roadways to an odd number of lanes and reassign the space to serve other functions can be beneficial. Segments noted as having a higher frequency of head-on, left-turn, or rear-end crashes with traffic volumes may benefit from this strategy. Using this strategy in locations with higher traffic volumes that result in significantly longer travel times along the corridor could result in diversion of traffic to less appropriate or desirable routes. Additionally, significant congestion levels may contribute to an increase in property damage only (PDO) crashes.

- Crash Reduction Factor – 30%
- Expected Life – 20 years
- Baseline Cost – Approximately $ 100,000

R21 – Improve pavement friction (High Friction Surface Treatments). Nationally, this countermeasure is referred to as "High Friction Surface Treatments" or HFST. Areas as noted having crashes on wet pavements or under dry conditions when the pavement friction available is significantly less then actual roadway speeds; including but not limited to curves, loop ramps, intersections, and areas with short stopping or weaving distances.

- Crash Reduction Factor – 55%
- Expected Life – 10 years
- Baseline Cost – Approximately $ 15,000

R22 – Install/Upgrade signs with new fluorescent sheeting (regulatory or warning). The target for this strategy should be on roadway segments with patterns of head on, nighttime, non-intersection, run-off road, and sideswipe crashes related to lack of driver awareness of the presence of a specific roadway feature or regulatory requirement. Ideally this type of safety CM would be combined with other sign evaluations and upgrades (install chevrons, warning signs, delineators, markers, beacons, and relocation of existing signs per MUTCD standards.).

- Crash Reduction Factor – 15%
- Expected Life – 10 years
- Baseline Cost – Approximately $ 2,000

R26 – Install dynamic/variable speed warning signs. This strategy primarily addresses crashes caused by motorists traveling too fast around sharp curves. It is intended to get the drivers attention and give them a visual warning that they may be traveling over the recommended speed for the approaching curve. Care should be taken to limit the placement of these signs to help maintain their effectiveness.

- Crash Reduction Factor – 30%
- Expected Life – 10 years
- Baseline Cost – Approximately $ 20,000

R27 – Install delineators, reflectors and/or object markers. Roadways that have an unacceptable level of crashes on curves (relatively flat to sharp) during periods of light and darkness. Any road with a history of fixed object crashes is a candidate for this treatment, as are roadways with similar fixed objects along the roadside that have yet to experience crashes.

- Crash Reduction Factor – 15%
- Expected Life – 10 years
- Baseline Cost – Approximately $ 2,000

R30 – Install centerline rumble strips/stripes. Rumble strips provide an auditory indication and tactile rumble when driven on, alerting drivers that they are drifting out of their travel lane, giving them time to recover before they depart the roadway or cross the center line. Additionally, rumble stripes (pavement marking in the rumble itself) provide an enhanced marking, especially in wet dark conditions.

- Crash Reduction Factor – 20%
- Expected Life – 10 years
- Baseline Cost – Approximately $ 2,000

R32PB– Install Bike Lanes. Most studies present evidence that bicycle lanes provide protection against bicycle/motor vehicle collisions. Bicycle lanes provide marked areas for bicyclist to travel along the roadway and provide for more predictable movements for both bicyclist and motorist. Evidence also shows that riding with the flow of vehicular traffic reduces bicyclists' chances of collision with a motor vehicle.

- Crash Reduction Factor – 35%
- Expected Life – 20 years
- Baseline Cost – Approximately $ 5,000

R33PB– Install Separated Bike Lanes. Separated bike lanes provide increased safety and comfort for bicyclists beyond conventional bicycle lanes. By separating bicyclists from motor traffic, "protected" or physically separated bike lanes can offer a higher level of comfort and are attractive to a wider spectrum of the public. Intersections and approaches must be carefully designed to promote safety and facilitate left turns for bicyclists from the primary corridor to cross street.

- Crash Reduction Factor – 45%
- Expected Life – 20 years
- Baseline Cost – Approximately $ 200,000

R34PB – Install sidewalk/pathway (to avoid walking along roadway). Sidewalks and walkways provide people with space to travel within the public right-of-way that is separated from roadway vehicles. The presence of sidewalks on both sides of the street has been found to be related to significant reductions in the "walking along roadway" pedestrian crash risk compared to locations where no sidewalks or walkways exist.

- Crash Reduction Factor – 80%
- Expected Life – 20 years
- Baseline Cost – Approximately $ 150,000

R35PB – Install/upgrade pedestrian crossing (with enhanced safety features). Adding pedestrian crossings has the opportunity to greatly enhance pedestrian safety at locations noted as being problematic. The enhanced safety elements, which may include curb extensions, medians and pedestrian crossing islands, beacons, and lighting, combined with pavement markings delineating a portion of the roadway that is designated for pedestrian crossing.

