COLMA TRANSPORTATION SAFETY ACTION PLAN

FINAL SYSTEMIC SAFETY ANALYSIS REPORT

KITTELSON & ASSOCIATES, INC.
1161 Mission Street, Suite 563
San Francisco, CA 94103 | **P** 415.579.1778

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1.0 EXECUTIVE SUMMARY

Kittelson & Associates, Inc. worked with the Town of Colma to identify countermeasures to improve roadway safety. This work was done through a Caltrans Systemic Safety Analysis Report Program (SSARP) Grant. This SSAR describes the Town's roadway network, crash trends and patterns, priority corridors, potential countermeasures, and benefit-cost ratios of viable project scopes. For this SSAR, the Town has identified several roadway corridors to be studies; these are listed below. Kittelson collected traffic volume and roadway data along these study corridors for the purpose of evaluating safety performance, and for identifying roadway characteristics associated with location exhibiting relatively frequent crashes, for subsequent analysis. The roadway corridor identified by the Town for study are:

- El Camino Real (State Highway 82);
- Junipero Serra Boulevard;
- Hillside Boulevard;
- Mission Road;
- Serramonte Boulevard;
- Collins Avenue;
- Colma Boulevard;
- Lawndale Boulevard; and,
- F Street.

The following is an overview of this SSAR content:

Safety Data Used

- Crash data was obtained and analyzed for the most recent six years of complete crash data available, from January 1, 2011 through December 31, 2016; there were 121 reported crashes in this period.
- Roadway data was provided by the Town of Colma which included information such as posted speed, median presence and break locations, number of lanes, bike lane presence, on-street parking, sidewalk presence, and access density and type. Some attributes were confirmed with Kittelson's field visit in November 2017 and others were collected via Google Earth.
- Kittelson collected traffic volumes at both point locations along roadway segments and at intersections, for a total of seven days in November 2017.
- High-priority intersections and segments were identified using the Equivalent Property Damange Only (EPDO) and Crash Rate network screening performance measures from the Highway Safety Manual (HSM).
- Kittelson factored existing and planned projects into consideration of selected priority locations and into recommended improvements.

Data Analysis and Techniques and Results

- Crash patterns and trends in the townwide data were considered by evaluating crash severity, crash type, primary reported contributing factor, lighting, year, and pedestrian crash characteristics.
- Crash trends along the key study corridors were considered by crash severity, crash type, and crash contributing factor.
- Intersections and roadway segments were ranked by EPDO scores.

Highest Occuring Crash Types

- Pedestrians were involved in 4% of the 121 reported crashes, and bicyclists were involved in 3%.
- Rear end (24%) and sideswipe (21%) crashes represent the largest shares of crash.
- Broadside crashes (71%), vehicle/pedestrian crashes (67%), and head-on crashes (50%) resulted in the highest proportion of injuries.
- The most frequently cited primary collision factors include improper turning (22%) and unsafe speed (19%).

High-Risk Corridors and Intersections

- Fifty-eight percent (58%) of reported crashes on Junipero Serra Boulevard and 50% of reported crashes on Hillside Boulevard resulted in injury, compared to a townwide fatal/injury rate of 43%.
- Two reported fatal crashes took place on Hillside Boulevard.
- Sixty-five percent (65%) of reported crashes on Colma Boulevard were rear end crashes, compared to 24% townwide.
- Thirty percent (30%) of reported crashes on Serramonte Boulevard and 29% of reported crashes on Colma Boulevard were attributed to unsafe speeds.

Proposed Countermeasures

- Roadway segment systemic treatment options include: Intersection Pavement Marking Delineation; Backplates with Retroreflective Borders; Green Pavement Markings for Bicycle-Vehicle Conflicts; Leading Pedestrian Intervals at Traffic Signals; No Right-Turn on Red; Enhanced Pedestrian Crossings; Pedestrian Hybrid Beacons (PHB) at Uncontrolled Marked Crossings; Mid-Block Crosswalks; Sidewalks; Bicycle Lanes (Class II); Speed Feedback Signs; Sight Distance Improvements; Road Diets; Road Segment Edgelines; Upgrade Street Name Signs; Gateway Treatments; Upgrade Regulatory and Warning Signs; Access Management; and Street Lighting.
- Location specific projects include: Intersection control evaluation at Mission Road/El Camino Real intersection; Reconfiguring roadway cross-section on Hillside Boulevard; Consistency in All Way Stop Control on Colma Boulevard; Reconfiguring Junipero Serra Boulevard/Serramonte Boulevard Intersection; Reconfiguring Serramonte Boulevard/Collins Avenue Intersection; and Intersection control evaluation at Collins Avenue/El Camino Real intersection.
- Safety policies, Education, and Enforcement strategies were also identified based on input from the community and Town. The most feasible and effective options include adopting a Vision Zero policy; Road Safety Education to Children; Speed Monitoring Awareness Radar Trailer; Vulnerable Road User Education; Enhanced Police Enforcement; Photo Enforcement; and Speed Survey and Enforcement Campaigns.

