CITY OF SANTA CRUZ

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LOCAL ROADWAY SAFETY PLAN

PREPARED BY Kimley»Horn

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By signing and stamping this Local Roadway Safety Plan, the engineer is attesting to this report's technical information and engineering data upon which local agency's recommendations, conclusions, and decisions are made.

INTRODUCTION

The City of Santa Cruz is the largest of four cities and thirty census-designated places (CDP) in Santa Cruz County. The City is located on the north shore of Monterey Bay (see **Figure 1**) and covers approximately 12.7 square miles. The City is encircled by the Santa Cruz Mountains and large public green open spaces (Arana Gulch, Moore Creek and Pogonip). The population of Santa Cruz is about 64,600[1]. Santa Cruz serves as a popular beach and entertainment destination that attracts a large seasonal population of tourists, doubling the population, for the well-known Santa Cruz Beach Boardwalk and oceanfront amusement park. The City is also home to the University of California, Santa Cruz (UCSC) which enrolls more than 15,000 students[2].

As part of the *City of Santa Cruz 2030 General Plan*, the City Council adopted the following statement regarding the mobility and circulation elements of its jurisdiction[3]:

> *"We will provide an accessible, comprehensive, and effective transportation system that integrates automobile use with sustainable and innovative transportation options—including enhanced public transit, bicycle, and pedestrian networks throughout the community."*

In addition, the City of Santa Cruz adopted a Vision Zero resolution on August 27, 2019, committing the city to work towards eliminating traffic fatalities and serious injuries on city streets by 2030.

The City intends to continue improving mobility for all roadway users and strives to make its roadway system safe and efficient for its diverse users and the transportation modes they use. The climate and built environment of the City, along with its coastal setting and college-town-feel, has encouraged higher than average transit use, as well as more bicycling and walking than in other California communities. Summer tourism and weekend traffic leads to frequent traffic congestion that degrades roadway safety performance.

Major roadways in the City include arterial highways and streets such as Highways 1, 17, and 9, Water Street, Ocean Street, Front Street, Soquel Avenue, and Bay Street, as well as collectors and local streets (**Figure 2** from the City of Santa Cruz 2030 General Plan highlights the city's road system). In general, the arterial highways and streets experience the heaviest traffic demand and volume while the collector and local streets provide circulation between neighborhoods and carry shorter trips. Many of these roadway networks overlap with other transportation elements such transit, bicycle, and pedestrian networks. **Figure 3** shows where classified bicycle and pedestrian paths are located throughout the City.

With a diverse existing transportation network and growing multimodal demands of the City's residents and visitors, ensuring the safety of all roadway users is a critical goal. Aligning with the *City of Santa Cruz 2030 General Plan*, the Local

[1] US Census Bureau, Population and Housing Units Estimate 2019 Estimate

2 Enrollment Year 2008-2009-City of Santa Cruz General Plan 2030

3 City of Santa Cruz 2030 General Plan

Road Safety Plan (LRSP) will analyze and help identify areas of improvement related to multi-modal transportation safety improvements.

The Santa Cruz LRSP identifies citywide collision trends, high-collision locations, and Emphasis Areas to inform and guide further safety evaluation of the City's transportation network. It analyzes collision data on an aggregate basis and at specific locations to identify trends, patterns and highest collision locations. The analysis of collision history throughout the City's transportation network allows for opportunities to: 1) identify factors in the transportation network that inhibit safety for all roadway users, 2) improve safety at the highest-collision locations, and 3) develop safety measures using the California Strategic Highway Safety Plan's (SHSP) five E's of safety: Engineering, Enforcement, Education, Emergency Response, and Emerging Technologies to encourage safer driver behavior and reduce severity outcomes. Additionally, Caltrans intends to update the 2020-20024 SHSP to include Equity as a driving principle. This change is anticipated in Spring 2021, and this document includes equity as a focus.

This report documents the process and analysis performed for the City's LRSP including the vision and goals for the LRSP development, collision history analysis, and Emphasis Areas. The information compiled in this report will provide a foundation for decision making and prioritization of safety countermeasures and projects that enhance safe mobility for all modes throughout the City. In future updates of the LRSP, the collision history analysis and Emphasis Areas will be refined to identify site specific infrastructure and non-infrastructure recommendations for selected signalized and non-signalized intersections, mid-block crossings, and roadway segments within the City, and will be used in determining how broader systemic recommendations can be applied city-wide as appropriate. Future updates could also include input for additional stakeholders and increased focus on non-engineering countermeasures.

The City of Santa Cruz is committed to reducing the risk of fatal and serious injuries that result from traffic collisions on the City's roadways. The LRSP tells the story of transportation safety needs and strategies for Santa Cruz. Implementation of the LRSP will help improve transportation safety and mobility for the residents and visitors of Santa Cruz. All phases of the LRSP were developed with input from partners including:

City of Santa Cruz
City of Santa Cruz Department of Public Health
City of Santa Cruz Fire Department
Metro Transit

***Figure 1**. Project Area - City of Santa Cruz*

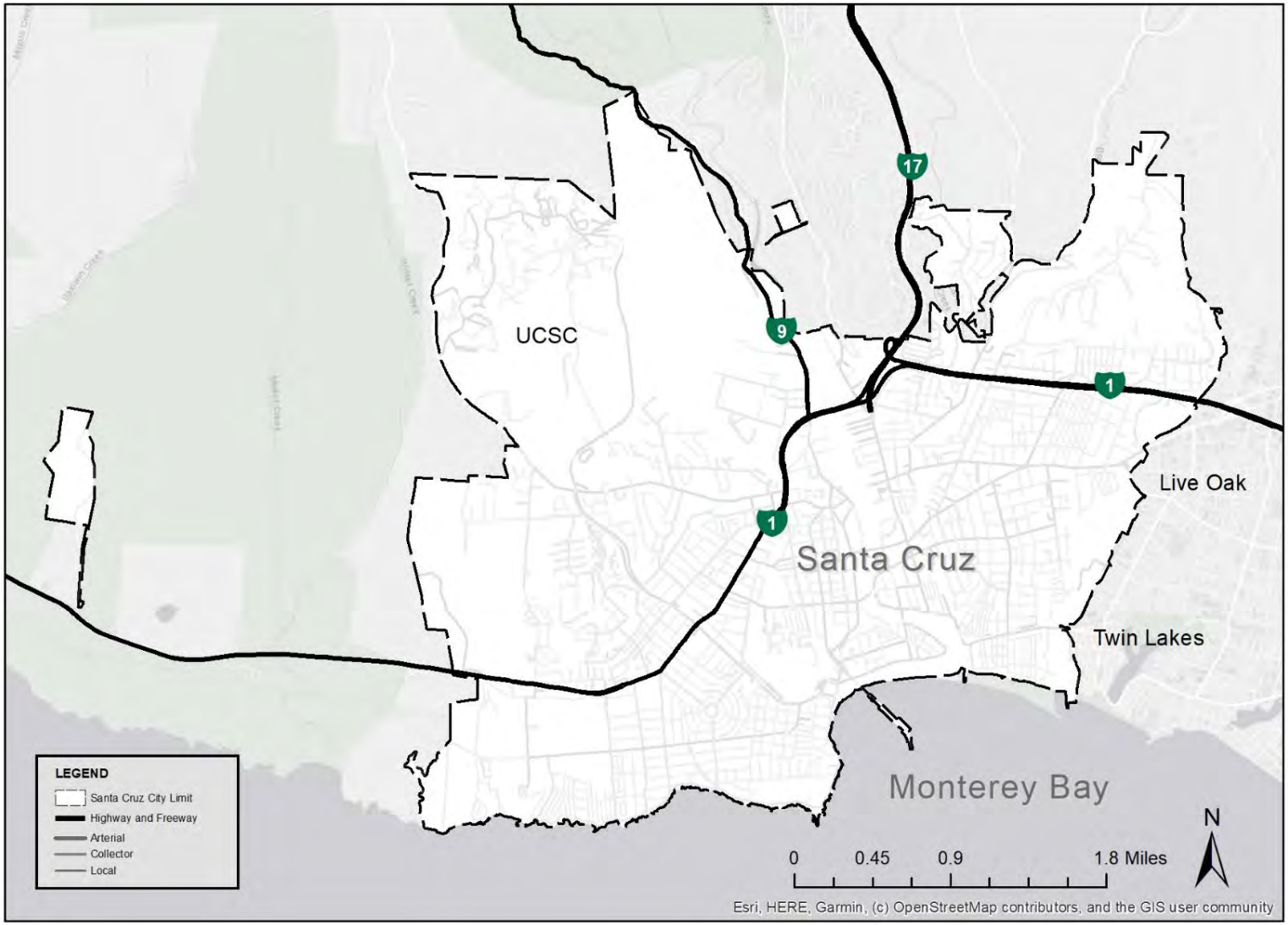


Figure 2. City of Santa Cruz Roadway Classifications

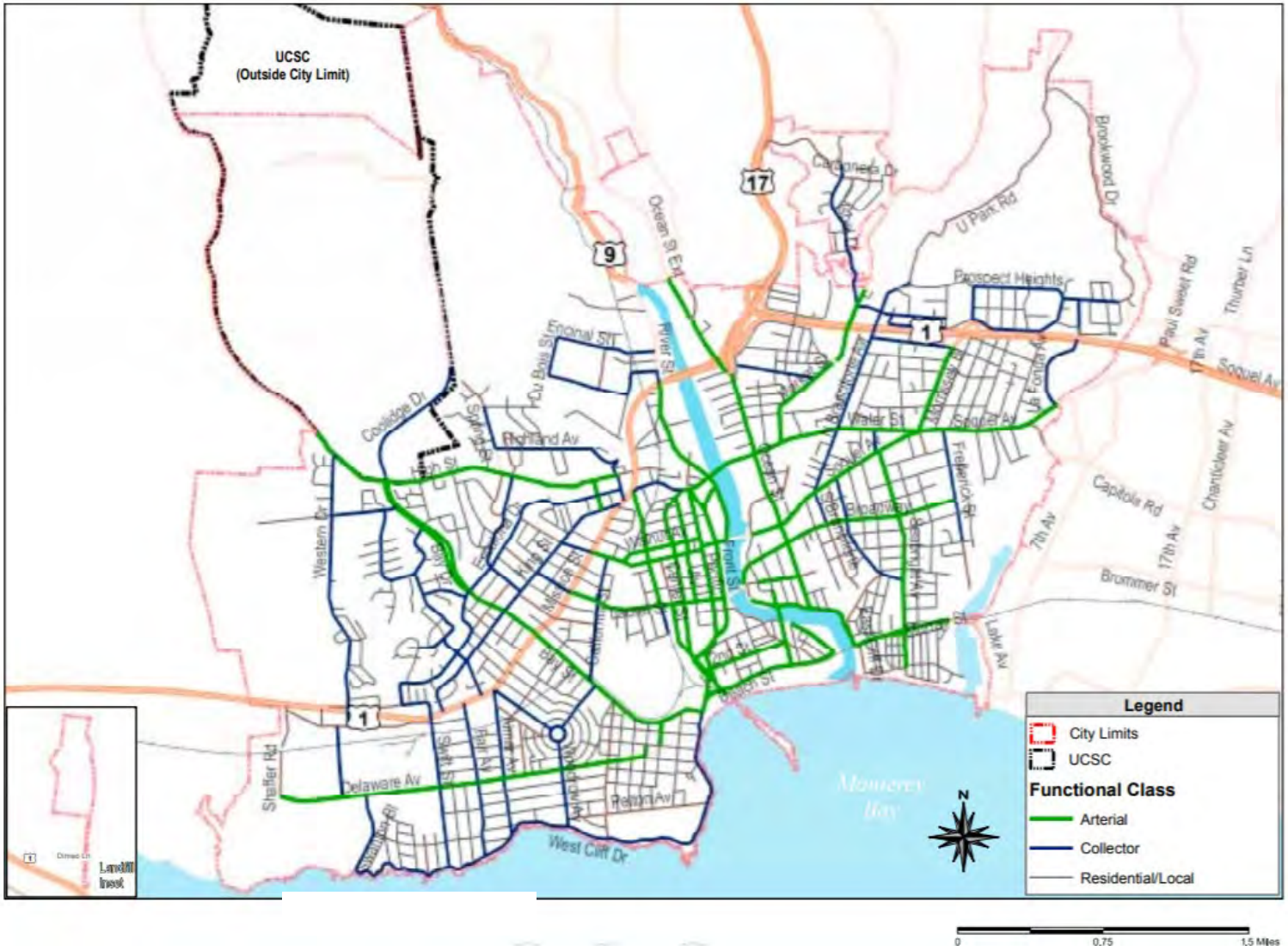


***Figure 3**. City of Santa Cruz Bicycle and Pedestrian Network*

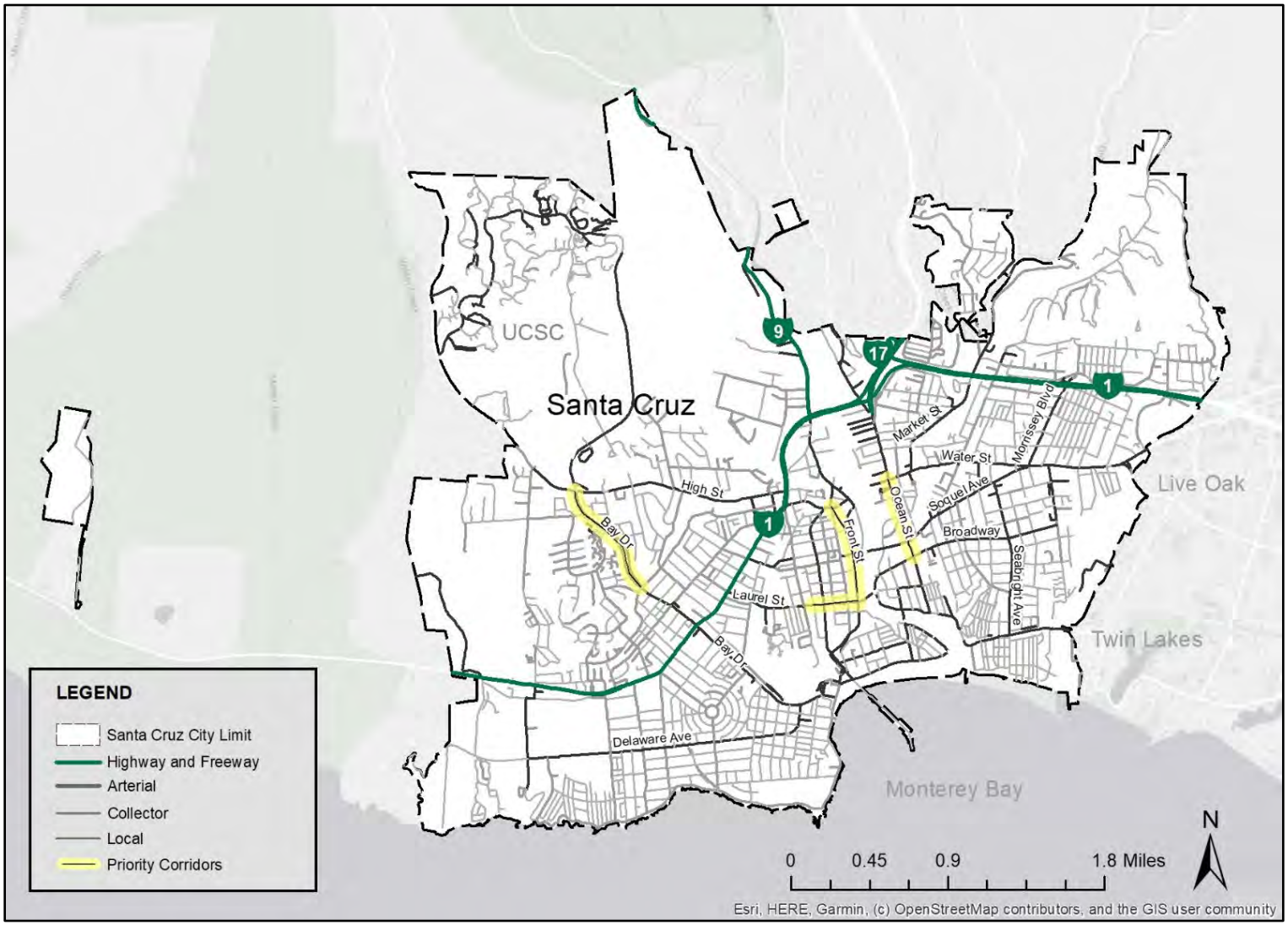
Prepared by: Kimley»Horn

Priority Corridors

The City of Santa Cruz is accessible via State Route 1 (SR 1), State Route 17 (SR 17) and State Route 9 (SR 9). State Route 1/Mission Street, while a state highway, represents an important arterial street within the city limits. The City's street network is comprised of the following east-west connectors: Water Street, Soquel Avenue, and Laurel Street/Broadway. North-south connections are made via Bay Street/Drive, River Street, Front Street, Ocean Street, Morrissey Boulevard, and Seabright Avenue.

The network screening process showed that Front Street, Ocean Street, Laurel Street, and Bay Drive have higher concentrations of crashes at multiple locations along their lengths and were therefore designated as priority corridors for the LRSP (see **Figure 4**). These roadways provide access to the City's commercial core, shopping centers, residential areas, ten city schools, and UCSC campus. Findings for these priority corridors can be found in the Case Study Locations – Project Development section.

Figure 4. City of Santa Cruz Roadway Network and Identified Priority Corridors



VISION AND GOALS

LRSPs are a Federal Highway Administration (FHWA) proven program that utilizes safety countermeasures that have been effective across the country as part of efforts to reduce fatal and severe injury collisions. They provide a locally developed and customized roadmap to directly address the most common safety challenges in the given jurisdiction. Based on discussions with City staff, the City's safety partners, and a review of the City's existing plans, policies, and safety efforts, the following vision and goals have been drafted for the LRSP.

VISION	Provide safe, efficient, and complete streets to expand mobility choices, and to meet and exceed the City's Vision Zero goal.

Goal #1: Identify areas with the highest risk for collisions

Objectives:

A. Identify intersections and segments in the transportation network that would most benefit from traffic safety countermeasures.

B. Identify areas of interest with respect to traffic safety concerns covering all Es of traffic safety.

C. Evaluate the collision history to identify the highest priority corridors.

Goal #2: Develop a comprehensive safety program and supporting a systemic process

Objectives:

A. Demonstrate the systemic process' ability to identify locations with higher risk for collisions based on present characteristics closely associated with fatal and serious injury collisions.

B. Demonstrate the gaps and data collection activities that can be improved upon.

C. Develop prioritization processes that help achieve the City's vision.

Goal #3: Plan future safety improvements that improve mobility choices

Objectives:

A. Identify safety countermeasures that are effective for specific locations.

B. Identify effective safety countermeasures that can be applied City-wide to address a certain behavior or condition.

Goal #4: Define safety projects for future HSIP and other program funding consideration

Objectives:

A. Create an outline for a prioritization process that can be used in forth-coming Highway Safety Improvement Program (HSIP) cycles to apply for funding.

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

PROCESS

Providing safe, sustainable, and efficient mobility choices for their constituents and visitors is a primary goal for the City and their safety partners. The City will continue their collaboration with their safety partners, including but not limited to the initiating the work of a multidisciplinary Vision Zero committee, to identify and discuss safety issues within the community as the LRSP is implemented and updated.

To begin the LRSP process, the City of Santa Cruz held a kick-off meeting in the spring of 2020 to collectively discuss existing safety efforts, the City's vision for safety, critical issues, and strategies to achieve the City's safety goals in its Vision Zero initiative. To help inform this discussion, initial safety concerns and data were collected and organized to identify critical safety issues and preliminary Emphasis Areas.

This LRSP documents the results of data and information obtained, including the vision and goals for the LRSP, existing safety efforts, collision analysis, and developed Emphasis Areas. The development of the LRSP recommendations considers the five E's of traffic safety defined by the California Strategic Highway Safety Plan (SHSP): Engineering, Enforcement, Education, Emergency Response, and Emerging Technologies throughout its process.

DATA SUMMARY

The following section describes the analysis process undertaken to evaluate safety within the City of Santa Cruz at a systemic level. Using a network screening process, locations within the City that will most likely benefit from safety enhancements were identified. Using historic collision data, collision risk factors for the entire network were derived. The analysis outcomes inform the identification and prioritization of engineering and non-infrastructure safety measures that address certain roadway characteristics and user behaviors that contribute to collisions between motor vehicles and active transportation users.

Guiding Manuals

Existing guidance for roadway design and safety are available at the national and state level. The following provides a brief summary for two of the more predominate manuals that guided the analysis process.

Local Roadway Safety Manual

The *Local Roadway Safety Manual: A Manual for California's Local Road Owners* (Version 1.5, April 2020) purpose is to encourage local agencies to pursue a proactive approach to identifying and analyzing safety issues, while preparing to

compete for project funding opportunities. A proactive approach is defined as analyzing the safety of the entire roadway network through either a one-time, network wide analysis, or by routine analyses of the roadway network.[3]

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

To provide the most benefit and to be competitive for funding, the analysis leading to countermeasure selection should focus on both intersections and roadway segments and be considerate of roadway characteristics and traffic volumes. The result should be a list of locations that are most likely to benefit from cost-effective countermeasures, preferably prioritized by benefit/cost ratio. The manual suggests using a mixture of quantitative and qualitative measures to identify and rank locations that considers both collision frequency and collision rates. These findings should then be screened for patterns such as collision types and severity to aid in the determination of issues causing higher numbers of collisions and the potential countermeasures that could be most effective. Qualitative analysis should include field visits and a review of existing roadway characteristics and devices. The specific roadway context can then be used to assess what conditions may increase safety risk at the site and how to address that risk at a systemic level.

Countermeasure selection should be supported using Crash Modification Factors (CMFs). These factors are the peer reviewed product of before and after research that quantifies the expected rate of collision reduction that can be expected from a given countermeasure. If more than one countermeasure is under consideration, the LRSM provides guidance on how to apply CMFs appropriately.

Highway Safety Manual

"The AASHTO *Highway Safety Manual* (HSM), published in 2010, presents a variety of methods for quantitively estimating collision frequency or severity at a variety of locations."[4] This four-part manual is divided into Parts: A) Introduction, Human Factors, and Fundamentals, B) Roadway Safety Management Process, C) Predictive Method, D) Crash Modification Factors.

Chapter 4 of Part B of the HSM discusses the Network Screening process. The Network Screening Process is a tool for an agency to analyze their entire network and identify/rank locations that (based on the implementation of a countermeasure) are most likely to least likely to realize a reduction in the frequency of collisions.

The HSM identifies five steps in this process:[5]

1. **Establish Focus:** Identify the purpose or intended outcome of the network screening analysis. This decision will influence data needs, the selection of performance measures and the screening method that can be applied.

3 Local Roadway Safety Manual (Version 1.3) 2016. Page 5.
4 AASHTO, Highway Safety Manual, 2010, Washington D.C., http://www.highwaysafetymanual.org/Pages/About.aspx
5 AASHTO. *Highway Safety Manual.* 2010. Washington, DC. Page 4-2.

2. **Identify Network and Establish Reference Populations:** Specify the types of sites or facilities being screened (i.e., segments, intersections, geometrics) and identify groupings of similar sites or facilities.

3. **Select Performance Measures:** There are a variety of performance measures available to evaluate the potential to reduce collision frequency at a site. In this step, the performance measure is selected as a function of the screening focus and the data and analytical tools available.

4. **Select Screening Method:** There are three principle screening methods described in this chapter (i.e., ranking, sliding window, peak searching). Each method has advantages and disadvantages; the most appropriate method for a given situation should be selected.

5. **Screen and Evaluate Results:** The final step in the process is to conduct the screening and analysis and evaluate the results.

The HSM provides several statistical methods for screening roadway networks to identify high risk locations based on overall collision histories. In addition to flat collision quantities, the method used in this study is referred to as Critical Crash Rate.

Critical Crash Rate

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

The Critical Crash Rate compares the observed crash rate to the expected crash rate at a particular location based on facility type and volume using a locally calculated average crash rate for the specific type of intersection or roadway segment being analyzed. The Critical Crash Rate formula is shown in **Figure 5**. Based on traffic volumes and a weighted citywide crash rate for each facility type, a critical crash rate threshold is established at the 95% confidence level to determine locations with higher crash rates that are unlikely to be random. The threshold is calculated for each location individually based on its traffic volume and the crash profile of similar facilities.

Figure 5. Critical Crash Rate Formula

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

Where,

$R_{c,i}$ = Critical crash rate for intersection i

R_a = Weighted average crash rate for reference population

P = P-value for corresponding confidence level

MEV_i = Million entering vehicles for intersection i

Probability of Specific Collision Types Exceeding Threshold Proportion

The Highway Safety Manual (HSM) describes the methodology for determining the probability that collision type is greater than an identified threshold proportion. This helps to identify locations where a collision type is likely to occur.

Data Needs

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

Strengths

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

The HSM methodology first determines the frequency of a specific collision type at an individual location, then determines the observed proportion of that collision type relative to all collision types at that location. A threshold proportion is then determined for the specific collision type; HSM suggests utilizing the proportion of the collision type observed in the entire reference population (e.g. throughout the entire City of Santa Cruz). These proportions are then utilized to determine the probability that the proportion of a specific collision type is greater than the long-term expected proportion of that collision type. The calculation is shown below in **Figure 6.**

Figure 6. Probability of Specific Collisions Types Exceeding Threshold Proportion

$$P(p_i > \overline{p^*_i} / N_{observed,i}, N_{observed,i(TOTAL)}) = 1 - betadist(\overline{p^*_i}, \alpha + N_{observed,i}, \beta + N_{observed,i(TOTAL)} - N_{observed,i})$$

Where:

$\overline{p^*_i}$ = Threshold proportion

p_i = Observed proportion

$N_{observed,i}$ = Observed target crashes for a site i

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

Analysis Techniques

Collision Analysis

A component of the LRSP is to identify locations with elevated risk of collisions either through their collision histories, or their similarities to other locations that have more active collision patterns. The initial step in analyzing this information is to spatially reference collisions that occurred within the study area from January 1st. 2015 through December 31st, 2019. The charts and figures below display all collision activity for this period using Statewide Integrated Traffic Records System (SWITRS) data processed through Crossroads Collision Software. In addition, Crossroads has access to the latest police reports, allowing validation of the City's data with Transportation Injury Mapping System (TIMS), which provides access to California injury and fatal collision data from the SWITRS data. This helps to confirm that all relevant data is included.