- Crash Reduction Factor – 35%
- Expected Life – 20 years
- Baseline Cost – Approximately $ 25,000

Other Countermeasures

Below is a list of countermeasures and improvements identified for high-risk locations. These improvements are not listed in the Local Roadway Safety Manual and are not HSIP eligible.

Bulb outs/curb extensions. Curb extensions (also called bulb-outs) extend the sidewalk into the parking lane to narrow the roadway and provide additional pedestrian space at key locations; they can be used at corners and at mid-block. Curb extensions enhance pedestrian safety by increasing pedestrian visibility, shortening crossing distances, slowing turning vehicles, and visually narrowing the roadway.

Green Thermoplastic Paint on Bike Lane. Colored pavement within a bicycle lane increases the visibility of the facility, identifies potential areas of conflict, and reinforces priority to bicyclists in conflict areas and in areas with pressure for illegal parking. Colored pavement can be utilized either as a corridor treatment along the length of a bike lane or cycle track, or as a spot treatment, such as a bike box, conflict area, or intersection crossing marking.

Speed Feedback Signs. Speed feedback signs, also known as dynamic speed displays, provide drivers with feedback about their speed in relationship to the posted speed limit. When appropriately complemented with police enforcement, speed feedback signs can be an effective method for reducing speeds at a desired location.

6. SAFETY PROJECTS

High-Collision Network Projects

This section summarizes the process of selecting safety projects as part of the analysis for the City of Antioch's LRSP. The next step after the identification of high-risk locations, emphasis areas and applicable countermeasures is to identify location-specific safety improvements for all high-risk roadway segments and intersections.

Specific countermeasures and improvements were selected from the 2020 LRSM, where:

- S refers to improvements at signalized locations,
- NS refers to improvements at non-signalized locations, and
- R refers to improvements at roadway segments.

The corresponding number refers to the countermeasure number in the LRSM (2020). The countermeasures were grouped into safety projects for high-risk intersections and roadway segments. A total of ten safety projects were developed. All countermeasures were identified based on the technical teams' assessment of viability that consisted of extensive analysis, observations, and City staff input. The most applicable and appropriate countermeasures as identified have been grouped together to form projects that can help make high-risk locations safer.

Table 6 lists the safety projects for high-risk intersections and roadway segments, along with total base planning level cost (2021 dollar amounts) estimates and the resultant preliminary Benefit-Cost (B/C) Ratio. The "Total Benefit" estimates were calculated for the proposed improvements being evaluated in the proactive safety analysis. This "Total Benefit" is divided by the "Total Cost per Location" estimates for the proposed improvements, giving the resultant B/C Ratio. The B/C Ratio Calculation follows the methodology as mentioned in the LRSM (2020) and can be found in **Appendix F**.

Table 6. Safety Projects

Location	CM1	CM2	CM3	Cost per Location	B/C Ratio
Project 1: Safety at Signalized Intersections					
Country Hills Drive and Deer Valley Road	S02	S03	S09	$ 20,405	129.40
18th Street and Cavallo Road	S02	S03		$ 28,700	
Davison Drive and Lone Tree Way	S02	S03		$ 28,553	
Lone Tree Way and Hillcrest Avenue	S02	S03	S09	$ 23,030	
18th Street and Hillcrest Avenue	S02	S03	S09	$ 30,660	
A St and Rossi Ave	S02	S03		$ 9,590	
Hillcrest and Larkspur Drive and East Tregallas Road		S03	S09	$ 8,890	
Delta Fair Boulevard and Somersville Road	S02	S03	S09	$ 23,240	
Project 2: Pedestrian Safety at Signalized Intersections					
Country Hills Drive and Deer Valley Road	S21PB			$ 5,600	372.80
18th Street and Cavallo Road	S21PB			$ 5,600	
Davison Drive and Lone Tree Way	S21PB			$ 5,600	
A St and Rossi Ave	S21PB			$ 5,600	
Delta Fair Boulevard and Somersville Road	S21PB			$ 5,600	
Hillcrest Avenue and Via Dora Drive	S21PB			$ 5,600	
Project 3: Safety at Unsignalized Intersections					
18th Street and Amber Drive	NS06	NS07	NS14	$ 115,689	38.17
18th St and Crestwood Drive	NS06	NS07	NS14	$ 108,822	
Project 4: Safety at Signalized Intersections					
E/W 18th St and A St		S12		$ 57,050	27.60
Deer Valley Road and Wildflower Drive	S02			$ 73,045	