Table 1 below shows the systemic treatments and location-specific projects identified as part of the corridors in the Town.

Table 1: Summary of the Systemic and Location Specific Projects for each Corridor

Corridor	Systemic Treatments	Location-specific Treatment
El Camino Real	▪ Pavement marking delineation ▪ Backplates with retroreflective borders ▪ Green pavement markings for bike-vehicle conflicts ▪ LPIs at traffic signals ▪ Install sidewalks ▪ Install PHBs at uncontrolled marked crossings ▪ Sight-distance improvements ▪ Speed-feedback signs ▪ Gateway treatments ▪ Larger street-name signs ▪ Install bike lanes ▪ Road-diet candidate ▪ Street lighting ▪ Upgrade signs ▪ No right-turn on red	▪ Intersection Control Evaluation at Mission Road/El Camino Real ▪ Intersection Control Evaluation at Collins Avenue/El Camino Real
Junipero Serra Boulevard	▪ Pavement marking delineation ▪ Backplates with retroreflective borders ▪ Green pavement markings for bike-vehicle conflicts ▪ LPIs at traffic signals ▪ No right-turn on red ▪ Install sidewalks ▪ Sight-distance improvements ▪ Speed-feedback signs ▪ Gateway treatments ▪ No right-turn on red ▪ Street lighting	▪ Reconfiguring Junipero Serra Boulevard/Serramonte Boulevard/ Intersection
Hillside Boulevard	▪ Pavement marking delineation ▪ Backplates with retroreflective borders ▪ Green pavement markings for bike-vehicle conflicts ▪ LPIs at traffic signals ▪ Install sidewalks ▪ Sight-distance improvements ▪ Speed feedback signs ▪ Enhanced pedestrian crossings ▪ Larger street-name signs ▪ Upgrade signs ▪ Gateway treatments ▪ Street lighting ▪ Mid-Block pedestrian crossings	▪ Reconfiguring roadway cross-section from Serramonte Boulevard Intersection to Lawndale Boulevard Intersection
Mission Road	▪ Backplates with retroreflective borders ▪ LPIs at traffic signals ▪ Sight-distance improvements ▪ Speed feedback signs ▪ Mid-Block pedestrian crossings	▪ Intersection Control Evaluation at Mission Road/El Camino Real

Corridor	Systemic Treatments	Location-specific Treatment
Serramonte Boulevard	▪ Pavement marking delineation ▪ Backplates with retroreflective borders ▪ Green pavement markings for bike-vehicle conflicts ▪ LPIs at traffic signals ▪ No right-turn on red ▪ Larger street-name signs ▪ Enhanced Pedestrian Crossings ▪ Install bike lanes ▪ Road-diet candidate ▪ Upgrade signs ▪ Access management ▪ Road segment Edgelines ▪ Mid-Block pedestrian crossings ▪ Street lighting	▪ Reconfiguring Serramonte Boulevard/Collins Avenue Intersection ▪ Reconfiguring Junipero Serra Boulevard/Serramonte Boulevard/ Intersection
Collins Avenue	▪ Pavement marking delineation ▪ Backplates with retroreflective borders ▪ Green pavement markings for bike-vehicle conflicts ▪ LPIs at traffic signals ▪ Install sidewalks ▪ Larger street-name signs ▪ Install bike lanes ▪ Upgrade signs ▪ Access management ▪ Sight-distance improvements ▪ Street lighting	▪ Reconfiguring Serramonte Boulevard/Collins Avenue Intersection ▪ Intersection Control Evaluation at Collins Avenue/El Camino Real
Colma Boulevard	▪ Pavement marking delineation ▪ Backplates with retroreflective borders ▪ LPIs at traffic signals ▪ No right-turn on red ▪ Install sidewalks ▪ Larger street-name signs ▪ Install bike lanes ▪ Road-diet candidate ▪ Street lighting	▪ Consistency in All Way Stop Control
Lawndale Boulevard	▪ Backplates with retroreflective borders ▪ Green pavement markings for bike-vehicle conflicts ▪ LPIs at traffic signals ▪ Install sidewalks ▪ Speed-feedback signs ▪ Close bike lane gap ▪ Larger street name signs ▪ Mid-Block pedestrian crossings at the school entrance	NA.