Network Screening Analysis

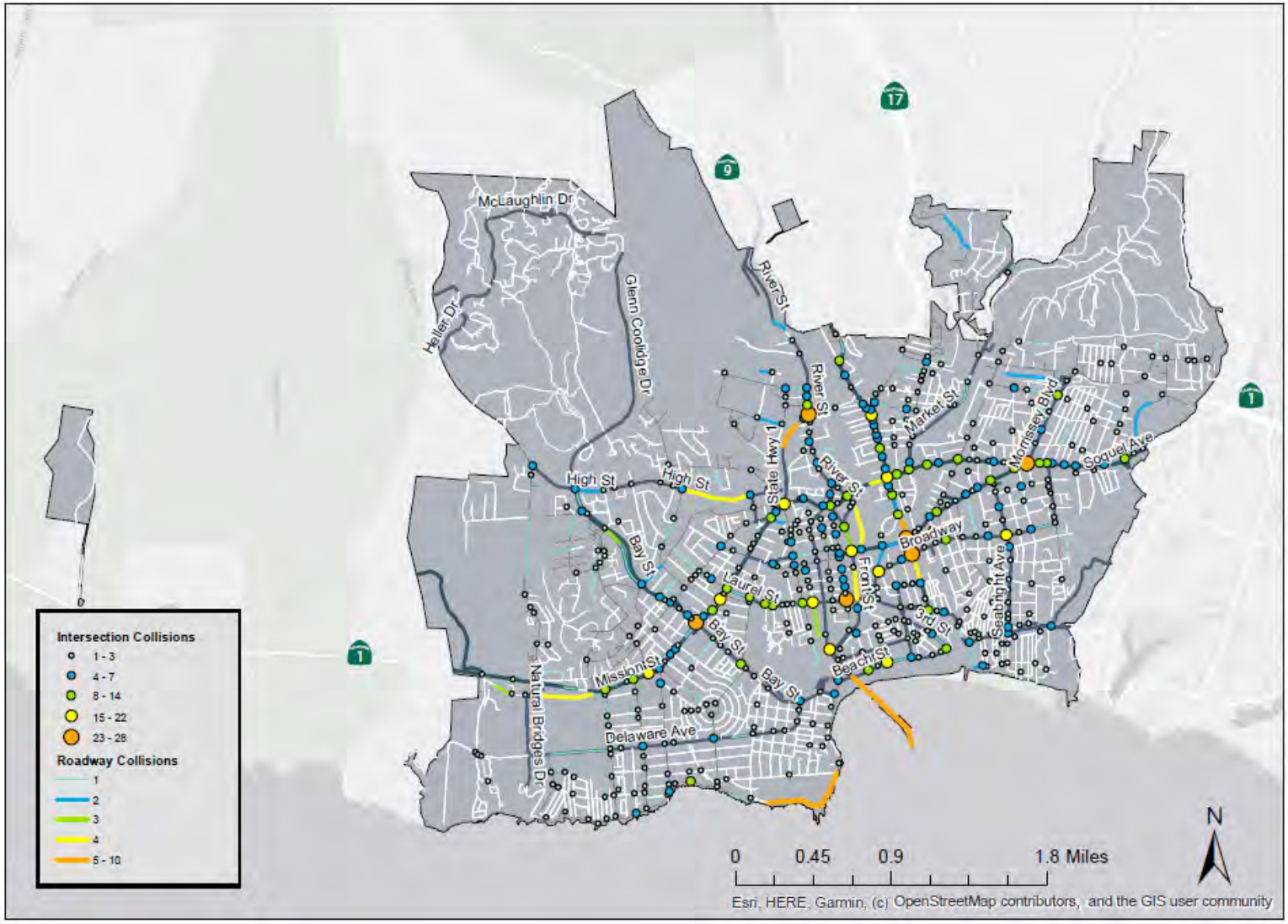
To help complete the initial collision history analysis, the network screening analysis was performed on the collision history data. The network screening analysis is a Geographic Information System (GIS) tool that helps identify the following: 1) collision hot spots (intersection and segment locations with the highest-number of collisions), 2) locations of fatal collisions, and 3) pedestrian-involved and bicycle-involved collision locations.

Key Findings

In this section, the collision findings are analyzed by the following groups: collision type, collision factor, collision impacts, fatal and serious injury collisions, pedestrian-involved collisions, and bicycle-involved collisions. Furthermore, Santa Cruz collision patterns are compared to other cities with similar-sized populations using the 2018 Office of Traffic Safety (OTS) Crash Ranking Results. This helps to see what traffic safety problems should be prioritized to combat. The City of Santa Cruz is grouped with approximately 102 other peer cities based on population size ranging from 50,001-100,000. Each ranking for OTS collision categories is based on a scale; ranking 1 being the highest city in the group for a given category. Santa Cruz ranks 65th out of 102 for total fatal and injury crashes. It is important to note that rankings are not normalized for tourist traffic or activities at the UC Santa Cruz campus. These comparative rankings can be seen in **Appendix A**. California Office of Traffic Safety Crash Rankings Results

A total of 2,496 collisions occurred within the City of Santa Cruz between January 2015 and December 2019 (the 5-year collision history period). The locations of these collisions are shown in **Figure 7**. The collisions are spread throughout the City's roadway network with most collisions occurring along arterial (and state highway) corridors such as Front Street, Ocean Street, Mission Street and Soquel Avenue.

Figure 7. Collisions Within the City of Santa Cruz



Collision Types

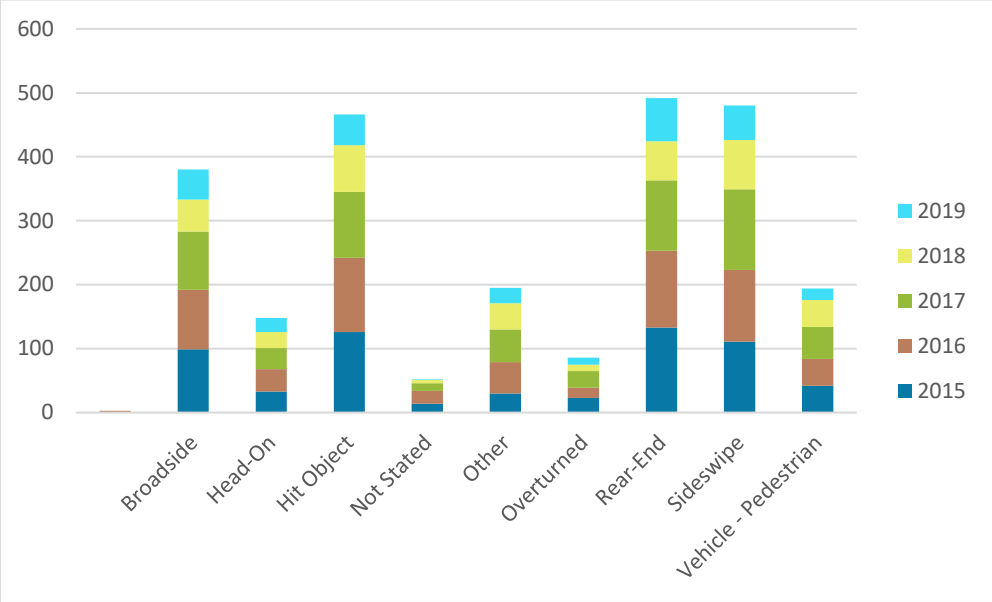
The collision types that occurred during the analysis period are shown in **Table 1.** The collision types, broken down by year and percentage, can be seen in **Figure 8.** Rear-end collisions (20%) are the most common collision type within the City. Sideswipe (19%), hit object (19%), and broadside (15%) collisions are the next leading collision types. The next highest category is vehicle-pedestrian (8%) collisions, a recognized vulnerable user group.

Table 1. *Percentage of Total Collisions by Collision Types in the City of Santa Cruz*

Collision Type	Percent of Total Collisions
Rear-End	20%
Sideswipe	19%
Hit Object	19%
Broadside	15%
Vehicle-Pedestrian	8%
Other	8%
Head-on	6%
Overturned	3%
Not Stated	2%
Number of Total Collisions	**2496**

Data Source: Statewide Integrated Traffic Records System (SWITRS) 2015-2019

Figure 8. *Number of Collisions by Collision Types for Each Collision History Year in the City of Santa Cruz*



Data Source: Statewide Integrated Traffic Records System (SWITRS) 2015-2019

Collision Factors

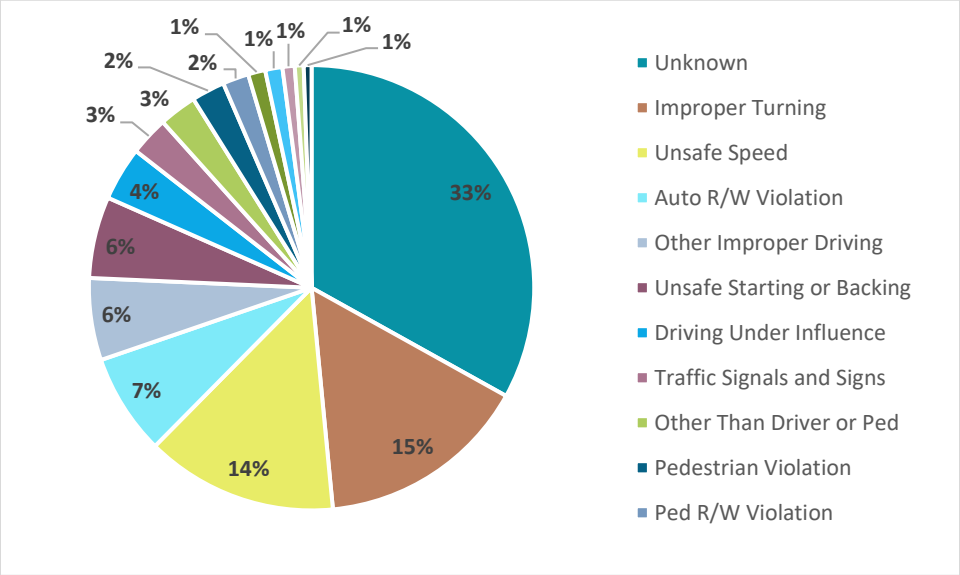
Knowing the reported causes of collisions can help identify safety factors systemwide that may contribute to collisions. **Table 2** and **Figure 9** shows the percent of total collisions by collision factor between 2015 and 2019. Approximately 33% of collisions have unknown primary collision factors. Of the known primary collision factors, the top leading collision factors are improper turning (15%) and unsafe speed (14%). The remaining collision factors for the collision history analyzed fall under 10% of all collisions. While many of the primary collision factors have remained constant or decreased over the past five years, driving under the influence has been a steadily increasing in the City of Santa Cruz with 15 collisions in 2015 to 26 in 2019. The 2018 OTS results show Santa Cruz ranked 26th for alcohol involved collisions, 70th for collisions where the driver between the ages of 21 and 34, and 52nd where the driver under the age of 21 had been drinking.

Table 2. *Percent of Total Collisions by Collision Factor in the City of Santa Cruz*

Collision Factor	Percent of Total Collisions
Unknown	33%
Improper Turning	15%
Unsafe Speed	14%
Auto Right of Way Violation	7%
Other Improper Turning	6%
Unsafe Starting or Backing	6%
Driving Under the Influence	4%
Traffic Signals and Signs	3%
Other Than Driver or Pedestrian	3%
Pedestrian Violation	2%
Pedestrian Right of Way Violation	2%
Following Too Closely	1%
Other Hazardous Movement	1%
Wrong Side of the Road	1%
Improper Passing	1%
Fell Asleep	1%
Number of Total Collisions	**2496**

Data Source: Statewide Integrated Traffic Records System (SWITRS) 2015-2019

Figure 9. Percent of Total Collisions by Collision Factor in the City of Santa Cruz

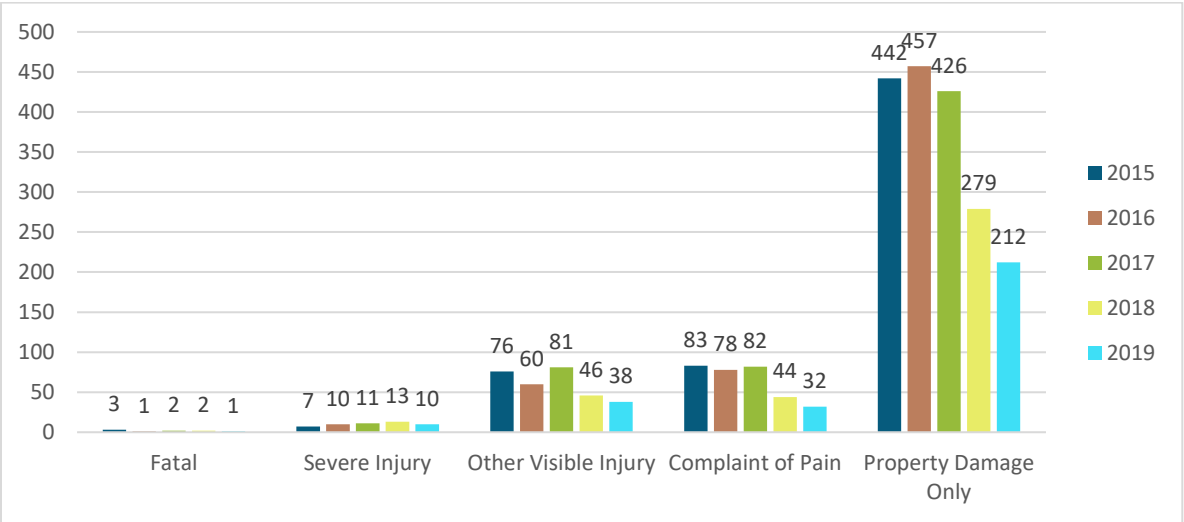


Data Source: Statewide Integrated Traffic Records System (SWITRS) 2015-2019

Collision Impacts

Knowing the collision impacts (the injuries or type of damage which occurred) is a key part of assessing the environment and safety factors around the site of a collision. **Figure 10** displays the count of each collision impact by year. While most collisions are property damage only (PDO) (73%) over the collision history, there were a total of nine (9) fatal collisions and 51 collisions resulting in severe injury within the five-year timeframe.

Figure 10. Number of Collisions by Collision Impact Type for Each Collision History Year



Data Source: Statewide Integrated Traffic Records System (SWITRS) 2015-2019

Fatal and Serious Injury Collision Impacts

Reviewing the collision type and collision factors specifically for fatal and serious injury collisions is a key step in detecting patterns in the City that are most associated with the worst collision outcomes. **Table 3** shows the comparison of Santa Cruz collisions to the statewide collisions by severity type from 2014 to 2019. For all comparable years, Santa Cruz fatal and serious injury (F+SI) collisions make up a lower percentage of total annual collisions than statewide F+SI collisions, except for 2018 serious injury collisions. As a result of having a lower proportion of injury collisions, property damage only (PDO) collisions make up a higher percentage of total annual collisions than statewide PDO collisions for all comparable years. **Table 4** shows the collision type for fatal, serious injury, and PDO collisions by the type of intersection (note: no fatal or serious injury collisions occurred within a roadway segment during the study period). The top leading collision types for fatal and serious injury collisions in the City of Santa Cruz are vehicle-pedestrian (32%) and broadside (20%) collisions. Compared to the 102 other cities in its population group, Santa Cruz is ranked 65th in 2018 regarding total number of fatal and injury collisions.

__Table 3__. Santa Cruz Collisions Compared to Statewide Collisions

Severity	State/City	2014	2015	2016	2017	2018	2019
Fatal	Statewide	0.7%	0.7%	0.7%	0.7%	0.7%	-
	Santa Cruz	-	0.5%	0.2%	0.3%	0.5%	0.3%
Serious Injury	Statewide	2.4%	2.4%	2.3%	2.5%	2.9%	-
	Santa Cruz	-	1.1%	1.7%	1.8%	**3.4%**	3.4%
Other Visible Injury	Statewide	12.5%	12.3%	11.5%	12.0%	12.7%	-
	Santa Cruz	-	**12.4%**	9.9%	**13.5%**	12.0%	13.0%
Complaint of Pain	Statewide	25.8%	26.1%	25.9%	25.3%	24.2%	-
	Santa Cruz	-	13.6%	12.9%	13.6%	11.5%	10.9%
Property Damage Only	Statewide	58.5%	58.5%	59.5%	59.5%	59.5%	-
	Santa Cruz	-	**72.3%**	**75.4%**	**70.8%**	**72.7%**	72.4%

Note: 2014 collisions not analyzed for Santa Cruz and 2019 collision data not available yet for statewide

Table 4. *Fatal & Serious Injuries by Collision Type and Intersection Type within the City of Santa Cruz*

Probably of Collision Type Exceeding Threshold Proportion	
Fatal/Serious Injury Collisions	All
> 1 KSI Collision	70-80%
= 1 KSI Collision	80-90%
	90-100%

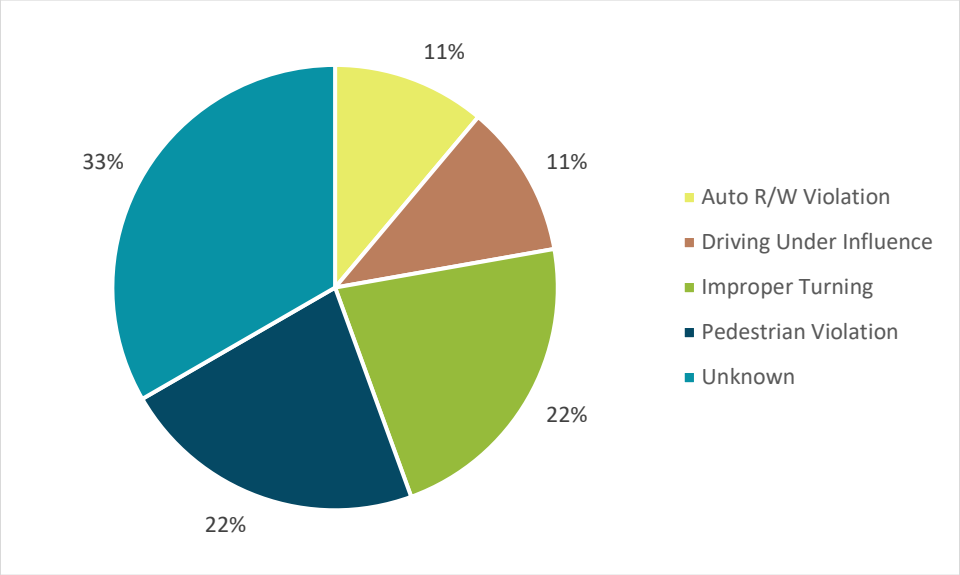
Intersection	Crashes	LCCR Differential	EPDO	*Fatal Collisions*	*Serious Injury Collisions*	*PDO Collisions*	Broadside	Sideswipe	Rear-End	Head On	Other	Pedestrian	Bicycle	Aggressive	Distracted	Impaired	Dark
Signalized Intersections																	
State Hwy 1 & State Hwy 9/River St	**28**	0.01	404	2	0	20	3	5	7	1	3	5	3	6	0	2	15
Seabright Ave & Broadway	**17**	4.81	221	1	0	8	5	1	2	5	1	2	1	3	0	2	8
Front St & Laurel St	**25**	-0.35	238	0	1	18	5	3	7	0	5	0	3	7	0	2	9
Pacific Ave & Laurel St	**24**	0.61	242	0	1	16	1	4	6	1	3	7	2	2	2	2	10
Ocean St & Water St	**22**	-0.16	220	0	1	16	1	5	5	1	7	3	0	5	3	3	9
Chestnut St Ext & State Hwy 1/Mission St	**20**	-0.11	238	0	1	11	4	0	9	3	2	1	0	11	1	2	7
Front St & Water St	**12**	-0.13	196	0	1	8	2	3	3	0	0	0	4	3	0	1	1
Front St & Cooper St	**9**	-0.08	173	0	1	8	0	4	1	0	1	1	2	0	0	1	3
Western Dr & State Hwy 1	**8**	2.01	172	0	1	7	3	3	1	0	1	0	0	3	0	1	1
King St & Bay St	**7**	-0.14	205	0	1	2	1	0	0	1	1	1	3	3	0	0	2
Hagemann Ave & Soquel Ave	**7**	-0.22	181	0	1	4	1	1	1	0	1	1	2	2	1	2	1

Intersection	Crashes	LCCR Differential	EPDO	*Fatal Collisions*	*Serious Injury Collisions*	*PDO Collisions*	Broadside	Sideswipe	Rear-End	Head On	Other	Pedestrian	Bicycle	Aggressive	Distracted	Impaired	Dark
Almar Ave & Mission St (Hwy 1)	**6**	-0.26	175	0	1	4	1	0	3	0	2	0	0	0	0	2	4
Potrero St & Madrona St	**6**	0.05	175	0	1	4	0	2	2	0	1	1	0	1	0	0	2
Unsignalized Intersections																	
David Way & W Cliff Dr	**8**	39.67	210	1	0	3	1	1	0	0	3	1	2	1	0	0	1
Limekiln St & Encinal St	**5**	-0.1	198	1	0	1	0	1	0	0	2	1	1	1	0	1	1
Toledo St & Bay St	**4**	0.13	173	1	0	2	0	0	0	0	1	1	2	1	1	2	3
Brook Ave & Murray St	**3**	-0.14	340	0	2	0	0	0	0	0	0	0	2	0	1	0	1
Seaside St & Rankin St	**2**	0.08	329	0	2	0	1	0	0	0	0	1	0	0	0	0	0
Pacific Ave & Beach St	**33**	-0.36	253	0	1	29	0	1	1	2	29	2	1	14	1	2	7
Washington St & Pacific Ave	**19**	0.10	232	0	1	12	2	0	1	1	10	0	5	5	1	2	3
Broadway & San Lorenzo Bl	**18**	0.09	222	0	1	10	2	2	3	1	7	2	0	1	0	1	7
Cliff St & Beach St	**17**	1.24	220	0	1	11	1	1	1	0	9	3	2	3	2	2	6
Mission St (Hwy 1) & Van Ness Ave	**16**	0.10	239	0	1	7	5	1	3	1	1	4	1	3	2	0	8
Ocean St & Hubbard St	**10**	0.10	184	0	1	7	0	1	3	0	4	2	0	1	0	1	6
Graham Hill Rd & Ocean St/Hillside Ave	**9**	0.09	192	0	1	6	0	1	1	1	5	0	1	0	0	0	4
State Hwy 9 & Fern St	**7**	-0.05	171	0	1	6	0	3	2	0	2	0	0	1	0	1	2
Laguna St & Bay St	**5**	0.02	174	0	1	3	2	0	1	1	0	0	1	0	0	0	1
Lincoln St & Walnut Ave	**5**	0.01	181	0	1	6	0	3	1	1	2	0	1	3	1	0	3
Darwin St & Gault St	**5**	0.50	188	0	1	2	0	1	1	0	1	1	1	1	0	0	0
Forest Ave & Soquel Ave	**5**	-0.11	183	0	1	2	0	1	0	0	3	0	1	1	0	0	3
Cleveland Ave & Laurel St	**4**	0.49	168	0	1	3	0	0	1	0	2	1	0	2	0	2	2

Intersection	Crashes	LCCR Differential	EPDO	*Fatal Collisions*	*Serious Injury Collisions*	*PDO Collisions*	Broadside	Sideswipe	Rear-End	Head On	Other	Pedestrian	Bicycle	Aggressive	Distracted	Impaired	Dark
Ocean St & Felker St	**4**	-0.13	168	0	1	3	1	0	2	0	0	1	0	1	0	0	2
Western Dr & Cypress Park	**3**	0.00	167	0	1	2	0	0	0	1	2	0	0	0	0	2	3
Pine St & Driveway	**3**	-0.15	167	0	1	2	0	0	1	1	0	1	0	1	0	0	1
Morrissey Blvd & Melrose Ave	**3**	-0.13	172	0	1	1	2	0	1	0	0	0	0	1	0	0	1
Burkett St & Mission St Exd	**2**	1.86	166	0	1	1	0	0	0	0	2	0	0	0	0	0	0
Myrtle St & Laurel St	**2**	-0.16	166	0	1	1	1	0	0	0	0	0	1	0	0	0	1
Seabright Ave & Pine St	**2**	-0.15	166	0	1	1	0	0	1	0	0	1	0	0	0	1	1
Roberts St & Broadway	**2**	-0.16	171	0	1	6	0	2	2	1	0	0	2	2	0	1	0
Swanton Blvd & Modesto Ave	**1**	0.04	165	0	1	0	0	0	0	1	0	0	0	0	0	0	0
Fairview Pl & Marine Parade	**1**	0.04	165	0	1	0	0	0	0	0	1	0	0	0	0	0	1
Pennsylvania Ave & Broadway	**1**	-0.27	165	0	1	0	1	0	0	0	0	0	0	0	0	0	0

Figure 11 displays the percentage of **fatal** collisions by their primary collision factor. As shown in the figure, there is not a clear, discernible collision factor associated with fatal collisions. The top collision factors for the nine fatal collisions in the City were improper turning and pedestrian violation, followed by driving under the influence and auto right-of-way violation. The primary collision factor was unknown for three of the collisions.

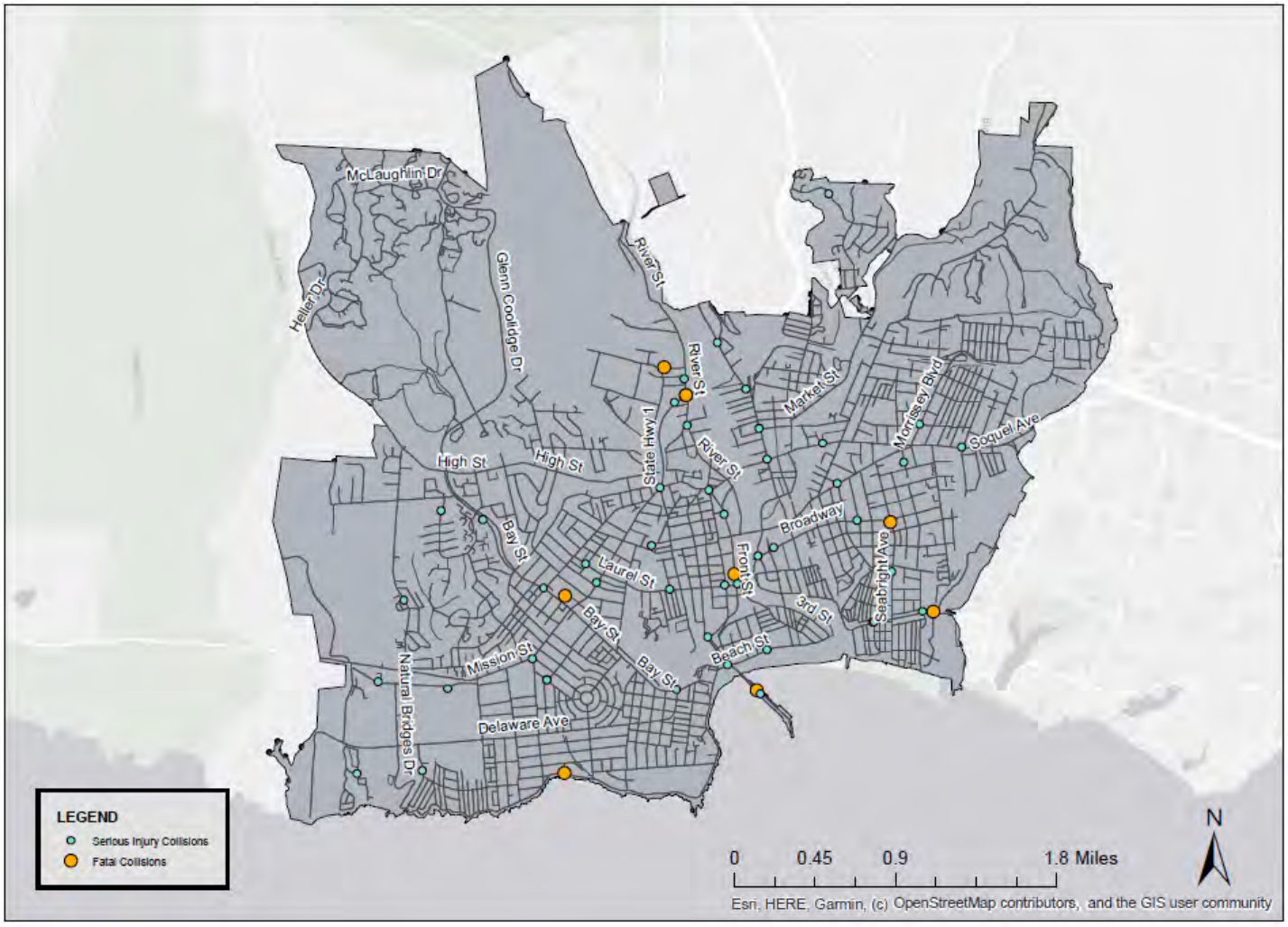
Figure 11. *Percentage of Fatal Collisions by Primary Collision Factor*



Data Source: Statewide Integrated Traffic Records System (SWITRS) 2015-2019

Figure 12 shows the locations of the fatal and serious injury collisions during the five-year collision history. Locating the fatal and serious injury collisions provides opportunity to look at the site conditions to determine the potential safety factors and roadway geometry/design that may improve safety.