Location	CM1	CM2	CM3	Cost per Location	B/C Ratio
Project 5: Safety at Roadway Segments					
W/E 18th St: A St to Phillips Lane	R22	R27		$ 24,430	263.61
Hillcrest Ave/ Davison Dr: Ashburton Dr/ Burwood Way to Wildhorse Rd	R22	R27		$ 44,100	
James Donlon Blvd: Hummingbird Drive to Lone Tree Way	R22	R27		$ 61,880	
Delta Fair Blvd/Gentrytown Dr: School St to Curtis Dr	R22	R27		$ 38,290	
Hillcrest Ave: Deerfield Dr to Lone Tree Way	R22	R27		$ 15,400	
Lone Tree Way: Putnam St/ Worrell Rd to Clayburn Rd	R22	R27		$ 17,430	
W 10th St: Auto Center Dr to Diamond St	R22	R27		$ 18,550	
Cavallo Rd: Amber Dr to E Tregallas Rd	R22	R27		$ 12,110	
G St: Minta Lane to Newbury Ave	R22			$ 12,740	
L St/ Contra Loma Blvd: W 18th St to San Jose Dr	R22	R27		$ 20,160	
Rossi Ave: D St to A St	R22	R27		$ 10,850	
Hillcrest Ave: Davison Dr/Deer Valley Rd to Larkspur Dr/ E Tregallas Rd	R22	R27		$ 14,910	
Lone Tree Way: Canada Valley to Empire Ave	R22	R27		$ 16,660	
Project 6: Pedestrian Safety Improvements along Corridors					
James Donlon Blvd: Hummingbird Drive to Lone Tree Way	R35PB			$ 165,326	54.50
W 10th St: Auto Center Dr to Diamond St	R35PB			$ 2,520	
Cavallo Rd: Amber Dr to E Tregallas Rd	R35PB			$ 66,612	
Lone Tree Way: Canada Valley to Empire Ave	R35PB			$ 97,160	
Project 7: Bike Safety Improvements along Corridors					
Hillcrest Ave: Davison Dr/Deer Valley Rd to Larkspur Dr/ E Tregallas Rd	R33PB			$ 249,746	3.60
Lone Tree Way: Canada Valley to Empire Ave	R33PB			$ 1,165,571	

Location	CM1	CM2	CM3	Cost per Location	B/C Ratio
Project 8: Pedestrian and Lighting Safety Improvements along Corridors					
W/E 18th St: A St to Phillips Lane	R01	R34PB		$ 1,332,167	29.40
G St: Minta Lane to Newbury Ave	R01			$ 120,083	
Rossi Ave: D St to A St	R01			$ 265,113	
Project 9: High-Friction Surface Treatments					
L St/ Contra Loma Blvd: W 18th St to San Jose Dr	R21			$ 2,139,386	2.55
Project 10: Corridor Improvements					
Delta Fair Blvd/Gentrytown Dr: School St to Curtis Dr	R26			$ 41,310	217.74
Hillcrest Ave: Deerfield Dr to Lone Tree Way	R26			$ 27,810	

S02- Improve signal hardware, S03- Improve signal timing, S09- Install raised markers or striping, S12-Install raised median on approaches, S21PB – Modify signal phasing to implement a leading pedestrian interval, NS06- Install/upgrade larger or additional stop signs or other intersection warning/ regulatory signs, NS07- Upgrade intersection pavement markings, NS14-Install raised median on approach, R01- Add segment lighting, R21- Improve pavement friction, R22 – Install/upgrade signs with new florescent sheeting, R26- install dynamic/ variable speed warning signs, R27- Install delineators, reflectors and/or object markers, R33- Install separated bike lanes, R34PB – Install sidewalk/pathway, R35PB – Install/upgrade pedestrian crossing

7. EVALUATION AND IMPLEMENTATION

This chapter describes the steps the City may take to evaluate the success of this plan and steps needed to update the plan in the future. The LRSP is a guidance document and requires periodic updates to assess its efficacy and re-evaluate potential solutions. It is recommended to update the plan every two to five years in coordination with the identified safety partners. This document was developed based on community needs, stakeholder input, and collision analysis conducted to identify priority emphasis areas throughout the City. The implementation of strategies under each emphasis area would aim to reduce fatal and severe injury collisions in the coming years. Funding is a critical component of implementing any safety project. While the HSIP program is a common source of funding for safety projects, there are numerous other funding sources that could be pursued for such projects, shown in **Table 7** below.