Corridor	Systemic Treatments	Location-specific Treatment
F Street	▪ Pavement marking delineation ▪ Backplates with retroreflective borders ▪ LPIs at traffic signals ▪ Sight-distance improvements ▪ Speed-feedback signs ▪ Larger street-name signs ▪ Install bike lanes ▪ Road segment edgelines ▪ Upgrade signs ▪ Intersection/Road segment street lighting	NA.

Viable Project Scopes and Prioritized List of Safety Projects

- Project scopes and concepts were developed for the top twelve locations in the Town. The project scopes were identified at the following locations: Hillside Boulevard from Serramonte Boulevard to Lawndale Boulevard Intersection; El Camino Real/Mission Road Intersection; Junipero Serra Boulevard/Serramonte Boulevard Intersection; Junipero Serra Boulevard from Colma Boulevard to Collins Avenue Intersection; Colma Boulevard from El Camino Real to Junipero Serra Boulevard Intersection; El Camino Real/F Street Intersection; El Camino Real/Serramonte Boulevard Intersection; El Camino Real/Colma Boulevard Intersection; Collins Avenue from El Camino Real to Junipero Serra Boulevard Intersection; El Camino Real/Collins Avenue Intersection; Serramonte Boulevard from El Camino Real to Hillside Boulevard Intersection; and Lawndale Boulevard from Mission Road to Hillside Boulevard Intersection.
- Of these, the project team developed 30 percent concept designs for five locations. A brief discussion on the respective projects being competitive for Highway Safety Improvement Program (HSIP) funding is also included at the end of each project scope and description in the later sections in the report. This decision was primarily based on the benefit-cost ratio values for the project scopes.
- The benefit-cost ratio expresses benefits in monetary terms, which requires an estimate of the number of crashes avoided as a result of the countermeasures proposed in the project scope, and the monetary value of each avoided crash on the corridor or at an intersection. For the countermeasures proposed in the project scopes that are eligible for HSIP benefit, the crash modification factors (CMFs) are provided in the Caltrans Local Road Safety Manual. Kittelson used these CMFs to calculate the expected reduction in crashes and convert that to a monetary value. Kittelson used the monetary value of the expected benefit divided by the estimated project cost to arrive at the benefit-cost ratio. This methodology is consistent with the Caltrans' HSIP Cycle 9 HSIP Analyzer tool used to calculate benefit cost ratios for the purpose of prioritizing proposed HSIP projects.

2.0 ENGINEER'S SEAL

By signing and stamping this Systemic Safety Analysis Report, Erin M. Ferguson, P.E., is attesting to this report's technical information and engineering data upon which local agency's recommendations, conclusions, and decisions are made.

3.0 STATEMENT OF PROTECTION OF DATA FROM DISCOVERY AND ADMISSIONS

Per Section 148 of Title 23, United States Code [23 U.S.C. §148(h) (4)] REPORTS DISCOVERY AND ADMISSION INTO EVIDENCE OF CERTAIN REPORTS, SURVEYS, AND INFORMATION—Notwithstanding any other provision of law, reports, surveys, schedules, lists, or data compiled or collected for any purpose relating to this section, shall not be subject to discovery or admitted into evidence in a Federal or State court proceeding or considered for other purposes in any action for damages arising from any occurrence at a location identified or addressed in the reports, surveys, schedules, lists, or other data.

4.0 SAFETY DATA UTILIZED (CRASH, VOLUME, ROADWAY)

This section documents the most recent crash data used by Kittelson in the townwide and corridor-specific crash analysis as well as the network screening and systemic risk analysis. The discussion describes the following data, which was used for analysis:

- SWITRS data
- TIMS data
- Colma Police Department reported crash data
- Local roadway, traffic volume, roadway/intersection characteristics, and transit data

The following also documents the sources of the data, years they were collected or represent, and actions we took to clean or adjust the data for analysis purposes.

