

LOCAL ROADWAY SAFETY PLAN

City of Yorba Linda, California



Final Report

September 2022



City of Yorba Linda



Local Roadway Safety Plan Final Report

Yorba Linda, CA

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Appendix A: Matrix of Planning Goals, Policies, and Projects

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EXECUTIVE SUMMARY

The City of Yorba Linda's Local Roadway Safety Plan (LRSP) is a comprehensive plan that creates a framework to systemically identify and analyze traffic safety related issues and recommend projects and countermeasures. The LRSP aims to reduce fatal and severe injury (F+SI) collisions through a prioritized list of improvements that can enhance safety on local roadways.

The LRSP takes a proactive approach to addressing safety needs. 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 routinely reviewed and updated by City staff and their safety partners to reflect evolving collision trends and community needs and priorities. With the LRSP as a guide, the City will be able to ready to apply for grant funds, such as the federal Highway Safety Improvement Program (HSIP).

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 – SAFETY PARTNERS

Involvement of safety partners is critical in the success of the LRSP. For the City of Yorba Linda, this included the Yorba Linda Traffic Commission, Orange County Sheriff's Department, Orange County Fire Authority, Placentia Yorba Linda School District, Yorba Linda Country Riders, and Orange County Bicycle Coalition. This chapter summarizes the involvement of the stakeholders in the LRSP process, as well as the results of the community outreach using an online interactive map tool.

CHAPTER 3 – 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 Yorba Linda General Plan - Circulation Element (2016), General Plan Riding, Hiking and Bikeway Trails Component (2005), Yorba Linda Town Center Specific Plan (2011), Savi Ranch Mobility Feasibility Study (2018), Yorba Linda School Zone Safety Assessment (2015), HSIP Cycle 8 Set Aside Pedestrian Improvements (2016), Orange County Safe Routes to School Action Plan (under development), OC Foothills Bikeways Strategy (2016), OC Active Orange County's Bike and Ped Plan (2019), The Orange County Loop 70/30 Plan (2015), SCAG 2019 Federal Transportation Improvement Program, and SCAG Regional Transportation Plan/Sustainable Communities Strategies (2016).

CHAPTER 4 – COLLISION DATA COLLECTION AND ANALYSIS

This chapter summarizes data analysis approach and presents preliminary as well as detailed collision analysis and findings in the study area. This analysis of F+SI collisions is performed by facility type (intersection and roadway segment). Collision data was obtained and analyzed for a five-year period from 2016 to 2020 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).

CHAPTER 5 - EMPHASIS AREAS

Emphasis areas are a focus of the LRSP that are identified through the various collision types and factors resulting in F+SI collisions within the City of Yorba Linda. The eight emphasis areas for Yorba Linda are:

- Improve Intersection Safety
- Reduce Broadside Collisions
- Reduce Nighttime Collisions
- Reduce Automobile Right-of-Way Violations
- Reduce Unsafe Speed Collisions
- Reduce DUI Collisions
- Reduce Younger Driver Collisions

CHAPTER 6 – 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 using the 4 E's strategies, and are included with the emphasis areas.

CHAPTER 7 – SAFETY PROJECTS

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

- **Project 1 - Systemic Improvements at Signalized Intersections:** Improve signal hardware, improve signal timing, and install raised pavement markers and striping.
- **Project 2 - Systemic Improvements at Signalized Intersections:** Install flashing beacons as advance warning, and modify signal phasing to implement a Leading Pedestrian Interval (LPI).
- **Project 3 - Spot-Location Improvements at Signalized Intersections:** Add intersection lighting, provide protected left turn phase (left turn lane already exists), and convert signal to mast arm (from pedestal-mounted).

- **Project 4 - Systemic Improvements at Unsignalized Intersections:** Add intersection lighting, install/upgrade larger or additional stop signs or other intersection warning/regulatory signs, and upgrade intersection pavement markings.
- **Project 5 - Spot Improvements at Unsignalized Intersections:** Install signals, install flashing beacon as advanced warning, and install transverse rumble strips on approaches.
- **Project 6 - Systemic Improvements at Roadway Segments:** Install/upgrade signs with new fluorescent sheeting (regulatory or warning), install dynamic/variable speed warning signs, and install delineators, reflectors, and/or object markers.
- **Project 7 - Systemic Improvements at Roadway Segments:** Add segment lighting, install curve advance warning signs, and add edge lines and centerlines.

CHAPTER 8 – 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 F+SI 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 F+SI collisions throughout the City. If the number of F+SI collisions does not decrease over time, then the emphasis areas and countermeasures should be re-evaluate.

1. INTRODUCTION

What is a LRSP?

The Local Roadway Safety Plan (LRSP) is a localized data-driven traffic safety plan that provides opportunities to address unique highway safety needs and reduce the number of F+SI collisions. The LRSP creates a framework to systemically identify and analyze traffic safety-related issues, and recommend safety projects and countermeasures. The LRSP facilitates the development of local agency partnerships and collaboration, resulting in the development of a prioritized list of improvements that can qualify for HSIP funding.

The 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.

Process

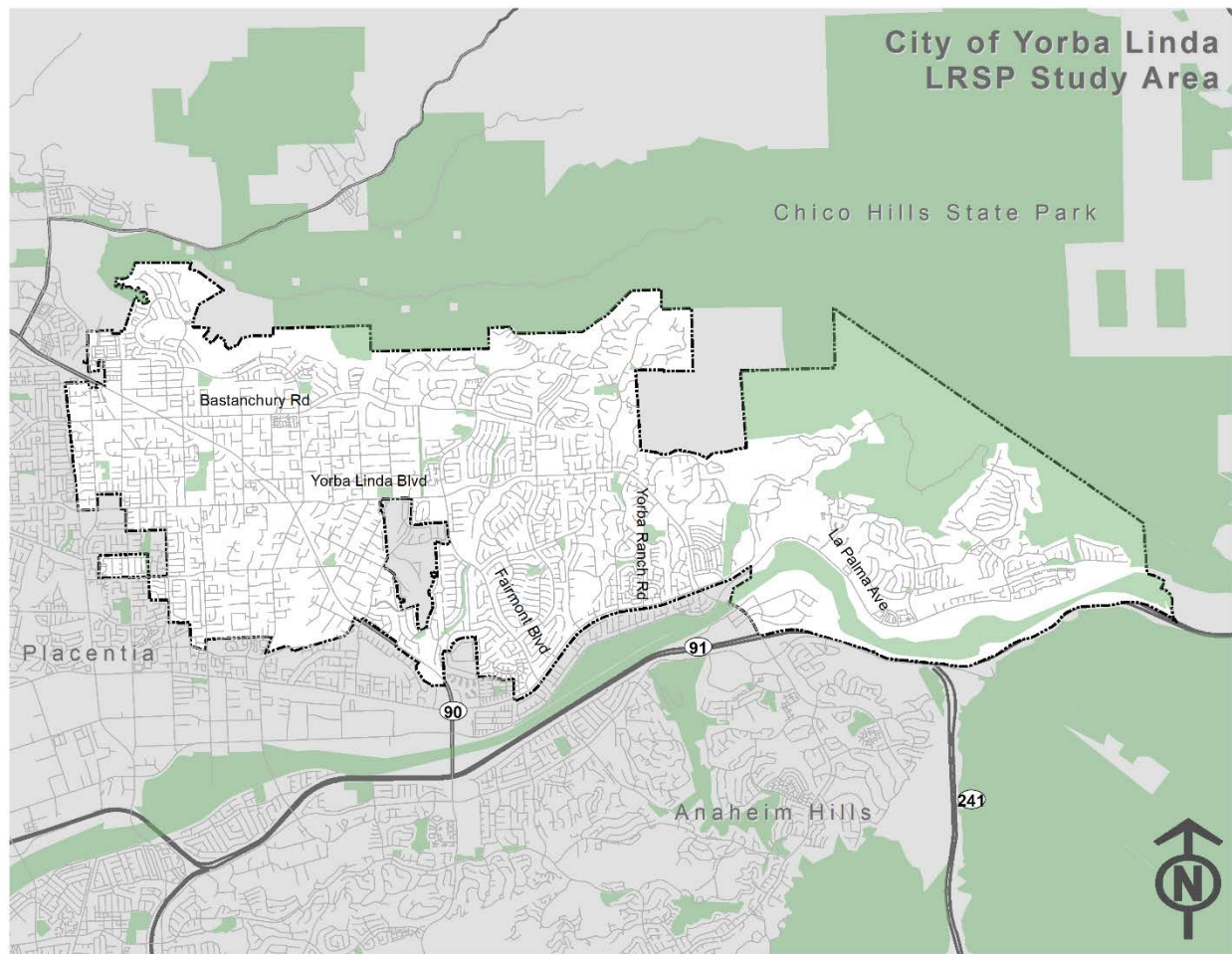
The systemic approach in preparing the LRSP involves the following steps:

- Develop plan goals and objectives
- Analyze collision data
- Meet with stakeholders/safety partners
- Determine focus areas and identify crash reduction strategies
- Prioritize countermeasures/projects
- Prepare the LRSP

Study Area

The City of Yorba Linda, located in Orange County, California, covers a total area of 19.9 square miles and is located approximately 37 miles southeast of Los Angeles. The City's estimated population is 68,336 (US Census 2020). State Route (SR) 90 and SR 91 are major thoroughfares that connect the city with the rest of Orange County, Los Angeles County, and the Inland Empire. The nearest cities include Brea to the north, Placentia to the west, Anaheim to the south, and Corona to the east. The study area is mapped in **Figure 1** on the following page.

Figure 1: Yorba Linda LRSP Study Area



2. SAFETY PARTNERS

Safety partners are vital to the development and implementation of an LRSP. For the City of Yorba Linda, these include City staff, Yorba Linda Traffic Commission, Orange County Sheriff's Department, Orange County Fire Authority, Placentia Yorba Linda School District, Yorba Linda Country Riders, and Orange County Bicycle Coalition. Many of these groups/agencies attended two virtual stakeholder meetings, which were held on November 16, 2021, and May 26, 2022 to review project goals and findings, and to solicit feedback from the group.

Figure 2: Zoom Meeting from Stakeholder Meeting #1



This stakeholder outreach was supplemented by a project website with an interactive map tool platform that was posted to the City's website. The interactive map was used to solicit input from Yorba Linda residents and stakeholders outside the confines of traditional meetings.

Figure 3: Yorba Linda LRSP Project Website



The interactive map tool was published on July 22, 2021 and public comments were closed on January 30, 2022. During this period 108 public comments were submitted regarding traffic safety issues. The most common commented on traffic safety issue was pedestrian safety, with 28 comments. The most common street with pedestrian safety issues were Village Center Drive, Lakeview Avenue, Yorba Linda Boulevard, and Fairmont Boulevard. Bicycle Safety was the second most common commented on traffic safety issues, with 24 comments. The intersections of Village Center Drive and Lakeview Avenue was the most commented on location with bicycle safety issues. Other traffic safety issues include, speeding, stop sign/red light violations, and pavement conditions and curve unsafe. The results of the interactive map are shown on the following page in **Figure 4**, and summarized in **Figure 5**.

Figure 4: Interactive Map Comment Responses

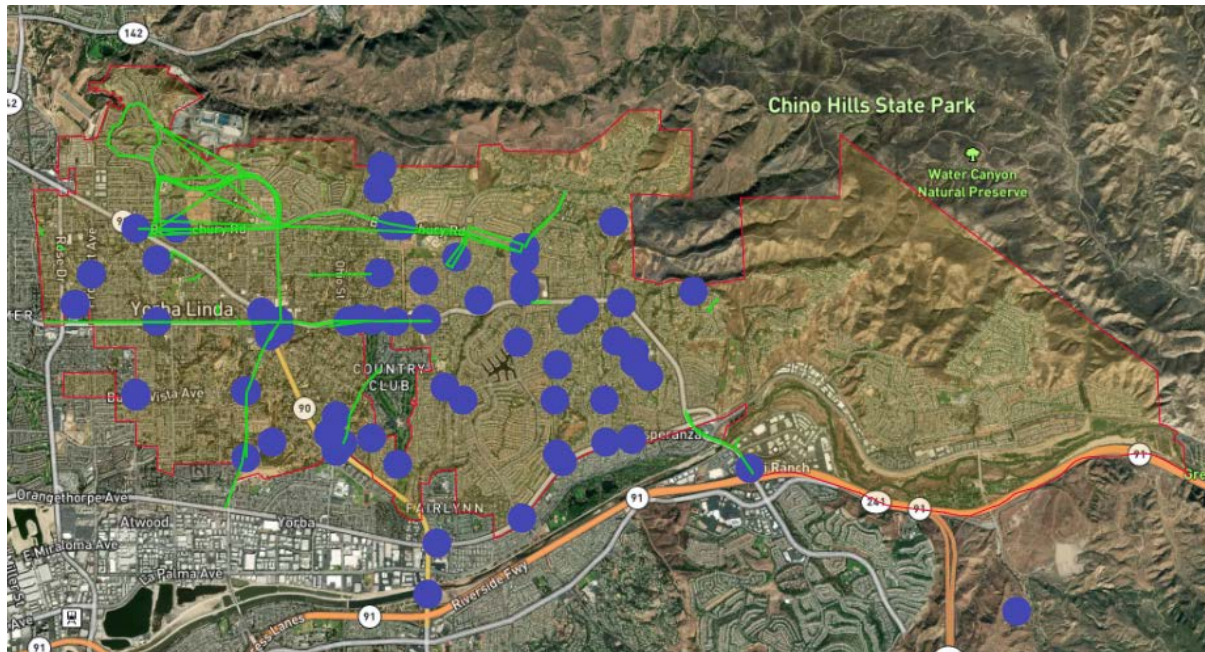
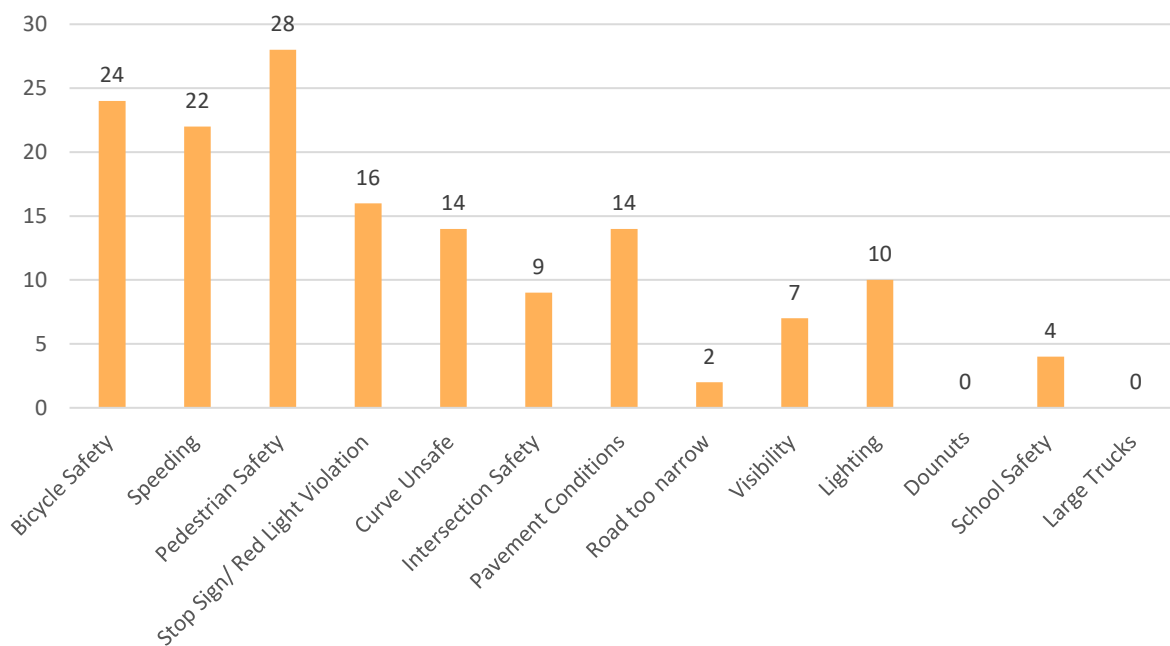


Figure 5: Public Comments on Traffic Safety



3. EXISTING PLANNING EFFORTS

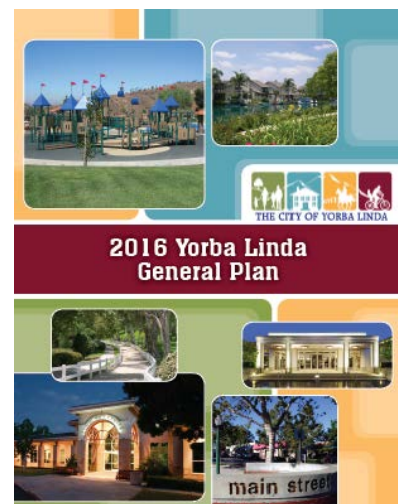
This chapter summarizes the planning documents, projects underway, and studies reviewed for the City of Yorba Linda LRSP. The purpose of this memorandum is to ensure the LRSP vision, goals, and E's strategies of traffic safety (Education, Enforcement, Engineering, and Emergency Medical Services (EMS)) are aligned with prior planning efforts, planned transportation projects, and non-infrastructure programs. The documents reviewed are listed below:

- City of Yorba Linda General Plan - Circulation Element (2016)
- General Plan Riding, Hiking, and Bikeway Trails Component (2005)
- Yorba Linda Town Center Specific Plan (2011)
- Savi Ranch Mobility Feasibility Study (2018)
- Yorba Linda School Zone Safety Assessment (2015)
- HSIP Cycle 8 Set Aside Pedestrian Improvements (2016)
- Orange County Safe Routes to School Action Plan (under development)
- OC Foothills Bikeways Strategy (2016)
- OC Active Orange County's Bike and Ped Plan (2019)
- The Orange County Loop 70/30 Plan (2015)
- SCAG 2019 Federal Transportation Improvement Program
- SCAG Regional Transportation Plan/ Sustainable Communities Strategies (2016)

The following sections include brief descriptions of these documents and how they inform the development of the LRSP. A detailed list of relevant projects, goals, policies and programs is provided in **Appendix A**.