Table 7. Potential Funding Sources

Funding Source	Funding Agency	Amount Available	Next Estimated Call for Projects	Applicable E's	Notes
Active Transportation Program	Caltrans, California Transportation Commission	~$223 million per year	2022	Engineering, Education	Can use used for most active transportation related safety projects as well as education programs
Highway Safety Improvement Program	Caltrans	TBD	April 2022	Engineering	Most common grant source for safety projects
Surface Transportation Block Group Program	FHWA (Administered through MTC)	TBD	TBD	Engineering	Typically used for roadway projects
Congestion Mitigation and Air Quality (CMAQ)	FHWA (Administered through MTC)	$6.1 million annually	TBD	Engineering	Focused on projects that improve air quality
Office of Traffic Safety Grants	California Office of Traffic Safety	Varies by grant	Closes January 31st annually	Education, Enforcement, Emergency Response	10 grants available to address various components of traffic safety

Funding Source	Funding Agency	Amount Available	Next Estimated Call for Projects	Applicable E's	Notes
Affordable Housing and Sustainable Communities Program	Strategic Growth Council and Dept. of Housing and Community Development	~$405 million	2022	Engineering, Education	Must be connected to affordable housing projects; typically focuses on bike/ped infrastructure/programs
Urban Greening	California Natural Resources Agency	$28.5 million	2022	Engineering	Focused on bike/pedestrian infrastructure and greening public spaces
Local Streets and Road Maintenance and Rehabilitation	CTC (distributed to local agencies)	$1.5 billion statewide	N/A; distributed by formula	Engineering	Typically pays for road maintenance type projects
RAISE Grant	USDOT	~$1 billion	2022	Engineering	Typically used for larger infrastructure projects
Sustainable Transportation Equity Project	California Air Resources Board	~$19.5 million	TBD; most recent call in 2020	Engineering, Education	Targets projects that will increase transportation equity in disadvantaged communities
Transformative Climate Communities	Strategic Growth Council	~$90 million	TBD; most recent call in 2020	Engineering	Funds community-led projects that achieve major reductions in greenhouse gas emissions in disadvantaged communities.

Implementation

The LRSP document provides engineering, education, enforcement, and emergency medical service related countermeasures that can be implemented throughout the City to reduce KSI collisions. It is recommended that the City of Antioch implement the selected projects high-collision locations in coordination with other projects proposed for the City's infrastructure development in their future Capital Improvement Plans. Additionally, the use of pilot projects, quick-build projects, and tactical urbanism strategies can accelerate the implementation of needed improvements.

The success of the LRSP can be achieved by fostering communication among the City and the safety partners. Regional partners should also include Contra Costa health services, 511, and members of the advocacy community.

Partnering with regional healthcare providers, anonymized emergency room information can be provided. This information could include likely crash types based on patient encounter interviews or physician opinions, relative location of crashes, general location of where patients live, severity of injuries, and likely contributing factors. For example, these factors could be bike crashes with head injuries where the patient was not wearing a helmet or was wearing the helmet improperly. Such information allows for targeted education and intervention through bike safety programs that provide helmets to people who perhaps cannot afford them. Or, the injury could be related to not using a car seat or that the seat was buckled into the vehicle improperly. Again, knowing generally where patients live gives information as to where to target education and assistance efforts, especially within marginalized communities or among vulnerable populations.

Providing anonymized health information for diseases such as hypertension, obesity, diabetes, and other similar diseases with known ties to socioeconomic environmental factors can allow for a targeted effort in improving walking and cycling infrastructure, recreational opportunities, and transit options. The information also helps with the, identification of "food deserts" and the opportunity to encourage infill development or redevelopment of stores which provide healthier food choices. Knowing where people live also allows for better targeted education and assistance, especially for those who are members of marginalized communities or vulnerable populations.

Monitoring and Evaluation

For the success of the LRSP, it is crucial to monitor and evaluate the four E-strategies continuously. Monitoring and evaluation help provide accountability, ensures the effectiveness of the countermeasures for each emphasis area, and help making decisions on the need for new strategies. The process would help the City make informed decisions regarding the implementation plan's progress and accordingly, update the goals and objectives of the plan.

After implementing countermeasures, the strategies should be evaluated annually as per their performance measures. The evaluation should be recorded in a before-after study to validate the effectiveness of each countermeasure as per the following observations:

- Number of fatal and severe injury collisions
- Number of police citations
- Number of public comments and concerns

Evaluation should be conducted during similar time periods and durations each year. The most important measure of success of the LRSP should be reduction in fatal and severe injury collisions throughout the City. If the number of KSI collisions doesn't decrease initially, then the countermeasures should be evaluated as per the other observations, as mentioned above. The effectiveness of the countermeasures should be compared to the goals for each emphasis area.