Figure 12. *Locations of Fatal and Serious Injury Collisions within City of Santa Cruz*



Collision by Mode and Behavior Characteristics

Collisions occur for a variety of reasons: combinations of roadway user behavior, inclement weather, traffic control features, and a myriad of other causes. The following sections discuss the collisions from 2015-2019 within the City of Santa Cruz based on the types of vehicle/mode involved. This includes:

- Bicycles
- Pedestrians
- Cars and trucks
    - Single Vehicle Collisions/Off-Road Collisions
    - Vehicular Night-Time Collisions (with and without streetlights)
    - Driver Negligence

Pedestrian and Bicycle Collisions

Table 5 shows the number of collisions within the City that involved a pedestrian or bicyclist. Between 2015-2019, there were a total of 448 collisions that involved a pedestrian or bicyclist, which is about 18% of the total collisions within the City. This reflects a combination of the active beach community, tourism, and active transportation culture of Santa Cruz. The high numbers of pedestrians and bicyclists highlight a need to enhance safety to protect vulnerable users. Compared to other cities in the 2018 OTS grouping, Santa Cruz ranks 2nd highest in collisions involving pedestrians, 7th involving pedestrians under the age of 15, and 6th involving pedestrians over the age of 65. As for the bicycling community, the 2018 OTS rankings show the City of Santa Cruz as having the 4th highest number of collisions involving bicyclists and 10th involving bicyclists under the age of 15. It is important to note that the high number of bicycle and pedestrian traffic throughout the city increases exposure for these vulnerable populations; however, the OTS rankings do not normalize for these volumes.

Table 5. *Number of Total Collisions Within the City of Santa Cruz Involving a Pedestrian or Bicyclist*

Collisions Involving a Pedestrian or Bicyclist	Number of Total Collisions
Number of Collisions Involving a Pedestrian	203
Number of Collisions Involving a Bicyclist	245
Number of Total Collisions Involving a Pedestrian or Bicyclist	**448**

Data Source: Statewide Integrated Traffic Records System (SWITRS) 2015-2019

Figure 13 displays the locations of pedestrian-involved collisions while **Figure 14** displays the locations of bicycle-involved collisions.

Figure 13. *Pedestrian-Involved Collisions*

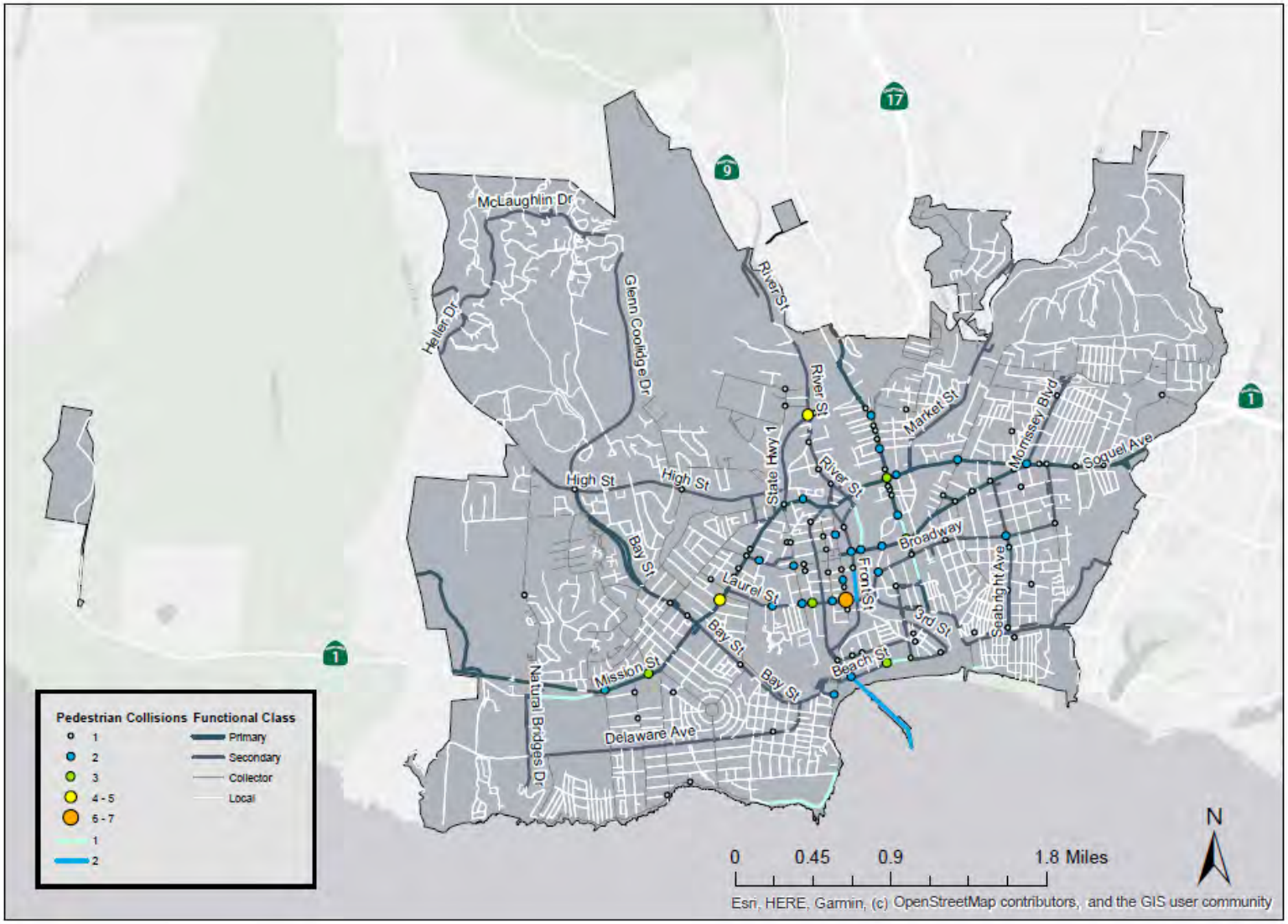
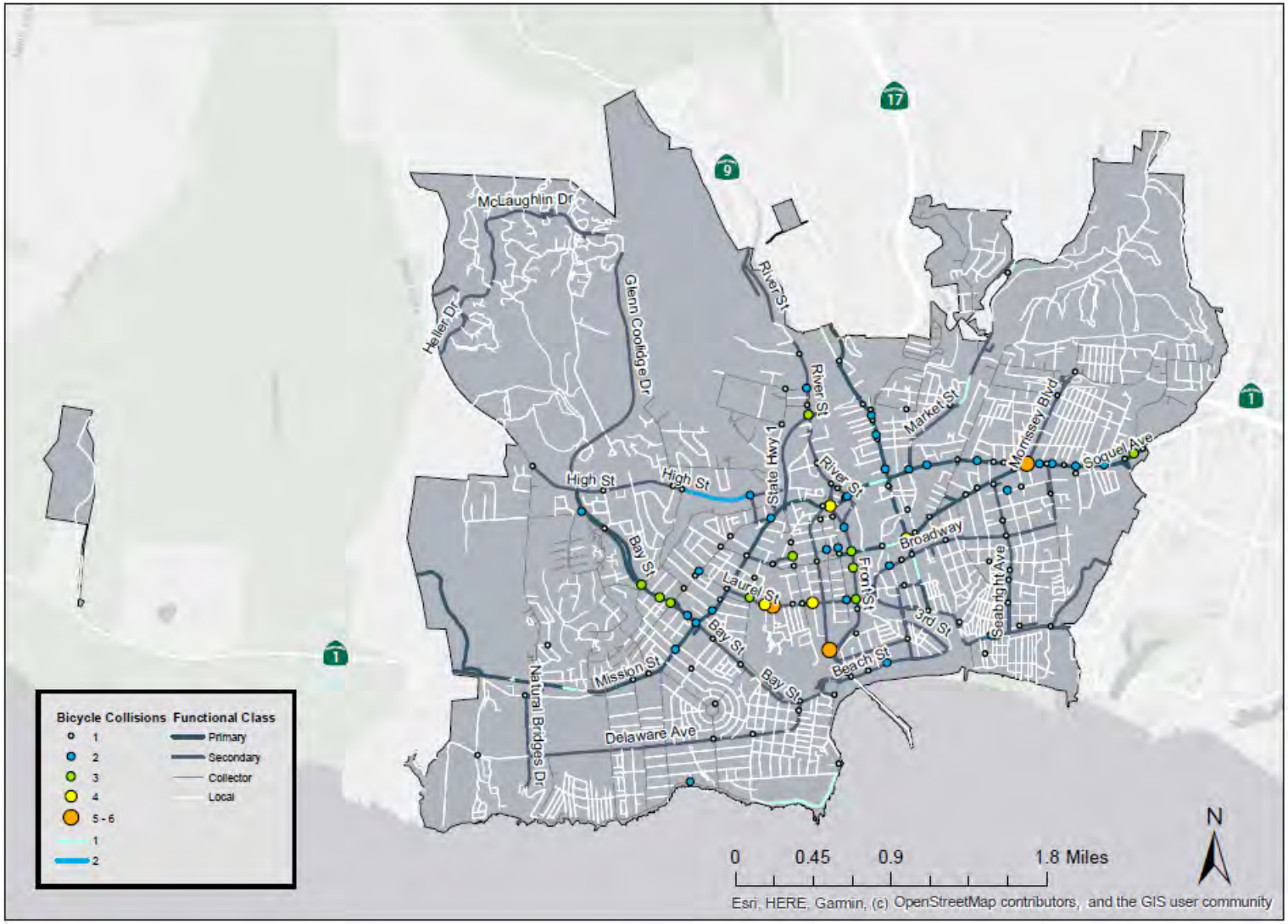


Figure 14. *Bicycle-Involved Collisions*



Vehicular Collisions

Time of Day

Vehicular Collisions are reported by time of day and presence of lighting at the collision site. Understanding the locations characteristics of these collisions is an important part of analyzing the safety conditions of the transportation network. Collisions occurring during night hours are categorized by the presence or lack of streetlights or, if lighting is present, whether it is operational. Collisions occurring at night make up 32% of all collisions over the analysis period. **Figure 15** displays the locations of vehicular collisions during the study period during dark periods. Compared to similar cities, Santa Cruz is ranked number 28 of 102 of similar sized cities with collision occurring at night (between 9:00 PM and 2:59 AM).

Impaired, Aggressive, and Distracted Driving

While impaired, aggressive, and distracted driving are dangerous anywhere, some roadway segments or intersections might need more driver attention than others.

Collisions involving impaired driving have been increasing in the City with 15 collisions in 2015 and 26 in 2019. Impaired driving collisions make up over 9% of all collisions over the analysis period. The 2018 OTS rankings show Santa Cruz ranked 26th for alcohol involved collisions, 70th for collisions where the driver was between the ages of 21 and 34, and 52nd where the driver under the age of 21 and had been drinking, respectively. These collisions are shown in **Figure 16.**

Aggressive driving is a challenge area that identifies collisions where, as defined by the SHSP, the responsible driver engaged in unsafe speeding, following too closely, or improper passing. Aggressive driving collisions make up 18% of all collisions over the analysis period. **Figure 17** is a map of where these collisions occurred.

Distracted driving is another SHSP challenge area that identifies collisions where the driver responsible for the collision was engaging in another activity that took their attention away from driving, thus increasing the chance of a collision. In recent years, distracted driving has been most attributed to cell phone usage while driving. Distracted driving is difficult to assess for responding officers and is assumed to be under-reported. Distracted driving collisions make up over 4% of all collisions over the analysis period. These collisions are shown in **Figure 18.**

Figure 15. Night Collisions

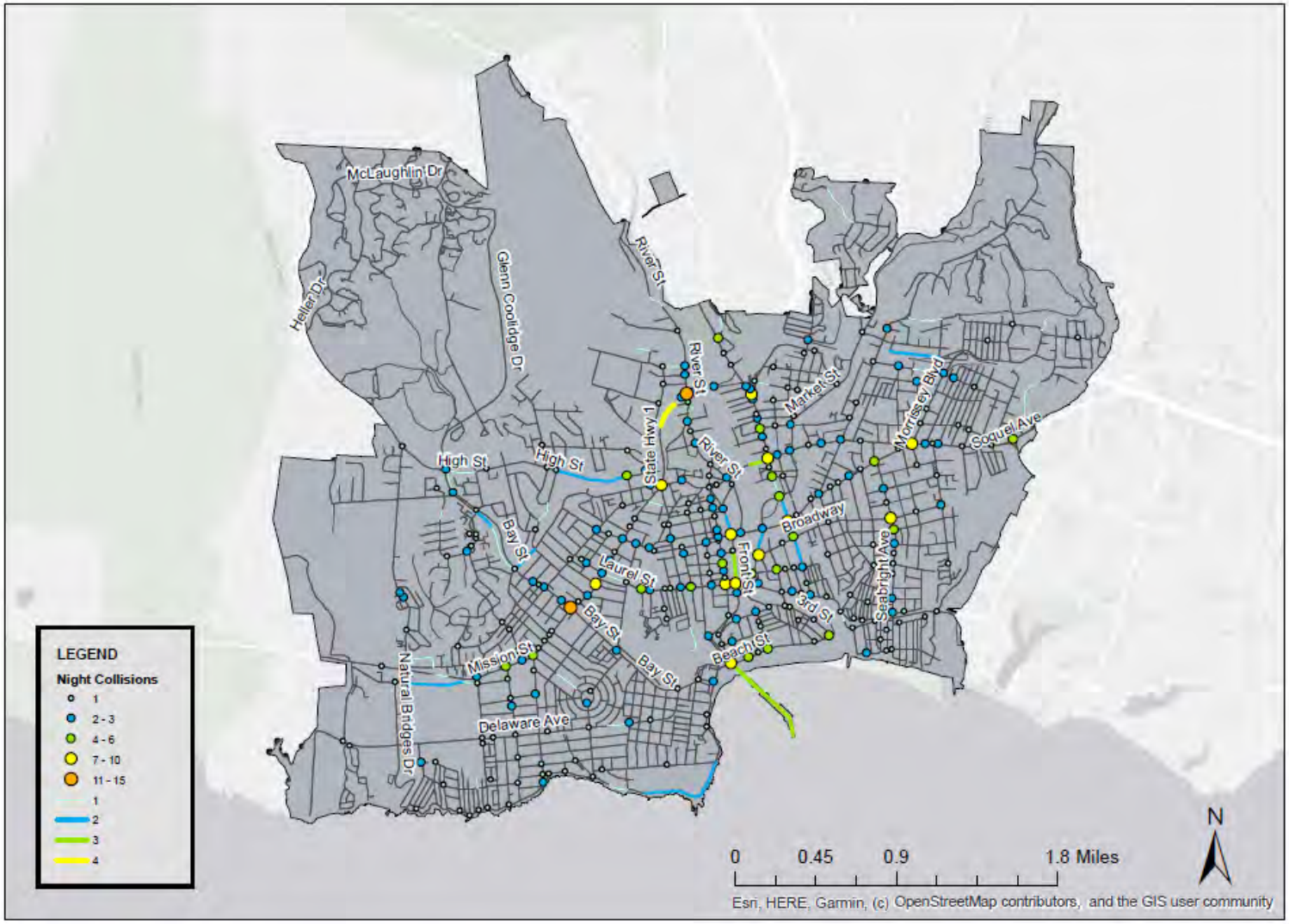


Figure 16. *Collisions Involving an Impaired Driver*

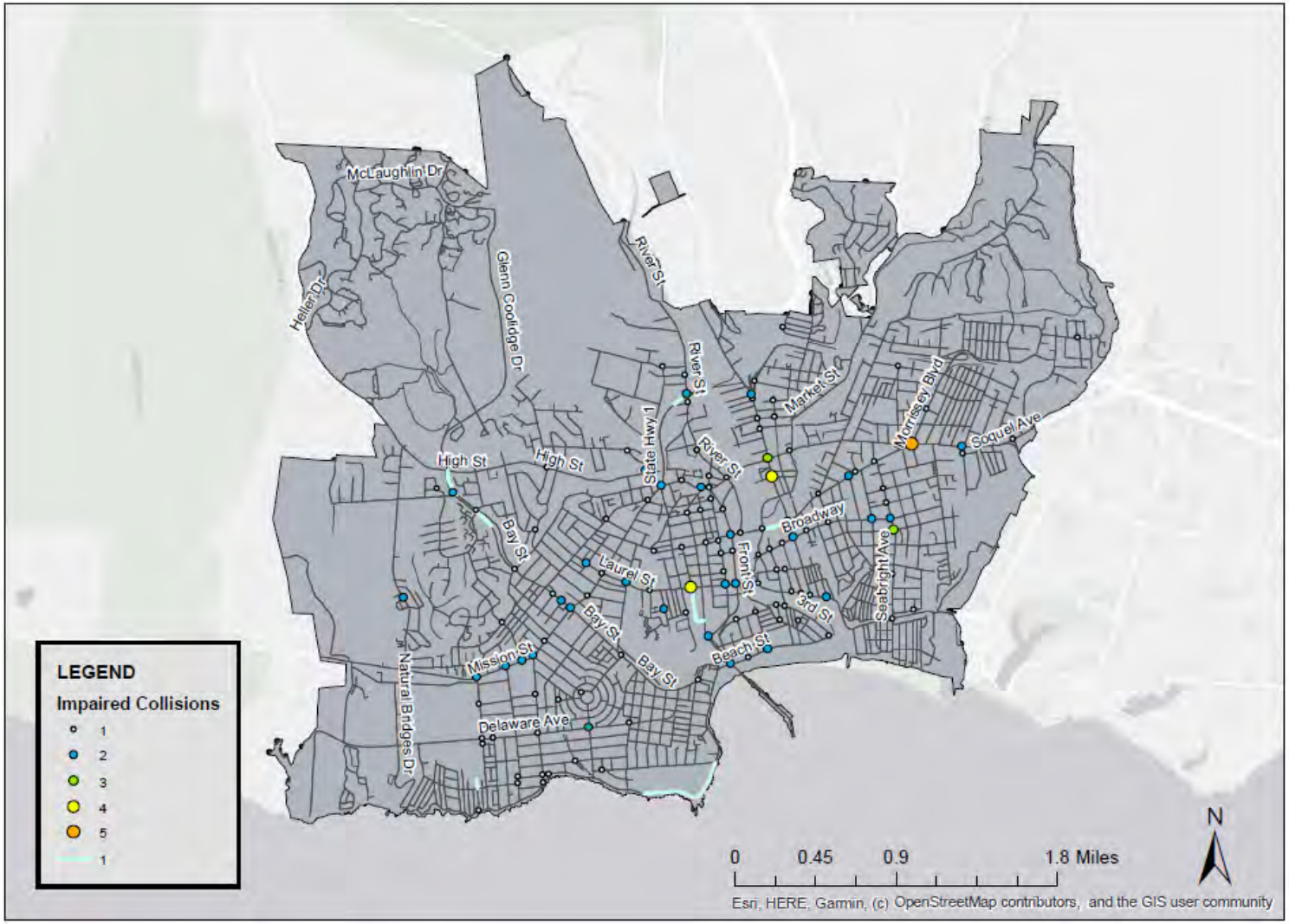


Figure 17. *Collisions Involving an Aggressive Driver*

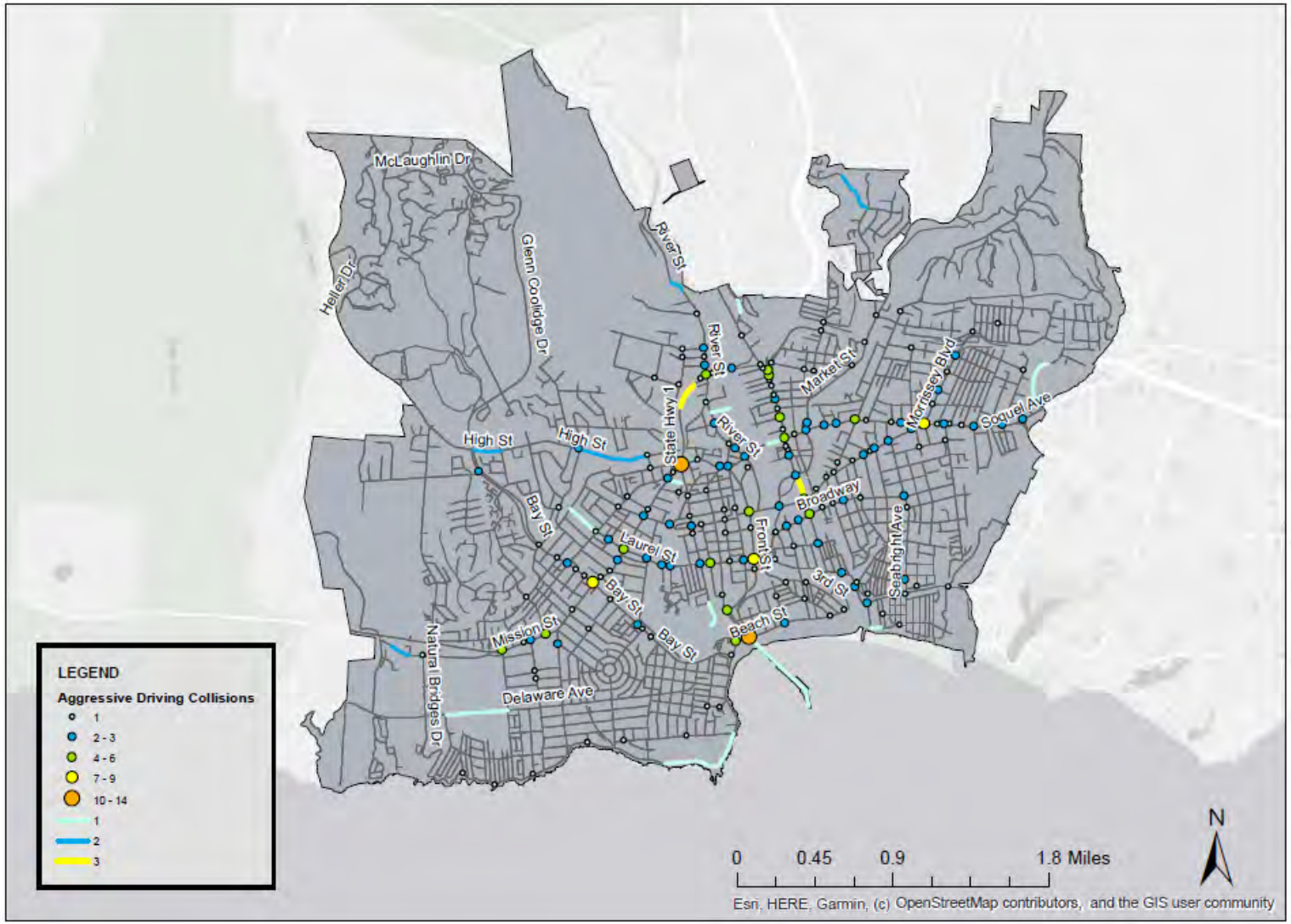
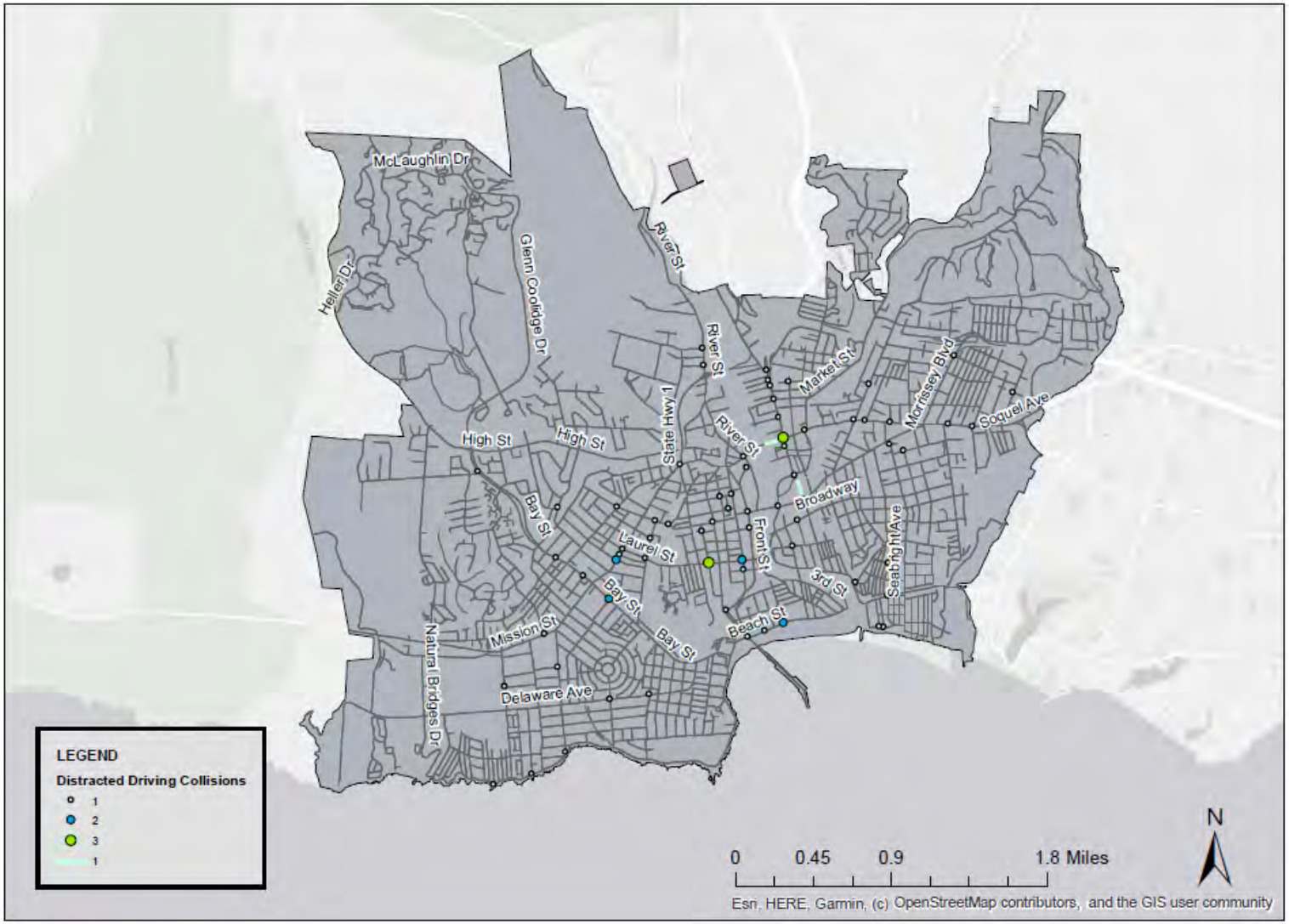


Figure 18. Collisions Involving a Distracted Driver



Top Collision Locations

Table 6 and **Table 7** list the intersections and segments where most collisions occurred. These intersections and segments are shown in the City's roadway network in **Figure 19**. Most of the collisions during the analysis period occurred at intersections along Ocean Street, Broadway, Mission Street (State Highway 1), State Highway 9, and River Street.