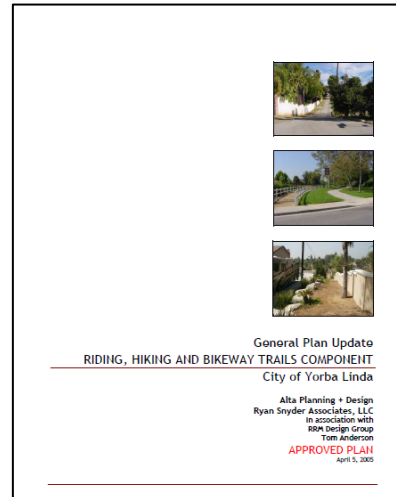
CITY OF YORBA LINDA GENERAL PLAN CIRCULATION ELEMENT (2016)

The General Plan presents a consolidated framework of decisions for guiding where and how development should occur in Yorba Linda. The Circulation Element details the policy, programs and goals of the circulation system in Yorba Linda. A multi-modal transportation system that safely and efficiently serves residents, businesses, and visitors, and provides access to neighborhoods, communities, and regional centers is essential for upholding Yorba Linda's quality of life and implementing the vision for the community's future. This plan will assist the LRSP in ensuring the identified goals and countermeasures are aligned with the existing policies and goals of the City.



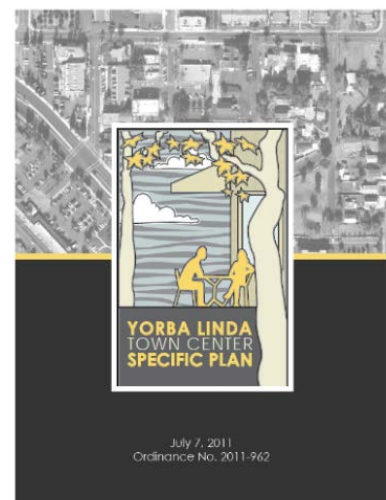
GENERAL PLAN RIDING, HIKING AND BIKEWAY TRAILS COMPONENT (2005)

The City of Yorba Linda has a goal of providing a comprehensive riding, hiking, and bikeway trail system. The General Plan states that the City of Yorba Linda views the trails system within the City as a linkage between recreational opportunities and nodes of employment or commercial uses with emphasis on interfacing with the trail systems of adjacent cities, Orange County, Chino Hills State Park, and the region. The General Plan acknowledges that missing links and incomplete connections exist in the trails system as identified in the 1972 Master Plan, and states that the City's goal is to complete these missing links to create a comprehensive, continuous trails system. This plan will help the LRSP in supporting the recommended safety projects along with the mobility and transportation needs of the City.



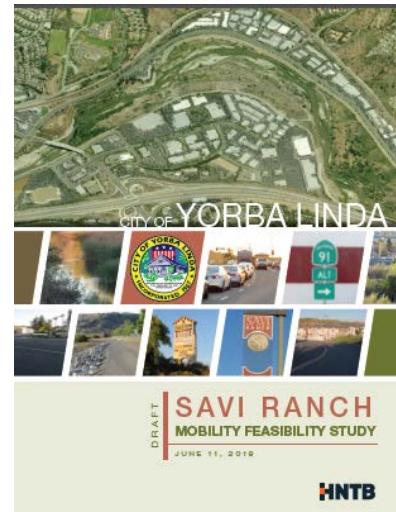
YORBA LINDA TOWN CENTER SPECIFIC PLAN (2011)

The Yorba Linda Town Center Specific Plan details the plan to implement the vision as detailed by the Blue Ribbon Committee for the Town Center Specific Plan Area. The Yorba Linda Town Center Specific Plan Area is bounded by Imperial Highway to the west, Yorba Linda Boulevard to the south, Lakeview Avenue to the east and Lemon Drive to the north. The heart and backbone of the study area is Main Street, which runs north and south between Imperial Highway and Lemon Drive. This plan will assist the LRSP in ensuring the identified goals and countermeasures are aligned with the existing plans of the City, including planned improvements in the area.



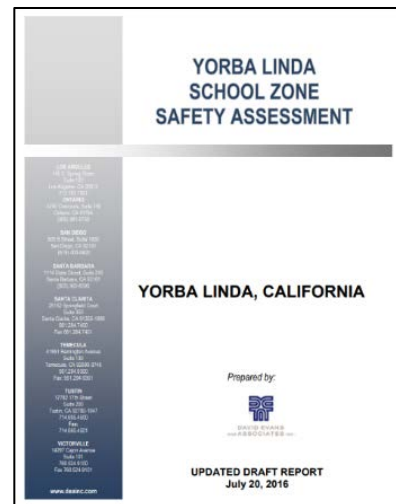
SAVI RANCH MOBILITY FEASIBILITY STUDY (2018)

In 2015, the City of Yorba Linda approved the Consolidated Summary Report – Savi Ranch Land Use and Mobility Vision Plan. This document was prepared with the collaborative effort with the community, businesses and property owners to envision the next 30 years for Savi Ranch. The goal was to set forth a range of land uses that provides flexibility to adapt to changing market trends, position Savi Ranch as a regional destination, and provide long-term economic stability. A number of road widening, access improvements, and active transportation improvement plans are outlined in the report. The plan will assist the LRSP in ensuring identified countermeasures in the Savi Ranch area are consistent with the City's plans.



YORBA LINDA SCHOOL ZONE SAFETY ASSESSMENT (2015)

Yorba Linda School Zone Safety Assessment assessed school area facilities in residential neighborhoods at 14 locations selected for further study. The 14 locations selected for review included elementary, middle, combined (elementary and middle), high, and private schools, all within the City limits. This assessment outlined various countermeasure and improvements for all the 14 Yorba Linda School Zones. These countermeasures will inform the LRSP countermeasures and ensure the strategies are aligned across current City plans and goals.



HSIP CYCLE 8 SET ASIDE PEDESTRIAN IMPROVEMENTS (2016)

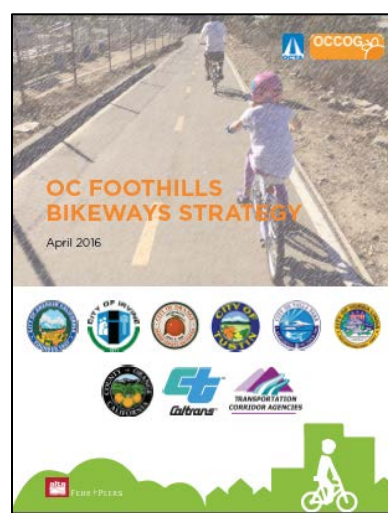
The City of Yorba Linda applied for and was awarded a grant in HSIP cycle 8 for \$249,700 to install 52 signalized intersections along various streets. The grant updated existing pedestrian signal heads to be ADA compliant, updated existing pedestrian heads with new countdown sequence modules, and push buttons with large button activators. Major streets include Imperial Highway, Bastanchury Road, Yorba Linda Avenue, Orangethorpe Avenue, Rose Drive, Prospect Avenue, and Fairmont Boulevard. This grant will help inform future HSIP grants for the City.

ORANGE COUNTY SAFE ROUTES TO SCHOOL ACTION PLAN (UNDER DEVELOPMENT)

In Orange County, the Orange County Transportation Authority (OCTA) and the Orange County Health Care Agency (OCHCA) are currently working to complete a Safe Routes to School Action Plan for the various schools in Orange County. The Safe Routes to School (SRTS) Action Plan will support and expand the current SRTS work underway by countywide stakeholders and outline specific ways to improve traffic safety and support more walking and bicycling. This could be through education, partnerships, programs and infrastructure improvements. The action plan will establish a countywide program structure that will support SRTS programs in school districts countywide, define roles and next steps for ongoing and potential stakeholders, and identify potential funding sources for specific action items. The SRTS Action Plan and LRSP efforts are mutually supportive of each other, and will inform one another.

OC FOOTHILLS BIKEWAYS STRATEGY (2016)

The Bikeway Strategy seeks to ensure that the bikeways in Orange County are connected and comprehensive for several regional trips as well as local bike trips. Two of the corridors identified in the plan run through Yorba Linda: Corridor B, Lakeview to San Diego Creek, and Corridor K, the Bastanchury Corridor. In addition to infrastructure improvements, the plan also identifies several programmatic recommendations. The infrastructure and programmatic recommendations will inform the LRSP and ensure the improvements, policies, and programs identified in the LRSP are aligned with existing strategies.



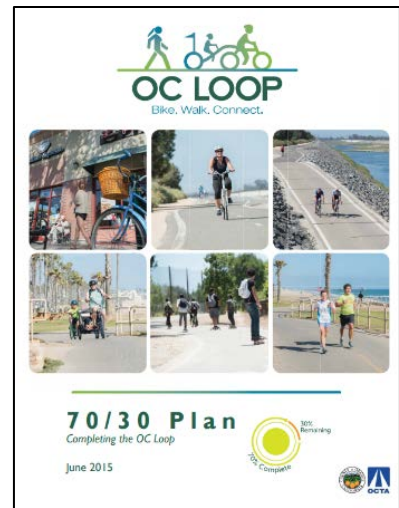
OC ACTIVE ORANGE COUNTY'S BIKE AND PED PLAN (2019)

OC Active: Orange County's Bike + Ped Plan is the first Countywide Active Transportation Plan (ATP) for Orange County. The ATP establishes a vision and roadmap to implementation for pedestrian and bicyclist facilities with the County. This plan allows local cities and the County of Orange to use this document as a foundation to apply for state funding to plan and implement local bicycle and pedestrian projects. The Plan hopes to ensure cross-sector collaboration, engage communities to advance improvements, and pursue funding of improvements. The projects, policies, and programs identified in this plan will inform the LRSP E's strategies.



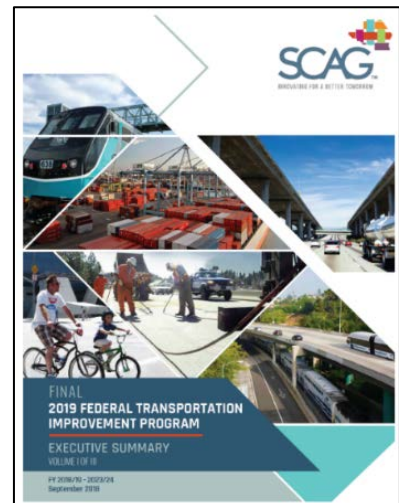
THE ORANGE COUNTY LOOP 70/30 PLAN (2015)

The OC Loop is a vision for 66 miles of seamless connections and an opportunity for people to bike, walk, and connect to some of California most scenic beaches and inland reaches. About 88% of the OC Loop is already in place and is used by thousands of people. Currently, nearly 58 miles use existing off-street trails along the San Gabriel River, Coyote Creek, Santa Ana River, and the Costal/Beach Trail. This plan lays out the missing segments and how to complete the Loop.



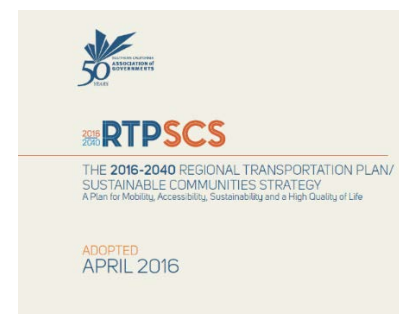
SCAG 2019 FEDERAL TRANSPORTATION IMPROVEMENT PROGRAM

The Federal Transportation Improvement Program (FTIP) is a federally mandated four year program for all surface transportation projects that will receive federal funding or are subject to a federally required action. The SCAG 2019 FTIP is a comprehensive listing of such transportation projects proposed over fiscal years (FY) 2018/19–2023/24. While there are not specific project detailed for Yorba Linda and other cities in the area, the plan contains policies reiterating the regions commitment to active transportation and traffic safety. It will provide a framework for the LRSP to ensure the policy and goals are aligned with the FTIP.



SCAG REGIONAL TRANSPORTATION PLAN/ SUSTAINABLE COMMUNITIES STRATEGIES (2016)

The SCAG RTP/SCS details a regional transportation plan for all six counties in Southern California Association of Government (SCAG) planning area: Los Angeles, Orange, San Bernardino, Riverside, Ventura, and Imperial. The Plan generally provides a framework to include sustainability as key principle in future development and seeks to increase mobility in the region. The plan does not contain any specific plans or policies directly related to Yorba Linda but will provide a framework for the LRSP to ensure the policy and goals are aligned with the sustainable communities' strategies.



4. COLLISION DATA COLLECTION AND ANALYSIS

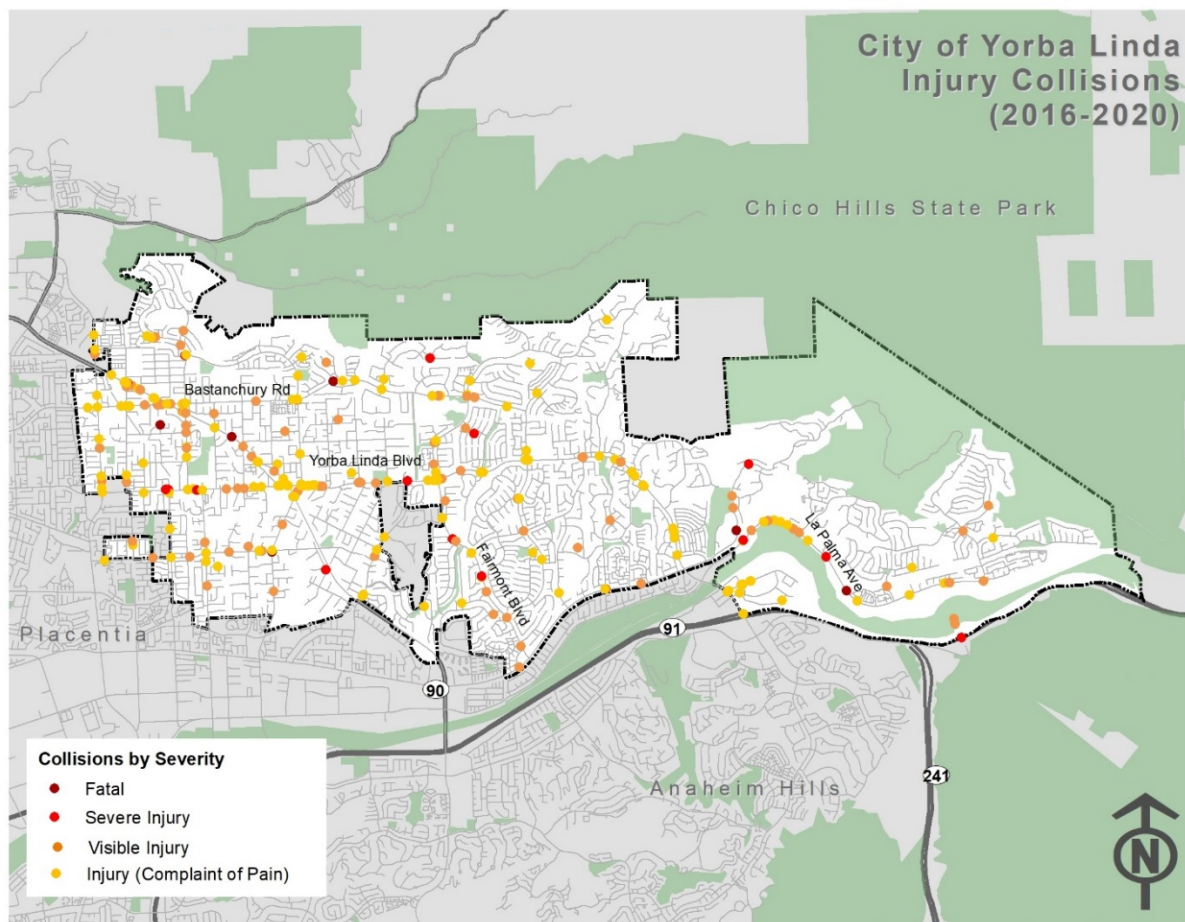
This chapter summarizes the results of a citywide collision analysis for collisions that have occurred in the City of Yorba Linda between January 2016 and December 2020, as part of the LRSP. A five-year city-wide collision data set was retrieved from TIMS and SWITRS.