LRSP Update

The LRSP is a guidance document and is recommended to be updated every two-five years after adoption. After monitoring performance measures focused on the status and progress of the E's strategies in each emphasis area, the next LRSP update can be tailored to resolve any continuing safety problems. The City of Antioch's Public Works Department will be accountable for the progress of the plan goals. An annual stakeholder meeting with the safety partners is also recommended to discuss the progress for each emphasis area and oversee the implementation plan. The City acknowledges that the document be updated as per the latest collision data (MTC and CCTA data sources), emerging trends, and the E's strategies' (including Equity) progress and implementation every two to five years.

Appendices:

Appendix A: Table of Policies and Projects from the Literature Review:

Document	Relevant Goals, Policies, and Projects
City of Antioch General Plan (1995)	**Goal 7.3.1: Vehicular Circulation Objective** • Provide adequate roadway capacity to meet the roadway performance standards set forth in the Growth Management Element. **Goal 7.3.2: Vehicular Circulation Policies** • **a.** Facilitate meeting the roadway performance standards set forth in the Growth Management Element and improving traffic flow on arterial roadways. o Promote the design of roadways to optimize safe traffic flow within established roadway configurations by minimizing driveways and intersections, uncontrolled access to adjacent parcels, on-street parking, and frequent stops to the extent consistent with the character of adjacent land uses. o Facilitate the synchronization of traffic signals. o Where needed provide acceleration and deceleration lanes for commercial access drives **b.** Design and reconfigure collector and local roadways to improve circulation within and connections to residential and commercial areas. o Implement appropriate measures to mitigate speeding and other traffic impacts in residential areas. o Implement roadway patterns that limit through traffic on local residential streets. • **d.** Where feasible, design arterial roadways, including routes of regional significance, to provide better service then the minimum standards set forth in Measure C and the Growth Management Element. Thus, where feasible, the City will strive to maintain a "High D" level of service within regional commercial areas and at intersections within 1,000 feet of a freeway interchange. The City

	will also strive where feasible to maintain low-range "D" in all other areas of the City, including freeway interchanges. **Goal 7.4.1: Non-Motorized Transportation Objectives** • Maintenance of a safe, convenient, and continuous network of pedestrian sidewalks, pathways, and bicycle facilities serving both experienced and casual bicyclists to facilitate bicycling and walking as alternatives to the automobile. **Goal 7.4.2: Non-Motorized Transportation Polices** • **b.** Design intersections for the safe passage of pedestrians and bicycles through the intersection. • **c.** Provide street lighting that is attractive, functional and appropriate to the character and scale of the neighborhood or area, and that contributes to vehicular, pedestrian, and bicycle safety. • **d.** Maintain roadway designs that maintain mobility and accessibility for bicyclists and pedestrians. • **e.** Integrate multi-use paths into creek corridors, railroad rights-of-way, utility corridors, and park facilities. • **f.** Provide, as appropriate, bicycle lanes (Class II) or parallel bicycle/pedestrian paths (Class I) along all arterial streets and high volume collector streets, as well as along major access routes to schools and parks. • **m.** Maximize visibility and access for pedestrians, and encourage the removal of barriers for safe and convenient movement of pedestrians. **Goal 7.5.2: Transit Polices** • **d.** Design transit stations to provide safe and convenient vehicular, bicycle, and pedestrian access.
Contra Costa Countywide Bicycle and Pedestrian Action Plan (2018)	**Implementation Actions** **Collaborate** • **1. Develop a Vision Zero and Systematic Safety approach for Contra Costa** • Support a countywide Vision Zero policy, and systematic pedestrian and bicycle safety analyses. Using a data-driven and systemic assessment of the leading causes of traffic injuries in the

	county, the Authority will support its partners in identifying efficient and cost-effective engineering countermeasures. Design transit stations to provide safe and convenient vehicular, bicycle, and pedestrian access. • **3. Overcome Across Barrier Connections** • Building on the analysis and recommendations in the Caltrans' District 4 Bicycle Plan, work with Caltrans and local agencies to make Across Barrier Connections – especially freeway interchanges and waterways that inhibit access to nearby destinations – emphasizing those connections where demand and safety issues are greatest. • **4. Support and Participate in Complete Street Corridor Studies** • Work with local jurisdictions and agencies and the public to develop Complete Streets Corridor Studies that identify improvements that would best serve all users within the corridor. ese studies would determine the most context-sensitive and cost-effective solutions to pedestrian and bicycle access issues within these corridors. Authority support may include direct funding or technical or staff support. Priority will be given to corridors on the CBN or within PPAs. • **Educate and Encourage** • **Support Education and Encouragement Efforts** • Continue support for 511 Contra Costa programs that educate both bicyclists and drivers on safe travel and rules of the road.
Antioch Downtown Specific Plan (2018)	**Goal V – Support Mobility** • **Objective 1.5: Create an integrated multi-modal transportation system that effectively serves the Downtown area. Improve all modes of access to and within Downtown, and provide opportunities for residents, workers, and visitors to walk, bike, drive or access transit (including Amtrak, buses, future ferry service, and links to the Hillcrest eBART station), Downtown.** o **Policy 1.5.1.** A wide range of circulation modes serve Downtown, including cars and trucks, several bus routes, Amtrak, the nearby Hillcrest EBART Station, bike and multi-use trails, and pedestrian sidewalks. Downtown ferry service is planned for the future. While most people will continue to arrive Downtown by car, this Plan encourages