Table 8 outlines the summary of collisions at the case study locations. The rankings include a breakdown of collision type as well as severity of collision and causes of driver negligence.

__Table 6.__ Top 10 Intersections for Collisions in the City of Santa Cruz

Signalized Intersections							
	Intersection	Total # of Collisions	# of Fatal Crashes	# of Serious Injury Crashes	Leading Collision Type	# of Bicycle Crashes	# of Pedestrian Crashes
1	State Hwy 9/River St & State Hwy 1	28	2	0	Rear-End	3	5
2	S Morrissey Ave & Soquel Ave	27	0	0	Rear-End	5	2
3	Mission St & Bay St	25	0	0	Rear-End	2	0
4	Ocean St & Broadway	25	0	0	Other	1	1
5	Ocean St & Soquel Ave	25	0	0	Other	4	3
Unsignalized Intersections							
	Intersection	Total # of Collisions	# of Fatal Crashes	# of Serious Injury Crashes	Leading Collision Type	# of Bicycle Crashes	# of Pedestrian Crashes
1	Ocean St & Pryce St	21	0	0	Broadside / Other	2	2
2	Washington St & Laurel St	20	0	0	Rear-End / Other / Bicycle	4	3
3	Broadway & San Lorenzo Bl	18	0	1	Other	0	2
4	Cliff St & Beach St	17	0	1	Other	2	3
5	Mission St (Hwy 1) & Van Ness Ave	16	0	1	Broadside	1	4

Table 7. Top Segments for Collisions in the City of Santa Cruz

Primary Arterial Segments							
	Corridor	End Segment Streets	Total # of Crashes	# of Fatal Crashes	# of Serious Injury Crashes	# of Bicycle Crashes	# of Pedestrian Crashes
1	Ocean St	FROM Soquel Ave TO Dakota Ave	7	0	0	0	1
2	Ocean St	FROM Broadway TO Barson St	4	0	0	1	1
3	Water St	FROM River St TO Ocean St	4	0	0	1	0
Secondary Arterial Segments							
	Corridor	End Segment Streets	Total # of Crashes	# of Fatal Crashes	# of Serious Injury Crashes	# of Bicycle Crashes	# of Pedestrian Crashes
1	State Hwy 1	FROM State Hwy 9 (River St) TO State Hwy 1 (Mission St)	7	0	0	0	0
2	Front St	FROM Cathcart St TO Laurel St	4	1	0	0	2
3	High St	FROM Laurent St TO Storey St	4	0	0	2	0
4	Front St	FROM Cooper St TO Soquel Ave	3	0	0	0	0
Commuter Segments							
	Corridor	End Segment Streets	Total # of Crashes	# of Fatal Crashes	# of Serious Injury Crashes	# of Bicycle Crashes	# of Pedestrian Crashes
1	W Cliff Dr	FROM Columbia St TO Pelton Ave	7	0	0	1	1

2	La Fonda Ave	FROM Abby Ct TO Oak Way	2	0	0	0	0
3	Harvey West Blvd	FROM Sylvania Ave TO Coral St	2	0	0	0	0
4	Carbonera Dr	FROM Carbonera Ct TO Isbel Dr	2	0	1	0	0
5	Escalona Dr	FROM Bay St TO Laurent St	2	0	0	0	0

Local Segments

	Corridor	End Segment Streets	Total # of Crashes	# of Fatal Crashes	# of Serious Injury Crashes	# of Bicycle Crashes	# of Pedestrian Crashes
1	Municipal Wharf	FROM South of Beach St TO End	10	1	1	0	2
2	South River St	FROM Water St TO Soquel Ave	4	0	0	0	1
3	Mission St Ext	FROM Western Dr TO Swift St	4	0	0	0	1
4	Washington St	FROM Laurel St TO Center St/Washington St	3	0	0	0	0
5	Bay St	FROM Nobel Dr TO Escalona Dr	3	0	1	0	0

Figure 19. Top 10 Collision Locations

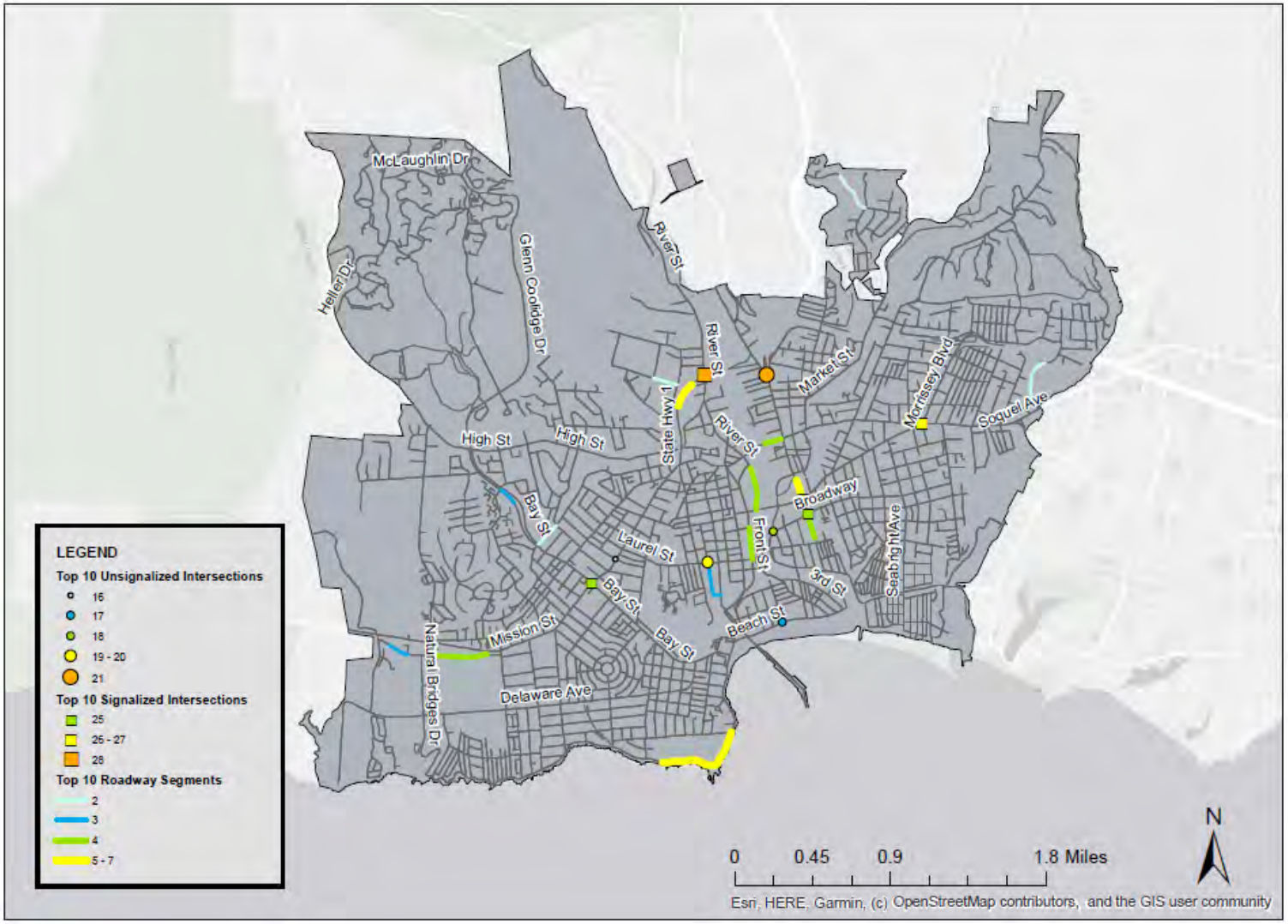


Table 8. Summary Collisions at Case Study Locations

Probably of Collision Type Exceeding Threshold Proportion	
Fatal/Serious Injury Collisions	All
> 1 KSI Collision	70-80%
= 1 KSI Collision	80-90%
	90-100%

Intersection	Type	Crashes	LCCR Differential	EPDO	Fatal	Serious Injury	Other Visible Injury	Compalint of Pain	PDO	Broadside	Sideswipe	Rear-End	Head On	Other	Pedestrian	Bicycle	Aggressive	Distracted	Impaired	Dark
Signalized Intersections																				
S Morrissey Ave & Soquel Ave	Signalized	**27**	0.01	111	0	0	6	5	16	2	4	7	1	4	2	5	7	0	5	9
Mission St (Hwy 1) & Bay St	Signalized	**25**	0.03	95	0	0	2	10	13	2	7	8	4	2	0	2	9	0	2	13
Seabright Ave & Broadway	Signalized	**17**	4.81	221	1	0	0	8	8	5	1	2	5	1	2	1	3	0	2	8
Unsignalized Intersections																				
Pacific Ave & Beach St	Roundabout	**36**	NA	253	0	1	5	1	29	0	1	1	2	29	2	1	14	1	2	7
Washington St & Pacific Ave	Roundabout	**19**	NA	232	0	1	4	2	12	2	0	1	1	10	0	5	5	1	2	3
Bay Corridor (from Nobel Dr to Escalona Dr)																				
Escalona Dr & Bay St	Unsignalized	**6**	-0.04	20.8	0	0	1	1	4	0	0	1	1	1	1	2	2	0	2	2
Bay St (from Nobel Dr to Escalona Dr)	Local	**3**	24.65	167	0	1	0	0	2	0	0	0	0	3	0	0	0	0	1	2
Nobel Dr & Bay St	Signalized	**3**	2.10	3	0	0	0	0	3	0	0	0	0	2	0	1	0	0	1	1
Front Street Corridor (Water Street to Soquel Avenue)																				
Front St/Pacific Ave & Water St	Signalized	**12**	-0.13	196	0	1	1	2	8	2	3	3	0	0	0	4	3	0	1	1

Intersection	Type	Crashes	LCCR Differential	EPDO	*Fatal*	*Serious Injury*	*Other Visible Injury*	*Compalint of Pain*	*PDO*	Broadside	Sideswipe	Rear-End	Head On	Other	Pedestrian	Bicycle	Aggressive	Distracted	Impaired	Dark
Front St (from Water St to Cooper St)	Sec. Arterial	**2**	NA	2	0	0	0	0	2	0	1	0	0	1	0	0	0	0	1	1
Front St & Cooper St	Signalized	**9**	-0.08	173	0	1	0	0	8	0	4	1	0	1	1	2	0	0	1	3
Front St (Cooper St to Soquel Ave)	Sec. Arterial	**3**	2.33	3	0	0	0	0	3	1	2	0	0	0	0	0	0	0	0	2
Front St & Soquel Ave	Signalized	**21**	0.26	71	0	0	3	4	15	1	4	5	1	6	2	3	6	1	2	7
Ocean Street Corridor (Water Street to Broadway)																				
Ocean St & Water St	Signalized	**22**	-0.16	220	0	1	2	3	16	1	5	5	1	7	3	0	5	3	3	9
Ocean St & County Gov Center Driveway	Unsignalized	**4**	-0.14	24	0	0	1	2	1	0	1	1	0	0	1	1	1	1	0	1
Ocean St & Leonard St	Unsignalized	**14**	7.62	29	0	0	1	1	12	3	2	4	0	3	1	0	2	0	4	6
Ocean St (Leonard St to Dakota Ave)	Prim. Arterial	**2**	0.28	2	0	0	0	0	2	0	1	1	0	0	0	0	0	0	0	1
Ocean St & Dakota Ave	Unsignalized	**10**	33.14	30	0	0	0	4	6	1	1	5	0	1	2	0	3	1	0	4
Ocean St (Dakota Ave to Soquel Ave)	Prim. Arterial	**7**	3.01	17	0	0	0	2	5	0	3	2	0	1	1	0	3	1	0	2
Ocean St & Broadway	Signalized	**25**	0.14	100	0	0	3	9	13	5	2	4	4	7	1	1	4	0	2	6
Ocean St & Soquel Ave	Signalized	**25**	-0.01	89	0	0	5	3	17	2	2	4	2	8	3	4	4	1	2	9
Laurel Street Corridor (Washington Street to Front Street)																				
Washington St & Laurel St	Unsignalized	**20**	0.62	123	0	0	8	5	7	1	3	4	1	4	3	4	4	3	4	5
Cedar St & Laurel St	Unsignalized	**3**	-0.08	22	0	0	2	0	1	0	0	0	0	1	2	0	1	0	0	2
Pacific Ave & Laurel St	Signalized	**24**	0.61	242	0	1	4	3	16	1	4	6	1	3	7	2	2	2	2	10
Front St & Laurel St	Signalized	**25**	-0.35	238	0	1	4	2	18	5	3	7	0	5	0	3	7	0	2	9

Key Findings Summary

Over 90% of the City's collision activities occur at or within 250 feet of an intersection. The highest occurring collision type in the City involved rear-ends (20%), followed by sideswipe (19%) and hit object (19%) collisions. Though 33% of collision have an unknown primary collision factor, the other top factors include improper turning (15%), unsafe speed (14%), and auto right-of-way violation (7%). On the priority corridors and intersections, the primary collision factor is lighting (34%), aggressive driving (23%), and impaired driving (11%).

From the key findings in the collision history analysis and discussions with City staff, the following three key Emphasis Areas have been identified:

1. Improving Visibility and Lighting
2. Reduce Aggressive Driving Behavior
3. Improve Traffic Safety for Vulnerable Roadway Users Including the Unhoused Population

The three developed emphasis areas are described in the next section. Each Emphasis Area includes preliminary supporting data findings, goals, and strategies.

EMPHASIS AREAS

Emphasis Area 1: Improving Visibility and Lighting

Description:

Visibility is an important factor in roadway safety that benefits drivers and active transportation users. Improving roadway visibility includes installing and/or maintaining street lighting, retroreflective backplates on signals and signs, and roadway striping. Between 2015-2019, of the 2,496 total collisions, 691 occurred while it was dark with streetlights, 97 occurred while it was dark with no streetlights, and 18 collisions took place at dark with streetlights not functioning. Of these dark condition collisions, 130 collisions involved a pedestrian or bicyclist. As the City expands and encourage active transportation use, it is important to make infrastructure improvements that ensure all roadway user safety at all times of the day.

DATA FINDING	*Out of the 943 collisions not occurring during daylight, the most common type of collision is hit object collisions (25%). Aside from the improvements to the safety of active transportation users, improved lighting and visibility can significantly reduce the number of collisions that result in some form of property damage.*

Goals:

- Improve, enhance, or install intersection and segment lighting throughout the City.

Strategies:

- Incorporate other visibility improvements:
    - Retroreflective backplates on signals and signs
    - Retroreflective poles
    - Retroreflective warning signs on curved roadways
    - High visibility marked crosswalks
    - Pedestrian crossing warning signs at pedestrian dense locations
    - Advanced stop bars
    - Curb extensions and/or curb bulb-outs where feasible

Emphasis Area 2: Reduce Aggressive Driving Behavior

Description:

The Strategic Highway Safety Plan (SHSP) describes aggressive driving as speeding or driving too fast for roadway conditions, tailgating, and other forms of reckless driving maneuvers such as weaving through traffic. Aggressive driving often includes instances where drivers disobey or run traffic signals and signs. Under the SHSP a collision may be deemed as an aggressive driving collision if any of the aforementioned criteria are documented but not necessarily the primary collision factor. In the past five years, there have been 447 collisions attributed to aggressive driving, eight of which resulted in a serious injury. Of these aggressive driving collisions, 346 (77%) were a result of unsafe speed, 70 (15%) were related to traffic signal and sign violation, and 31 (7%) were a result of following too closely. Nearly half of the aggressive driving collisions (201 in total) were rear-end collisions with the second highest collision type being broadside collisions at a total of 69.

DATA FINDING	*The City and its safety partners identified aggressive driving as a safety concern. Nearly 20% of all collisions in the City of Santa Cruz are related to aggressive driving.*

Goals:

- Reduce annual aggressive driving collisions

Strategies:

- Evaluate use of Flashing Yellow Arrow for left turns at permissive signalized intersections
- Install speed warning signs at "high risk" intersections
- Implement advanced dilemma zone detection
- Consider the use of geometric roadway changes to reduce speeding
- Develop a public outreach campaign or expand the existing Street Smarts campaign to coincide with other jurisdictions' efforts to raise awareness about speeding and aggressive driving
- Conduct routine speed surveys to keep speed limits current and enforceable
- Enforce legislation that specifically penalizes aggressive driving
- Target key intersections and road segments and review striping and signage through roadway safety assessments
- Organize targeted education campaign on safety problems at "high risk" intersections
- Additional focused traffic enforcement presence using an equity lens

Emphasis Area 3: Improve Traffic Safety for Vulnerable Roadway Users Including the Unhoused Population

Description:

There are many pedestrians and bicyclists, especially those in the unhoused population, throughout the City that need appropriate infrastructure to safely use the roadway system. The City of Santa Cruz has outlined policies for complete streets and has developed an Active Transportation Plan to improve and maintain multi-modal street designs. These policies will ensure that street and highway designs further the goal of providing safe and efficient mobility for all users of the city. Throughout the City, updates to active transportation facilities such as high visibility crosswalks, bike paths, intersection control, and speed controls can help provide a safe and comfortable environment for people walking and biking. Of the 448 collisions in which at least one pedestrian or bicyclist was involved, 19 resulted in serious injuries and 7 resulted in a fatality.

DATA FINDING	*About 18% of the total collisions in the City involves at least one bicyclist or pedestrian. Of the 319 pedestrian involved collisions, 230 occurred where the pedestrian was crossing at a designated marked crossing.*

Goals:

- Reduce the number of fatal and serious injury collisions involving pedestrians and bicyclists, with an additional focus area on unhoused populations

Strategies:

- Provide outreach, education and enforcement to encourage more separation between vehicular and pedestrian traffic.
- Incorporate safer crossings by:
    - High visibility marked crosswalks
    - Advanced stop bars
    - Pedestrian countdown signals with lead pedestrian intervals at signalized intersections
    - Reduce pedestrian crossing distance, including treatments such as median refuge islands, curb extensions and/or curb bulb-outs
    - Installing midblock crossings at pedestrian dense locations: schools, shopping, beach access, etc. where feasible
- Provide advance signing and wayfinding
- Provide dedicated pedestrian and bicycle infrastructure to and from bus stops

- Install adequate street lighting
- Widen street shoulders
- Provide signage (e.g., pedestrian crossing ahead) to help drivers expect to slow down for pedestrians and bikes
- Install bicycle storage facilities in public areas, such as the beach, City Hall, schools and parks and in other public facilities in order to encourage bicycle use
- Work with County Public Health partners to implement additional traffic safety outreach to unhoused populations
- Support bicycle facilities providing a dedicated right-of-way for the sole use of bicyclists where feasible

POTENTIAL IMPROVEMENT LOCATION	*The top locations for collisions involving bicycles and pedestrians are along Laurel Street and Front Street. The City can consider doing a vulnerable roadway users education campaign along these streets to help pedestrians and bicyclists navigate these roadways safely. In addition, the City can consider improving active transportation infrastructure and visibility along these streets, supplementing those done on Laurel Street in 2015.*

INFRASTRUCTURE TOOLBOX

The following sections provide more information on potential safety measures that might address conditions that were observed to contribute to collision activity in the City. This includes information on Crash Modification Factors, improvements and countermeasures identified for Santa Cruz, as well as for specific projects and locations identified as part of this analysis.

Countermeasure Selection Process

Crash Modification Factors

Part D of the HSM provides information on Crash Modification Factors (CMF) for roadway segments, intersections, interchanges, special facilities, and road networks.

CMF's are used to estimate the safety effects of highway improvements and apply CMFs to compare and select highway safety improvements. A CMF less than 1.0 indicates that a treatment has the potential to reduce collisions. A CMF greater than 1.0 indicates that a treatment has the potential to increase collisions. The application of an appropriate CMF can influence the decision to implement a particular project, while the misapplication of CMFs can lead to poor decisions. Key factors to consider when applying CMFs include:

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

Examples of Safety Countermeasure can be found through several sources. This Report utilizes the countermeasures found in the California LRSM (**http://www.dot.ca.gov/hq/LocalPrograms/HSIP/2018/CA-LRSM.pdf**) and the CMF Clearinghouse website (**http://www.cmfclearinghouse.org/**).

Traffic Safety Toolbox

The systemic improvements identified as most likely effective for Santa Cruz are listed in **Table 9** below include low-cost and higher-cost items that can be implemented in phases where appropriate. The CMF indicates how effective the countermeasure is at reducing collisions. A value of 0.0 would indicate that it would prevent all future collisions, while a value of 1.0 would indicate that it has no effect on collisions:

Table 9. *Traffic Safety Toolbox*

Countermeasure	Crash Modification Factor
Vehicle	
Install raised pavement markers and striping	0.90
Signal ahead warning signs	0.85
Improve signal timing (coordination)	0.85
Fluorescent sheeting on regulatory and warning signs	0.85
Retroreflective heads	0.85
Intersection warning signs	0.85
Install right-turn lane	0.80
Install transverse rumble strips on horizontal curves	0.80
Install guardrail roadside barrier	0.75
Install curves warning signs	0.75
Upgrade pavement markings	0.75
Protected left turn phase	0.70
Convert signal from pedestal-mounted to mast arm	0.70
Install dynamic/variable speed warning signs	0.70
Road diet	0.70
Install segment lighting	0.65
Advanced dilemma zone detection	0.60
Conduct warrant studies for all-way STOP control/Signal	0.50
Lane indicators	0.50
Pedestrian	
Pedestrian countdown signal	0.75
RRFB2	0.65
Crosswalks	0.65
Curb extensions	0.63

Countermeasure	Crash Modification Factor
Colored bicycle lanes	0.61
Crosswalk lighting	0.60
Continental crosswalk	0.60
In-ground flashers	0.60
Pedestrian scramble	0.60
Pedestrian refuge island	0.55
Pedestrian HAWK1	0.45
Leading pedestrian interval	0.40
Crossing guard	Qualitative
Bicycle	
Bicycle box	0.85
Bike lanes	0.65
Separated (protected) bike lanes	0.55

1. High Intensity Activated Crosswalk (HAWK)
2. Rectangular Rapid Flashing Beacon (RRFB)

Benefit to Cost Ratio Process

Benefit to Cost Ratio (B/C Ratio) is a way to compare the overall benefits against the overall cost of a project over a specified time period. The process of calculating the B/C Ratio begins with the identification of a horizon year (typically a 20-year project life span). The Benefit (B) of a project is the monetized value of collisions that would be prevented by the improvement over the project lifespan. No build collisions are computed assuming a consistent collision rate as traffic grows in the future. The collision modification factor is then used to reduce future year collisions over the 20-year period. The Cost (C) is the initial construction cost of the project and the cost per year to maintain the project over the same 20-year span.

The B/C Ratio calculations will illustrate the expected benefits of the Crash Modification Factors (CMFs) using four steps from the Local Roadway Safety Manual:

1. Estimation of the number of expected collisions without treatment
2. Application of CMFs by type and severity
3. Application of multiple CMFs at same location/facility
4. Application of benefit of value by collision severity

For step 4, the benefit discussed is evaluated in dollars. Caltrans maintains an evaluation for the cost of collisions (injury, incapacitating, and fatal). This number is applied to the amount of collisions "avoided" and is considered the benefit value. The final step of the evaluation is to determine if the benefit equals or exceeds the costs.

Cost/benefit ratios are the most typical prioritization metric used by grant programs to determine funding awards. The overall list of projects should then be listed by their cost/benefit ratio and bundled into funding groups. This will assist the

City in prioritizing the implementation of projects that will have the highest benefit first, while still planning for other recommended projects. Cost/benefit calculations will ensure that the highest ranked projects are most competitive for external funding and will lead to the greatest amount of safety improvement for the lowest possible investment.

Case Study Locations – Project Development

The case study locations informed the development of the overall countermeasure toolbox. However, the development of the prioritized projects was based on the systemic nature of the analysis. Additional countermeasures were identified for the high-level issues on a city-wide level. The following eight case study locations were prioritized for further project development:

1. Morrissey Avenue at Soquel Avenue
2. Mission Street (State Highway 1) at Bay Street
3. Seabright Avenue at Broadway
4. Bay Corridor (from Nobel Drive to Escalona Drive)
5. Front Street Corridor (from Water Street to Soquel Avenue)
6. Ocean Street Corridor (from Water Street to Broadway)
7. Laurel Street Corridor (from Washington Street to Front Street)
8. Pacific Avenue at Beach Street (Roundabout)

Case Studies were also conducted on the UC Santa Cruz campus but were not included in this report because they are outside of the city limits. Further detail on these findings can be found in **Appendix D**. University of California Santa Cruz (UCSC) Countermeasure Opportunities.

The case studies included a detailed review of local collision histories, a field review, and a stakeholder brainstorming session to identify the specific types of improvements from the infrastructure toolbox that would most directly address the observed conditions along with their planning level cost estimates and benefits. The benefit-cost results can be used to prioritize the lower-cost, higher-impact projects for near-term implementation. Larger investments can then be implemented as funding is available. For case studies with multiple solutions that would conflict with each other or be redundant, the City can select alternatives using the benefit/cost results along with a public outreach process. Analysis of additional factors such as traffic operations, environmental impacts, and investment equity should also be conducted before advancing implementation of projects that require larger levels of investment. The benefits of these projects were analyzed utilizing the CMFs identified in the HSIP Analyzer and CMF Clearinghouse.

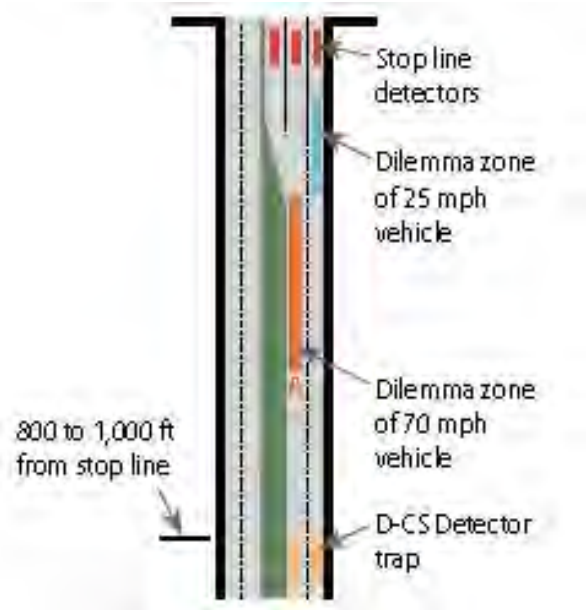
Citywide Countermeasure Opportunities

The following countermeasures were identified as city-wide improvements that help address the key Emphasis Areas at a systemic level: Advanced Dilemma Zone Detection, Retroreflective Borders on Existing Traffic Signal Backplates, and Lighting Assessment Studies. These countermeasures can be considered at most of the case study locations.

Advanced Dilemma Zone Detection

The dilemma zone is the space where drivers approaching an intersection at the onset of a yellow phase are required to choose whether to stop or proceed. The Advanced Dilemma Zone Detection system modifies traffic signal timing to reduce the number of drivers that may have difficulty deciding whether to stop or proceed during a yellow phase. This enhances safety by potentially reducing rear-end collisions associated with unsafe stopping and angle collisions associated with drivers illegally continuing into the intersection during the red phase. Dilemma Zone Detection systems minimizes the number of vehicles exposed to a dilemma zone by adjusting the start time of the yellow phase to earlier or later depending on the vehicle locations and speeds. **Figure 20** shows the dilemma zone locations for vehicles traveling at higher and lower speeds, as well as the location of the Dilemma Zone Detector trap (800 – 1,000 feet from intersection stop bar).