4.1 CRASH DATA

Kittelson downloaded and spatially located all reported crashes from January 1, 2011, through December 31, 2016 in the following databases:

Statewide Integrated Traffic Reporting System (SWITRS) – This database is maintained by the California Highway Patrol and provides attributes (like crash type and primary contributing factor) for all crashes that are reported from local jurisdictions.

University of California, Berkeley Transportation Injury Mapping System (TIMS) – The TIMS database, maintained by SafeTREC research center, maps all reported injury and fatal crashes from the SWITRS database and is used to aide in the spatial location of crashes.

There were 56 reported crashes in this period. The location data in both data sets were used to geocode the crashes and map them in GIS software. Crashes reported to occur on Interstate 280 within Town limits were excluded from the data set. All other reported crashes for public streets in Colma were included in the database. In addition to the crashes located from the databases above, the Town also provided supplementary crash data from October 2014 through 2016. All non-duplicative crashes with a reported severity level were added to the crash database. Kittelson identified these crashes as data entries with unique date and time information when compared to SWITRS and TIMS crashes; there were an additional 65 crashes added to the database as a result of this cross referencing.

This report includes analysis of the 121 reported crashes in the dataset described above. Of these, 2 resulted in fatal crashes, 50 resulted in injury crashes, and 69 resulted in the property damage only crashes.

4.2 TRAFFIC VOLUME DATA

Kittelson collected traffic volumes at both point locations along roadway segments and at intersections.

Roadway Segment Counts

Kittelson collected roadway segment counts for a total of seven days. The data collection has yielded directional average daily traffic (ADT), 85th percentile speeds by direction, and peak hour volumes at each of 13 points along the listed roadway segments in Table 2. These data are also stored in a spatial database and can be overlaid onto the roadway network for analysis.

Table 2: Roadway Segment Data Collection Locations and Dates

Roadway Segment	Location	Collection Dates
El Camino Real	Between F Street and Colma Boulevard	November 28 – December 3, 2017
El Camino Real	Just North of Mission Road	October 31 – November 6, 2017
Mission Road	North of Lawndale Boulevard	October 31 – November 6, 2017
Junipero Serra Boulevard	Just South of Philip Drive	October 31 – November 6, 2017
Junipero Serra Boulevard	North of Colma Boulevard	November 13 – November 19, 2017
Serramonte Boulevard	Between Collins Avenue and El Camino Real	October 31 – November 6, 2017
Serramonte Boulevard	Between El Camino Real and Hillside Boulevard	October 31 – November 6, 2017
Hillside Boulevard	Between Hoffman Street and F Street	October 31 – November 6, 2017
Lawndale Boulevard	Between Mission Road and Hillside Boulevard	October 31 – November 6, 2017
F Street	East of Clark Avenue	October 31 – November 6, 2017
Colma Boulevard	West of El Camino Real	October 31 – November 6, 2017
Collins Avenue	Between Serramonte Boulevard and El Camino Real	October 31 – November 6, 2017
Hillside Boulevard	South of Sand Hill Road	October 31 – November 5, 2017

Source: Kittelson & Associates, 2017.

Intersection Multimodal Turning Movement Counts

Kittelson also collected multimodal turning movement counts at the intersections listed below and added the following attributes into the spatial database:

- Total entering motor vehicle volume, AM and PM peak hour;
- Total entering motor vehicle volume by approach leg, AM and PM peak hour;
- Total entering bicyclist volume, AM and PM peak hour;
- Total entering bicyclist volume by approach leg, AM and PM peak hour;
- Total pedestrian crossing volume, AM and PM peak hour;
- Total pedestrian crossing volume by leg, AM and PM peak hour;

Counts were conducted on Wednesday, November 1, 2017, during both the AM peak period (7:00 AM to 9:00 AM) and the PM peak period (4:00 PM to 6:00 PM). In addition to vehicle turning movements, the counts collected bicyclist turning movement volume and pedestrian volume by crossing leg.

- Junipero Serra Boulevard/Colma Boulevard;
- El Camino Real/Colma Boulevard;
- El Camino Real/F Street;
- El Camino Real/Serramonte Boulevard;
- El Camino Real/Collins Avenue;
- El Camino Real/Mission Road;

- Junipero Serra Boulevard/Serramonte Boulevard - I-280 On-Ramp;
- Junipero Serra Boulevard /Southgate Avenue;
- Hillside Boulevard/F Street;
- Hillside Boulevard/Serramonte Boulevard;
- Hillside Boulevard/Lawndale Boulevard;
- Lawndale Boulevard/Mission Road; and,
- Serramonte Boulevard/Collins Ave.