	people to use alternative modes of transportation, rather then cars, to get to and around Downtown. o **Policy 1.5.5.** Downtown traffic is one indicator of economic health. As traffic increases due to the revitalization of Downtown, congestion issues may arise. Increasing roadway capacity to Downtown would be expensive, disruptive, and could harm existing good examples of community character, landscaping and architecture. Rather then widen streets, this Plan encourages the City to consider relaxing traffic level of service (LOS) thresholds into and in Downtown, if needed, to preserve the street environment, and prioritize pedestrian, bike and transit access. o **Policy 1.5.6.** The existing network of bicycle lanes and multi-use trails in and around Downtown is fragmented. This Plan encourages the City to explore the means to improve such access. • **Goal VII: Sustainable Infrastructure** o **Policy 1.7.3.** Promote green leadership in Antioch by expanding Downtown as a green and healthy community with sustainable building and landscape design, sustainable water use and irrigation practices, and reduced energy use. Encourage outdoor and active living with more opportunities for healthy choices including walking and biking, readily available access to transit, housing in close proximity to shopping, dining and workplaces, and access to parks, play spaces and open space for children and families to enjoy. • **Goal B: An attractive, walkable, neighborhood-serving commercial district that complements and adds value to the adjacent residential neighborhoods.** o **Policy 2.6.2.** The City supports the permanent improvement of sidewalks, medians, crosswalks and roadway surfaces to improve circulation and pedestrian safety along 10th Street and other neighborhood commercial corridors. • **Goal A: A street network within and to Downtown Antioch that offers ease of connectivity and access.** o **Objective 4.1: Maintain a pedestrian-friendly environment.**

	○ **Policy 4.1.1:** In Downtown Antioch, the City of Antioch prioritizes pedestrians, cyclists, and quality of life for its residents over simple increases in traffic efficiency. ○ **Program 4.1.1a:** The City of Antioch will pursue a study to determine whether two way stop sign intersections should be converted to four way stop intersections. ○ **Program 4.1.1b:** The City of Antioch will re-evaluate the benefits of converting 9th and 10th Streets to an Arterial Couplet and 2nd and 4th Streets as Major Collector one-way Couplets and the potential impacts on existing residents, quality of life, and pedestrians and cyclists. • **Objective 4.2: Improve pedestrian access to and within the Downtown, and maintain a street and sidewalk system that enables walkability to major destinations, shopping, employment, housing and transit.** • **Policy 4.2.1:** Close gaps in the sidewalk ramp network to ensure continuous pedestrian/wheelchair access to and within the Downtown. Currently, not all intersections have full four corner ramp access. • **Program 4.2.1a:** Close gaps in sidewalk/wheelchair ramp network • **Policy 4.2.2:** Ensure that new sidewalks, crosswalks, ramps and other pedestrian streetscape features are ADA compliant. • **Objective 4.3:** Improve bicycle access to and within the Downtown that is safe and inviting for bicyclists. ○ **Policy 4.3.1:** Fill in gaps in existing bicycle facilities and provide proposed new bicycle routes or trails as follows that connect key destinations, housing, shopping, employment and transit: ○ **Program 4.3.1a:** The Rivertown to Southeast Antioch bike lane: The feasibility of this proposed bicycle facility as called for in the General Plan should be analyzed. ○ **Program 4.3.1b:** 9th Street: Has a few disparately spaced bike route signs on it, and it should be determined whether additional signage would be beneficial. ○ **Program 4.3.1c: G Street: Bike route from 6th Street south.**
Hillcrest Station Area Plan (2009)	**Street Network Design** **Street Network Policies**

- **C-3.** Design streets so that they incorporate medians, landscaping, sidewalks, street trees, travel lanes, bike lanes, and on-street parking, such that they:
    - Are consistent with the desired pedestrian-oriented character and safety; and,
    - Meet the needs of all users including drivers, pedestrians, persons with disabilities, bicyclists, and transit users.