Figure 20. *Advanced Dilemma Zone Detection Design*



Source: FHWA

Traffic safety in the City would benefit from the installation of Dilemma Zone Detection systems due to the concentration of speeding and other aggressive driving behaviors seen in the collision data from 2015 to 2019. This is especially true for the major corridors throughout the City, including the State Highways.

Retroreflective Borders on Existing Traffic Signal Backplates

Retroreflective borders along the backplates of signal heads, shown in **Figure 21**, improve the visibility of the illuminated face of the signal and are more conspicuous in both daytime and nighttime conditions. Adding a retroreflective border to existing signal backplates is a very low-cost safety treatment with a very high systemic approach opportunity.

Figure 21. Example of Signal Head with Retroreflective Borders along Backplate

Source: FHWA

Traffic safety in the City would benefit from the installation of retroreflective borders on existing signal heads, especially at the signalized intersections along major corridors (i.e. Soquel Avenue, Water Street, and Ocean Street).

Streetlight Assessment Study

Lighting has already been identified as an emphasis area that requires citywide improvement. Over 28 percent of collisions between 2015 and 2019 occurred while it was dark with streetlights present. Proper lighting exposure and allocation is necessary for multimodal traffic safety. In order to properly evaluate and address existing lighting issues throughout the City, a citywide lighting assessment study would be beneficial.

1. Morrissey Avenue at Soquel Avenue

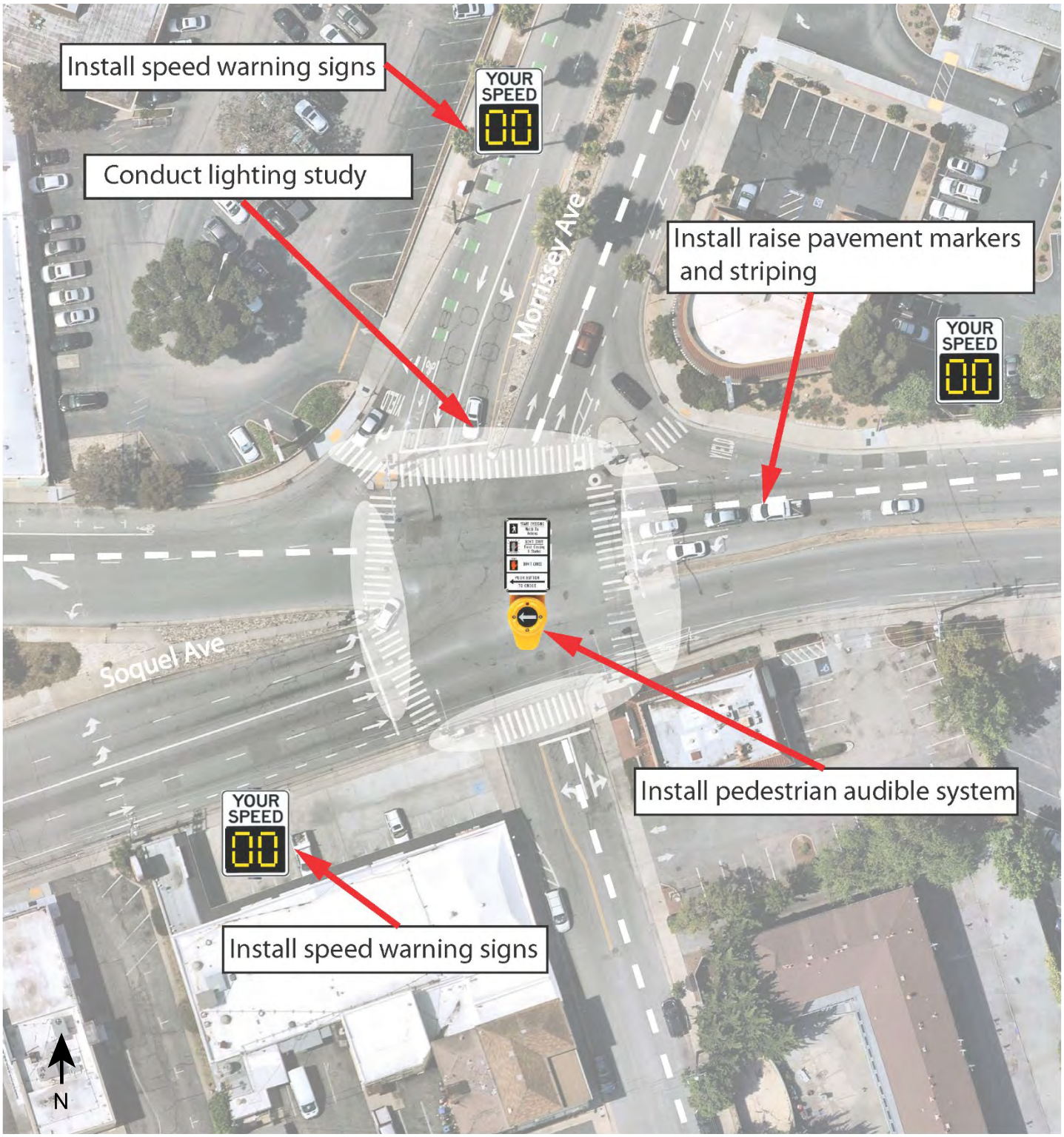
Morrissey Avenue at Soquel Avenue is a signalized intersection with a history of collisions involving bicyclists, sideswipes, and rear-ends, as well as collisions occurring while it is dark. The intersection has bicycle and pedestrian traffic accessing the Safeway grocery store and nearby shopping centers. Field observation found consistent queuing on westbound Water Street toward Poplar Avenue.

Countermeasures at this location are focused on reducing speeds and addressing lighting issues. All citywide countermeasure opportunities apply at this location, as well as those shown in **Figure 22**. These include installing speed feedback signs, installing raised pavement markers, and coupling a pedestrian audible system with the existing pedestrian countdown signal heads. **Table 10** shows the benefits and costs for each of these site-specific countermeasures.

Table 10. *Morrissey Avenue at Soquel Avenue Countermeasure Benefit-Cost*

Countermeasure	CMF	Expected Life (Years)	Collisions Prevented	Benefit	Estimated Cost	B/C
Install raised pavement markers and striping (through intersection)	0.90	10	10.80	$588,442	$13,827	42.6
Pedestrian Audible System	0.75	20	7.00	$547,703	$12,955	42.3
Install dynamic/variable speed warning signs	0.70	10	32.40	$1,765,327	$93,545	18.9
Lighting Assessment Study	Varies; Requires further evaluation					

Figure 22. *Morrissey Avenue at Soquel Avenue Countermeasure Opportunities*



2. Mission Street (State Highway 1) at Bay Street

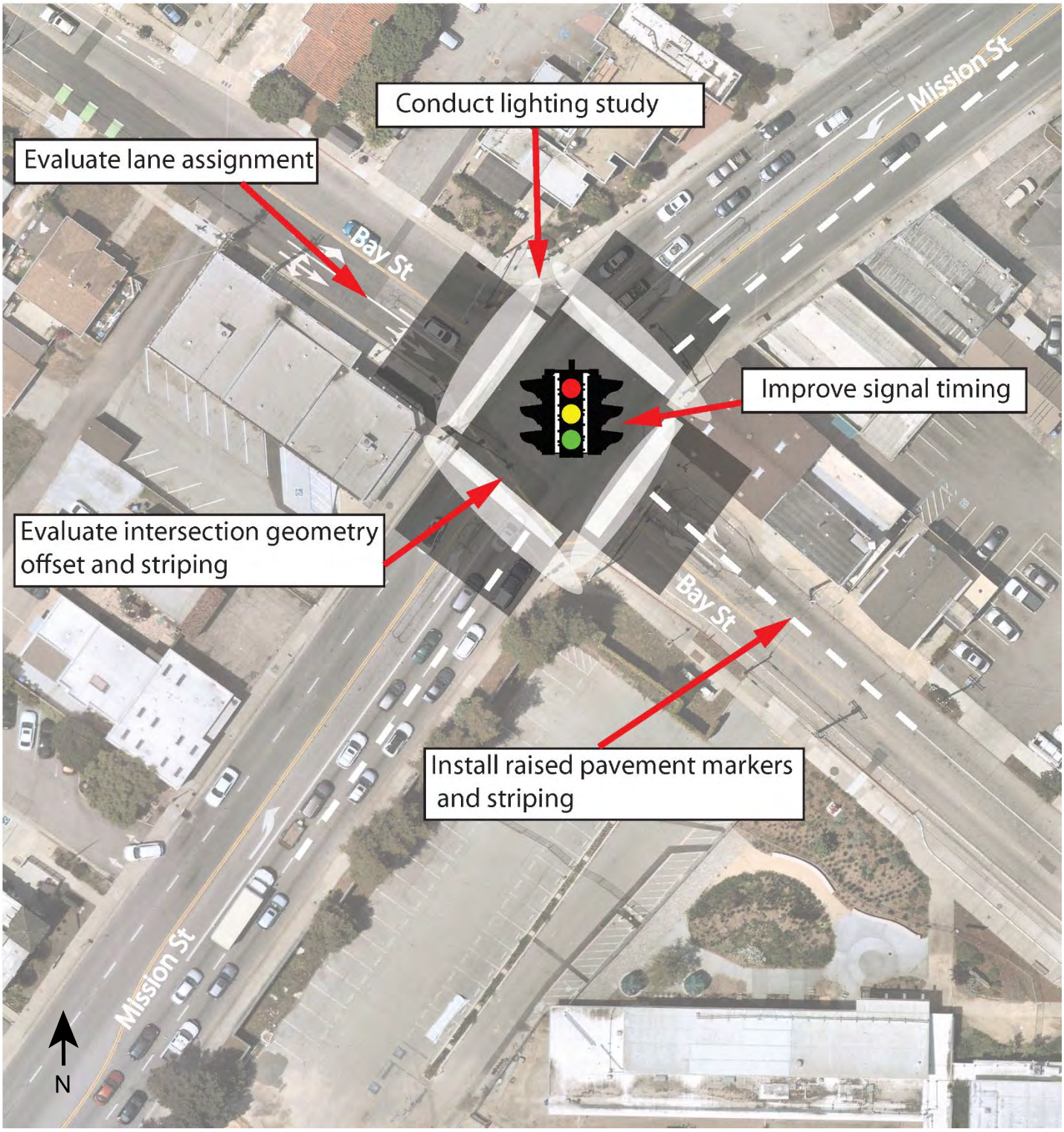
Mission Street (State Highway 1) at Bay Street is a Caltrans-maintain signalized intersection with a history of collisions involving bicyclists, sideswipes, rear-ends, angled collisions, and collisions occurring while it is dark. Mission Street is an arterial corridor/state highway with frequent heavy vehicle traffic. Bicycle traffic is shifted nearby to Seaside Street and King Street. Mission Street, north of Bay Street, has roadway skew which poses a sight distant issue to drivers approaching this intersection. There are two high frequency transit stops serving the university located on the northeast and southwest corners of the intersection. Bay Street westbound lane traffic experiences long queuing.

The constrained right-of-way at this intersection has led to a challenging alignment of lanes. The City can seek opportunities at this intersection to address some of the alignment and geometry issues. Countermeasures at this location are focused on reducing speeds, protecting bicyclists, and addressing lighting issues. All citywide countermeasure opportunities apply at this location, as well as those shown in **Figure 23**. These include further evaluation of the alignment and geometry issues, installing raised pavement markers, improving signal timing, and installing bicycle boxes. **Table 11** shows the benefits and costs for each of these site-specific countermeasures.

Table 11. *Mission Street at Bay Street Countermeasure Benefit-Cost*

Countermeasure	CMF	Expected Life (Years)	Collisions Prevented	Benefit	Estimated Cost	B/C
Improve signal timing (coordination, phases, red, yellow, or operation)	0.85	10	15.00	$759,901	$15,591	48.7
Install raised pavement markers and striping (through intersection)	0.90	10	10.00	$506,601	$13,791	36.7
Convert lane assignment	Varies; Requires further evaluation					
Adjust intersection geometry and striping to reduce lane offset	Varies; Requires further evaluation					
Lighting Assessment Study	Varies; Requires further evaluation					

Figure 23. *Mission Street at Bay Street Countermeasure Opportunities*



3. Seabright Avenue at Broadway

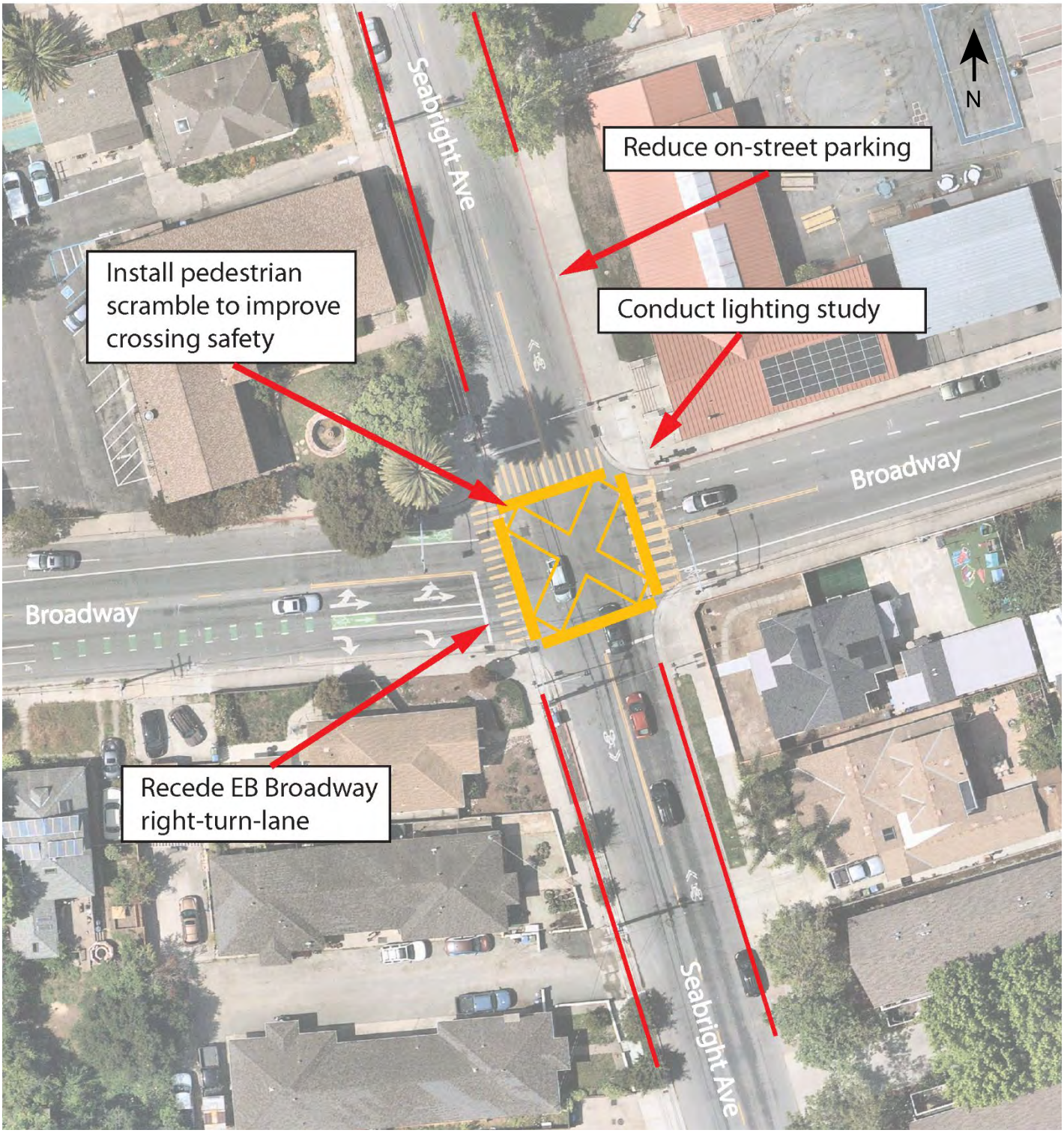
Seabright Avenue at Broadway is a signalized intersection located just south of a Gault Elementary school with a history of collisions involving pedestrians and bicyclists, head-on crashes, collisions occurring while it is dark, as well as one fatal collision. A transit stop is located on the northwest corner of Broadway and Seabright Avenue. Pick-up and drop-off zone in front of the school on Broadway and other parallel parking creates stop and go traffic yielding to pull-in and pull-out vehicles. The intersection experiences high bicycle and pedestrian traffic. A crossing guard is present during school bell times. Right turn radii of each approach pose sight distant issues to drivers regarding pedestrian, back-up traffic, or parallel parked vehicles.

Countermeasures at this location are focused on improving general mobility and comfort for active transportation users by reducing vehicle speeds, improving and addressing lighting issues, and improving sight distance. All citywide countermeasure opportunities apply at this location, as well as those shown in **Figure 24**. These include installing a time-based pedestrian scramble signal phase, reducing on-street parking on Seabright Avenue, and receding the eastbound Broadway right-turn lane. **Table 12** shows the benefits and costs for each of these site-specific countermeasures.

Table 12. *Seabright Avenue at Broadway Countermeasure Benefit-Cost*

Countermeasure	CMF	Expected Life (Years)	Collisions Prevented	Benefit	Estimated Cost	B/C
Evaluate Pedestrian Scramble	0.60	20	4.80	$3,762,880	$68,182	55.2
Reduce on-street parking on Seabright Ave to daylight intersection	Varies; Requires further evaluation					
Recede EB Broadway right-turn lane	Varies; Requires further evaluation					
Lighting Assessment Study	Varies; Requires further evaluation					

Figure 24. *Seabright Avenue at Broadway Countermeasure Opportunities*



4. Bay Corridor (from Nobel Drive to Escalona Drive)

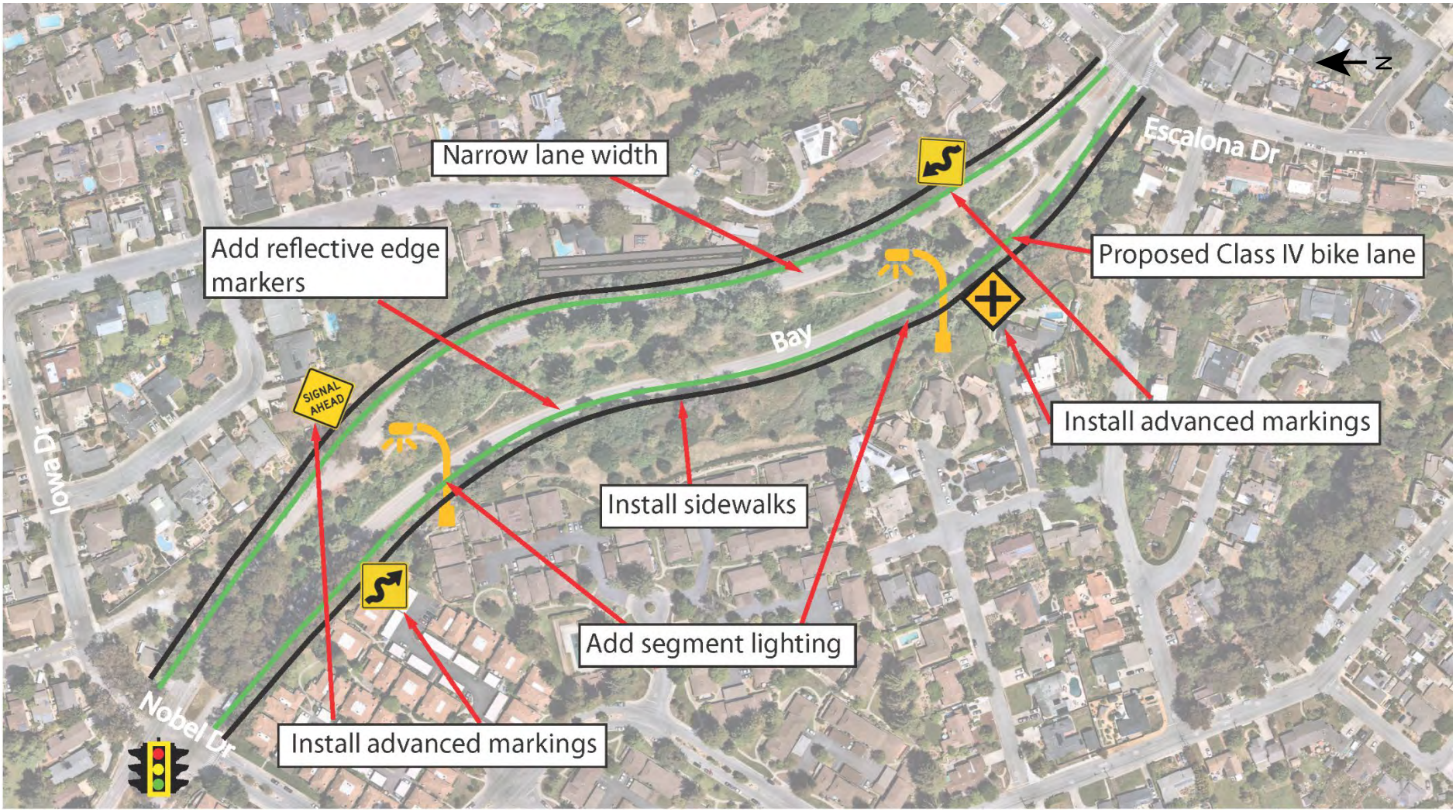
Bay from Nobel Drive to Escalona Drive is an arterial road with a history of collisions involving bicyclists and collisions occurring while it is dark. This corridor is frequently used by transit vehicles serving the campus. Dense vegetation in the center ravine and on both side of the roads pose sight distant and lighting issues, especially to high speed traffic and the existing Class II bike lane. In addition, the horizontal and vertical curvature of the road is also significant between Nobel Drive and Escalona Drive.

Countermeasures at this location are focused on improving mobility and comfort for bicyclists by reducing vehicle speeds and improving and addressing lighting issues. All citywide countermeasure opportunities apply at this location, as well as a few more shown in **Figure 25**. These include complete street improvements such as narrowing lane widths and installing Class IV bicycle lanes, as well as adding retroreflective edge markers, installing advanced warning signage, and installing sidewalks. **Table 13** shows the benefits and costs for each of these site-specific countermeasures. The City also has plans to analyze volumes and roadway capacity along this corridor.

Table 13. *Bay Corridor (from Nobel Drive to Escalona Drive) Benefit-Cost*

Countermeasure	CMF	Expected Life (Years)	Collisions Prevented	Benefit	Estimated Cost	B/C
Install advanced warning signage	0.85	10	1.95	$1,641,962	$8,909	184.3
Install reflective edge markers	0.85	10	7.80	$1,641,962	$19,921	82.4
Add segment lighting	0.65	20	18.20	$3,831,244	$1,679,994	2.3
Install back-plates with retroreflective borders on existing signal hardware	0.85	10	0.45	$23,940	$34,923	0.7
Narrow lane width	Varies; Requires further evaluation					
Install Class IV bike lanes	Varies; Requires further evaluation					
Install traditional sidewalks along both sides of roadway	Varies; Requires further evaluation					

Figure 25. *Bay Corridor (from Nobel Drive to Escalona Drive) Countermeasure Opportunities*



5. Front Street Corridor (from Water Street to Soquel Avenue)

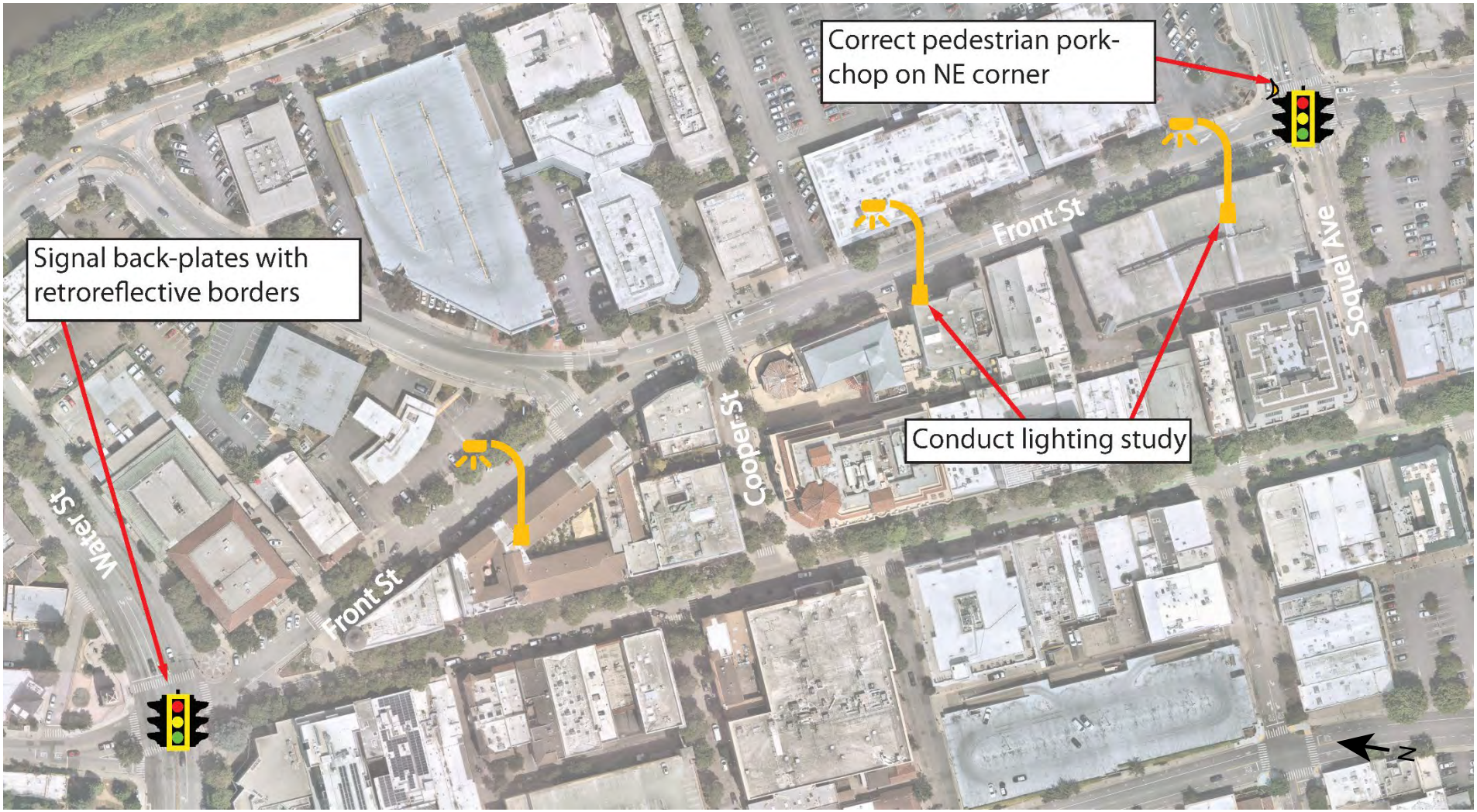
Front Street from Water Street to Soquel Avenue is a minor arterial with a history of collisions involving pedestrians and bicyclists, sideswipes, and rear-ends, as well as collisions occurring while it is dark. Front Street (and Pacific Avenue) at Water Street has some intersection offsets. Water Street, north of Front Street, is at a steep grade with dense plants in center island limiting sight distant for vehicles approaching the intersection. Several pedestrian mid-block crossings were observed in the segment between Cooper Street and Soquel Avenue. Front Street at Soquel Avenue has high pedestrian traffic and high-volume transit stops. Roadway surface has tires marks and worn lane striping/pedestrian crosswalks. The corridor experiences aggressive driving behaviors, high bicycle traffic, and sight distant issues.