The LRSP focuses on systemically identifying and analyzing traffic safety issues to recommend appropriate safety strategies and improvements. This chapter starts with an analysis of citywide collisions of all severity, including Property Damage Only (PDO) collisions, retrieved from TIMS and SWITRS. Further on, a detailed analysis was conducted for high-injury collisions, including F+SI collisions that have occurred on Yorba Linda's roadways. 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. The following is a brief overview of the sections:

1. Data Collection
2. Collision Data Analysis
3. Fatal and Severe Injury Collision Analysis
4. Geographic Collision Analysis
5. High Injury Network
6. Summary

Figure 6 illustrates all the injury collisions that have occurred in Yorba Linda from January 2016 to December 2020.

Figure 6: All Injury Collisions on Yorba Linda Roadways (2016 – 2020)



Data Collection

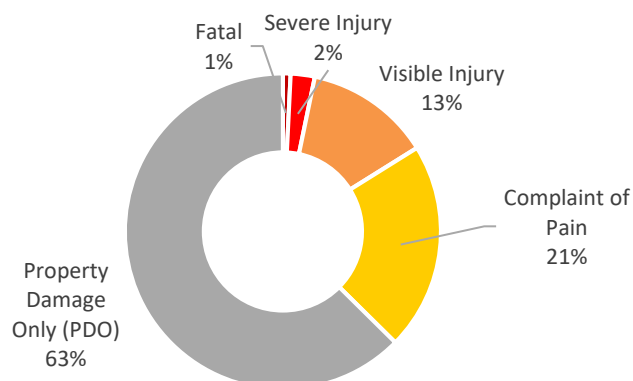
Collision data helps understand different factors that might be influencing collision patterns and various factors leading to collisions in a given area. For the purpose of this analysis, a five-year jurisdiction-wide collision data, from 2016 to 2020 was retrieved from TIMS and SWITRS. The collision data was analyzed and plotted in ArcMap to identify high-risk intersections and roadway segments.

Collision Data Analysis Results

COLLISION CLASSIFICATION

There were a total of 893 collisions reported citywide from 2016 to 2020. Out of these 559 collisions (63%) were PDO collisions, 190 collisions (21%) led to complaint of pain injury, and 115 collisions (13%) led to a visible injury. There were 29 F+SI collisions, 22 collisions (2%) led to a severe injury, and seven collisions (1%) led to a fatality. **Figure 7** illustrates the classification of all collisions based on severity.

Figure 7: Collisions by Severity (2016-2020)



The analysis first includes a comparative evaluation between all collisions and F+SI collisions, based on various factors including but not limited to the collision trend, primary collision factor, collision type, facility type, motor vehicle involved with, weather, lighting, and time of the day. Further on, a comprehensive analysis is conducted for only F+SI collisions. F+SI collisions cause the most damage to those affected, infrastructure and the aftermath of these collisions lead to great expenses for jurisdiction administration. The LRSP process thus focuses on these collision locations to proactively identify and counter their respective safety issues. The collision data was segregated by facility type, i.e. based on collisions occurring on intersections and roadway segments. For the purposes of the analysis, a collision was designated 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 1**.

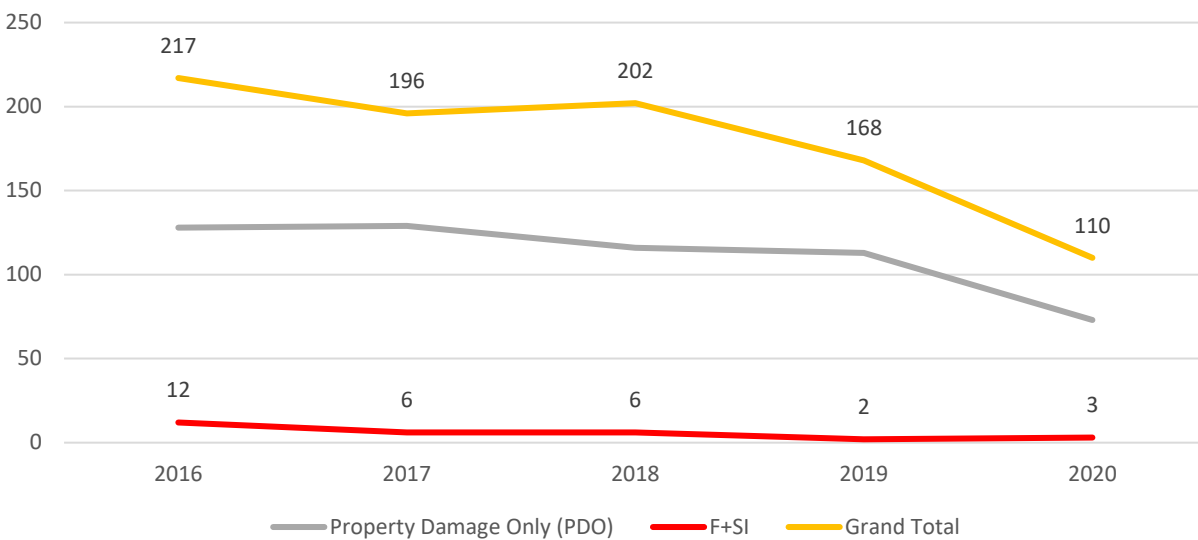
Table 1: Collisions by Severity and Facility Type

Collision Severity	Roadway Segment	Intersection	Total
Fatal	3	4	7
Severe Injury	1	21	22
Visible Injury	28	87	115
Complaint Of Pain	35	155	190
Property Damage Only (PDO)	127	432	559
TOTAL	194	699	893

Preliminary Analysis

YEARLY TRENDS

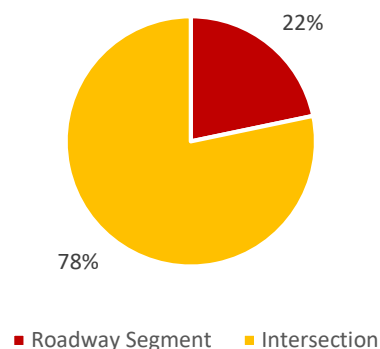
For all collisions, the number of reported collisions decreased from 2016 to 2020. The highest number of collisions (217 collisions) were observed in 2016 and the lowest number of collisions (110) were observed in 2020. A total of 29 F+SI collisions occurred in the City of Yorba Linda during the study period. They were observed to be the lowest (two collision) in 2019, and the highest in 2016 (12 collisions). **Figure 8** illustrates the five-year collision trend for all collisions, F+SI collisions and also PDO collisions.

Figure 8: Five Year Collision Trend

ROADWAY SEGMENT VS. INTERSECTION

When evaluating the roadway geometry, it was observed that the majority of collisions occurred at intersections. In the City of Yorba Linda, 78% of all collisions (699 collisions) occurred at intersections whereas 22% (194 collisions) occurred on roadway segments. This classification by facility type can be observed in **Figure 9**.

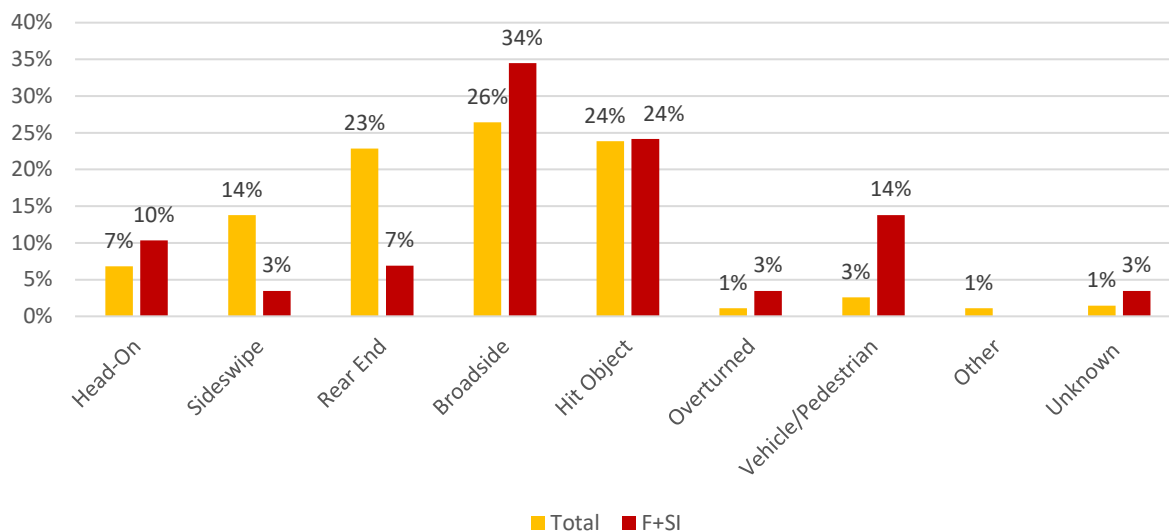
Figure 9: Intersection vs Roadway Collisions – All Collisions



COLLISION TYPE

The most commonly occurring collision type was broadside collisions (26%) and hit object collisions (24%). The collision type for F+SI collisions follow a similar trend. For F+SI collisions, the most commonly occurring collision type was broadside collisions (34%) and hit object collisions (24%). **Figure 10** illustrates the collision type for all collisions as well as F+SI collisions.

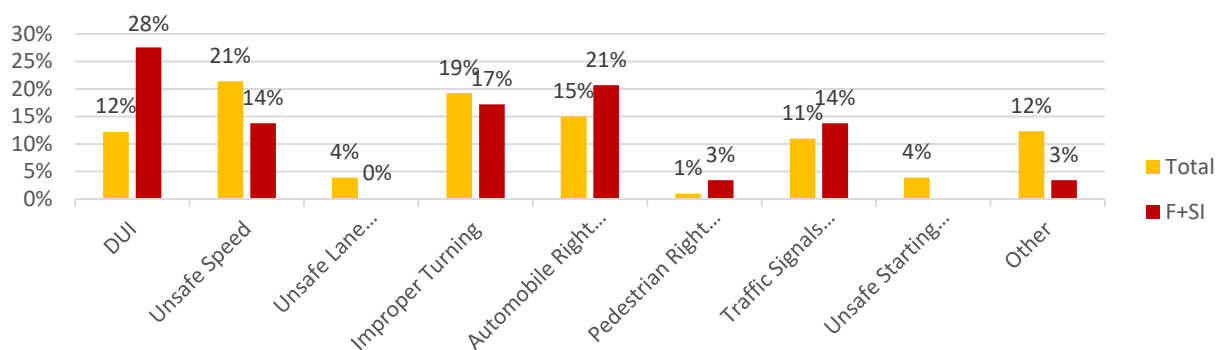
Figure 10: Collision Type – All Collisions vs. F+SI Collisions



VIOLATION CATEGORY

The most common violation category for all collisions was observed to be unsafe speed (21%) and improper turning collisions (19%). For F+SI collisions, driving under the influence (DUI) (28%), automobile right of way (21%) and improper turning (17%) were observed to be the most common violation categories. **Figure 11** illustrates the violation category for all collisions and F+SI collisions.

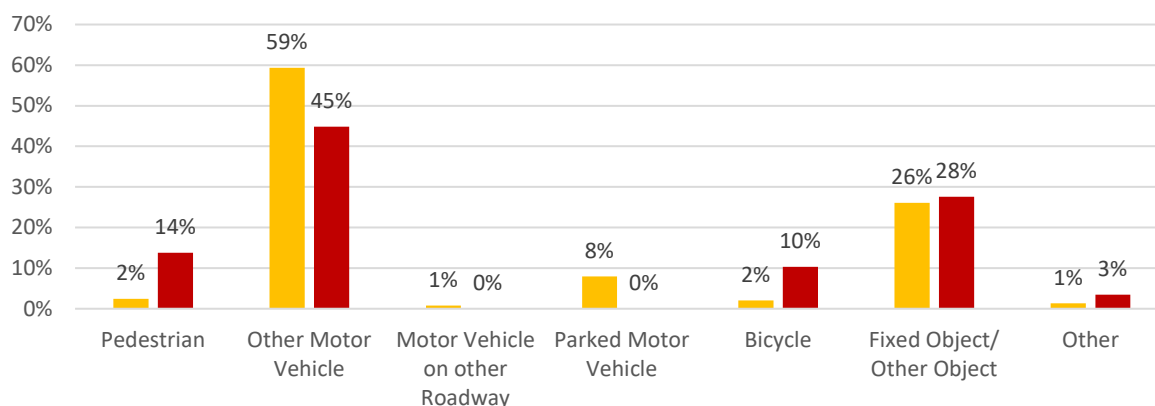
Figure 11: Violation Categories: All Collisions vs. F+SI Collisions



MOTOR-VEHICLE INVOLVED WITH

When considering all collisions, 59% occurred between two motor vehicles. The remaining collisions include motor vehicle involved with fixed object/other object (26%) and motor vehicle involved with parked motor vehicle (8%). For F+SI collisions, 45% of the collisions involved another motor vehicle, 28% involved a fixed object/other object, and 14% involved a pedestrian. **Figure 12** illustrates the percentage for all collisions as well as F+SI collisions.

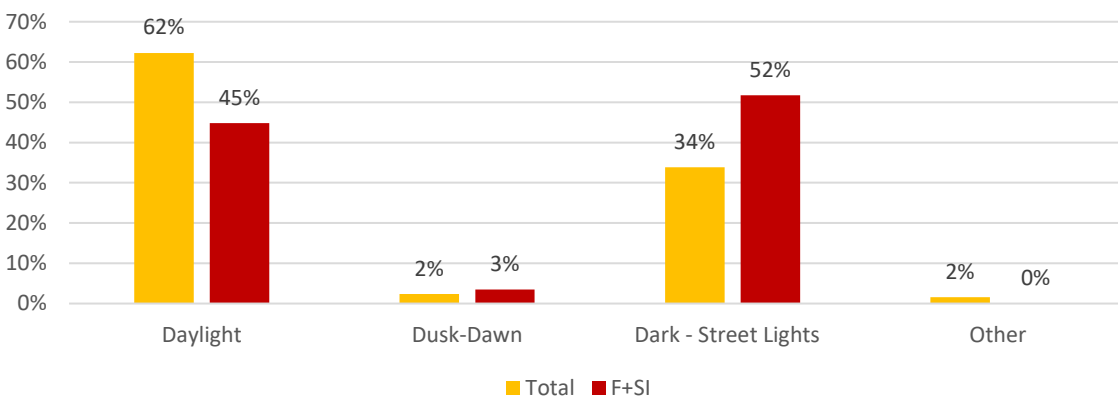
Figure 12: Motor Vehicle Involved with: All Collisions vs. F+SI Collisions



LIGHTING

For collisions of all severity, 62% of collisions occurred in daylight and 34% of collisions occurred in the dark on streets with street lights. For F+SI collisions, 45% of collisions occurred in daylight and 52% of collisions occurred in the dark on streets with street lights. **Figure 13** illustrates the lighting condition for all collisions and F+SI collisions.

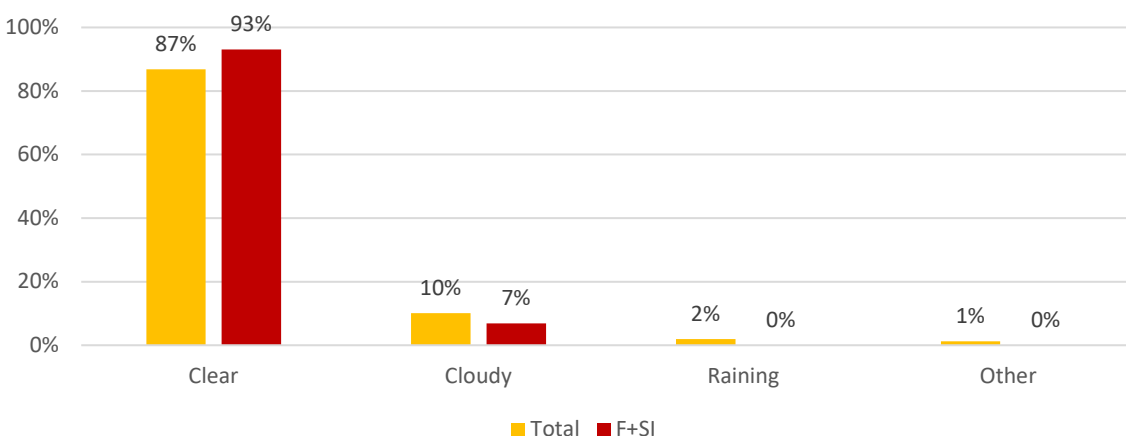
Figure 13: Lighting Conditions: All Collisions vs. F+SI Collisions



WEATHER

For all collisions, 87% of the collisions occurred during clear weather conditions. F+SI collisions follow similar trends, with 93% of the collisions having occurred during clear weather conditions. **Figure 14** illustrates the percentage distribution of weather conditions during occurrence of collisions of all severity as well as F+SI collisions.