Summary of traffic volumes collected in Colma in the year 2017 are enclosed in Attachment B.

4.3 ROADWAY SEGMENT CHARACTERISTIC DATA

The following data attributes are housed in GIS files referenced to the Town's roadway network, to allow for precise location. Some attributes were confirmed with a field visit in November 2017 and others were collected via Google Earth. These roadway characteristics and data collection sources are shown in Table 3.

Table 3: Roadway Characteristics and Sources

Roadway characteristic	Collection source
Posted speed	Field visit
Median presence and break locations	Field visit
Number of lanes	Field visit
Bike lane presence	Field visit
On-street parking presence	Field visit
Sidewalk presence	Google Earth
Access density and type	Google Earth
Street Lighting	Field visit

Source: Kittelson & Associates, 2017.

Intersection Characteristic Data

Kittelson also collected the following roadway characteristics at intersections within the Town with field confirmation:

- Type of control (signal, side-street stop control, all-way stop control); and
- Lane configuration

4.4 TRANSIT DATA

Kittelson obtained shapefiles including the spatial location of all SamTrans bus stops and routes within the Town of Colma, current as of May 4, 2017. We obtained this data from the San Mateo County Transit District website[1].

[1] http://www.smctd.com/Data.html

5.0 DATA ANALYSIS TECHNIQUES AND RESULTS

5.1 TOWNWIDE TREND ANALYSIS FINDINGS

This section includes findings and discussion of townwide crash trend analysis, including tables and figures as appropriate. Key findings include the following:

- From 2011 – 2016, there were 121 reported crashes in the Town of Colma and only 46% of these were included in SWITRS database.
- Pedestrians were involved in 4% of the 121 reported crashes, and bicyclists were involved in 3%.
- Rear end (24%) and sideswipe (21%) crashes represent the largest shares of crash.
- Broadside crashes (71%), vehicle/pedestrian crashes (67%), and head-on crashes (50%) resulted in the highest proportion of injuries.
- The most frequently cited primary collision factors include improper turning (22%) and unsafe speed (19%).
- Crashes with the cited primary collision factor automobile right of way resulted in a higher proportion of injury crashes at 69% compared to 42% for reported crashes Townwide.
- Two of five reported pedestrian crashes were coded as occurring in the road (including the shoulder), indicating the pedestrian was likely walking along the road or on the shoulder rather than trying to cross the street.

Kittelson considered crash patterns and trends in the townwide data by evaluating the following crash attributes:

- Crash severity;
- Crash type;
- Primary reported contributing factor;
- Lighting conditions;
- Year;
- Pedestrian crash characteristics ; and,
- Bicycle crash characteristics.

KEY TERMS>>

- ***Descriptive crash statistics –*** *Townwide and segment-specific summaries of crash severity, crash type, and contributing factors.*
- ***Network Screening –*** *Evaluating the entire townwide street network to identify high-crash locations based on number of crashes, severity of crashes, and traffic volume.*
- ***Systemic analysis –*** *Identifying risk factors associated with high-crash locations and prioritizing locations based on risk factors and crash history.*
- ***Primary Collision Factor –*** *The element or driving action which, in the police officer's opinion, best describes the primary factor contributing to the collision.*

In the six years of data analyzed, 7% of reported crashes involved pedestrians or bicyclists, with the rest of crashes involved motor vehicles exclusively (Table).

Crash Severity

Table 4 summarizes the reported crashes by severity and road user type involved (e.g. pedestrian, bicycle, motor vehicle). Severity is classified as fatal, injury, and property damage only (PDO). Injury crashes include severe injuries, other visible injuries, and injuries involving a complaint of pain but no visible injury.

Table 4: Road Users Involved and Crash Severity, Town of Colma, 2011 - 2016

Road Users Involved in Crashes	Fatal Crash	Injury Crash	Property Damage Only	Total
Bicycle – Vehicle	0 (0%)	4 (3%)	0 (0%)	4 (3%)
Pedestrian – Vehicle	1 (1%)	4 (3%)	0 (0%)	5 (4%)
Vehicle-Vehicle or Vehicle-Other	1 (1%)	42 (35%)	69 (57%)	112 (93%)
Total Crashes	**2 (2%)**	**50 (41%)**	**69 (57%)**	**121 (100%)**

Source: Town of Colma, SWITRS, Kittelson 2018

- Among crashes involving only motor vehicles, 36% of reported crashes resulted in an injury or fatality. Pedestrian- or bicyclist-involved crashes resulted in some level of injury, with one fatal pedestrian crash.
- Pedestrians were involved in 4% of reported crashes, and bicyclists were involved in 3% of reported crashes.