Countermeasures at this location are focused on improving mobility and comfort for bicyclists by reducing vehicle speeds and addressing lighting issues. There is also an opportunity to improve the pedestrian pork-chop island at the northeast corner of Front Street and Soquel Avenue. All citywide countermeasure opportunities apply at this location as shown in **Figure 26**. **Table 14** shows the benefits and costs for each of these site-specific countermeasures.

Table 14. *Front Street Corridor (from Water Street to Soquel Avenue) Benefit-Cost*

Countermeasure	CMF	Expected Life (Years)	Collisions Prevented	Benefit	Estimated Cost	B/C
Install back-plates with retroreflective borders on existing signal hardware	0.85	10	19.80	$2,122,322	$84,814	25.0
Lighting Assessment Study	Varies; Requires further evaluation					
Correct NE corner pedestrian pork chop at Front Street and Soquel Avenue	Varies; Requires further evaluation					

Figure 26. *Front Street Corridor (from Water Street to Soquel Avenue) Countermeasure Opportunities*



6. Ocean Street Corridor (from Water Street to Broadway)

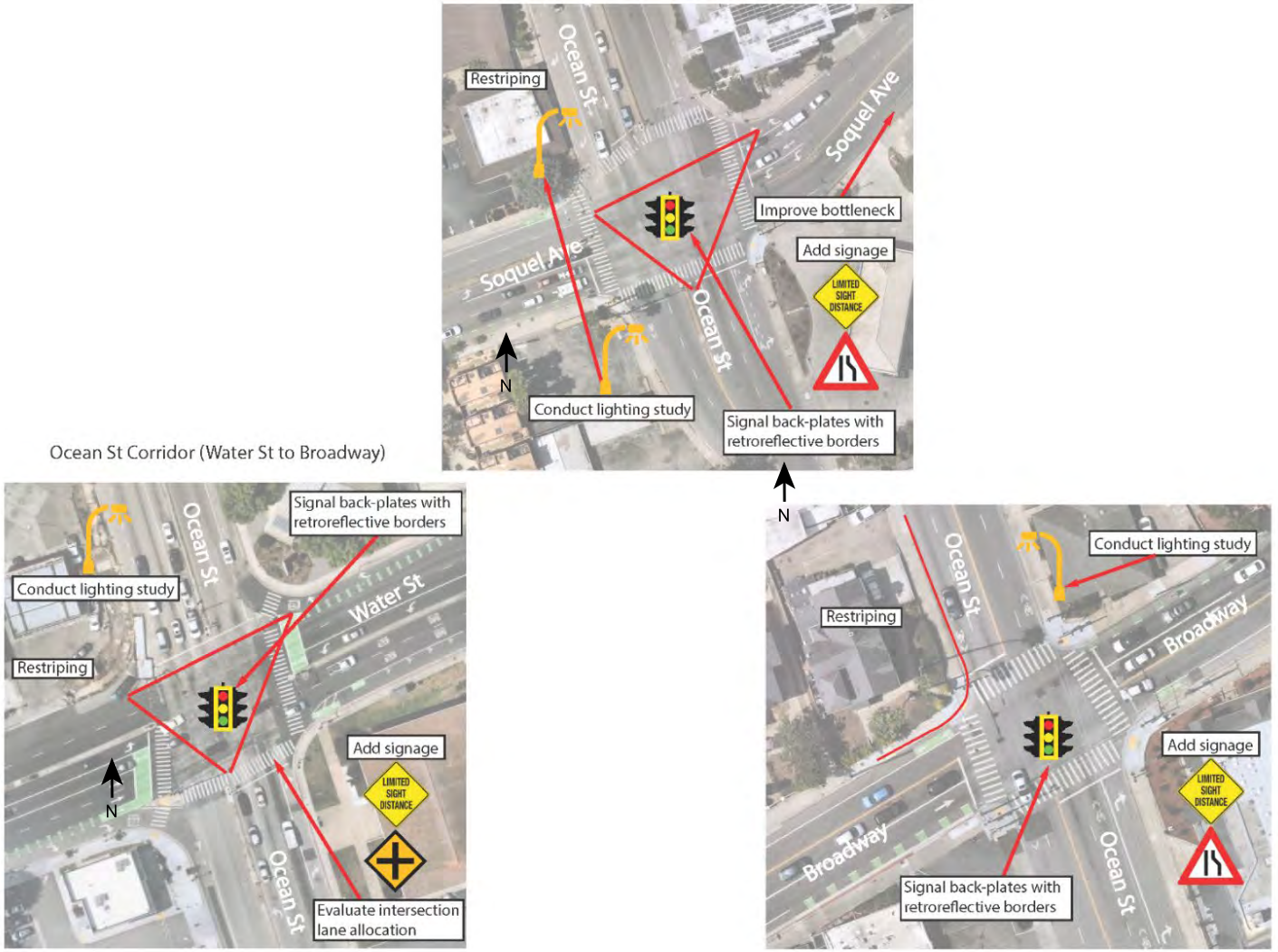
Ocean Street from Water Street to Broadway is a principal arterial with a history of various collision types, including collisions involving pedestrians and bicyclists, angled collisions, sideswipes, rear-ends, and collisions occurring while it is dark. At Ocean Street and Water Street, there are four major transit stops on each far-side of the intersection. There is a consistent base of heavy commuter and tourist traffic assessing this intersection. There is opportunity to improve advance decision making and vehicle maneuvers at the intersection. Ocean Street and Soquel Avenue intersection has limited sight distance on the Soquel Avenue east leg and significant roadway width reduction on south leg of Ocean Street.

There are opportunities along this corridor, especially at the major intersections, to address lane alignment and geometry issues. Countermeasures along this corridor are focused on reducing speeds, protecting bicyclists, and addressing lighting issues. All citywide countermeasure opportunities apply at this location, as well as a few more shown in **Figure 27**. These include evaluating the intersection lane allocations and bottlenecks, conducting a sign safety audit, and restriping. **Table 15** shows the benefits and costs for each of these site-specific countermeasures.

Table 15. *Ocean Street Corridor (from Water Street to Broadway) Benefit-Cost*

Countermeasure	CMF	Expected Life (Years)	Collisions Prevented	Benefit	Estimated Cost	B/C
Install back-plates with retroreflective borders on existing signal hardware	0.85	10	43.20	$3,262,986	$144,683	22.6
Improve bottleneck at Soquel Ave	Varies; Requires further evaluation					
Lighting Assessment Study	Varies; Requires further evaluation					
Traffic Sign Audit Study	Varies; Requires further evaluation					
Evaluate intersection lane allocation	Varies; Requires further evaluation					
Restriping	Varies; Requires further evaluation					

Figure 27. Ocean Street Corridor (from Water Street to Broadway) Countermeasure Opportunities



7. Laurel Street Corridor (from Washington Street to Front Street)

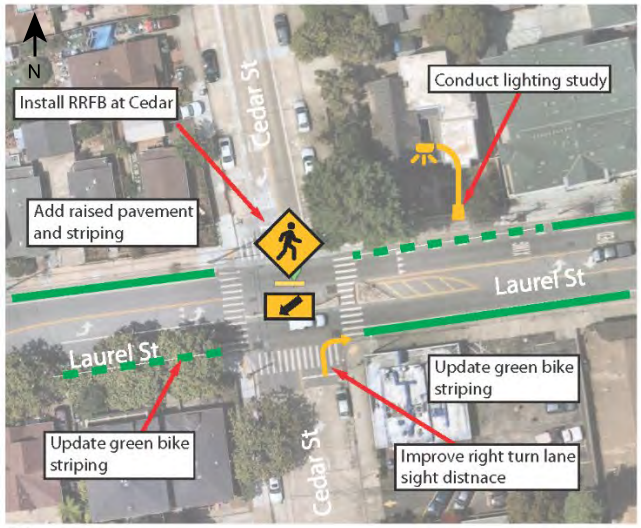
Laurel Street from Washington Street to Front is an arterial road with high intersection density and a history of collisions involving pedestrians and bicyclists, sideswipes, and rear-ends, as well as collisions occurring while it is dark. There are Class II bike lane and busy on-street parking along the stretch near Washington Street. There are some opportunities to improve right-turn sight distance from minor streets onto Laurel Street. At Front Street and Laurel intersection, there are opportunities to improve bicycle safety, address issues with speeds, and roadway offset toward the bridge.

Countermeasures at this location are focused on reducing speeds and addressing lighting issues. All citywide countermeasure opportunities apply at this location, as well as a few more shown in **Figure 28**. These include improving all-red and all-yellow phase signal timing at Laurel Street and Front Street, installing raised pavement markers, extending the green bicycle lanes, and install a rectangular rapid flashing beacon at Laurel Street and Washington Street. **Table 16** shows the benefits and costs for each of these site-specific countermeasures.

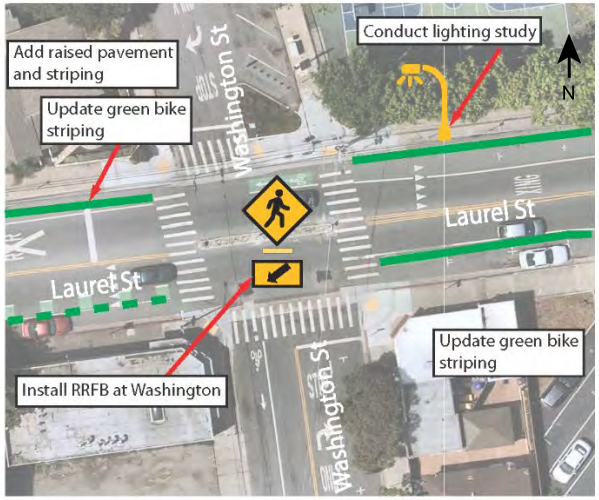
Table 16. *Laurel Street Corridor (from Washington Street to Front Street) Benefit-Cost*

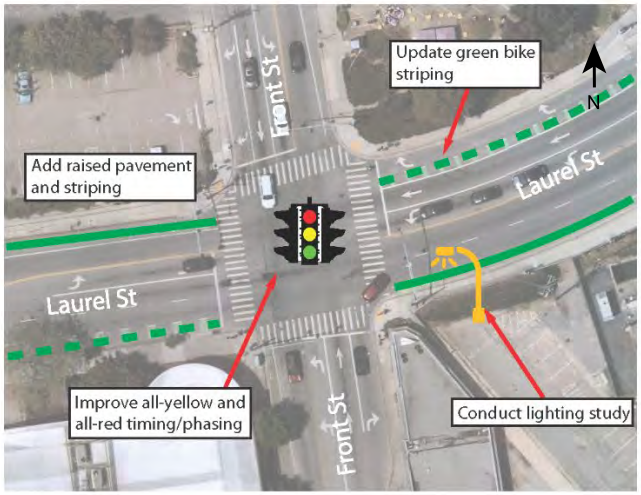
Countermeasure	CMF	Expected Life (Years)	Collisions Prevented	Benefit	Estimated Cost	B/C
Improve signal timing (all-red and all-yellow phases) at Front Street	0.45	20	55.00	$6,952,889	$9,545	728.4
Install raised pavement markers and striping	0.90	10	28.80	$3,323,607	$14,165	234.6
Extend Bike Lane Green Paint Striping	0.61	10	32.76	$9,555,796	$165,566	57.7
Install Rectangular Rapid Flashing Beacon at Washington Street	0.65	10	9.80	$947,386	$133,636	7.1
Lighting Assessment Study	Varies; Requires further evaluation					
Improve right-turn lane sight distance at Cedar Street	Varies; Requires further evaluation					

Figure 28. Laurel Street Corridor (from Washington Street to Front Street) Countermeasure Opportunities



Laurel Street Corridor (Washington St to Front St)





8. Pacific Avenue at Beach Street (Roundabout)

The intersection of Pacific Avenue and Beach Street is a modern roundabout located less than a quarter mile west of the Santa Cruz Beach Boardwalk. The roundabout legs consist of Pacific Avenue to the north, Beach Street to the east and west, and the Municipal Wharf to the south. Pacific Avenue and Beach Street are both secondary arterials with several different attractions and destinations surrounding the intersection, including bars, restaurants, shops, and beach parking. There is a railroad crossing that runs east-west through the roundabout, crossing the north leg and the entirety of the right-turn pocket on the east leg. This roundabout has striped lane markings and street signage to direct vehicle, bicycle, and pedestrian traffic, as well as railroad crossing indications. There are striped pedestrian crossings with refuge islands on the south, west, and east legs. There is also a green-striped bicycle path for bidirectional bicycle traffic. The south leg leading to the Municipal Wharf has a parking toll booth and parking lot located less than 100 feet from the intersection. Traffic volumes vary significantly by season with incredibly high volumes in the summer and very low volumes in the winter and off-season. Planned improvements in the area include Segment 7 Phase II of the Rail Trail, which will add a significant number of pedestrians and cyclists. Additional multimodal improvements on the Municipal Wharf are also planned.

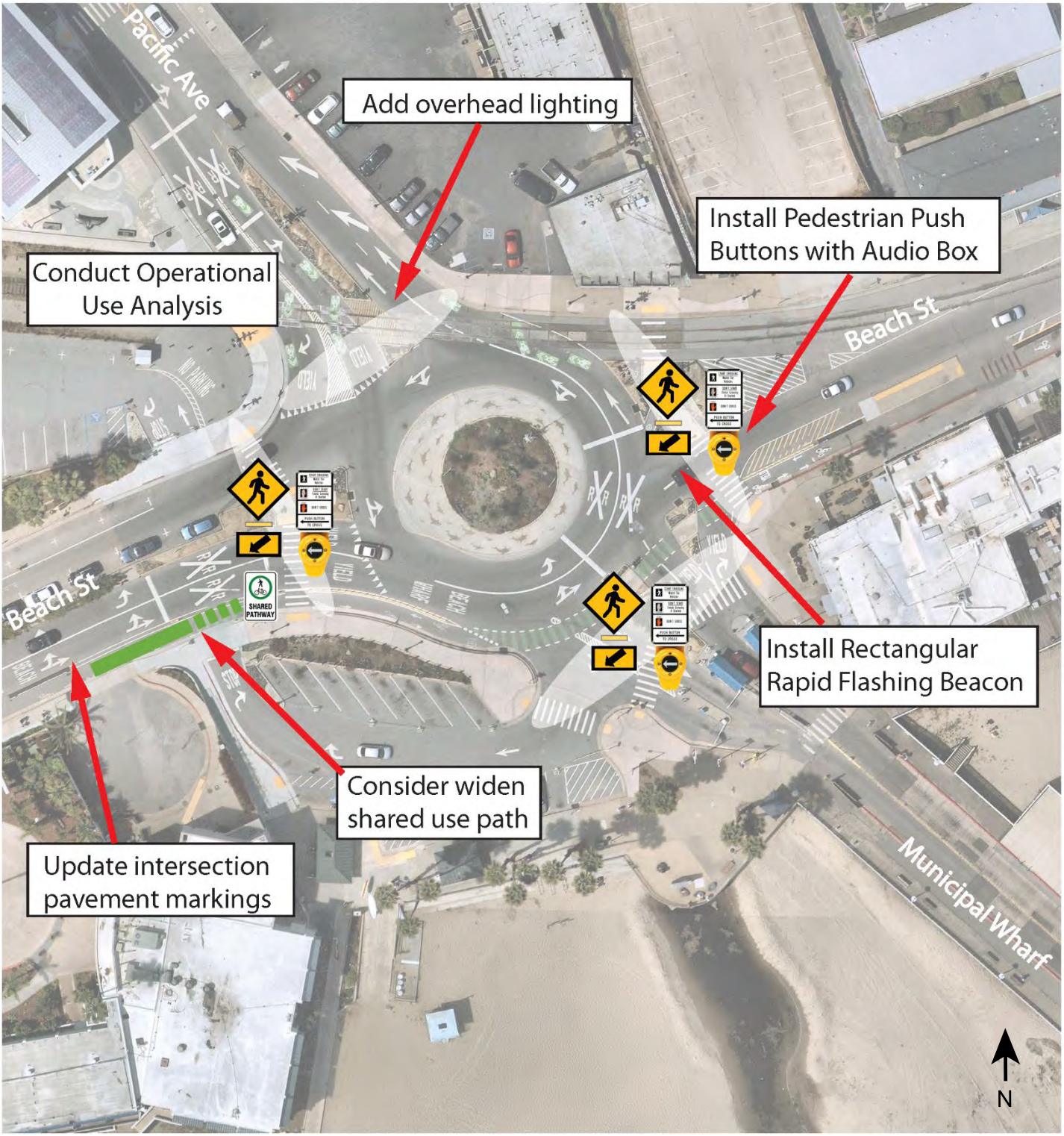
Countermeasures at this location are focused on reducing speeds and addressing lighting issues. Most of the collisions at this location involved hitting a fixed object and aggressive-driving behaviors. The potential countermeasure opportunities at this intersection (shown in **Figure 29**) include: upgrading intersection directional pavement markings, adding more overhead lighting, installing pedestrian push buttons with audio systems and rectangular rapid flashing beacons at all marked pedestrian crossings, conducting an Operational Use Analysis[6], and widening the shared-use path. shows the benefits and costs for each of these site-specific countermeasures.

__Table 17__. Pacific Avenue at Beach Street Roundabout Benefit-Cost

Countermeasure	CMF	Expected Life (Years)	Collisions Prevented	Benefit	Estimated Cost	B/C
Update intersection directional pavement markings	0.75	10	36.00	$3,368,105	$22,273	151.2
Add overhead lighting	0.60	20	11.20	$3,631,680	$229,090	15.9
Install pedestrian push buttons with audio systems	0.75	20	3.00	$168,901	$57,273	2.9
Install Rectangular Rapid Flashing Beacons	0.65	20	4.20	$236,461	$114,545	2.1
Conduct Operational Use Analysis	Varies; Requires further evaluation					
Widen the shared use path (West leg)	Varies; Requires further evaluation					

Figure 29. Pacific Avenue at Beach Street Roundabout Countermeasure Opportunities

[6] This study aims to determine the maximum capacity design of an intersection by analyzing the movement patterns and proportion of movements of all modes of travel at the intersection


Add overhead lighting
Conduct Operational Use Analysis
Install Pedestrian Push Buttons with Audio Box
Install Rectangular Rapid Flashing Beacon
Consider widen shared use path
Update intersection pavement markings
Pacific Ave
Beach St
Beach St
Municipal Wharf
SHARED PATHWAY
N

BEST PRACTICES & NON-INFRASTRUCTURE OPPORTUNITIES

Non-Infrastructure opportunities have also been proven to impact safety conditions of the transportation network. These education and enforcement measure opportunities are developed to target specific behavior types and populations.

Summary of Programs, Policies, and Practices for City of Santa Cruz		
Topic	**Initiatives**	
	Developed	**Opportunity**
Safety/Active Transportation Coordinator	The role is currently informally assigned to a transportation planner	Formalize this position
Safety or Active Advisory Committee	Has a Transportation and Public Works Commission	Link existing committee with the Vision Zero sub-committee
Active Transportation Safety Education Program	City has its own Street Smarts program and funds several local non-profit organizations focused on safety. City also has walking education to second graders, biking education for fifth graders, and general bicycle and pedestrian education taught throughout elementary to high school	-
Safe Routes to School	City received ATP HSIP, local non-profit and infrastructure funding for the Santa Cruz Safe Routes to School program.	-
Inventory/Mapping of Active Transportation Routes	Currently the City maintains an active transportation inventory. Pedestrian facilities need updating.	Continue updating inventory and work on making a portal for public use
Traffic Calming Policies	Traffic calming funding was eliminated in 2008 due to the economic downturn. Traffic calming is implemented with capital projects, private development and privately funded efforts.	Reinitiate funding for traffic calming applicable throughout the city-
Inventory of Pedestrian Signs and Signals	Initiated, but not completed	Continue developing inventory and monitoring for condition and appropriateness as infrastructure and travel patterns change
Speed Surveys	Regularly conduct and maintain speed survey	-
Citizen Feedback	The City has a community portal (CRISP) and the Regional Transportation Commission (RTC) maintains a hazards report for citizen feedback.	-
Institutional Coordination	Coordination occurs with transit providers to ensure safe connectivity and bicycle accommodation on transit. The City and transit providers coordinate on safe and equitable access to transit stops as well as policy work and development review on an as-need basis, approximately bi-weekly. With health agencies, engagement with the city is active especially with the Community Traffic Safety Coalition and Vision Zero. Coordination occurs with Caltrans and the SC County Regional Transportation Commission.	-

Summary of Programs, Policies, and Practices for City of Santa Cruz		
Topic	**Initiatives**	
	Developed	**Opportunity**
School Engagement	City currently has relationship with school and shares information via listservs. City reaches out directly to schools when applying for safe routes to school and other related grant applications	-
Law Enforcement/Emergency Service Engagement	The City formerly had a dedicated traffic unit that coordinates with municipal and adjacent jurisdictions. Both police and fire services are engaged in transportation development and project review	Consider renewing the dedicated traffic unit
Pedestrian Signal Timing	City has adopted policy and recently updated timing to reflect current standards	-
Crosswalks	Most City crosswalks that have an identified need have crosswalks; however, they sometimes prioritize vehicle operations	Examine where crosswalks could improve pedestrian experience and should have appropriate traffic control device based on the crossing environment
Active Transportation Volume Counting	Only collect when it is a requirement for a grant or specific project. The RTC does have a monitoring programs available for city use as needed.	Take active transportation counts more regularly
Traffic Collision Monitoring	Only actively monitors serious collisions, other collisions are looked at only for grants and other applications. Conducts Annual Traffic Safety Report.	Conduct annual review of collision trends
Warrants for Stop Signs and Signals	The City has adopted local standard forms for traffic control devices.	-
Complete Streets	City has regional and local adoption of a Complete Streets Policy	-
Active Transportation Master Plan	Bicycle/pedestrian master plan has been developed in the past, approximately 2-3 years old.	-
Traffic Reporting Practices	Reporting methods have varied over time	Standardize traffic reporting practices to address gaps in collision data
Funding for Active Transportation	City has received SB821 and ATP grant funding in the past	Continue applying for active transportation funding
Transportation Demand Management	The City has several programs related to TDM including, Go Santa Cruz which is eligible for 4000+ downtown employees, transit passes, and bike lockers throughout the city. These programs are funded by parking revenues. Outside of downtown there are no TDM programs; however, over a certain size private development projects are required to implement TDM.	-

ACTION PLAN

The action plan for implementation of the LRSP will serve as a system for the City to use on an on-going basis to update their queue of planned projects. The City may adopt a systemic approach for including safety improvements into other

maintenance and construction activities that may impact roadways identified with characteristics that contribute to safety challenges. Steps for the inclusion of this process in regular activities include:

- Reference this plan in any future grant applications
- Use analyses in this plan to inform future construction and maintenance activities
- Utilize the Countermeasure Toolbox for future safety projects to address systemic issues
- Identifying similar intersection/roadway segments to those outlined in the Safety Project Sheet templates

This process will help create an avenue for the City to check that safety issues identified in existing locations are not recreated in new locations as developers and capacity enhancements are constructed.

Implementation Strategies

The following sections identify potential focus areas for the City in the near-to-mid-term, outlines the prioritization process for identifying improvements with the most impact, and provides steps for future analysis. Finally, it identifies funding sources for the development and implementation of safety projects in the City.

Near- & Mid-Term Focus Areas

The opportunities identified in this report provide more of the systemic countermeasures that can be applied within the City. Over the next three to five years, it is recommended that the City concentrate its efforts on the emphasis areas:

1. Improving Visibility and Lighting
2. Reducing Aggressive Driving Behaviors
3. Improving Traffic Safety for Vulnerable Roadway Users including the Unhoused Population

Analysis conducted at the citywide level indicated that these factors were some of the most frequent influences contributing to collisions within the City. The countermeasure opportunities previously discussed in this report for both systemic and project-specific improvements can be used as a basis for developing projects at locations where addressing these focus areas would be of the most benefit. Projects that address these focused areas can be developed with a high benefit-to-cost ratio (by applying City-wide collision rates), allowing competitive projects to be developed even at sites with little to no direct collision history, but with conditions that might contribute to future collisions.

Prioritization Process

As the underlying goal of this LRSP – to approach zero traffic deaths – the focus of analysis is on identifying improvements that can have the most substantial impact on reducing collisions. Locations of pedestrian and bicycle collisions were prioritized for this study based on a combination of severity and quantity. Using statistics to analyze the network for the most challenging locations in the City from a safety perspective, locations that may not yet see these challenges (but are composed of similar characteristics to those locations) could be identified as part of the ongoing safety program in the City.

The following summarized the process that was undertaken for this initial prioritization process and will subsequently be updated throughout its life. The first step in the prioritization process is to rank location by CCR (referenced in Section 5: Select Screening Method of the *Highway Safety Manual*). After all intersections and segments have been ranked, the process requires identification of:

- Location with higher severity of collisions (fatality, serious injury)
- Locations with higher collision activity overall
- Locations with higher number of vulnerable user collisions (pedestrians and bicyclists)

Patterns in this data (location, type, severity, etc.) were analyzed and used to identify emphasis areas.

Stakeholder Engagement

As part of the LRSP, local stakeholders were included in the process to ensure the local perspective was kept at the forefront of this planning effort. A stakeholder group of City staff and external partners was formed. This group consisted of members of City staff, representatives from the Department of Public Health, Fire Department, and Metro Transit. For the LRSP to be systemic and proactive, factors beyond crash history need to be incorporated into the ranking process. Stakeholder engagement and local knowledge helped refined the priorities of the LRSP. The local Police Department and City Staff identified known recent issues or challenges at the locations highlighted during the prior steps of the prioritization process. Their intimate knowledge of these locations and typical observed human behaviors provided another data point to be factored into the analysis of safety challenges. This coincides with the Local Roadway Safety Manual's recommendations to use a mixture of quantitative and qualitative measures to identify and rank locations.

Stakeholder Meeting

The stakeholder meeting was conducted virtually using the Microsoft Teams platform. At the meeting, stakeholders were introduced to the project and provided an overview of the data used, the required outputs, and the potential outcomes of the study.

In addition to the overview, Stakeholders were asked to provide local insight and knowledge at 10 "case study" locations that were identified after the initial network screening and crash analysis process. Potential countermeasures were recommended and discussed. Additionally, potential emphasis/challenge areas were proposed during the meeting to include semi-truck traffic, pedestrians, bicyclists, aggressive driving, and impaired driving.

Stakeholder feedback regarding the plan and recommendations were reviewed and incorporated into the study process for the development of the LRSP. Most of the feedback received expressed a strong desire to prioritize bicycle safety throughout the City.

Benefit/Cost

Finally, once countermeasures are established, cost/benefit ratios based on these countermeasures are calculated. Cost/benefit ratios are the most typical prioritization metric used by grant programs to determine funding awards. The overall list of projects should then be listed by their cost/benefit ratio and bundled into funding groups. This will assist the City in prioritizing the implementation of projects that will have the highest benefit first, while still planning for other

project improvements. Cost/benefit calculations will ensure that the highest ranked projects are most competitive for external funding and will lead to the greatest amount of safety improvement for the lowest possible investment.