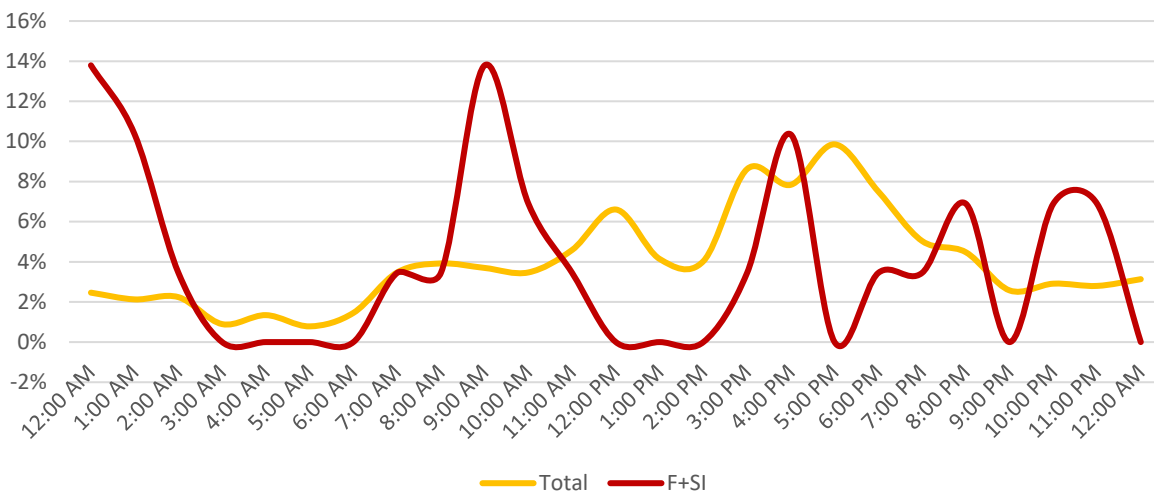
Figure 14: Weather Conditions: All Collisions vs. F+SI Collisions



TIME OF THE DAY

For collisions of all severity, the maximum number of collisions occurred between 5:00 p.m. to 6:00 p.m. (10%), while the minimum number of collisions occurred between 3:00 a.m. to 5:00 a.m. (1%). For all F+SI collisions, maximum number of collisions occurred between 9:00 a.m. to 10:00 a.m. and 12:00 a.m. to 1:00 a.m. **Figure 15** illustrates the percentage of collisions occurring during the day for all collisions as well as F+SI collisions.

Figure 15: Time of Day: All Collisions vs. F+SI Collisions



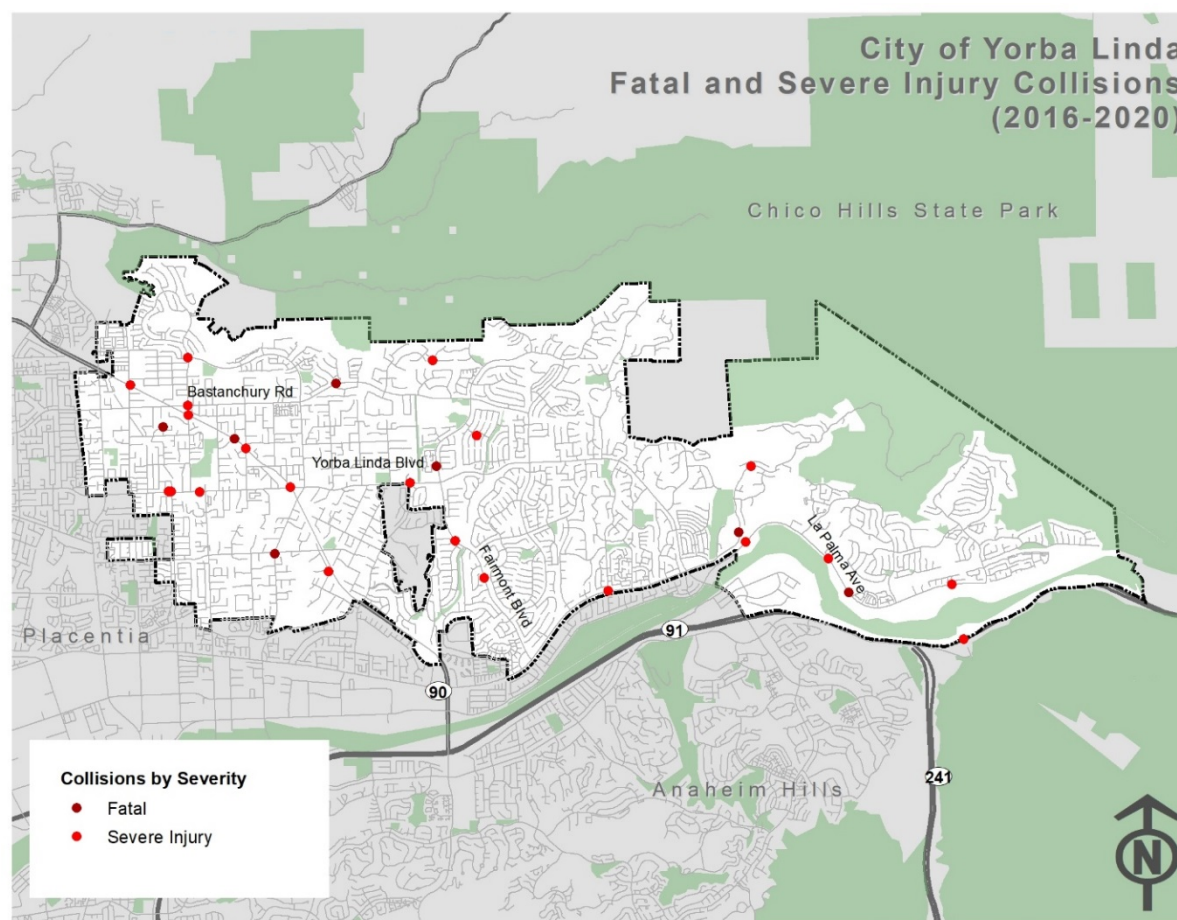
5. FATAL AND SEVERE INJURY COLLISIONS

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. Roadway segment and intersection F+SI collisions have been further analyzed taking into account the following collision attributes:

- Collision Type and Severity
- Collision Type and Violation Category
- Collision Type and Motor Vehicle Involved With
- Collision Type and Lighting

Figure 16 illustrate all the F+SI collisions that have occurred in the City of Yorba Linda between 2016 and 2020. A total of four F+SI collisions occurred on roadway segments, while 25 F+SI collisions occurred at intersections.

Figure 16: Fatal and Severe Injury Collisions City of Yorba Linda (2016-2020)

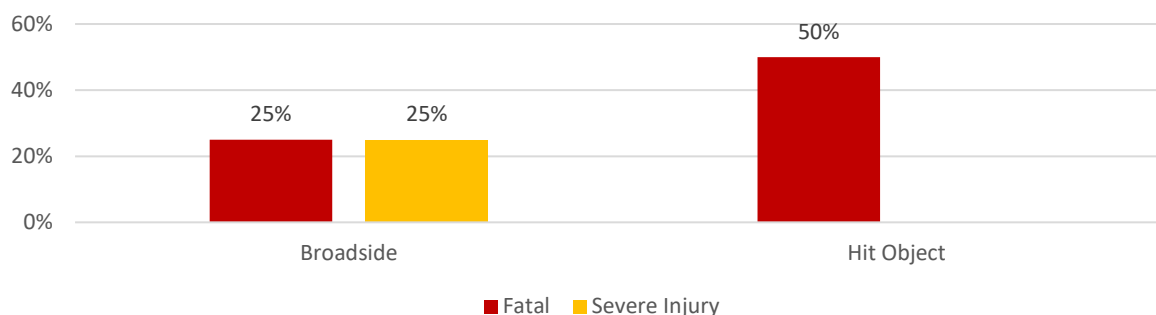


Roadway Segment Collision Analysis

COLLISION TYPE AND SEVERITY

For F+SI collisions that occurred on roadway segments, the highest percentage of fatal collisions were observed to be hit-object collisions. 50% of collisions that led to a fatality or severe injury were hit object collisions. **Figure 17** illustrates this distribution of collision type vs. severity.

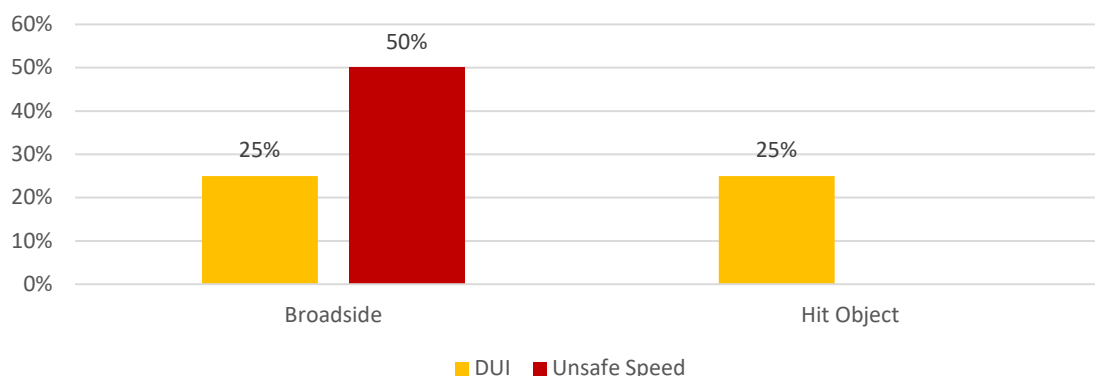
Figure 17: Collision Type vs. Severity: Roadway Segment F+SI Collisions



COLLISION TYPE AND VIOLATION CATEGORY

For F+SI collisions that occurred on roadway segments, broadside collisions were mainly caused due to unsafe speed violations. All hit-object collisions were observed to be caused due to DUI. **Figure 18** illustrates this distribution of collisions.

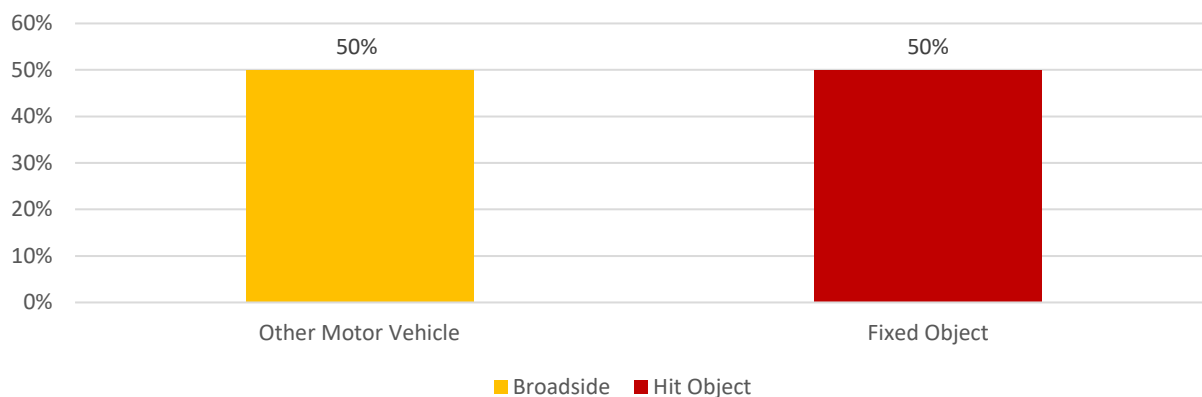
Figure 18: Collision Type vs. Violation Category: Roadway Segment F+SI Collisions



COLLISION TYPE AND MOTOR VEHICLE INVOLVED WITH

For F+SI collisions that occurred on roadway segments, the hit object collisions occurred due to the motor vehicle being involved with a fixed object or other object. Broadside collisions mainly occurred between two motor vehicles. **Figure 19** illustrates this distribution.

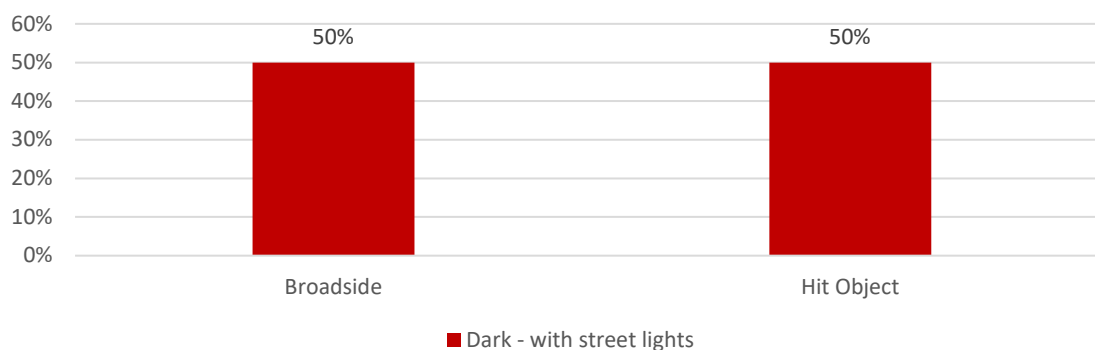
Figure 19: Collision Type vs. Motor Vehicle Involved With: Roadway Segment F+SI Collisions



COLLISION TYPE AND LIGHTING

For F+SI collisions that occurred on roadway segment locations in Yorba Linda, broadside and hit object collisions all occurred at locations that were dark with no street lights. **Figure 20** illustrates the distribution of the collision type vs. lighting.

Figure 20: Collision Type vs. Lighting: Roadway Segment F+SI Collisions

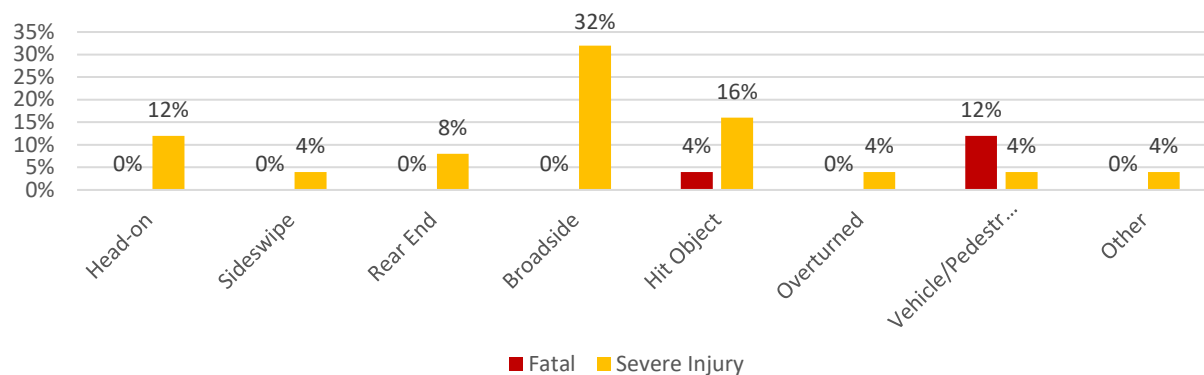


Intersection Collision Analysis

COLLISION TYPE AND SEVERITY

For F+SI collisions that occurred on intersections, the highest percentage of fatal collisions were observed to be vehicle/pedestrian collisions. 32% of collisions that led to a severe injury were broadside collisions. **Figure 21** illustrates this distribution of collision type vs. severity.

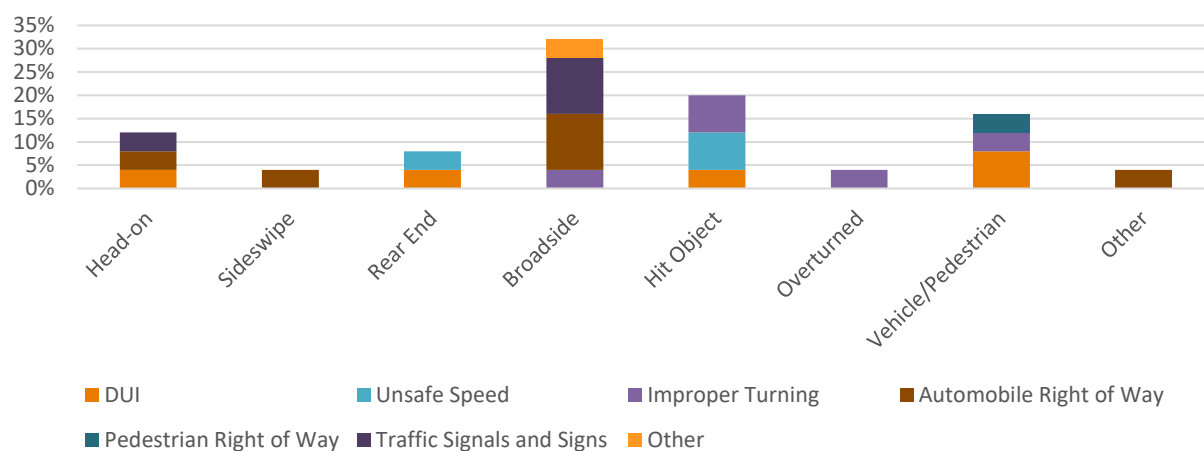
Figure 21: Collision Type vs. Severity: Intersection F+SI Collisions



COLLISION TYPE AND VIOLATION CATEGORY

For F+SI collisions that occurred at intersections, broadside collisions were the most common collisions type, primarily caused by traffic signals and signs violations and automobile right of way violations. **Figure 22** illustrates this distribution of collisions.