Pedestrian and Bicycle Circulation Policies

- **C-40.** Prioritize pedestrian and bicyclist safety at intersections and street crossings with measures such as:
    - Contrasting and/or textured paving crosswalks;
    - In-ground, blinking crosswalk lights; and,
    - Pedestrian refuges and bulb-outs.
- **C-47.** Sidewalks should have at least a five-foot wide clear path of travel.
- **C-49.** Facilitate the provision of bike lanes on Hillcrest Avenue and East 18th Street in order to connect the Hillcrest Station Area to the regional trail network.
- **C-50.** Allow bicycle circulation on all local streets, to the extent feasible.
- **C-51.** Design and implement a multi-use trail loop around the wetlands and East Antioch Creek. This loop should include at least two pedestrian crossings across the creek.
- **C-52** Provide multi-use trails that connect from East Antioch Creek to existing neighborhood parks north of the Station Area.

Freight Rail Policies

- **C-54**. Work with Union Pacific to ensure safe pedestrian C-54 and vehicular railroad crossings.

Street Design Policies

- **UD-32.** Design streets that are consistent with the pedestrian-oriented character and safety requirements for all users, including pedestrians, bicyclists, persons with disabilities, and transit users, such that:
    - Design speeds for arterials should not exceed 35 miles per hour;
    - The width of vehicular travel lanes may be as narrow as 10 feet To help calm traffic; and,

	○ Other traffic calming measures should be incorporated as necessary.
2017 Contra Costa Countywide Transportation Plan	• **Goal 1: Support the efficient, safe, and reliable movement of people and goods using all available travel modes** • **Goal 3: Expand safe, convenient and affordable alternatives to the single occupant vehicle** ○ 3.3 Complete Streets. Require local jurisdictions to incorporate policies and standards for "complete streets" that support transit, bicycle and pedestrian access in new developments, infill development areas ("Priority Development Areas"), and transit priority areas. ○ 3.4 Walkways and Trails. Support transit-oriented and pedestrian-friendly developments, and invest in trails, walkways, and pedestrian-oriented improvements. ○ 3.5 Alternative Modes. Promote the formation of more carpools and vanpools, and greater use of transit, bicycling, and walking. ○ 3.8 Expand Bicycle Facilities. Encourage local jurisdictions and other agencies to develop a connected and coordinated system of bicycle facilities through financial assistance, technical support, other aid, and encouragement. ○ 3.10 Safe Routes to School. Support Safe Routes to Schools projects and programs. • **Performance Target 4: Reducing by 50 percent the number of injuries and fatalities from collisions**
Contra Costa Countywide Transportation Safety Policy and Implementation Guide (2021)	• **A. SIGNAL TIMING & PHASING** ○ Additional Signal Heads ○ Extend Pedestrian Crossing Time ○ Flashing Yellow Turn Phase ○ Leading Pedestrian Interval ○ Pedestrian Phase Recall ○ Replace Permissive with Protected Left Turn ○ Pedestrian Scramble ○ Reduce Cycle Lengths ○ Coordinated Signal Operation ○ Extend Green Time for Bikes ○ Extend Yellow and All Red Time • **B. INTERSECTION & ROADWAY DESIGN** ○ Close Slip Lane ○ Raised Intersection

- Convert Two-Way Stop to All-Way Stop
- Install Sidewalk
- Protected Intersection
- Raised Median
- Lane Narrowing
- Road Diet
- Widen Shoulder
- Roundabout
- Signal Head Improvements
- Traffic Circles
- Programmable Signals/Visors/Louvers
- Edge Line/Center Line Rumble Strips
- Hardened Centerlines

- **C. BIKEWAY DESIGN**
  - Bicycle Crossing (Solid Green Paint)
  - Bicycle Signal/Exclusive Bike Phase
  - Bike Detection
  - Class I Bicycle Path or Mixed Use Trail
  - Bike Box
  - Class II Bike Lane
  - Class IV Separated Bikeway
  - Green Bike Lane Conflict Zone Markings
  - Two-Stage Turn Queue Bike Box
- **D. PEDESTRIAN CROSSINGS**
  - Install Pedestrian Countdown Timer
  - Pedestrian Hybrid Beacon (PHB)
  - Curb Extension
  - High-Visibility Crosswalk
  - Pedestrian Median Barrier
  - Raised Crosswalk
  - Pedestrian Refuge Island
  - Rectangular Rapid Flashing Beacon (RRFB)
  - Reduce Curb Radius
  - ADA-Compliant Directional Curb Ramps and Audible Push Buttons
  - Extended Time Push Button
- **E. SIGNS & MARKINGS**
  - Prohibit Right-Turn-on-Red
  - Advance Yield Markings
  - Advance Stop Markings
  - Pedestrian Signs
- **F. OTHER**
  - Access Management
  - Intersection & Street Scale Lighting