Evaluation

For the LRSP to be successful, it must be implemented and monitored. The success of the LRSP will be evaluated using the preliminary process outlined below. This process will be useful to ensure proper implementation of objectives and to determine when updates are needed.

- Quarterly progress updates will be presented to the Vision Zero committee by the City's Safety Coordinator to track the implementation of the plan. In addition, the success of the plan will be evaluated on an annual basis.
- An update to the plan should be considered after no more than five years.
- Continued monitoring and recording of traffic incidents on local roadways by law enforcement.
- Maintain a list of focus areas where there are transportation safety concerns.

Applying improvements that can have the most substantial impact on reducing collisions is the most effective way to show commitment to traffic safety. Using statistics to analyze the network for the most challenging locations in the City from a safety perspective, locations that may not yet see these challenges but are composed of similar characteristics to those locations should be identified and included for investments as part of the ongoing safety program.

The strategies discussed in the emphasis area section of this report include some of the systemic countermeasures that can be applied. The emphasis areas highlighted some of the most frequent influences contributing to collisions and/or issues expressed by the community. The recommended countermeasures for both systemic and project-specific improvements can be used as a basis for developing projects at locations where addressing these focus areas would be of the most benefit. Projects that address these emphasis areas can be developed with a high benefit-to-cost ratio allowing competitive projects to be developed even at sites with little to no direct collision history, but with conditions that might contribute to future collisions.

Funding Opportunities

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

Highway Safety Improvement Program

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

- New or upgraded traffic signals
- Upgraded guard rails
- Pedestrian warning flashing beacons
- Marked crosswalks

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

Additional information regarding this program at the Federal level can be found online at: **https://safety.fhwa.dot.gov/hsip/**. California specific HSIP information – including dates for upcoming call for projects - can be found at: **http://www.dot.ca.gov/hq/LocalPrograms/hsip.html**.

Caltrans Active Transportation Program

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

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

This program funding is provided annually. The ATP call for projects typically comes out in the Spring. Information on this program and cycles can be found online at: **http://www.dot.ca.gov/hq/LocalPrograms/atp/**

State Transportation Improvement Program

The State Transportation Improvement Program (STIP) provides state and federal gas tax money for improvements on the state highway system. The STIP is a multi-year capital improvement program of transportation projects on and off the State Highway System, funded primarily from state and federal gas taxes. STIP programming occurs every two years. The programming cycle begins with the release of a proposed fund estimate, followed by California Transportation Commission (CTC) adoption of the fund estimate. The fund estimate serves to identify the amount of new funds available for the programming of transportation projects. Once the fund estimate is adopted, Caltrans and the regional planning agencies prepare transportation improvement plans for submittal. Caltrans prepares the Interregional Transportation Improvement Program (ITIP) using Interregional Improvement Program (IIP) funds, and regional agencies prepare Regional Transportation Improvement Programs (RTIPs) using Regional Improvement Program (RIP) funds. The STIP is then adopted by the CTC.

California Senate Bill 1 (SB 1)

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

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

- Bike and Pedestrian Projects: $100 million
    - This will go to cities, counties and regional transportation agencies to build or convert more bike paths, crosswalks and sidewalks. It is a significant increase in funding for these projects through the Active Transportation Program (ATP).
- Local Planning Grants: $25 million
    - Addresses community needs by providing support for planning that may have previously lacked funding, good planning will increase the value of transportation investments.

Santa Cruz County Regional Transportation Committee (RTC)

Santa Cruz County RTC, the Regional Transportation Planning Agency (RTPA), makes decisions and sets priorities for the expenditure of certain local, state and federal transportation funds for public transit, rail, local streets and roads, highways, and bicycle and pedestrian facilities. Long range planning for transportation funding is done through the Regional Transportation Plan (RTP). Projects the RTC selects to receive state or federal funds are listed in the Regional Transportation Improvement Program (RTIP).

The RTC has historically distributed $5-10 million per year for capital projects that repair local roads, build new bicycle and walking facilities, improve transit service, and improve traffic flow on local roads and state highways. The RTC distributes, or is responsible for selecting projects to receive, funds from the following programs: Measure D, Transportation Development Act (TDA), SB 1 (other than direct allocations to agencies), Surface Transportation Block Grant/Regional Surface Transportation Program Exchange (STBG/RSTP), STIP, Cap-and-Trade Low Carbon Transit Operations Program (LCTOP), and Department of Motor Vehicles Fees.

Measure D is a ½-cent sales tax that guarantees every city and the County a steady, direct source of local funding for local streets and road maintenance, bicycle and pedestrian projects (especially near schools), safety projects, and transit and paratransit service, as well as many others. Measure D funds cover transportation projects that support:

- Providing safer routes to schools for local students
- Maintaining mobility and independence for seniors and those with disabilities
- Investing in bicycle and pedestrian pathways and bridges

- Repaving roadways, repair potholes, and improve safety on local streets
- Improving traffic flow on major roadways
- Investing in projects that reduce the pollution that causes global warming

Information on RTC funding sources can be found online at: **https://sccrtc.org/funding-planning/funding-overview/**

Association of Monterey Bay Area Governments (AMBAG)

AMBAG serves as both a federally designated Metropolitan Planning Organization (MPO) and Council of Governments (COG). AMBAG performs metropolitan level transportation planning on behalf of the region. AMBAG prepares transportation plans and programs for the tri-county Monterey Bay region consisting of Monterey, San Benito and Santa Cruz Counties.

Metropolitan Transportation Improvement Program (MTIP)

AMBAG is responsible for preparing the Monterey Bay MTIP, the region's short range transportation programming document that contains transportation improvement projects including public mass transit, highway, bridge, local road, bicycle and pedestrian projects proposed for funding based on anticipated available federal, state and local funds over the next four federal fiscal years. More information on this program and cycles can be found online at: **https://ambag.org/program/metropolitan-transportation-improvement-program-mtip**

CONCLUSION

The City of Santa Cruz has completed this LRSP to guide the process of future transportation safety improvements for years to come. The data-driven analysis process identified collision types, related primary collision factors, and locations of many collisions. Based on this process, three Emphasis Areas were developed. These Emphasis Areas will guide corridor improvements, education programs, and capital improvements for the City. The City will actively seek funding opportunities, collaborate with established safety partners, and iteratively evaluate existing and proposed transportation safety programs and capital improvements to design a safer transportation network in Santa Cruz.

APPENDICES

Appendix A. California Office of Traffic Safety Crash Rankings Results

OTS Crash Rankings Results

OTS CRASH RANKINGS

Click here to see how it's done now.

Select a Year and City/County from the drop-down lists and click on the Submit Button.

2018 DUI Arrest Ranking Data will be posted once available.

Year:

2018

City and County:

Santa Cruz

Submit

What are the OTS Rankings?

How are the OTS Rankings determined?

How to Read and Understand the OTS Rankings

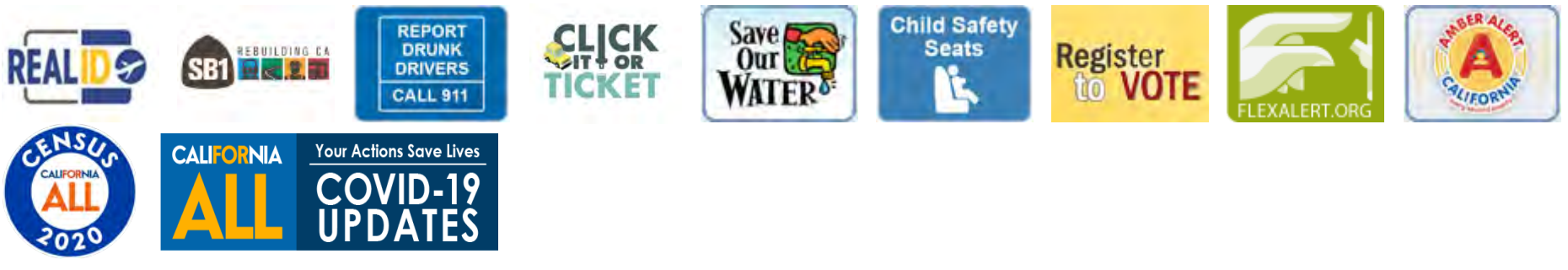
Agency	Year	County	Group	Population (Avg)	DVMT
Santa Cruz	2018	SANTA CRUZ COUNTY	C	65241	469304

TYPE OF CRASH	VICTIMS KILLED & INJURED	OTS RANKING
Total Fatal and Injury	187	65/102
Alcohol Involved	32	26/102
Had Been Drinking Driver < 21	1	52/102
Had Been Drinking Driver 21 – 34	5	70/102
Motorcycles	27	3/102
Pedestrians	48	2/102
Pedestrians < 15	6	7/102
Pedestrians 65+	7	6/102
Bicyclists	52	4/102
Bicyclists < 15	5	10/102
Composite	117	38/102

TYPE OF CRASH	FATAL & INJURY CRASHES	OTS RANKING
Speed Related	31	64/102
Nighttime (9:00pm – 2:59am)	25	28/102

Hit and Run	23	22/102

TYPE OF ARRESTS	ARRESTS	OTS RANKING*
DUI Arrests		NA



Appendix B. Intersection Collision Ranking Table

Intersection	Cross Street 1	Cross Street 2	UNQ_ID	Collisions	LCCR Differential	EPDO	*Fatal Collisions*	*Serious Injury Collisions*	*Other Visible Injury Collisions*	*Complaint of Pain Collisions*	*PDO Collisions*	Broadside	Sideswipe	Rear End	Head On	Other	Pedestrian	Bicycle	Aggressive	Distracted	Impaired	Dark
Signalized Intersections																						
River St & State Hwy 1	River St	State Hwy 1	1093	**28**	0.01	404	2	0	4	2	20	3	5	7	1	3	5	3	6	0	2	15
S Morrissey Ave & Soquel Ave	S Morrissey Ave	Soquel Ave	976	**27**	0.01	111	0	0	6	5	16	2	4	7	1	4	2	5	7	0	5	9
Mission St & Bay St	Mission St	Bay St	444	**25**	0.03	95	0	0	2	10	13	2	7	8	4	2	0	2	9	0	2	13
Ocean St & Broadway	Ocean St	Broadway	734	**25**	0.14	100	0	0	3	9	13	5	2	4	4	7	1	1	4	0	2	6
Ocean St & Soquel Ave	Ocean St	Soquel Ave	760	**25**	-0.01	89	0	0	5	3	17	2	2	4	2	8	3	4	4	1	2	9
Front St & Laurel St	Front St	Laurel St	557	**25**	-0.35	238	0	1	4	2	18	5	3	7	0	5	0	3	7	0	2	9
Pacific Ave & Laurel St	Pacific Ave	Laurel St	546	**24**	0.61	242	0	1	4	3	16	1	4	6	1	3	7	2	2	2	2	10
Ocean St & Water St	Ocean St	Water St	932	**22**	-0.16	220	0	1	2	3	16	1	5	5	1	7	3	0	5	3	3	9
Front St & Soquel Ave	Front St	Soquel Ave	680	**21**	0.26	71	0	0	3	4	15	1	4	5	1	6	2	3	6	1	2	7
Chestnut St Exd & Mission St	Chestnut St Exd	Mission St	863	**20**	-0.11	238	0	1	3	5	11	4	0	9	3	2	1	0	11	1	2	7
Miramar Dr & Mission St	Miramar Dr	Mission St	276	**18**	0.03	48	0	0	2	2	14	2	4	5	0	2	3	1	5	1	2	3
Seabright Ave & Broadway	Seabright Ave	Broadway	789	**17**	4.81	221	1	0	0	8	8	5	1	2	5	1	2	1	3	0	2	8
Grandview St & Mission St	Grandview St	Mission St	246	**13**	-0.07	28	0	0	0	3	10	0	3	5	1	2	2	0	4	0	2	3
River St & Water St	River St	Water St	893	**13**	-0.12	37	0	0	2	1	10	0	1	3	0	7	0	2	2	1	1	3
Seabright Ave &	Seabright Ave		945	**13**	0.19	23	0	0	0	2	11	1	2	3	1	4	1	0	3	0	1	4
Front St & Water St	Front St	Water St	856	**12**	-0.13	196	0	1	1	2	8	2	3	3	0	0	0	4	3	0	1	1
Chestnut St & Laurel St	Chestnut St	Laurel St	475	**11**	-0.05	36	0	0	1	3	7	1	3	3	0	1	2	1	3	0	0	3
Mission St & Laurel St	Mission St	Laurel St	572	**11**	-0.22	26	0	0	0	3	8	0	2	7	1	0	0	1	4	1	1	3
N Branciforte Ave & Water St	N Branciforte Ave	Water St	988	**11**	-0.14	46	0	0	1	5	5	3	0	3	1	1	2	1	6	1	0	2
Mission St & King St	Mission St	King St	827	**10**	-0.21	35	0	0	1	3	6	2	3	1	0	2	0	2	3	0	1	0
Dakota Ave & Water St	Dakota Ave	Water St	969	**10**	0.01	45	0	0	2	3	5	0	2	3	0	3	0	2	3	1	1	3
Capitola Rd & Soquel Ave	Capitola Rd	Soquel Ave	748	**9**	-0.20	29	0	0	1	2	6	2	2	2	1	1	0	1	2	0	1	4
S Branciforte Ave & Broadway	S Branciforte Ave	Broadway	761	**9**	0.17	53	0	0	4	1	4	3	2	1	0	1	1	1	2	0	1	1
Front St & Cooper St	Front St	Cooper St	762	**9**	-0.08	173	0	1	0	0	8	0	4	1	0	1	1	2	0	0	1	3
Western Dr & Coast Rd	Western Dr	Coast Rd	253	**8**	2.01	172	0	1	0	0	7	3	3	1	0	1	0	0	3	0	1	1
California St & Laurel St	California St	Laurel St	551	**8**	-0.10	32	0	0	2	1	5	0	0	3	0	1	0	3	2	1	2	1
Ocean St & E Cliff Dr	Ocean St	E Cliff Dr	552	**8**	-0.12	18	0	0	0	2	6	1	1	3	1	0	0	1	0	0	1	2
S Branciforte Ave & Soquel Ave	S Branciforte Ave	Soquel Ave	852	**8**	-0.22	33	0	0	1	3	4	2	1	3	0	2	0	0	1	0	1	2
Frederick St & Soquel Ave	Frederick St	Soquel Ave	1007	**8**	-0.20	28	0	0	1	2	5	1	2	2	0	1	1	1	2	0	0	1
King St & Bay St	King St	Bay St	528	**7**	-0.14	205	0	1	3	1	2	1	0	0	1	1	1	3	3	0	0	2
Broadway & San Lorenzo Bl	Broadway	San Lorenzo Bl	580	**7**	6.05	37	0	0	2	2	3	0	1	1	0	3	0	2	1	0	1	4
Glenn Coolidge Dr & High St	Glenn Coolidge Dr	High St	855	**7**	6.54	46	0	0	3	2	2	3	1	1	0	1	1	0	0	0	0	3
Hagemann Ave & Soquel Ave	Hagemann Ave	Soquel Ave	977	**7**	-0.22	181	0	1	0	2	4	1	1	1	0	1	1	2	2	1	2	1
S Park Way & Soquel Ave	S Park Way	Soquel Ave	1001	**7**	-0.17	37	0	0	2	2	3	1	1	1	0	1	1	2	2	0	0	1
Ocean St & Ocean St	Ocean St	Ocean St	1111	**7**	-0.20	22	0	0	1	1	5	1	0	4	0	1	0	1	5	1	0	2
Almar Ave & Mission St	Almar Ave	Mission St	277	**6**	-0.26	175	0	1	0	1	4	1	0	3	0	2	0	0	0	0	2	4
Riverside Ave & Beach St	Riverside Ave	Beach St	350	**6**	0.74	16	0	0	1	0	5	1	1	1	0	2	1	0	0	0	0	0
S River St & Soquel Ave	S River St	Soquel Ave	688	**6**	-0.04	36	0	0	2	2	2	0	1	1	1	1	2	0	0	0	1	3
Potrero St & Madrona St	Potrero St	Madrona St	1025	**6**	0.05	175	0	1	0	1	4	0	2	2	0	1	1	0	1	0	0	2
Ocean St & Washburn Ave	Ocean St	Washburn Ave	1032	**6**	-0.26	16	0	0	1	0	5	1	0	2	0	1	1	1	2	1	1	2
Seabright Ave & Murray St	Seabright Ave	Murray St	455	**5**	9.52	15	0	0	1	0	4	0	0	1	0	3	0	0	1	0	1	0
N Pacific Ave & River St	N Pacific Ave	River St	930	**5**	0.05	39	0	0	3	1	1	0	1	1	0	1	1	1	1	0	0	1
Center St & Mission St	Center St	Mission St	857	**4**	-0.28	9	0	0	0	1	3	0	0	2	0	1	0	1	2	0	2	0
Iowa Dr & Bay St	Iowa Dr	Bay St	767	**3**	2.10	3	0	0	0	0	3	0	0	0	0	2	0	1	0	0	1	1
Roundabouts																						
Pacific Ave & Beach St	Pacific Ave	Beach St	133	**33**	NA	253	0	1	5	1	29	0	1	1	2	29	2	1	14	1	2	7
Washington St & Pacific Ave	Washington St	Pacific Ave	352	**19**	NA	232	0	1	4	2	12	2	0	1	1	10	0	5	5	1	2	3
Unsignalized Intersections																						

Intersection	Cross Street 1	Cross Street 2	UNQ_ID	Collisions	LCCR Differential	EPDO	*Fatal Collisions*	*Serious Injury Collisions*	*Other Visible Injury Collisions*	*Complaint of Pain Collisions*	*PDO Collisions*	Broadside	Sideswipe	Rear End	Head On	Other	Pedestrian	Bicycle	Aggressive	Distracted	Impaired	Dark
Ocean St & Pryce St	Ocean St	Pryce St	1103	**21**	0.05	41	0	0	1	2	18	6	2	3	0	6	2	2	5	0	2	8
Washington St & Laurel St	Washington St	Laurel St	536	**20**	0.62	123	0	0	8	5	7	1	3	4	1	4	3	4	4	3	4	5
Broadway & San Lorenzo Bl	Broadway	San Lorenzo Bl	624	**18**	0.09	222	0	1	1	6	10	2	2	3	1	7	2	0	1	0	1	7
Cliff St & Beach St	Cliff St	Beach St	340	**17**	1.24	220	0	1	3	2	11	1	1	1	0	9	3	2	3	2	2	6
Mission St & Van Ness Ave	Mission St	Van Ness Ave	523	**16**	0.10	239	0	1	4	4	7	5	1	3	1	1	4	1	3	2	0	8
Ocean St & Leonard St	Ocean St	Leonard St	878	**14**	7.62	29	0	0	1	1	12	3	2	4	0	3	1	0	2	0	4	6
Walti St & Laurel St	Walti St	Laurel St	539	**13**	0.35	77	0	0	4	5	4	1	0	2	2	4	0	4	2	0	0	4
Poplar Ave & Water St	Poplar Ave	Water St	998	**13**	0.12	28	0	0	1	1	11	2	1	2	2	6	0	0	5	0	2	6
Western Dr & Mission St Exd	Western Dr	Mission St Exd	181	**12**	0.70	22	0	0	1	0	11	3	1	7	0	0	0	1	5	1	1	2
Felix St & Laurel St	Felix St	Laurel St	473	**11**	0.43	35	0	0	2	1	8	0	0	1	1	1	2	6	3	0	1	3
Fair Ave & Mission St	Fair Ave	Mission St	255	**10**	0.01	59	0	0	4	2	4	1	1	4	1	2	0	1	2	0	2	4
3rd St & Beach St	3rd St	Beach St	395	**10**	1.38	20	0	0	1	0	9	0	2	0	1	7	0	0	1	0	1	5
Ocean St & Dakota Ave	Ocean St	Dakota Ave	822	**10**	33.14	30	0	0	0	4	6	1	1	5	0	1	2	0	3	1	0	4
Poplar Ave & Soquel Ave	Poplar Ave	Soquel Ave	957	**10**	0.01	49	0	0	3	2	5	2	1	4	0	1	1	1	3	0	0	1
Ocean St & Hubbard St	Ocean St	Hubbard St	1018	**10**	0.10	184	0	1	0	2	7	0	1	3	0	4	2	0	1	0	1	6
River St & Coral St	River St	Coral St	1116	**10**	0.01	20	0	0	0	2	8	0	3	1	1	4	0	1	2	1	0	0
California St & Bay St	California St	Bay St	311	**9**	0.15	24	0	0	1	1	7	1	2	3	0	1	1	1	2	0	0	2
Morrissey Blvd &	Morrissey Blvd		1174	**9**	-0.03	29	0	0	1	2	6	1	2	1	0	3	1	1	2	1	0	2
Graham Hill Rd &	Graham Hill Rd		1177	**9**	0.09	192	0	1	2	0	6	0	1	1	1	5	0	1	0	0	0	4
David Way & W Cliff Dr	David Way	W Cliff Dr	83	**8**	39.67	210	1	0	4	0	3	1	1	0	0	3	1	2	1	0	0	1
Main St & Beach St	Main St	Beach St	134	**8**	0.15	13	0	0	0	1	7	1	2	0	1	3	0	1	0	1	1	4
Mission St & Laurent St	Mission St	Laurent St	491	**8**	-0.05	28	0	0	1	2	5	0	1	2	1	2	0	2	1	0	1	2
May Ave & Water St	May Ave	Water St	937	**8**	-0.05	18	0	0	0	2	6	0	0	2	0	4	2	0	1	0	0	3
Reed Way & Water St	Reed Way	Water St	948	**8**	-0.03	28	0	0	1	2	5	2	2	0	0	2	0	2	2	0	0	1
Pacheco Ave & Soquel Ave	Pacheco Ave	Soquel Ave	1008	**8**	-0.03	32	0	0	2	1	5	1	0	2	0	2	1	2	1	0	0	2
W Cliff Dr & Beach St	W Cliff Dr	Beach St	132	**7**	0.66	42	0	0	2	3	2	0	1	1	0	4	0	0	4	0	0	0
Cliff St & 1st St	Cliff St	1st St	351	**7**	0.19	7	0	0	0	0	7	1	2	1	0	2	0	0	0	0	2	4
Bay St & Mission St	Bay St	Mission St	463	**7**	-0.07	22	0	0	1	1	5	1	3	2	0	1	0	0	1	0	0	1
Cedar St & Locust St	Cedar St	Locust St	796	**7**	2.31	17	0	0	1	0	6	1	1	1	0	4	0	0	0	0	1	1
Bay St & Bay St	Bay St	Bay St	804	**7**	0.98	27	0	0	1	2	4	2	0	1	1	1	0	2	3	1	2	2
Storey St & High St	Storey St	High St	873	**7**	-0.05	31	0	0	2	1	4	0	2	0	1	2	0	2	1	0	0	5
Ocean St & Blaine St	Ocean St	Blaine St	981	**7**	-0.08	17	0	0	0	2	5	0	1	5	0	1	0	0	4	1	0	2
River St & Fern St	River St	Fern St	1138	**7**	-0.05	171	0	1	0	0	6	0	3	2	0	2	0	0	1	0	1	2
Fair Ave & Delaware Ave	Fair Ave	Delaware Ave	126	**6**	0.54	16	0	0	1	0	5	2	2	1	0	1	0	0	0	0	0	1
Pacific Ave & Beach St	Pacific Ave	Beach St	308	**6**	-0.04	21	0	0	1	1	4	0	0	1	1	1	1	2	2	0	2	2
Front St & Spruce St	Front St	Spruce St	490	**6**	-0.07	16	0	0	0	2	4	3	0	1	0	1	0	1	1	0	0	3
Escalona Dr & Bay St	Escalona Dr	Bay St	577	**6**	0.06	35	0	0	3	0	3	1	0	0	0	2	0	3	1	0	1	1
Pacific Ave & Cathcart St	Pacific Ave	Cathcart St	654	**6**	0.46	12	0	0	0	1	6	2	1	1	1	1	1	0	0	0	1	2
Chestnut St & Walnut Ave	Chestnut St	Walnut Ave	695	**6**	0.00	6	0	0	0	0	6	1	1	1	0	0	0	3	1	0	0	2
Dakota Ave & Soquel Ave	Dakota Ave	Soquel Ave	723	**6**	-0.04	40	0	0	3	1	2	1	0	1	0	1	2	1	3	1	1	2
Seabright Ave & Windsor St	Seabright Ave	Windsor St	741	**6**	0.90	6	0	0	0	0	6	0	2	3	0	0	1	0	1	0	3	5
Pacific Ave & Church St	Pacific Ave	Church St	763	**6**	1.11	16	0	0	1	0	5	0	2	1	0	1	2	0	0	1	0	1
Pennsylvania Ave & Soquel Ave	Pennsylvania Ave	Soquel Ave	887	**6**	-0.07	21	0	0	1	1	4	1	0	2	0	2	0	1	2	0	2	2
Ocean St & Coloma St	Ocean St	Coloma St	958	**6**	-0.11	25	0	0	2	0	4	0	2	0	0	0	1	2	1	0	0	1
River St & Mora St	River St	Mora St	979	**6**	0.37	16	0	0	1	0	5	0	0	2	0	3	0	1	2	0	0	2
Ocean St & Franklin St	Ocean St	Franklin St	1076	**6**	-0.12	25	0	0	2	0	4	2	1	1	0	1	1	0	1	1	0	0
& State Hwy 1		State Hwy 1	1091	**6**	-0.10	180	0	1	0	2	3	0	0	4	0	2	0	0	1	0	0	2
Woodrow Ave & Delaware Ave	Woodrow Ave	Delaware Ave	154	**5**	0.12	20	0	0	1	1	3	1	1	1	0	1	0	1	0	1	2	1
Laguna St & Bay St	Laguna St	Bay St	225	**5**	0.02	174	0	1	0	1	3	2	0	1	1	0	0	1	0	0	0	1