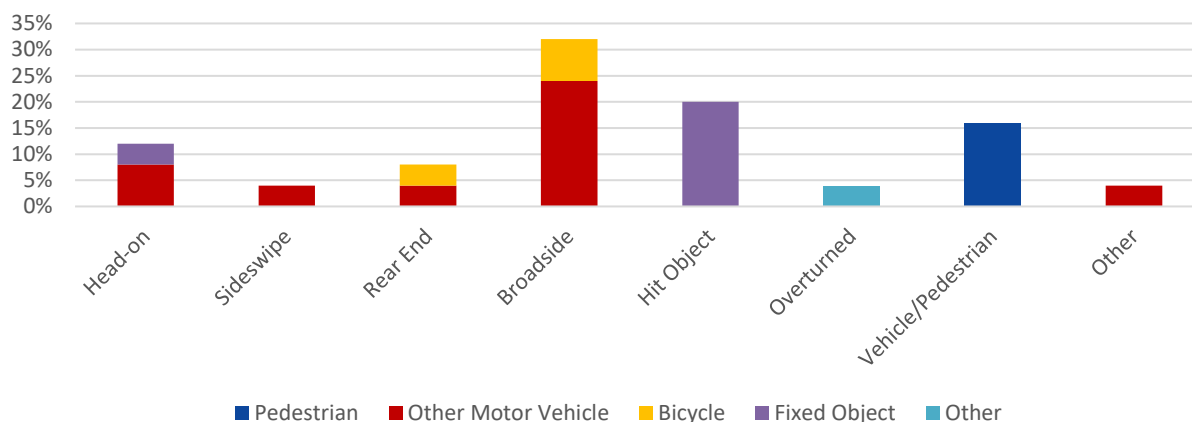
Figure 22: Collision Type vs. Violation Category: Intersection F+SI Collisions



COLLISION TYPE AND MOTOR VEHICLE INVOLVED WITH

For F+SI collisions that occurred at intersections, broadside collisions occurred primarily between two motor vehicles. Head-on collisions also primarily occurred between two motor vehicles. **Figure 23** illustrates this distribution.

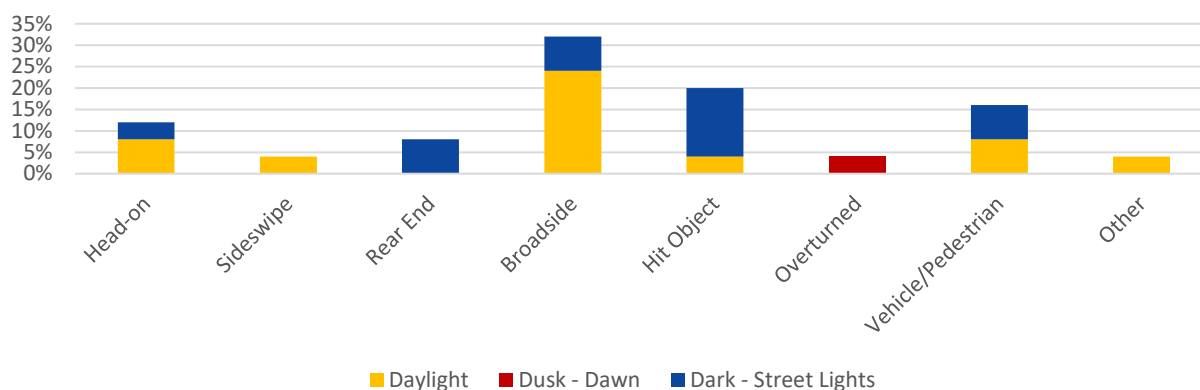
Figure 23: Collision Type vs. Motor Vehicle Involved With: Intersection F+SI Collisions



COLLISION TYPE AND LIGHTING

For F+SI collisions that occurred at intersection locations in Yorba Linda, rear-end collisions occurred at locations that were dark with street lights. All sideswipe collisions occurred during daylight. Vehicle/pedestrian collisions have been observed to occur both during daylight as well as at locations that were dark with no street lights. **Figure 24** illustrates the distribution of the collision type vs. lighting.

Figure 24: Collision Type vs. Lighting: Intersection F+SI Collisions



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 Yorba Linda. The above collision analysis was used to identify five main collision factors that highlight the top trends among collisions in Yorba Linda. These five collision factors were identified to be nighttime collisions, broadside collisions, DUI collisions, hit object collisions, and automobile right of way collisions.

NIGHTTIME COLLISIONS

52% of collisions of F+SI collisions in Yorba Linda were nighttime collisions. **Figure 25** shows the distribution of nighttime collisions throughout the City of Yorba Linda between 2016 and 2020. Yorba Linda Boulevard, Valley View Avenue, and La Palma Avenue have a higher concentration of nighttime collisions, compared to other Yorba Linda roads.

BROADSIDE COLLISIONS

34% of F+SI collisions were broadside collisions. **Figure 26** shows the distribution of broadside collisions throughout the City of Yorba Linda between 2016 and 2020. Valley View Avenue, Van Buren Street, and Prospect Avenue have a higher concentration of broadside collisions, compared to other Yorba Linda roads.

DUI COLLISIONS

28% of F+SI collisions were due to DUI violations. **Figure 27** shows the distribution of DUI collisions throughout the City of Yorba Linda between 2016 and 2020. La Palma Avenue, Yorba Linda Boulevard, and Yorba Ranch Road have a higher concentration of DUI collisions, compared to other Yorba Linda roads.

HIT OBJECT COLLISIONS

For F+SI collisions in the City of Yorba Linda, 24% of collisions were hit object collisions. **Figure 28** shows the distribution of hit object collisions throughout the City of Yorba Linda between 2016 and 2020. La Palma Avenue, Lakeview Avenue, and Imperial Highway have a higher concentration of hit object collisions, compared to other Yorba Linda roads.

AUTOMOBILE RIGHT OF WAY COLLISIONS

For F+SI collisions in the City of Yorba Linda, 22% of collisions were due to automobile right-of-way violations. **Figure 29** shows the distribution of automobile right of way collisions throughout the City of Yorba Linda between 2016 and 2020. Yorba Linda Boulevard, Valley View Avenue, and Savi Ranch Parkway have a higher concentration of automobile right of way collisions, compared to other Yorba Linda roads.

Figure 25: City of Yorba Linda Nighttime Collisions (2016-2020)

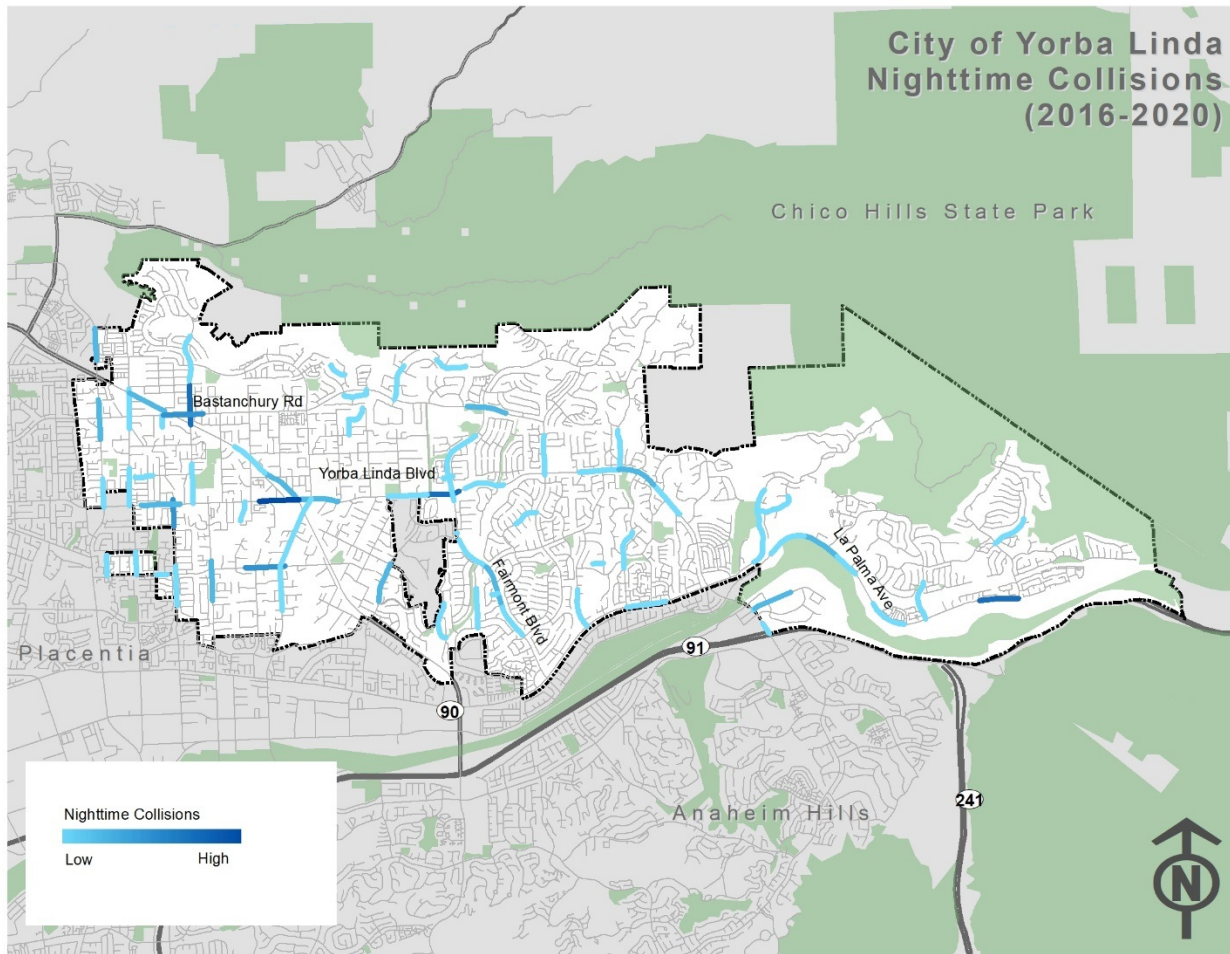


Figure 26: City of Yorba Linda Broadside Collisions (2016-2020)

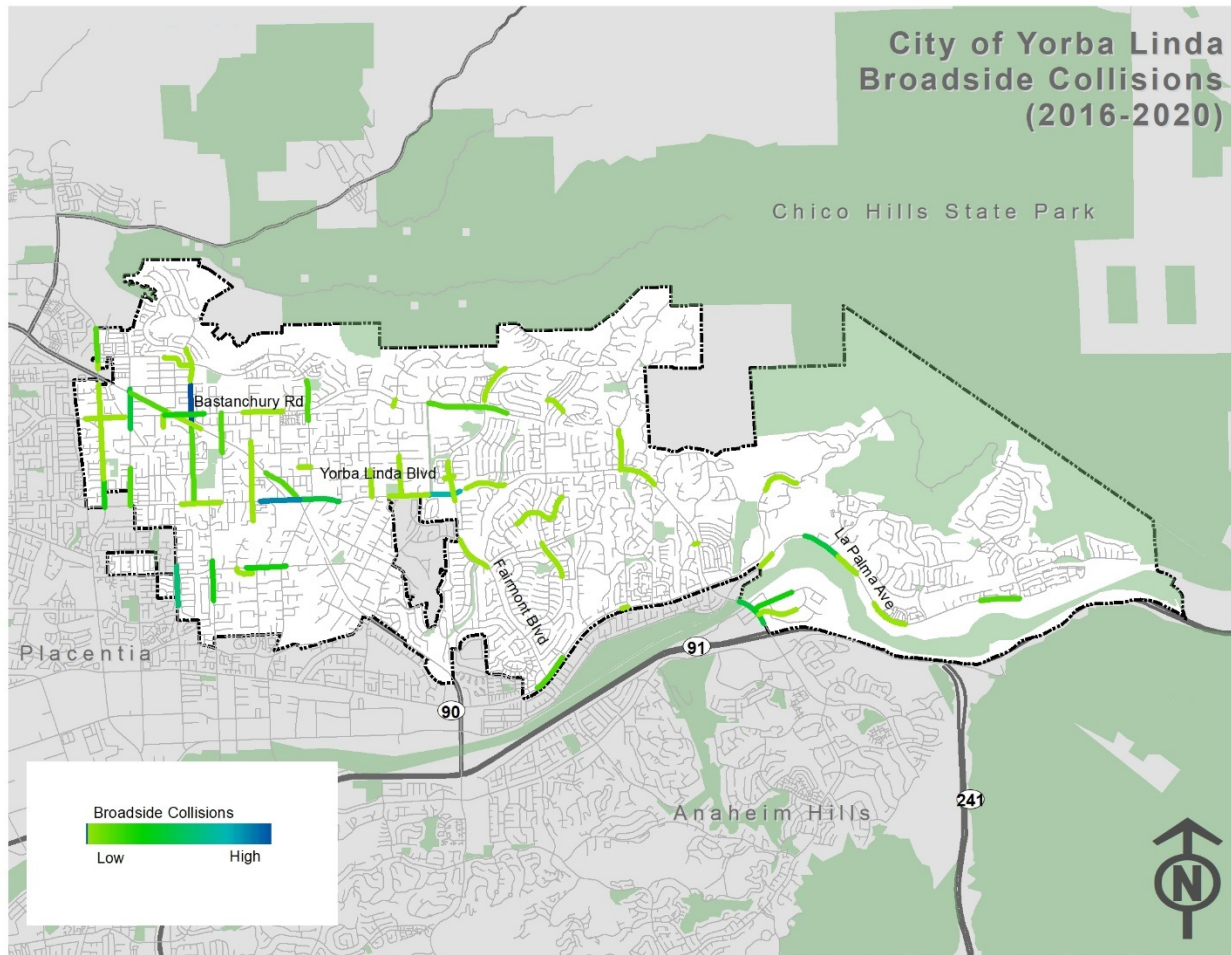


Figure 27: City of Yorba Linda DUI Collisions (2016-2020)

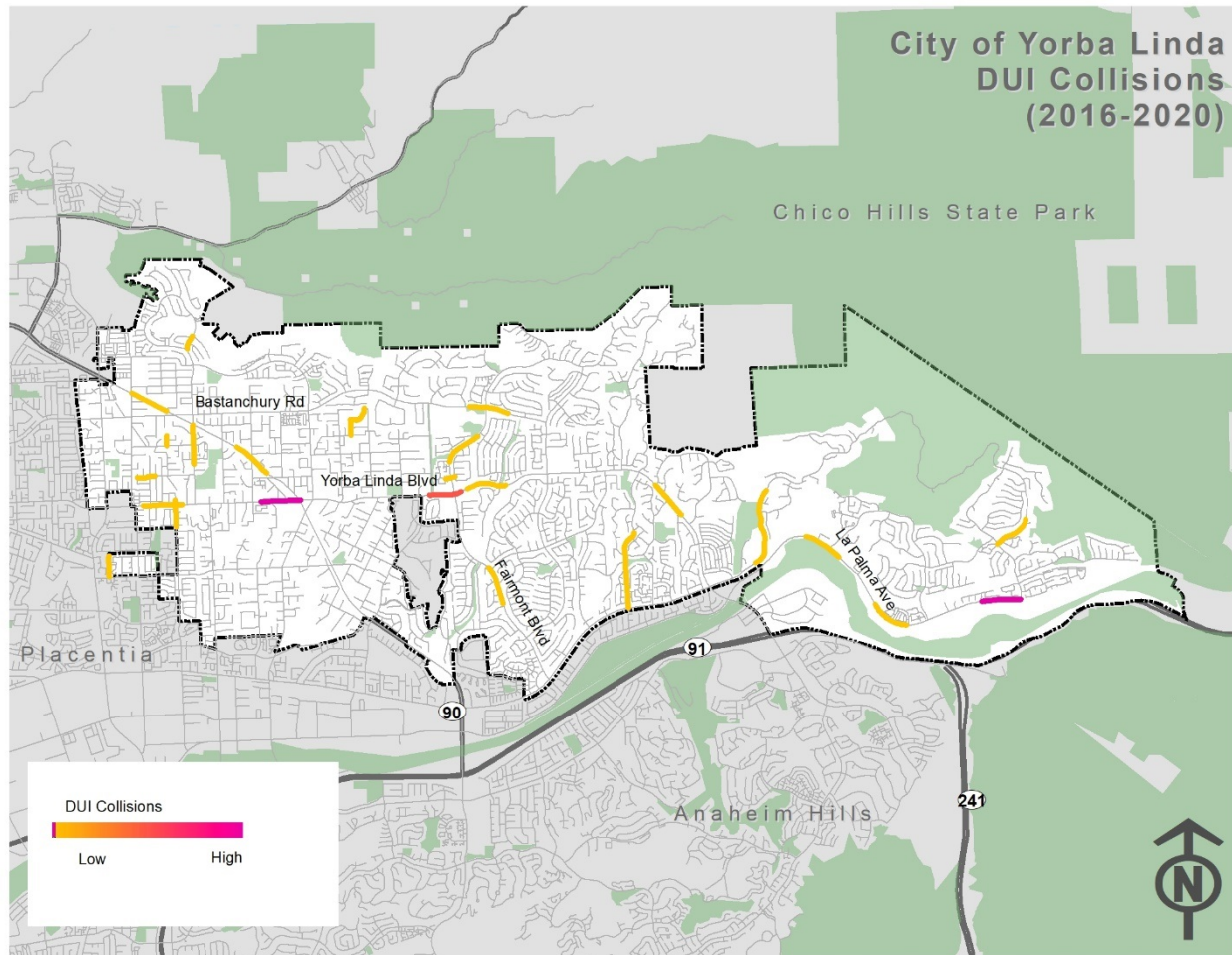


Figure 28: City of Yorba Linda Hit Object Collisions (2016-2020)