Contributing Factors

Figure 1 presents findings by reported primary collision factor and severity.

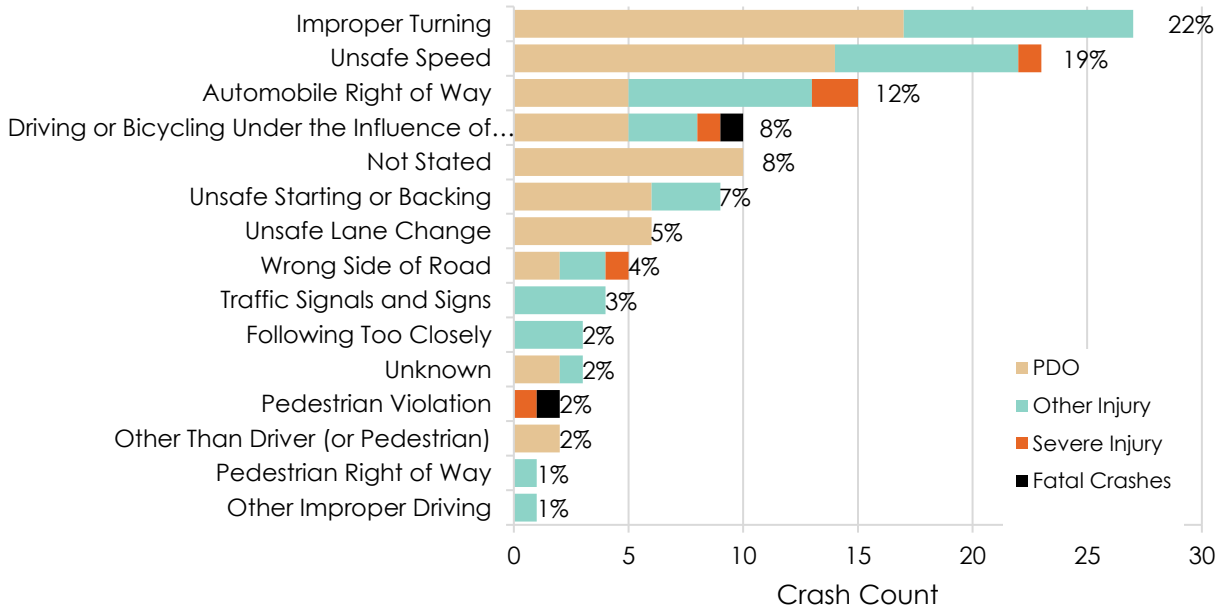


Figure 1: Crashes by Reported Primary Collision Factor, Town of Colma, 2011 - 2016

Automobile Right of Way refers to a crash resulting from one motorist's failure to yield to another motorist who had the right of way.

Pedestrian Violation refers to a crash in which a pedestrian violated a motor vehicle's right of way.

Traffic Signals and Signs refer to a crash resulting from a motorist's failure to comply with a traffic control device (traffic signal, yield sign, or stop sign).

Sources: Town of Colma, SWITRS, Kittelson 2018

- The most frequently cited primary collision factors include improper turning (22%), unsafe speed (19%), and automobile right of way (12%).
- The two fatal crashes included the following primary contributing factors: driving or bicycling under the influence and pedestrian violation.

- Among PCFs cited in ten or more crashes, automobile right of way crashes exhibited the highest proportion of injuries, at 69%. The proportion injury crashes for total reported crashes was 42%.
- The PCFs associated with multiple fatal or severe injury crashes include automobile right of way, driving or bicycling under the influence of alcohol or drugs, and pedestrian violation.

Lighting Conditions

Figure 2 presents findings by reported lighting conditions.