Intersection	Cross Street 1	Cross Street 2	UNQ_ID	Collisions	LCCR Differential	EPDO	*Fatal Collisions*	*Serious Injury Collisions*	*Other Visible Injury Collisions*	*Complaint of Pain Collisions*	*PDO Collisions*	Broadside	Sideswipe	Rear End	Head On	Other	Pedestrian	Bicycle	Aggressive	Distracted	Impaired	Dark
W Cliff Dr & Bay St	W Cliff Dr	Bay St	237	**5**	0.05	35	0	0	2	2	1	0	0	1	0	1	2	1	1	0	0	2
Almar Ave & Rankin St	Almar Ave	Rankin St	258	**5**	0.38	5	0	0	0	0	5	1	0	1	1	2	0	0	2	0	0	1
Alhambra Ave & E Cliff Dr	Alhambra Ave	E Cliff Dr	339	**5**	13.42	5	0	0	0	0	5	1	1	0	0	3	0	0	0	1	0	2
Mission St & Baldwin St	Mission St	Baldwin St	353	**5**	-0.10	20	0	0	1	1	3	1	1	1	0	0	0	2	1	0	0	1
Jessie St & E Cliff Dr	Jessie St	E Cliff Dr	542	**5**	-0.08	24	0	0	2	0	3	0	0	3	0	2	0	0	3	0	2	1
Anthony St & Bay St	Anthony St	Bay St	561	**5**	-0.02	10	0	0	0	1	4	0	1	1	0	0	0	3	1	1	0	3
Pacific Ave & Maple St	Pacific Ave	Maple St	579	**5**	0.43	15	0	0	1	0	4	0	3	0	0	1	1	0	0	0	1	2
Campbell St & Barson St	Campbell St	Barson St	605	**5**	4.92	5	0	0	0	0	5	0	2	1	1	0	1	0	1	1	1	4
Pacific Ave & Elm St	Pacific Ave	Elm St	616	**5**	0.56	5	0	0	0	0	5	0	2	0	0	1	2	0	0	0	0	4
Clay St & Broadway	Clay St	Broadway	645	**5**	-0.05	20	0	0	1	1	3	0	2	2	0	0	0	1	2	1	1	1
Chestnut St & Lincoln St	Chestnut St	Lincoln St	668	**5**	-0.02	25	0	0	1	2	2	0	1	0	0	1	2	1	3	0	0	0
& Walnut Ave		Walnut Ave	679	**5**	0.01	181	0	1	1	0	6	0	3	1	1	2	0	1	3	1	0	3
Cayuga St & Broadway	Cayuga St	Broadway	775	**5**	0.68	20	0	0	1	1	3	4	1	0	0	0	0	0	0	0	2	0
Highland Ave & Mission St	Highland Ave	Mission St	840	**5**	-0.13	10	0	0	0	1	4	1	3	0	0	0	0	0	1	0	0	0
Highland Ave & High St	Highland Ave	High St	882	**5**	0.43	10	0	0	0	1	4	1	1	1	0	2	0	0	0	0	2	3
N Pacific Ave & Bulkhead St	N Pacific Ave	Bulkhead St	892	**5**	0.49	5	0	0	0	0	5	1	1	0	0	3	0	0	0	0	1	1
Darwin St & Gault St	Darwin St	Gault St	916	**5**	0.50	188	0	1	2	0	2	0	1	1	0	1	1	1	1	0	0	0
Cayuga St & Soquel Ave	Cayuga St	Soquel Ave	940	**5**	-0.10	5	0	0	0	0	5	0	0	3	0	1	0	1	3	0	0	1
San Juan Ave & Soquel Ave	San Juan Ave	Soquel Ave	978	**5**	-0.11	25	0	0	1	2	2	0	0	0	2	1	0	2	1	1	0	2
Josefa Way & Water St	Josefa Way	Water St	987	**5**	-0.10	189	0	1	1	2	1	0	0	0	0	5	0	0	3	0	0	2
Forest Ave & Soquel Ave	Forest Ave	Soquel Ave	997	**5**	-0.11	183	0	1	1	1	2	0	1	0	0	3	0	1	1	0	0	3
Ocean St &	Ocean St		1090	**5**	-0.13	15	0	0	1	0	4	1	0	3	0	0	0	1	1	1	1	2
Plymouth St & Grant St	Plymouth St	Grant St	1136	**5**	-0.05	5	0	0	0	0	5	1	1	1	2	0	0	0	1	0	1	1
Ocean St &	Ocean St		1137	**5**	-0.08	10	0	0	0	1	4	2	1	1	0	0	0	1	1	0	0	0
River St & Encinal St	River St	Encinal St	1142	**5**	-0.10	5	0	0	0	0	5	1	0	1	0	1	0	2	2	1	0	2
Limekiln St & Encinal St	Limekiln St	Encinal St	1152	**5**	-0.10	198	1	0	3	0	1	0	1	0	0	2	1	1	1	0	1	1
Getchell St & W Cliff Dr	Getchell St	W Cliff Dr	20	**4**	5.52	14	0	0	1	0	3	1	1	0	0	1	0	0	1	1	0	1
Almar Ave & W Cliff Dr	Almar Ave	W Cliff Dr	63	**4**	5.52	14	0	0	1	0	3	1	1	0	0	2	0	0	0	1	1	2
Mission St & Berkshire Ave	Mission St	Berkshire Ave	313	**4**	-0.09	9	0	0	0	1	3	1	0	1	0	2	0	0	0	0	1	1
Main St & 3rd St	Main St	3rd St	383	**4**	-0.05	9	0	0	0	1	3	0	2	0	0	1	0	1	0	0	1	3
Kaye St & 3rd St	Kaye St	3rd St	397	**4**	0.05	4	0	0	0	0	4	2	1	1	0	0	0	0	0	0	0	1
E Cliff Dr & Murray St	E Cliff Dr	Murray St	400	**4**	-0.10	14	0	0	1	0	3	0	1	1	0	2	0	0	2	0	0	1
Mott Ave & Murray St	Mott Ave	Murray St	421	**4**	-0.13	14	0	0	1	0	3	0	0	1	0	0	0	3	3	0	0	0
Seabright Ave & Watson St	Seabright Ave	Watson St	471	**4**	0.08	4	0	0	0	0	4	1	1	1	0	0	1	0	0	0	0	2
Toledo St & Bay St	Toledo St	Bay St	488	**4**	0.13	173	1	0	0	1	2	0	0	0	0	1	1	2	1	1	2	3
& Murray St		Murray St	511	**4**	-0.13	168	1	0	0	0	3	0	1	1	0	0	0	1	1	0	0	1
Ocean St & Barson St	Ocean St	Barson St	603	**4**	0.22	4	0	0	0	0	4	0	0	2	2	0	0	0	2	0	0	3
Cleveland Ave & Laurel St	Cleveland Ave	Laurel St	614	**4**	0.49	168	0	1	0	0	3	0	0	1	0	2	1	0	2	0	2	2
Washington St & New St	Washington St	New St	644	**4**	7.30	4	0	0	0	0	4	0	1	1	0	1	1	0	0	1	0	3
Pacific Ave & Lincoln St	Pacific Ave	Lincoln St	682	**4**	0.01	4	0	0	0	0	4	0	2	1	0	0	0	0	0	0	1	1
Pacific Ave & Soquel Ave	Pacific Ave	Soquel Ave	719	**4**	-0.05	14	0	0	1	0	3	0	1	0	0	2	0	1	0	0	0	2
Chestnut St & Church St	Chestnut St	Church St	722	**4**	-0.12	14	0	0	1	0	3	1	1	0	0	0	1	1	0	0	0	1
King St & Walnut Ave	King St	Walnut Ave	730	**4**	-0.02	4	0	0	0	0	4	0	1	1	0	1	0	1	1	1	0	3
& Soquel Ave		Soquel Ave	808	**4**	-0.07	14	0	0	0	2	2	2	0	0	1	0	0	1	1	0	0	1
Darwin St & Broadway	Darwin St	Broadway	809	**4**	5.05	4	0	0	0	0	4	1	0	0	0	3	0	0	0	0	0	1
Pacific Ave & Plaza Ln	Pacific Ave	Plaza Ln	829	**4**	0.36	14	0	0	1	0	3	0	2	0	0	1	0	1	0	0	1	2
Laurent St & High St	Laurent St	High St	835	**4**	-0.12	28	0	0	2	1	1	0	0	1	0	1	1	1	3	0	0	1
Highland Ave & Escalona Dr	Highland Ave	Escalona Dr	861	**4**	-0.12	4	0	0	0	0	4	0	1	1	0	1	0	1	0	0	0	2
Seabright Ave & Hanover St	Seabright Ave	Hanover St	862	**4**	0.17	9	0	0	0	1	3	1	1	1	1	0	0	0	0	0	1	3

Intersection	Cross Street 1	Cross Street 2	UNQ_ID	Collisions	LCCR Differential	EPDO	*Fatal Collisions*	*Serious Injury Collisions*	*Other Visible Injury Collisions*	*Complaint of Pain Collisions*	*PDO Collisions*	Broadside	Sideswipe	Rear End	Head On	Other	Pedestrian	Bicycle	Aggressive	Distracted	Impaired	Dark
Emmett St & Mission St	Emmett St	Mission St	864	**4**	-0.09	14	0	0	1	0	3	0	1	0	0	1	2	0	0	0	1	2
High St & Western Dr	High St	Western Dr	921	**4**	-0.07	23	0	0	2	0	2	1	0	0	0	2	0	1	0	0	0	1
Ocean St &	Ocean St		927	**4**	-0.14	24	0	0	1	2	1	0	1	1	0	0	1	1	1	1	0	1
Market St & Victorian Ct	Market St	Victorian Ct	986	**4**	-0.10	23	0	0	2	0	2	0	3	0	1	0	0	0	2	0	0	0
Marnell Ave & Soquel Ave	Marnell Ave	Soquel Ave	992	**4**	-0.13	9	0	0	0	1	3	0	0	1	0	2	0	1	1	0	0	0
Mentel Ave & Soquel Ave	Mentel Ave	Soquel Ave	1000	**4**	-0.13	24	0	0	1	2	1	1	0	1	1	0	1	0	1	0	0	1
Magnolia St & Water St	Magnolia St	Water St	1011	**4**	-0.10	9	0	0	0	1	3	0	0	2	0	0	0	1	1	1	0	0
Ocean St & Hunolt St	Ocean St	Hunolt St	1048	**4**	-0.14	4	0	0	0	0	4	0	1	1	0	0	0	2	1	0	0	1
Morrissey Blvd & Hammond Ave	Morrissey Blvd	Hammond Ave	1086	**4**	-0.09	9	0	0	0	1	3	0	1	3	0	0	0	0	2	0	1	1
Berry St & Grant St	Berry St	Grant St	1104	**4**	0.43	33	0	0	3	0	1	1	0	0	0	0	1	1	1	0	0	1
Ocean St & Ocean St	Ocean St	Ocean St	1126	**4**	-0.13	168	0	1	0	0	3	1	0	2	0	0	1	0	1	0	0	2
Poplar Ave & Fairmount Ave	Poplar Ave	Fairmount Ave	1167	**4**	0.08	4	0	0	0	0	4	0	2	1	1	0	0	0	1	0	1	2
Jewell St & Hillside Ave	Jewell St	Hillside Ave	1183	**4**	-0.10	4	0	0	0	0	4	0	1	0	0	3	0	0	1	0	0	1
Emeline Ave & Lee St	Emeline Ave	Lee St	1217	**4**	0.17	4	0	0	0	0	4	0	2	1	0	1	0	0	1	0	0	2
Fair Ave & W Cliff Dr	Fair Ave	W Cliff Dr	31	**3**	3.69	3	0	0	0	0	3	0	1	0	0	2	0	0	0	0	0	0
Columbia St & Delaware Ave	Columbia St	Delaware Ave	170	**3**	0.21	3	0	0	0	0	3	0	0	1	0	1	0	1	0	1	1	2
California Ave & Errett Cir	California Ave	Errett Cir	219	**3**	0.24	3	0	0	0	0	3	1	0	0	0	1	0	1	0	0	0	1
Natural Bridges Dr & Mission St Exd	Natural Bridges Dr	Mission St Exd	228	**3**	-0.05	13	0	0	0	2	1	0	1	1	0	0	0	1	1	0	0	1
Pacific Ave & 2nd St	Pacific Ave	2nd St	321	**3**	-0.14	8	0	0	0	1	2	1	0	0	0	1	1	0	0	0	0	0
Front St & 2nd St	Front St	2nd St	330	**3**	-0.11	3	0	0	0	0	3	1	0	1	0	1	0	0	0	0	0	1
Seabright Ave & Atlantic Ave	Seabright Ave	Atlantic Ave	334	**3**	12.27	3	0	0	0	0	3	0	1	1	0	1	0	0	0	0	0	1
Cypress Ave & E Cliff Dr	Cypress Ave	E Cliff Dr	336	**3**	4.76	13	0	0	1	0	2	0	1	0	0	2	0	0	1	0	0	1
Mission St & Palm St	Mission St	Palm St	363	**3**	-0.15	8	0	0	0	1	2	1	1	1	0	0	0	0	0	0	0	1
Seaside St & Bay St	Seaside St	Bay St	389	**3**	-0.06	13	0	0	0	2	1	0	1	1	0	0	0	1	1	2	0	0
Park Ave & Hiawatha Ave	Park Ave	Hiawatha Ave	402	**3**	12.27	3	0	0	0	0	3	0	0	0	1	1	0	0	1	0	0	1
Brook Ave & Murray St	Brook Ave	Murray St	423	**3**	-0.14	340	0	2	1	0	0	0	0	0	0	0	0	2	0	1	0	1
Western Dr & Cypress Park	Western Dr	Cypress Park	445	**3**	0.00	167	0	1	0	0	2	0	0	0	1	2	0	0	0	0	2	3
Western Dr & Westview Ct	Western Dr	Westview Ct	478	**3**	0.00	3	0	0	0	0	3	0	2	0	0	1	0	0	0	0	0	2
3rd St & 3rd St	3rd St	3rd St	492	**3**	-0.12	3	0	0	0	0	3	0	0	1	0	2	0	0	1	0	0	1
Pacific Ave & Spruce St	Pacific Ave	Spruce St	508	**3**	-0.07	13	0	0	1	0	2	0	0	0	2	0	1	0	0	1	0	0
Bixby St & E Cliff Dr	Bixby St	E Cliff Dr	510	**3**	-0.12	3	0	0	0	0	3	1	0	0	0	1	1	0	0	0	1	1
Canfield Ave & San Lorenzo Blvd	Canfield Ave	San Lorenzo Blvd	526	**3**	-0.12	3	0	0	0	0	3	1	0	1	0	1	0	0	0	0	1	2
Cedar St & Laurel St	Cedar St	Laurel St	537	**3**	-0.08	22	0	0	2	0	1	0	0	0	0	1	2	0	1	0	0	2
Pearl St & E Cliff Dr	Pearl St	E Cliff Dr	548	**3**	-0.14	3	0	0	0	0	3	1	0	0	0	2	0	0	0	0	0	0
Alta Vista Dr & Nobel Dr	Alta Vista Dr	Nobel Dr	618	**3**	0.52	3	0	0	0	0	3	1	1	0	0	1	0	0	0	0	0	2
Seabright Ave & Clinton St	Seabright Ave	Clinton St	637	**3**	0.33	13	0	0	1	0	2	0	1	0	1	0	0	1	0	0	0	1
Chestnut St & Taylor St	Chestnut St	Taylor St	643	**3**	-0.09	13	0	0	0	2	1	0	1	1	0	1	0	0	1	0	0	0
King St & Laurel St	King St	Laurel St	646	**3**	-0.13	18	0	0	1	1	1	1	0	0	0	0	0	2	1	0	0	0
Mission St & Otis St	Mission St	Otis St	664	**3**	-0.15	13	0	0	1	0	2	1	1	0	0	0	1	0	0	0	0	1
Washington St & Lincoln St	Washington St	Lincoln St	676	**3**	0.05	10	0	0	0	1	4	1	1	0	0	2	1	0	1	0	1	1
Seabright Ave & Windham St	Seabright Ave	Windham St	702	**3**	0.21	3	0	0	0	0	3	0	2	1	0	0	0	0	0	0	0	3
Cedar St & Walnut Ave	Cedar St	Walnut Ave	718	**3**	-0.06	3	0	0	0	0	3	0	0	0	0	0	1	2	1	0	0	0
Pacific Ave & Walnut Ave	Pacific Ave	Walnut Ave	742	**3**	0.01	13	0	0	1	0	2	0	1	0	0	0	0	2	1	0	0	2
Ocean View Ave & Broadway	Ocean View Ave	Broadway	751	**3**	-0.08	18	0	0	1	1	1	1	0	1	0	1	0	0	1	0	0	0
Pearl Aly & Walnut Ave	Pearl Aly	Walnut Ave	753	**3**	-0.06	3	0	0	0	0	3	1	1	0	0	1	0	0	0	1	0	0
Cedar St & Church St	Cedar St	Church St	764	**3**	0.10	8	0	0	0	1	2	0	0	0	0	2	1	0	0	1	0	0
Soquel Ave &	Soquel Ave		769	**3**	-0.14	13	0	0	1	0	2	0	0	1	0	1	0	1	0	0	0	1
Center St & Locust St	Center St	Locust St	785	**3**	-0.02	3	0	0	0	0	3	0	1	2	0	0	0	0	1	0	1	1
Seabright Ave & Effey St	Seabright Ave	Effey St	824	**3**	0.08	13	0	0	1	0	2	0	0	2	0	0	0	1	0	0	1	1

Intersection	Cross Street 1	Cross Street 2	UNQ_ID	Collisions	LCCR Differential	EPDO	*Fatal Collisions*	*Serious Injury Collisions*	*Other Visible Injury Collisions*	*Complaint of Pain Collisions*	*PDO Collisions*	Broadside	Sideswipe	Rear End	Head On	Other	Pedestrian	Bicycle	Aggressive	Distracted	Impaired	Dark
Pine St & Driveway	Pine St	Driveway	869	**3**	-0.15	167	0	1	0	0	2	0	0	1	1	0	1	0	1	0	0	1
May Ave & Dakota Ave	May Ave	Dakota Ave	870	**3**	2.65	3	0	0	0	0	3	0	1	0	0	1	0	1	0	0	0	0
Lindbergh St & River St	Lindbergh St	River St	911	**3**	0.11	8	0	0	0	1	2	0	0	2	0	0	0	1	2	0	0	0
River St & Driveway	River St	Driveway	943	**3**	0.00	8	0	0	0	1	2	0	0	1	0	1	1	0	0	0	1	0
& Soquel Ave		Soquel Ave	953	**3**	-0.13	32	0	0	3	0	0	0	0	0	0	0	0	3	0	0	0	0
Seabright Ave & Water St	Seabright Ave	Water St	982	**3**	-0.14	13	0	0	1	0	2	1	0	1	0	1	0	0	0	0	0	0
Benito Ave & Water St	Benito Ave	Water St	983	**3**	-0.14	3	0	0	0	0	3	0	0	0	0	1	0	2	0	0	0	1
River St & Josephine St	River St	Josephine St	991	**3**	-0.03	8	0	0	0	1	2	1	1	0	0	1	0	0	0	0	0	1
Catalpa St & Water St	Catalpa St	Water St	995	**3**	-0.13	13	0	0	1	0	2	0	0	2	0	0	0	1	2	0	0	0
Morrissey Blvd & Melrose Ave	Morrissey Blvd	Melrose Ave	1051	**3**	-0.13	172	0	1	0	1	1	2	0	1	0	0	0	0	1	0	0	1
River St &	River St		1092	**3**	-0.15	172	0	1	0	1	1	0	0	2	0	0	1	0	1	0	0	2
Driveway & State Hwy 1	Driveway	State Hwy 1	1110	**3**	0.00	8	0	0	0	1	2	0	0	2	1	0	0	0	2	0	0	2
Limekiln St & Fern St	Limekiln St	Fern St	1132	**3**	-0.14	13	0	0	0	2	1	1	0	2	0	0	0	0	1	0	0	0
Harrison Ave & Chilverton St	Harrison Ave	Chilverton St	1139	**3**	0.23	3	0	0	0	0	3	0	2	1	0	0	0	0	0	0	0	3
N Branciforte Ave &	N Branciforte Ave		1248	**3**	1.87	3	0	0	0	0	3	0	0	0	0	3	0	0	1	0	0	2

Appendix C. Segment Collision Ranking Table

Facility	Cross Street 1	Cross Street 2	Collisions	LCCR Differential	EPDO	*Fatal Collisions*	*Serious Injury Collisions*	*Other Visible Injury Collisions*	*Complaint of Pain Collisions*	*PDO Collisions*	Broadside	Sideswipe	Rear End	Head On	Other	Pedestrian	Bicycle	Aggressive	Distracted	Impaired	Dark
Primary Arterial																					
Ocean St	Soquel Ave	Dakota Ave	**7**	3.01	17	0	0	0	2	5	0	3	2	0	1	1	0	3	1	0	2
Ocean St	Broadway	Barson St	**4**	1.39	4	0	0	0	0	4	1	0	0	0	1	1	1	0	0	0	2
Water St	River St	Ocean St	**4**	0.42	9	0	0	0	1	3	0	0	1	0	2	0	1	1	1	0	3
Secondary Arterial																					
State Hwy 1	River St	Mission St	**7**	118.94	12	0	0	0	1	6	0	0	5	0	2	0	0	3	0	0	4
Front St	Cathcart St	Laurel St	**4**	2.65	168	1	0	0	0	3	0	1	1	0	0	2	0	0	0	0	3
High St	Laurent St	Storey St	**4**	0.01	33	0	0	3	0	1	0	0	0	1	1	0	2	2	0	0	2
Front St	Cooper St	Soquel Ave	**3**	2.33	3	0	0	0	0	3	1	2	0	0	0	0	0	0	0	0	2
Collector																					
W Cliff Dr	Columbia St	Pelton Ave	**7**	32.16	36	0	0	3	0	4	0	0	0	0	4	1	1	1	0	1	2
La Fonda Ave	Abby Ct	Oak Way	**2**	2.13	2	0	0	0	0	2	0	0	1	0	0	0	0	1	0	0	1
Harvey West Blvd	Sylvania Ave	Coral St	**2**	2.07	2	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0
Carbonera Dr	Carbonera Ct	Isbel Dr	**2**	13.39	166	0	1	0	0	1	0	0	0	0	2	0	0	2	0	0	1
Escalona Dr	Bay St	Laurent St	**2**	3.21	2	0	0	0	0	2	0	0	1	1	0	0	0	0	0	0	2
Local																					
Municipal Wharf	South of Beach St		10	45.67	347	1	1	0	2	6	0	3	1	1	3	2	0	1	0	0	3
S River St	River St	Soquel Ave	4	20.17	9	0	0	0	1	3	1	1	1	0	0	1	0	0	0	0	0
Mission St Exd	Western Dr	Swift St	4	25.91	4	0	0	0	0	4	1	0	1	0	1	1	0	0	0	0	2
Washington St	Laurel St	Center St/Washington St	3	0.18	27	0	0	2	1	0	2	0	0	0	0	0	0	0	0	1	0
Bay St	Nobel Dr	Escalona Dr	3	24.65	167	0	1	0	0	2	0	0	0	0	3	0	0	0	0	1	2
Mission St Exd	Shaffer Rd	Burkett St	3	52.44	32	0	0	3	0	0	0	0	0	0	3	0	0	2	0	0	0

**Changes to Segment occurred during analysis process; may be omitted. Recent construction has changed roadway geometry; omitted from countermeasure analysis

Appendix D. University of California Santa Cruz (UCSC) Countermeasure Opportunities

University of California Santa Cruz (UCSC) Campus Intersections

There are four intersections selected and reviewed:

- Coolidge Drive/Bay Drive at High Street
- Cardiff Path and High St
- Moore St and High St
- Ranch View Rd and Coolidge Dr

These are arterial road with a history of high-speed vehicles and high-volume pedestrian traffic and collisions involving bicyclists. Countermeasures at these locations are focused on reducing speeds, improving pedestrian and bicycle facilities, and considering intersection treatments such as roundabout, all-way-stop or rectangular rapid flashing beacon. There are also several high frequency transit stops located near the intersections served by all sizes transit vehicles.

Coolidge Drive/Bay Drive at High Street

Countermeasures:

- Restriping of faded crosswalks, travel lanes
- Add green striping for bicycle lane
- Replace pedestal traffic signals with mast arms
- Install retroreflective borders on backplates of signal heads
- Add signal ahead warning signs
- Add Leading Pedestrian Interval
- Add Advanced Dilemma Zone Detection
- Consider Pedestrian scramble to improve crossing safety
- Consider convert to Roundabout

Cardiff Path and High St

Countermeasures:

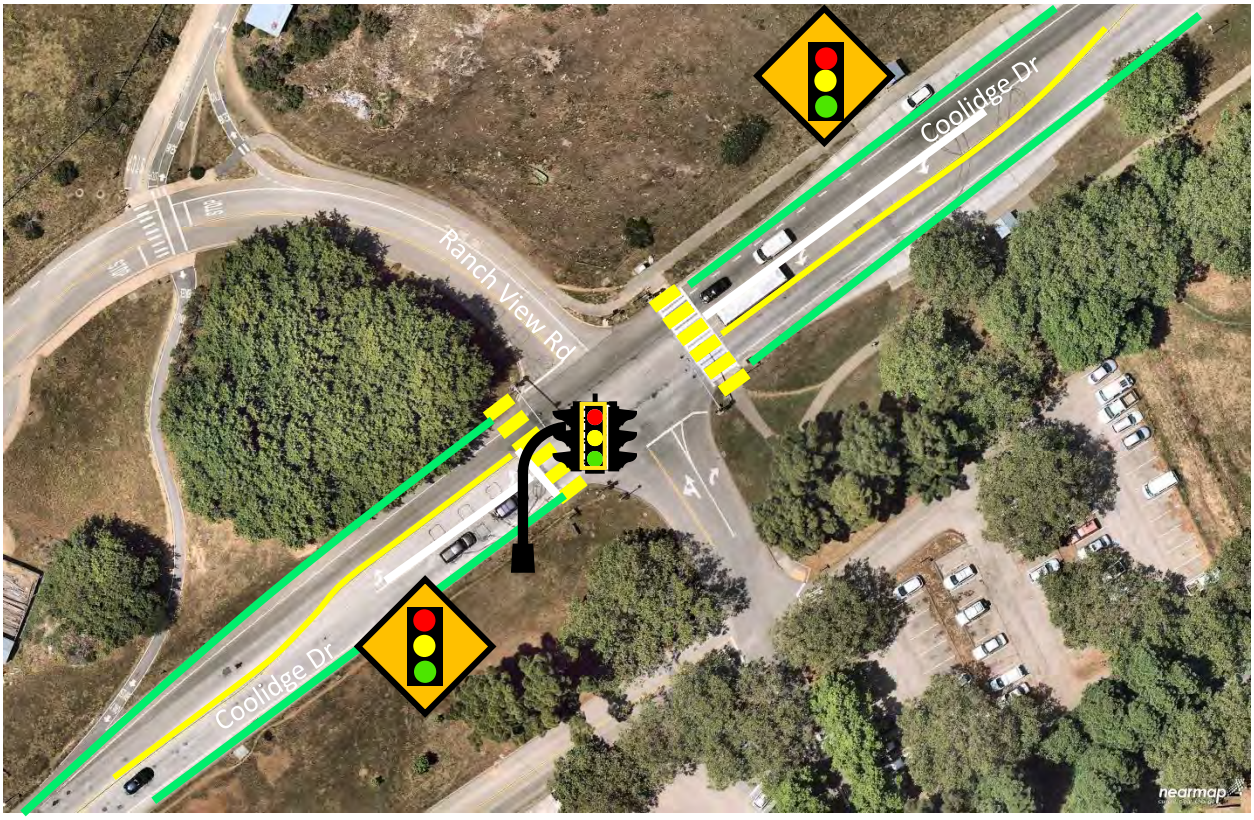
- Add High Visibility Crosswalk
- Restriping travel lanes
- Install Pedestrian Crossing on West Leg
- Add green bicycle lane paint
- Consider All-Way Stop Controlled
- Rectangular Rapid Flashing Beacon (RRFB)
- Consider Roundabout/Traffic Circle

Moore St and High St

Countermeasures:

- Add High Visibility Crosswalk
- Restriping travel lanes
- Add green bicycle lane paint
- Consider Rectangular Rapid Flashing Beacon (RRFB)
- Consider All-Way Stop Controlled
- Consider Roundabout/Traffic Circle

Ranch View Rd and Coolidge Dr



Countermeasures:

- Restriping of faded crosswalks, travel lanes
- Add green bicycle lane paint
- Replace pedestal traffic signals with mast arms
- Install retroreflective borders on backplates of signal heads
- Install Signal ahead warning signs
- Consider Roundabout/Traffic Circle