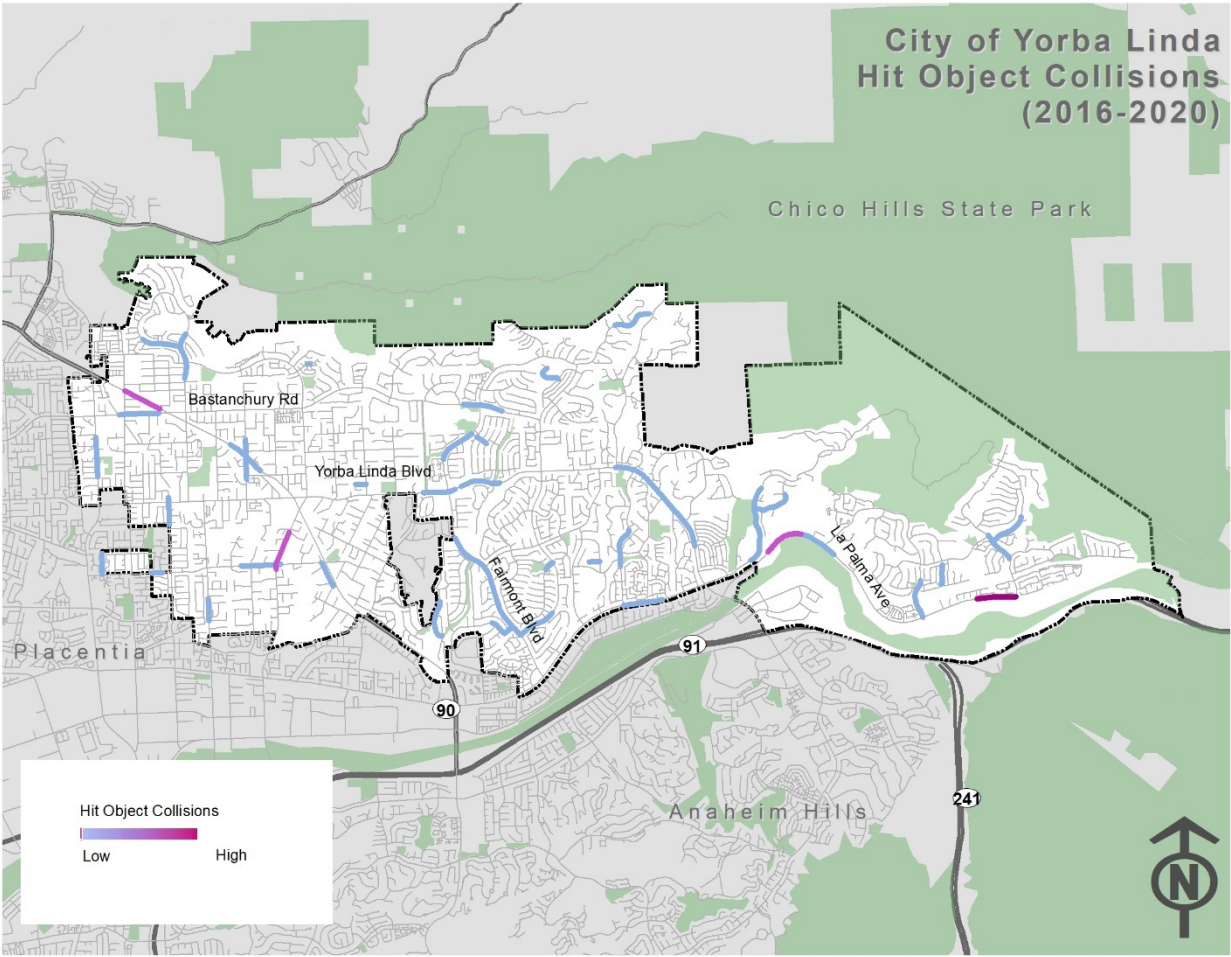
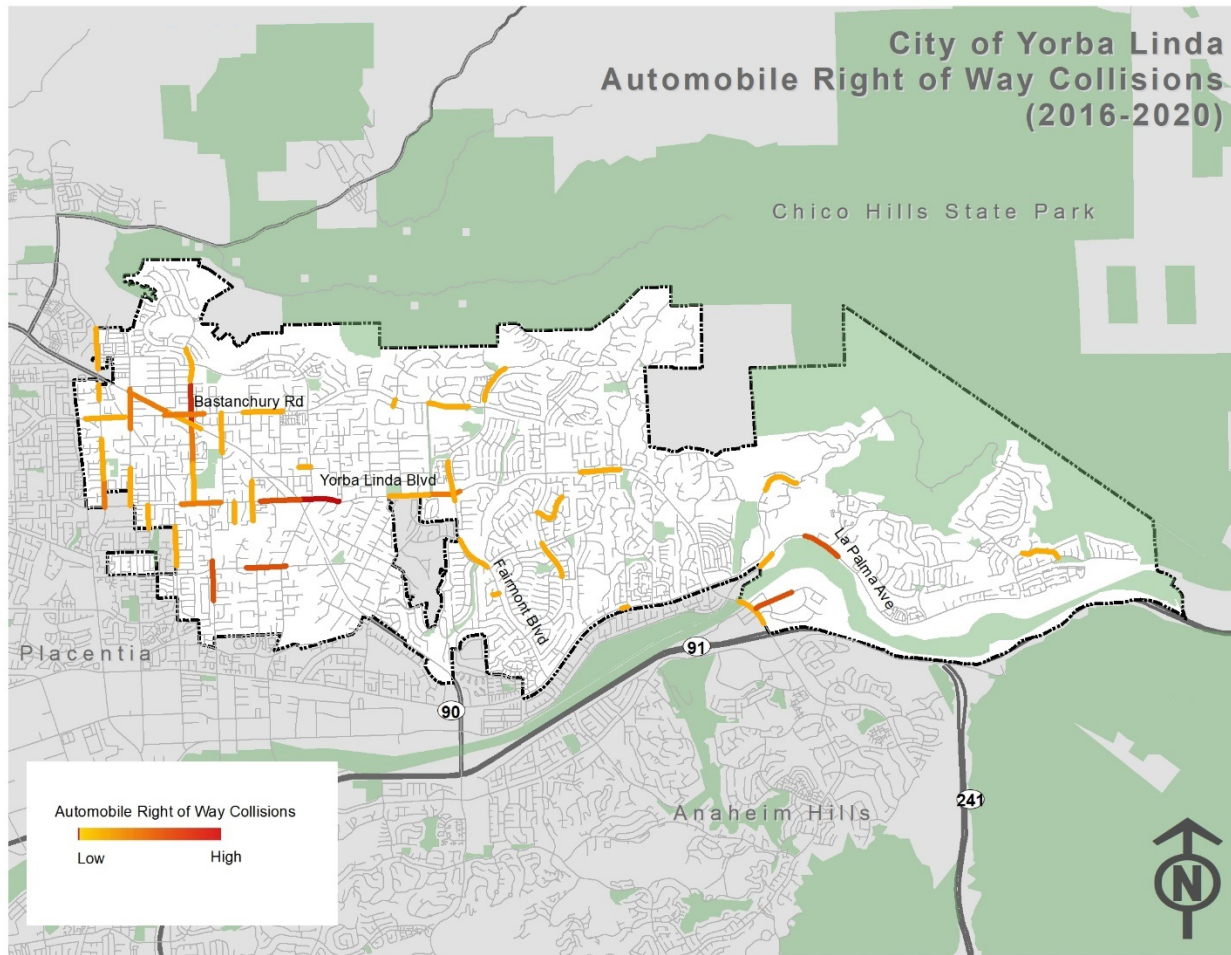


Figure 29: City of Yorba Linda Automobile Right of Way Collisions (2016-2020)



Collision Severity Weight

A collision severity weight 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 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 a simplified version of the comprehensive crash costs per HSIP Cycle 10 application. The weights used in the analysis are shown below in **Table 2**.

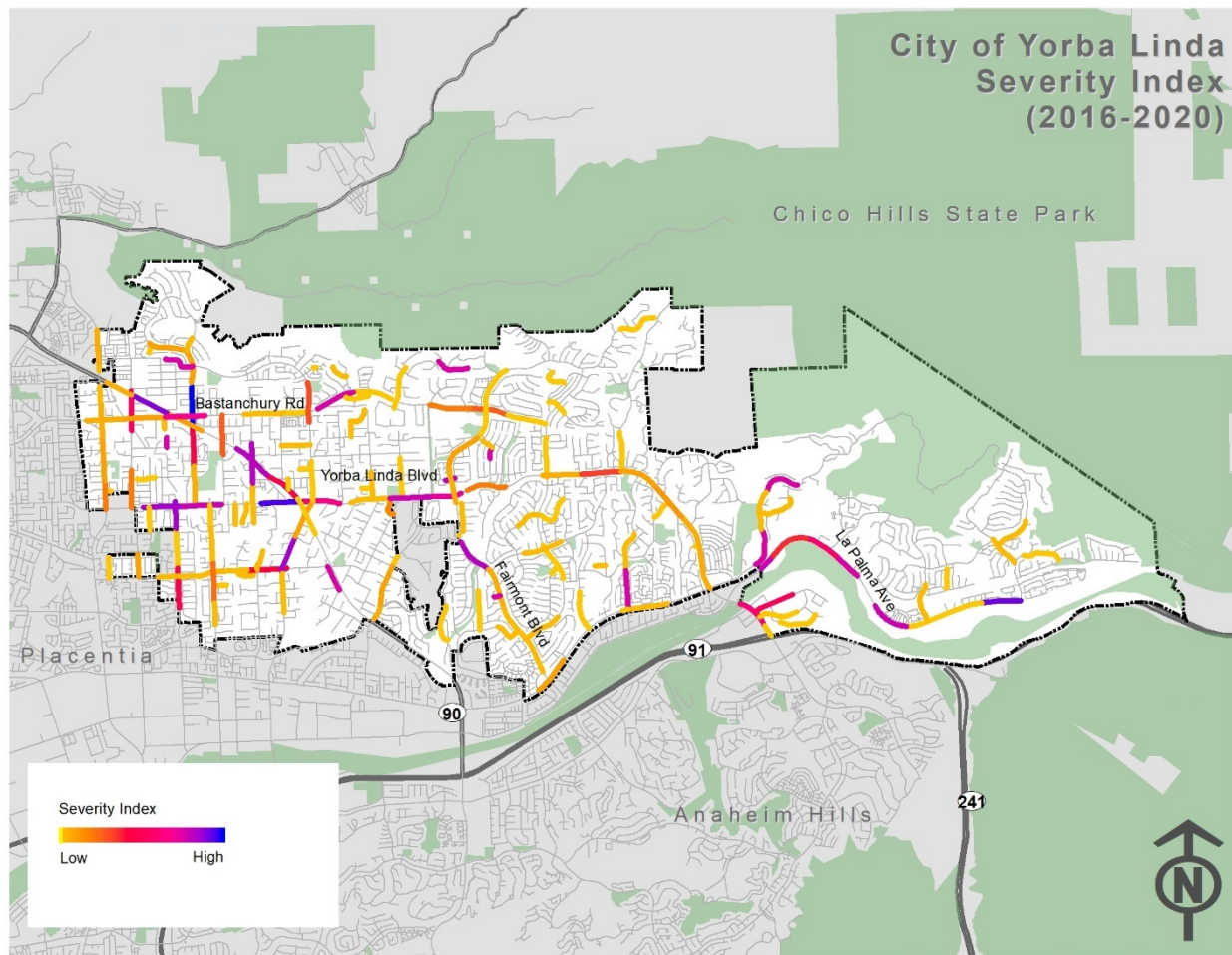
Table 2: EPDO Score used in HSIP Cycle 10

Collision Severity	EPDO Score
F+SI Combined	165*
Visible Injury	11
Possible Injury	6
PDO	1

*This is the score used in HSIP Cycle 10 for collisions on roadways segments, to simplify the analysis this study uses the same score for all F+SI collisions regardless of location

The EPDO scores for all collisions can then be aggregated in a variety of ways to identify collision patterns, such as location hot-spots. The weighted collisions for the City of Yorba Linda were geolocated onto Yorba Linda's road network. **Figure 30** shows the location and geographic concentration of collisions by their EPDO score.

Figure 30: City of Yorba Linda Severity Index

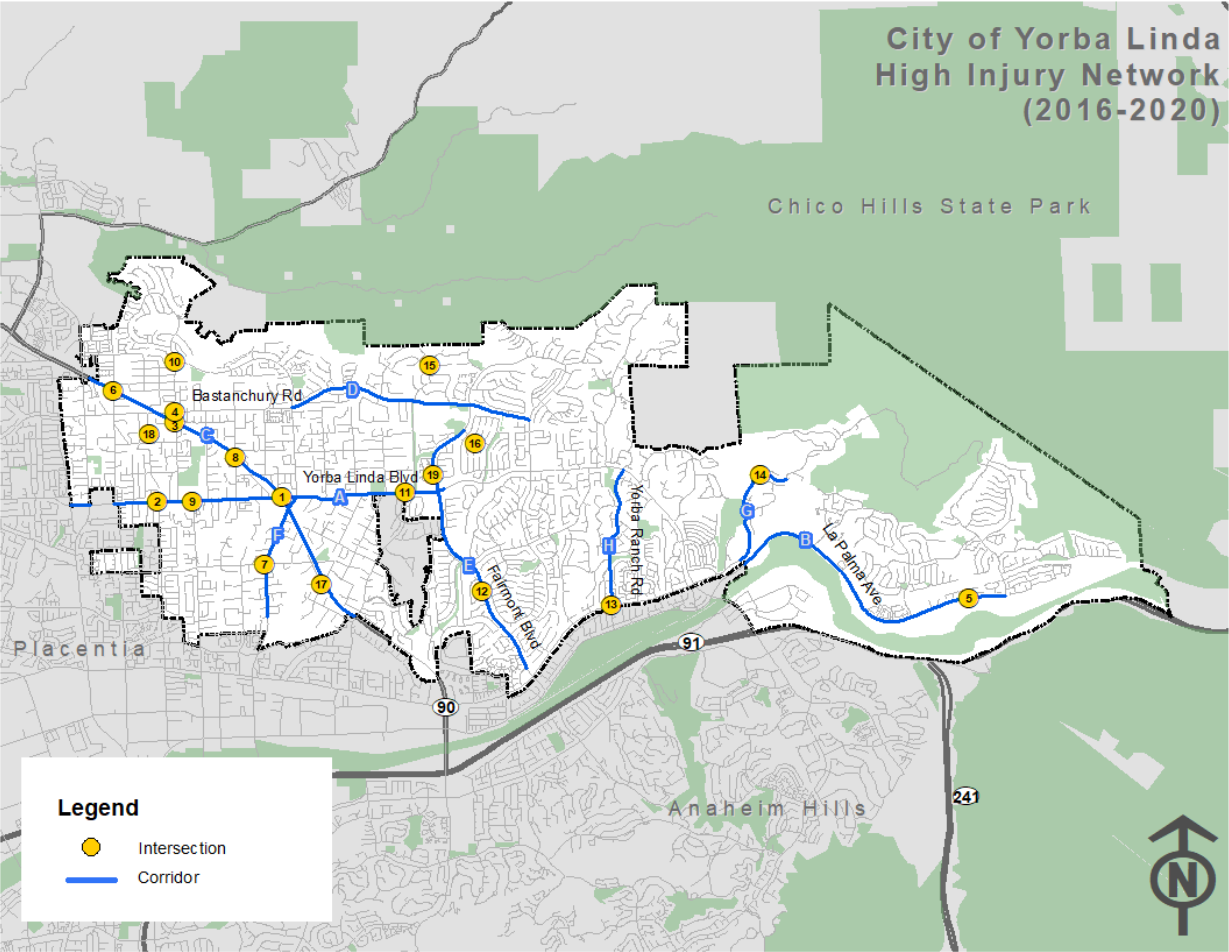


High Injury Network

Following the detailed collision analysis, the next step was to identify the high-risk roadway segments and intersections in the City of Yorba Linda. The methodology for scoring the high injury locations is the same method used in the severity weight section. **Figure 31** shows the top eight high-collision roadway segments, and top 19 high-collision intersections.