	Remove Obstructions for Sightlines
Contra Costa Transportation Authority Transportation Expenditure Plan 2020	**Policy: Complete Streets Policy** • Encourages making local streets more efficient and safe for all users—including drivers, pedestrians, bicyclists, and transit riders—and giving travelers convenient options while minimizing the need to widen roadways. **Policy: Road Traffic Safety** • Requires all funding recipients to systematically apply planning and design practices that quantifiably reduce the risk of traffic-related deaths and severe injuries.
Contra Costa County General Plan	**Roadway Transit Goals 5-A. To provide a safe, efficient and integrated multimodal transportation system.** • **5-11.** The use of freeways for community circulation shall be minimized by prioritizing transit circulation, safe, direct non-motorized routes, and secondarily by additional arterials and expressways. • **5-15.** Adequate lighting shall be provided for pedestrian, bicyclist, and vehicular, safety, consistent with neighborhood desires. • **5-18**. The design and the scheduling of improvements to arterials and collectors shall give priority to intermodal safety over other factors including capacity. • **5-ag.** Design and allow for on-road bikeways on arterials and collectors as an alternative to car travel where this can be safely accommodated and off-street bikeways where on-road facilities cannot be safely accommodated or where a dedicated non-motorized facility is otherwise justified. • **5-36.** Describe a system of bicycle facilities and key attractors of bicycle and pedestrian traffic so that all travelers, including people with disabilities, can travel safely and independently. • **5-ai.** Design a growing comprehensive and safe bicycle network using a mix of existing local roads, collectors and bikeways which prioritizes bicycle movement from residences to key attractors while minimizing automobile presence on the network. Coordinate with cities, transit agencies, community groups and public utilities. • **5-aj**. Where possible, roads selected for the comprehensive bikeway system should be 35 mph or less.

	• **5.ak.** Provide safe and convenient pedestrian and bike ways in the vicinity of schools and other public facilities and in commercial areas and provide convenient access to bus routes. • **5-am.** Construct the bikeways shown in the Bikeway Network map and incorporate the needs of bicyclists in roadway construction and maintenance projects and normal safety and operational improvements. • **5-M** Improve safety for pedestrians and bicyclists. • **5-39**. Reduce conflicts among motorists, pedestrians and bicyclists. • **5-aw**. Use curb extensions and pedestrian islands and other strategies to reduce pedestrian crossing distances. • **5-ax.** Use traffic control devices such as signs, signals or lights to warn motorists that pedestrians or bicyclists are in the roadway. • **5-ay.** Provide buffers between roads and sidewalks utilizing planter strips or buffer zones that provide streetscape improvements. • **5-az.** Provide buffers between train tracks and non-motorized facilities when necessary, utilizing distance, barriers, or grade separation. • **5-ba.** Ensure that users of non-motorized facilities are channeled to legal crossings of train tracks, which are use appropriate traffic control devices and are adequately inspected and maintained. • **5-40.** Provide information to improve safety for pedestrians and bicyclists. • **5-bb.** Support development of a countywide collision data analysis program that will generate collision rates useful for planning purposes. • **5-bc**. Support the development and implementation of programs to educate drivers, bicyclists, and pedestrians as to their rights and responsibilities,
City of Antioch Traffic Calming Policy (2020)	**Phase I – Enforcement & Engineering** • Conduct a Speed Study • Establish and Post Appropriate Signage and Striping • Mobile radar trailer • Traffic Enforcement **Phase II – Traffic Calming Devices** • Speed Humps/Cushions

	• Neighborhood Support **Phase III – Removal of Traffic Calming Devices** • Determine Neighborhood Support
City of Antioch 5 Year Capital Improvement Program (2020 – 2025)	**Projects in Progress** • **Roadway Improvements** o L Street Improvements o Pedestrian/ ADA Improvements o Sidewalk Repair Program o Pavement Management System Program o Citywide Signage Program o Traffic Calming Program o Downtown Lighting o Hillcrest Ave. Left Turn at Wild Horse Road o Hillcrest Ave/ E 18th St Median Landscape • **Traffic Signal Improvements** o Traffic Signal: James Donton Blvd/ Metcalf St o Traffic Signal: Laurel Road/ Canada Valley Road

Appendix B: Community Input - Public Comments

Appendix C: Consolidated Collision Database

Appendix D: HSIP Eligible Countermeasures

Appendix E: Countermeasure Toolbox

Appendix F: B/C Ratio Calculation - LRSM (2020)