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 directly at an intersection, or collisions that are assigned a zero value in distance from intersection value column in the SWITRS. This may lead to double counting of collisions when developing the high injury network. However, the analysis is done this way to follow HSIP guidance for including collisions in intersection related applications and roadway segment applications, to allow the City to apply for such funds with ease.

Figure 31: City of Yorba Linda High Injury Network



INTERSECTION RANKING

There is 19 intersections that were identified as high injury intersections. A total of 21 F+SI collisions occurred at these intersections. The intersection of Imperial Highway and Yorba Linda Boulevard has the highest EPDO score.

Table 3 lists the EPDO score of the top 10 identified high-risk intersections along with the type of collisions and the number of F+SI collisions that occurred at these locations.

Table 3: High Injury Intersections

ID	Intersection	Total	F+SI	Night-Time	Broad-Side	DUI	Hit Object	EPDO Score
		Collisions						
1	Imperial Hwy and Yorba Linda Blvd	12	2	5	8	3	0	400
2	Van Buren St and Yorba Linda Blvd	6	2	5	0	2	1	364
3	Imperial Hwy and Valley View	9	1	2	6	0	0	238
4	Bastanchury Rd and Valley View	9	1	2	5	0	0	223
5	La Palma Ave and Gypsum Canyon Rd	6	1	1	2	0	0	205
6	Prospect Ave and Imperial Hwy	5	1	2	2	1	0	199
7	Lakeview and Buena Vista	5	1	4	2	0	2	189
8	Eureka Ave and Imperial Hwy	2	1	0	1	0	1	176
9	Richfield Rd and Yorba Linda Blvd	2	1	0	0	0	0	171
10	Valley View and Drake St/ Lakeview Ave	2	1	1	2	0	0	171
11	Yorba Linda and Kellog Dr	2	1	1	1	0	0	171
12	Fairmont Blvd and Big Spring Dr	2	1	2	0	1	1	171
13	Esperanza Rd and Yorba Ranch Rd	2	1	0	1	1	0	171
14	Hidden Hills Rd and Stonewood Dr	1	1	0	1	0	0	165
15	Welsh Pony Ln and Red Roan Rd	1	1	1	0	0	0	165
16	Avenida Del Rey and Via Del La Plz	1	1	0	0	0	0	165
17	Ohio St and Scenic View Dr	1	1	0	0	0	1	165
18	Casa Oro Dr and Casa Hermosa Dr	1	1	0	0	1	0	165
19	Fairmont Blvd and Lorca Ln	1	1	1	0	1	0	165

ROADWAY SEGMENT RANKING

A total of eight corridors were identified as high injury corridors. There were a total 13 F+SI collisions on these corridors. The corridor with the highest amount of F+SI collisions is Yorba Linda Boulevard and La Palma Avenue with 3 F+SI collisions.

Table 4 lists the EPDO score of the top eight identified high-collision corridors along with the number of F+SI collisions and total collisions.

Table 4: High Injury Corridors

ID	Corridors	Total	F+SI	Night-time	Broad-side	DUI	Hit Object	Length (miles)	EPDO Score
		Collisions							
A	Yorba Linda Blvd: Fairmont Blvd to N Jefferson St	28	3	9	9	3	2	2.74	685
B	La Palma Ave: Western City Limits to Cam De Bryant	18	3	4	4	3	4	2.6	610
C	Imperial Hwy: Prospect Ave to Yorba Linda Blvd	17	2	2	2	1	0	1.6	450
D	Bastanchury Rd: Imperial Hwy to Humboldt Ln	9	1	2	2	1	1	1.5	228
E	Fairmont Blvd: Cordova Ln to Esperanza Rd	8	1	5	1	2	4	0.3	222
F	Lakeview Ave: Flora Dr to Buena Vista Ave	5	1	2	0	0	2	0.3	199
G	Hidden Hills: Esperanza Rd to Mission Hills Ln	3	1	3	0	2	3	1	187
H	Yorba Ranch Rd: Esperanza Rd to Yorba Linda Blvd	2	1	1	9	2	1	1.1	176

Summary

About 52% of F+SI collisions have occurred at night. Yorba Linda Boulevard, Valley View Avenue, and La Palma Avenue have a higher concentration of nighttime collisions, compared to other roads in Yorba Linda. This may indicate that lighting at these locations should be evaluated to ensure lumen levels are adequate. Many different factors can contribute to nighttime collisions, such as low lighting levels that can be targeted with appropriate countermeasure, but extraneous factors can also contribute to nighttime injury such as driving under influence, sleep, and fatigue. Improvements such as installing new lighting, upgrading existing lighting to a higher lumen, installing larger signal heads, installing and upgrade signs with new fluorescent sheeting, and installing pedestrian improvements with lighting elements such as rectangular rapid flashing beacons (RRFB's) and HAWKs can help make these locations safer for all road users.

For F+SI collisions in the City of Yorba Linda, 34% of collisions were broadside collisions. This calls for evaluating broadside collisions along the high injury network and other locations throughout the City with similar characteristics. Improvements at these location may consist of improved signal hardware/larger signal heads, provide protected left turn phase, convert signal to mast arm (from pedestal-mounted), raised medians at the approach to intersections, and others.

The next steps include identifying strategies corresponding to the 4 E's of safety to comprehensively make the roadways of the City of Yorba Linda safer for all modes of transportation.

6. EMPHASIS AREAS

Emphasis areas are focus areas for the LRSP that are identified through the comprehensive collision analysis of the identified high injury locations within the City of Yorba Linda. Emphasis areas help in identifying appropriate safety strategies and countermeasures with the greatest potential to reduce collisions occurring at these high injury locations. This technical memorandum summarizes the top seven emphasis areas identified for the City of Yorba Linda. These emphasis areas were derived from the consolidated high injury collision database (**Appendix A**) where top injury factors were identified by combing the data manually.

Based on the systemic safety analysis and identified high-injury intersections and roadway segments, the top risk factors are as follows –

- Improve Intersection Safety
- Reduce Broadside Collisions
- Reduce Nighttime Collisions
- Reduce Automobile Right-of-Way Violations
- Reduce Unsafe Speed Collisions
- Reduce DUI Collisions
- Reduce Younger Driver Collisions

The 4 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**MS. This approach recognizes that not all locations can be addressed solely by infrastructure improvements.

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 enforcement. Additionally, education efforts can supplement enforcement to improve the efficiency of each. 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, EMS entails strategies around supporting organizations that provide rapid response and care when responding to collisions causing injury, by stabilizing victims and transporting them to facilities.

Existing Traffic Safety Efforts

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

Table 5: Existing Traffic Safety Efforts

Program/Document	Description	E's Addressed
OCTA Bike and Walk Safety Programs	OCTA has a number of resources for bike and walk safety including hosting virtual bike and pedestrian safety classes and online published material.	Education
Yorba Linda School Zone Safety Assessment	Yorba Linda School Zone Safety Assessment assessed school area facilities in residential neighborhoods at 14 locations selected for further study.	Engineering
Bike and Pedestrian Safety Enforcement Operation Program	Orange County Sheriff's Department provides contract police services for the City of Yorba Linda. The program periodically conducts bike and pedestrian safety enforcement operations which focus enforcement on collision factors involving motorists, pedestrians, and bicyclists.	Enforcement

Factors Considered in the Determination of Emphasis Areas

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

EMPHASIS AREA 1 – INTERSECTION SAFETY

A total of 164 reported injury collisions occurred on the high injury network in the City of Yorba Linda. 124 (76%) of these collisions occurred at intersections, including 19 F+SI collisions. The following collision data is based on only intersection injury collisions that occurred on the high injury network in the City of Yorba Linda, followed by strategies to make these locations safer in **Table 6**.



Table 6: Emphasis Area 1 Strategies

Objective: To reduce the number of F+SI collisions at intersections			
	Strategies	Performance Measure	Agencies/ Organizations
EDUCATION	Conduct public information and education campaign for intersection safety laws regarding traffic signals, stop signs, and turning left or right.	Number of education campaigns	City/School District/Police Department
ENFORCEMENT	Targeted enforcement at high-risk intersections to monitor traffic law violations right-of-way violations, speed limit laws, and other violations that occur at intersections.	Number of tickets issued	Police Department
ENGINEERING	<ul style="list-style-type: none"> 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) NS06, Install/upgrade larger or additional stop signs or other intersection warning/regulatory signs NS07, Upgrade intersection pavement markings (NS.I.) 	Number of intersections improved	City
EMS	S05, Install emergency vehicle pre-emption systems.	EMS vehicle response time	City/Emergency Department

EMPHASIS AREA 2 – BROADSIDE COLLISIONS

A total of 164 reported injury collisions occurred on the high injury network in the City of Yorba Linda. 63 (38%) of these collisions were broadside collisions, including eight F+SI collisions. The following collision data is based on only broadside injury collisions that occurred on the high injury network in the City of Yorba Linda, followed by strategies to make these locations safer in **Table 7**.

43%

Automobile right-of-way collisions

32%

Traffic signal or signs violation

51%

Occurred on Imperial Hwy or Yorba Linda Blvd

Table 7: Emphasis Area 2 Strategies

Objective: To reduce the number of F+SI broadside collisions			
	Strategies	Performance Measure	Agencies/ Organizations
EDUCATION	Conduct public information and education campaign for intersection safety laws regarding traffic lights, stop signs, and turning left or right.	Number of education campaigns	City/ School District/ Police Department
ENFORCEMENT	Targeted enforcement at high-risk locations.	Number of citations and/or warnings issued	Police Department
ENGINEERING	<ul style="list-style-type: none"> 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 	Number of locations improved to mitigate night-time collisions	City
EMS	Improve resource of deployment for emergency responses to collision sites.	EMS vehicle response time at night	City/Emergency Department

EMPHASIS AREA 3 – NIGHTTIME COLLISIONS

A total of 164 reported injury collisions occurred on the high injury network in the City of Yorba Linda. Of these 58 (35%) collisions occurred at nighttime, including 12 F+SI collisions. The following collision data is based on only nighttime injury collisions that occurred on the high injury network in the City of Yorba Linda, followed by strategies to make these locations safer in **Table 8**.



Table 8: Emphasis Area 3 Strategies

Objective: To reduce the number of F+SI collisions that occur at nighttime			
	Strategies	Performance Measure	Agencies/ Organizations
EDUCATION	Conduct public information and education campaign for safety laws regarding and the larger risk of collisions during the nighttime.	Number of outreach events and safety campaigns	City/School District/Police Department
ENFORCEMENT	Targeted enforcement at high-risk locations to monitor collisions that occur at nighttime.	Number of citations issued	Police Department
ENGINEERING	<ul style="list-style-type: none"> S02, Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size and number S10, Install flashing beacon as warning NS06, Install/upgrade larger or additional stop signs or other intersection warning/regulatory signs R01, Add segment lighting R22, Install/Upgrade signs with new fluorescent sheeting (regulatory or warning) R27, Install delineators, reflectors and/or object markers R26, Install dynamic/ variable speed warning signs R27, Install delineators, reflectors and/or object markers 	Number of locations improved	City
EMS	Improve resource deployment for emergency responses at collision sites.	EMS vehicle response time	City/Emergency Department

EMPHASIS AREA 4 – AUTOMOBILE RIGHT OF WAY COLLISIONS

A total of 164 reported injury collisions occurred on the high injury network in the City of Yorba Linda. 37 (22%) of these collisions were automobile right of way violations, including five F+SI collisions. The following collision data is based on only automobile right of way injury collisions that occurred on the high injury network in the City of Yorba Linda, followed by strategies to make these locations safer in **Table 9**.

95%

Involved another motor vehicle

73%

Broadside collisions

32%

Occurred on Yorba Linda Blvd

Table 9: Emphasis Area 4 Strategies

Objective: To reduce the number of automobile right-of-way collisions			
	Strategies	Performance Measure	Agencies/ Organizations
EDUCATION	Conduct public information and education campaign for intersection safety laws regarding traffic lights, stop signs, and turning left or right.	Number of education campaigns	City/School District/Police Department
ENFORCEMENT	Targeted enforcement at locations with most automobile right of way collisions.	Number of citations issued	Police Department
ENGINEERING	<ul style="list-style-type: none"> 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) 	Number of locations improved	City
EMS	S05, Install emergency vehicle pre-emption systems.	EMS vehicle response time	City/Emergency Department

EMPHASIS AREA 5 – UNSAFE SPEED COLLISIONS

A total of 164 reported injury collisions occurred on the high injury network in the City of Yorba Linda. 30 (18%) of these collisions were unsafe speed collisions, including one F+SI collision. The following are major findings based on unsafe speed injury collisions that occurred on the high injury network in the City of Yorba Linda followed by strategies to make these locations safer in **Table 10**.

80%

Rear-end collisions

27%

**Collisions occurred on
Yorba Linda Blvd**

57%

**Automobile Right-of-Way
violations**

Table 10: Emphasis Area 5 Strategies

Objective: To reduce the number of fatal and severe injury collisions that are a result of unsafe speed			
	Strategy	Performance Measure	Agencies/Organizations
EDUCATION	Conduct public information and education campaign for safety laws regarding unsafe speed and its dangers.	Number of education campaigns	City/ School District/Police Department
ENFORCEMENT	Targeted enforcement at high-risk locations to monitor unsafe speed.	Number of tickets issued	Police Department
ENGINEERING	<ul style="list-style-type: none"> • NS07, Upgrade intersection pavement markings (NS.I.) • R22, Install/Upgrade signs with new fluorescent sheeting (regulatory or warning) • R27, Install delineators, reflectors and/or object markers • R26, Install dynamic/ variable speed warning signs • R28, Install edge-lines and centerlines • R36PB, Install/upgrade pedestrian crossing (with enhanced safety features) • Decrease width of travel lanes. • Simplify turn configurations. • Decrease curb radius of intersections. 	Number of locations improved	City
EMS	S05, Install emergency vehicle pre-emption systems.	EMS vehicle response time	City/ Emergency Department

EMPHASIS AREA 6 – DUI COLLISIONS

A total of 164 reported injury collisions occurred on the high injury network in the City of Yorba Linda. 21 (13%) of these collisions were DUI collisions, including six F+SI collisions. The following collision data is based on only DUI injury collisions that occurred on the high injury network in the City of Yorba Linda, followed by strategies to make these locations safer in **Table 11**.

76%	9%	57%
DUI collisions occurred at night	DUI collisions party at fault was a driver over 50 years old	DUI collisions party at fault was a driver younger than 30 years old

Table 11: Emphasis Area 6 Strategies

Objective: Reduce the number of fatal and severe injury collisions that are a result of driving under the influence from older drivers			
	Strategy	Performance Measure	Agencies/ Organizations
EDUCATION	Conduct public information and education campaign for safety laws regarding driving under the influence and publicize alternatives.	Number of education campaigns	City/Police Department
ENFORCEMENT	Targeted enforcement at high-risk locations to monitor driving under the influence.	Number of tickets issued	Police Department
ENGINEERING	<ul style="list-style-type: none"> S02, Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number S08, Convert signal to mast arm (from pedestal-mounted) 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 	Number of locations improved	City
EMS	S05, Install emergency vehicle pre-emption systems.	EMS vehicle response time	City/ Emergency Department

EMPHASIS AREA 7 – YOUNGER ADULT PARTY AT FAULT COLLISIONS

A total of 164 reported injury collisions occurred on the high injury network in the City of Yorba Linda. The following is a review of the demographic data, specifically age group, provided in the party data of the collisions occurring on the high injury network.

63%

**Fatal or severe collisions party at
fault was age 29 or younger**

Table 12: Emphasis Area 7 Strategies

Objective: Reduce the number of younger adult fatal and severe injury collisions			
Strategy		Performance Measure	Agencies/Organizations
EDUCATION	Target education programs for younger adults. Distribute brochures/fliers with basic red light running, speeding, distracted driving, aggressive driving, and stop sign violations information at driver training programs. Include statistics of younger adult larger risks of fatalities.	Number of education campaigns	City/ School District/ Police Department

7. COUNTERMEASURE IDENTIFICATION

This section summarizes the process of selecting countermeasures on Yorba Linda streets as part of the analysis for the LRSP. Countermeasures were selected for each of the identified high-risk intersections and roadway segments based on extensive review of existing conditions at the site and characteristics of identified collisions on the High Injury Network.

Identified collision factors and existing conditions were cross referenced with the Caltrans LRSM identified countermeasures that are HSIP approved. Countermeasures that best fit the site and had the highest opportunity for systemic implementation were selected. Countermeasures were selected not only for each high-risk location, but also for each identified citywide Emphasis Area.

Draft Countermeasure Toolbox

Table 13 provides a description of each countermeasure along with the crash reduction factor (CRF), federal funding eligibility, and opportunity for systemic implementation. An excerpt of the LRSM, detailing each available HSIP countermeasure referenced in the recommendations tables, is included as **Appendix D**.

Table 13: Countermeasures Selected for City of Yorba Linda

Code	Countermeasure Name	Countermeasure Description	CRF	Federal Funding	Systemic Approach Opportunity
S01	Add intersection lighting	Provision of lighting at intersection.	40%	90%	Medium
S02	Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number	Includes New LED lighting, signal back plates, retro-reflective tape outlining the back plates, or visors to increase signal visibility, larger signal heads, relocation of the signal heads, or additional signal heads.	15%	90%	Very High
S03	Improve signal timing (coordination, phases, red, yellow, or operation)	Includes adding phases, lengthening clearance intervals, eliminating or restricting higher-risk movements, and coordinating signals at multiple locations.	15%	50%	Very High
S07	Provide protected left turn phase (left turn lane already exists)	Left turns are widely recognized as the highest-risk movements at signalized intersections. Providing Protected left-turn phases for signalized intersections with existing left turn pockets significantly improve the safety for left-turn maneuvers by removing the need for the drivers to navigate through gaps	30%	90%	High

Code	Countermeasure Name	Countermeasure Description	CRF	Federal Funding	Systemic Approach Opportunity
		in oncoming/opposing through vehicles.			
S08	Convert signal to mast arm (from pedestal-mounted)	Providing better visibility of intersection signs and signals aids the drivers' advance perception of the upcoming intersection. Visibility and clarity of the signal should be improved without creating additional confusion or distraction for drivers.	30%	90%	Medium
S09	Install raised pavement markers and striping (Through Intersection)	Adding clear pavement markings can guide motorists through complex intersections. When drivers approach and traverse through complex intersections, drivers may be required to perform unusual or unexpected maneuvers.	10%	90%	Very High
S10	Install flashing beacons as advance warning (S.I.)	Increased driver awareness of an approaching signalized intersection and an increase in the driver's time to react.	30%	90%	Medium
S11	Improve pavement friction (High Friction Surface Treatments)	Improving the skid resistance at locations with high frequencies of wet road crashes and/or failure to stop crashes.	55%	90%	Medium
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.	25%	90%	Medium
S21PB	Modify signal phasing to implement a Leading Pedestrian Interval (LPI)	Addition of LPI gives pedestrians the opportunity to enter an intersection three-seven seconds before vehicles are given a green indication; only minor signal timing alteration is required.	60%	90%	Very High
NS01	Add intersection lighting (NS.I.)	Provision of lighting at intersection.	40%	90%	Medium
NS03	Install signals	Installs a traffic signal at an unsignalized intersection if warrants are met.	30%	90%	Low
NS06	Install/upgrade larger or additional stop signs or other intersection warning/regulatory signs	Replaces existing or installs new larger signs to assist the driver in perceiving an intersection from a greater distance, particularly at night.	15%	90%	Very High

Code	Countermeasure Name	Countermeasure Description	CRF	Federal Funding	Systemic Approach Opportunity
NS07	Upgrade intersection pavement markings (NS.I.)	Typical improvements include "Stop Ahead" markings and the addition of centerlines and stop bars.	25%	90%	Very High
NS09	Install flashing beacons as advance warning	Adds a flashing beacon to a warning sign to call driver attention to intersection control signs.	30%	90%	High
NS10	Install transverse rumble strips on approaches	Transverse rumble strips provide an auditory and tactile sensation for each motorist approaching the intersection.	20%	90%	High
NS11	Improve sight distance to intersection (Clear Sight Triangles)	Improves sight distance by removing restrictions, such as vegetation, parked vehicles, signs, buildings, etc.	20%	90%	High
NS13	Install splitter-islands on the minor road approaches	Splitter islands can provide a positive separation between turning vehicles on a through road and vehicles stopped on the minor road approach. Also allows for an extra stop sign at an intersection.	40%	90%	Medium
R01	Add Segment Lighting	Provision of lighting along roadways.	35%	90%	Medium
R21	Improve pavement friction (High Friction Surface Treatments)	Improving the skid resistance at locations with high frequencies of wet road crashes and/or failure to stop crashes.	55%	90%	High
R22	Install/Upgrade signs with new fluorescent sheeting (regulatory or warning)	Additional or new signage can address crashes caused by lack of driver awareness or compliance of roadway signing.	15%	90%	Very High
R24	Install curve advance warning signs	Placed in advance of curves with an unacceptable level of crashes to warn drivers of an impending sharp curve.	25%	90%	Very High
R26	Install dynamic/variable speed warning signs	Includes the addition of dynamic speed warning signs (also known as Radar Speed Feedback Signs).	30%	90%	High
R27	Install delineators, reflectors and/or object markers	Installation of delineators, reflectors, and/or object markers are intended to warn drivers of an approaching curve or fixed object that cannot easily be removed.	15%	90%	Very High

Code	Countermeasure Name	Countermeasure Description	CRF	Federal Funding	Systemic Approach Opportunity
R28	Install edge-lines and centerlines	Any road with a history of run-off-road right, head-on, opposite-direction-sideswipe, or run-off-road-left crashes is a candidate for this treatment -install where the existing lane delineation is not sufficient to assist the motorist in understanding the existing limits of the roadway. Depending on the width of the roadway, various combinations of edge line and/or center line pavement markings may be the most appropriate.	25%	90%	Very High

Other Countermeasures

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.

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.

In Road Yield/Stop Signs. In-street pedestrian crossing signs (MUTCD R1-6 or R1-6a) are placed within the roadway, either between travel lanes or in a median. The sign may be used to remind road users of laws regarding right-of-way at an unsignalized pedestrian crossing. This countermeasure is used with other crosswalk visibility enhancements to indicate optimal or preferred locations for people to cross and to help reinforce the driver requirement to yield the right-of-way to pedestrians at crossing locations.

8. SAFETY PROJECTS

High-Collision Network Projects

This chapter summarizes the process of selecting safety projects as part of the analysis for the City of Yorba Linda' LRSP. The next step after the identification of high-risk locations, emphasis areas, and applicable countermeasures was 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 (2022). The countermeasures were grouped into safety projects for high-risk intersections and roadway segments. A total of eight 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 14 lists the safety projects for high-risk intersections and roadway segments, along with total base planning level cost (2022 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).

Appendix E lists the detailed methodology to calculate B/C Ratio, the complete cost, benefit and B/C Ratio calculation spreadsheet.

The next step in the process will be to prepare grant ready materials for HSIP Cycle 11 applications. However, it should be noted that while the LRSP projects were based on high-risk locations, HSIP applications can be expanded to include other locations across the city.

About 52% of F+SI collisions have occurred at night. Yorba Linda Boulevard, Valley View Avenue, and La Palma Avenue have a higher concentration of nighttime collisions, compared to other roads in Yorba Linda. This has indicated that lighting at these locations needs to be evaluated to ensure lumen levels are adequate. Improvements such as installing new lighting, upgrading existing lighting to a higher lumen, installing larger signal heads, installing and upgrade signs with new fluorescent sheeting, and installing pedestrian improvements with lighting elements such as RRFBs and HAWKS can help make these locations safer for all road users.

For F+SI collisions in the City of Yorba Linda, 34% of collisions were broadside collisions. This has called for evaluating broadside collisions along the high injury network and other locations throughout the City with similar characteristics. Improvements at these location can consist of improved signal hardware, provide protected left turn phase, convert signal to mast arm (from pedestal-mounted), raised medians at the approach to intersections, and others.

28% of F+SI collisions were due to DUI violations. La Palma Avenue, Yorba Linda Boulevard, and Yorba Ranch Road have a higher concentration of DUI collisions, compared to other Yorba Linda roads. Viable safety projects to address these collisions (in addition to educational and enforcement measures) include improving signal hardware, installing raised pavement markers, installing flashing beacons, adding intersection lighting, installing/upgrading larger or additional STOP signs or other intersection warning/regulatory signs, installing delineators, reflectors, and object markers, and installing transverse rumble strips on approach.

For F+SI collisions in the City of Yorba Linda, 24% of collisions were hit object collisions. La Palma Avenue, Lakeview Avenue, and Imperial Highway have a higher concentration of hit object collisions, compared to other Yorba Linda roads. Viable safety projects to address these include lighting, install/upgrading signs with new fluorescent sheeting, curve advance warning signs, installing delineators, reflectors, and object markers, and install edge lines/centerlines.

For F+SI collisions in the City of Yorba Linda, 22% of collisions were due to automobile right of way violations. Yorba Linda Boulevard, Valley View Avenue, and Savi Ranch Parkway have a higher concentration of automobile right-of-way collisions, compared to other Yorba Linda roads. Viable safety projects to address these include installing signals, flashing beacons, transverse rumble strips on approaches, install/upgrade larger or additional stop signs or other intersection regulatory/warning signs, upgrading intersection pavement markings, and adding intersection lighting.

Table 14: Safety Projects - City of Yorba Linda

#	Location	CM 1	CM 2	CM 3	Cost Per Location	B/C Ratio
Project 1 Systemic Improvements At Signalized Intersections						
1	Imperial Hwy and Yorba Linda Blvd	S02	S03	S09	\$41,650	60.00
2	Van Buren St and Yorba Linda Blvd	S02	S03	S09	\$33,908	
3	Imperial Hwy and Valley View	S02	S03	S09	\$29,540	
4	Bastanchury Rd and Valley View	S02	S03	S09	\$38,976	
5	La Palma Ave and Gypsum Canyon Rd	S02	S03	S09	\$28,000	
6	Prospect Ave and Imperial Hwy	S02	S03	S09	\$29,064	
7	Eureka Ave and Imperial Hwy	S02	S03	S09	\$32,172	
8	Richfield Rd and Yorba Linda Blvd	S02	S03	S09	\$43,239	
9	Valley View and Drake St/Lakeview Ave	S02	S03	S09	\$37,114	
10	Yorba Linda and Kellogg Dr	S02	S03	S09	\$27,916	
TOTAL					\$251,489	
<i>S02 Improve signal hardware: lenses, back-plates with retroreflective borders, mounting, size, and number</i> <i>S03 Improve signal timing (coordination, phases, red, yellow, or operation)</i> <i>S09 Install raised pavement markers and striping (Through Intersection)</i>						
Project 2 Systemic Improvements at Signalized Intersections						
1	Imperial Hwy and Yorba Linda Blvd	S10	S21PB		\$79,800	178.71
2	Van Buren St and Yorba Linda Blvd	S10			\$36,400	
3	Valley View and Drake St/Lakeview Ave		S21PB		\$7,000	
TOTAL					\$123,200	
<i>S10 Install flashing beacons as advance warning (S.I.)</i> <i>S21PB Modify signal phasing to implement a Leading Pedestrian Interval (LPI)</i>						
Project 3 Spot-Location Improvements at Signalized Intersections						
1	Van Buren St and Yorba Linda Blvd	S01			\$8,680	43.17
2	Richfield Rd and Yorba Linda Blvd		S08		\$51,800	
TOTAL					\$60,480	
<i>S01 Add intersection lighting</i> <i>S07 Provide protected left turn phase (left turn lane already exists)</i> <i>S08 Convert signal to mast arm (from pedestal-mounted)</i>						

Project 4 Systemic Improvements At Unsignalized Intersections						
1	Lakeview and Buena Vista	NS01	NS06	NS07	\$130,550	50.72
2	Fairmont Blvd and Big Spring Dr	NS01	NS06	NS07	\$51,030	
3	Esperanza Rd and Yorba Ranch Rd	NS01	NS06	NS07	\$160,174	
4	Hidden Hills Rd and Stonewood Dr	NS01		NS07	\$73,592	
5	Welsh Pony Ln and Red Roan Rd	NS01	NS06	NS07	\$101,164	
6	Avenida Del Rey and Via Del La Plz	NS01	NS06	NS07	\$93,828	
7	Ohio St, White Oak Dr and Scenic View Dr	NS01	NS06	NS07	\$99,848	
8	Casa Oro Dr and Casa Hermosa Dr	NS01	NS06	NS07	\$122,472	
9	Fairmont Blvd and Lorca Ln	NS01	NS06	NS07	\$82,292	
TOTAL					\$756,512	
NS01 Add intersection lighting (NS.I.) NS06 Install/upgrade larger or additional stop signs or other intersection warning/regulatory signs NS07 Upgrade intersection pavement markings (NS.I.)						
Project 5 Spot Improvements at Unsignalized Intersections						
1	Lakeview and Buena Vista	NS03	NS09		\$787,500	4.16
3	Esperanza Rd and Yorba Ranch Rd	NS03	NS09		\$613,300	
TOTAL					\$1,400,800	
NS03 Install Signals NS09 Install flashing beacons as advance warning NS10 Install transverse rumble strips on approaches						

Project 6 Systemic Improvements at Roadway Segments						
1	Yorba Linda Blvd: Fairmont Blvd to N Jefferson St	R22	R26	R27	\$183,181	39.07
2	La Palma Ave: Western City Limits to Cam De Bryant	R22	R26	R27	\$146,020	
3	Imperial Hwy: Prospect Ave to Yorba Linda Blvd	R22	R26		\$67,978	
4	Bastanchury Rd: Imperial Hwy to Humboldt Ln	R22	R26	R27	\$164,197	
5	Fairmont Blvd: Cordova Ln to Esperanza Rd	R22	R26	R27	\$118,846	
6	Lakeview Ave: Flora Dr to Buena Vista Ave	R22		R27	\$72,040	
7	Hidden Hills: Esperanza Rd to Mission Hills Ln	R22	R26	R27	\$71,578	
8	Yorba Ranch Rd: Esperanza Rd to Yorba Linda Blvd	R22		R27	\$141,106	
TOTAL					\$1,011,066	
R22 Install/Upgrade signs with new fluorescent sheeting (regulatory or warning) R26 Install dynamic/variable speed warning signs R27 Install delineators, reflectors and/or object markers						
Project 7 Systemic Improvements At Roadway Segments						
1	Fairmont Blvd: Cordova Ln to Esperanza Rd		R24		\$85,302	19.44
2	Lakeview Ave: Flora Dr to Buena Vista Ave	R01			\$328,370	
3	Hidden Hills: Esperanza Rd to Mission Hills Ln	R01	R24		\$378,266	
4	Imperial Hwy: Prospect Ave to Yorba Linda Blvd			R28	\$89,838	
5	Bastanchury Rd: Imperial Hwy to Humboldt Ln			R28	\$61,180	
6	La Palma Ave: Western City Limits to Cam De Bryant		R24		\$3,500	
TOTAL					\$946,456	
R01 Add Segment Lighting R24 Install curve advance warning signs R28 Install edge-lines and centerlines						

HSIP APPLICATIONS

The next step will be to prepare HSIP grant ready materials, so that the City may submit them for HSIP Cycle 11 funding in 2022. As per previous HSIP funding cycles, projects with a higher benefit to the community have a higher probability of receiving funding successfully.

9. 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 F+SI 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. Potential funding sources are listed below in **Table 15**.

Table 15: 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	Early 2022	Engineering	Most common grant source for safety projects
Surface Transportation Block Group Program	FHWA (Administered through OCTA)	Varies by FY	TBD	Engineering	Typically used for roadway projects
Congestion Mitigation and Air Quality	FHWA (Administered through OCTA)	Varies by FY	TBD	Engineering	Focused on projects that improve air quality
Office Of Traffic Safety Grants	California Office of Traffic Safety	Varies by grant	Closes January 31 st annually	Education, Enforcement, Emergency Response	10 grants available to address various components of traffic safety
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

Funding Source	Funding Agency	Amount Available	Next Estimated Call For Projects	Applicable E's	Notes
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
Safe Streets and Roads for All (SS4A)	USDOT	\$5 billion over five years	2022	Engineering	Provides grants for planning and infrastructure to address roadway safety
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 4 E's related countermeasures that can be implemented throughout the City to reduce F+SI collisions. It is recommended that the City of Yorba Linda 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.

The success of the LRSP can be achieved by fostering communication among the City and the safety partners.

Monitoring and Evaluation

For the success of the LRSP, it is crucial to monitor and evaluate the 4 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 F+SI 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 F+SI collisions throughout the City. If the number of F+SI 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 to five years after adoption. After monitoring performance measures focused on the status and progress of the 4 E's strategies in each emphasis area, the next LRSP update can be tailored to resolve any continuing safety problems. The City of Yorba Linda'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 document should then be updated as per the latest collision data, emerging trends, and the 4 E's strategies' progress and implementation.

Appendix A

Matrix of Planning Goals, Policies, and Projects

Appendix B

Consolidated Collision Database

Appendix C

HSIP Eligible Countermeasures

Appendix D

Countermeasure Toolbox

Appendix E

B/C Ratio Calculation - LRSM (2020)