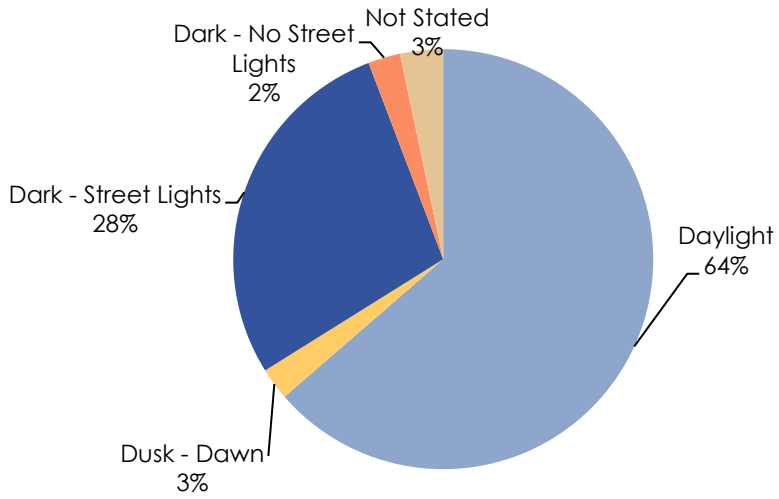


Figure 2: Crashes by Reported Lighting Conditions, Town of Colma, 2011-2016

Source: Town of Colma, SWITRS, Kittelson 2018.

- The majority of crashes occurred in daylight conditions (64%). Of the 38 crashes reported to have occurred in the dark, two percent (2%) occurred where no street lights were present.
- Kittelson reviewed pedestrian- and bicycle- related crashes, as well as crash severity by lighting conditions, and found no notable differences from the overall trends above.

Pedestrian Crashes

Of the five reported pedestrian crashes in the data set, four resulted in injuries and one in a pedestrian death. Two pedestrian crashes were coded as occurring in the road (including the shoulder), indicating the pedestrian was likely walking along the road or on the shoulder rather than trying to cross.

Bicycle Crashes

The four reported bicycle crashes in the data set resulted in injuries. Three bicycle crashes were coded as associated with "other/not stated" crash type, and one crash was coded as the sideswipe crash. The primary contributing factors for these crashes were biking on the wrong side of the road, automobile right-of-way, improper turning, and driving or biking under the influence of alcohol or drugs.

Time-of-Day

Figure 3 and Figure 4 present time-of-day findings.

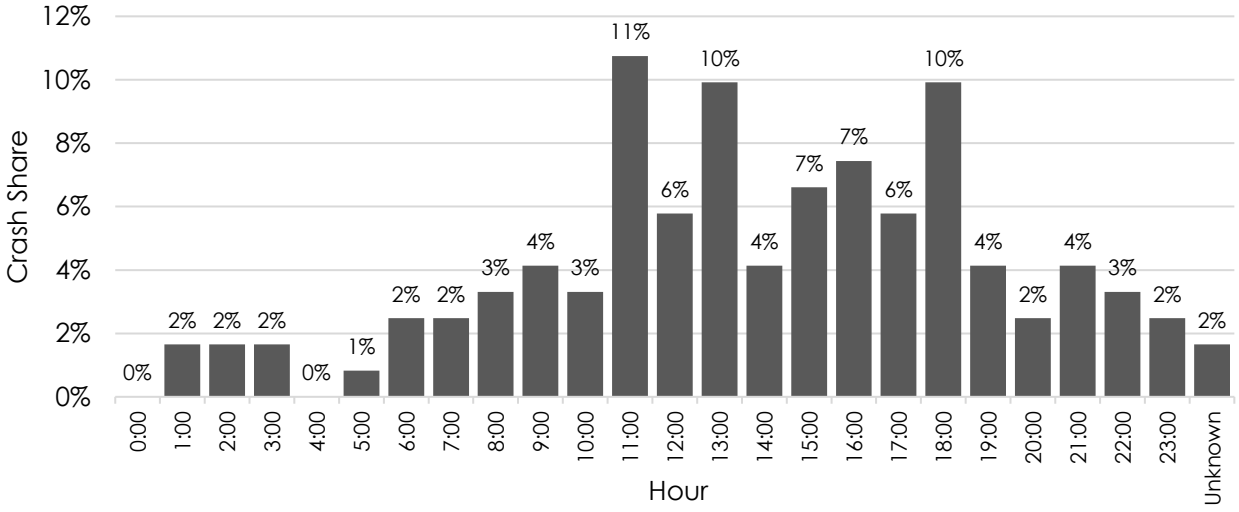


Figure 3: Crashes by Hour of Day, Town of Colma, 2011 - 2016

Source: Town of Colma, SWITRS, Kittelson 2018.

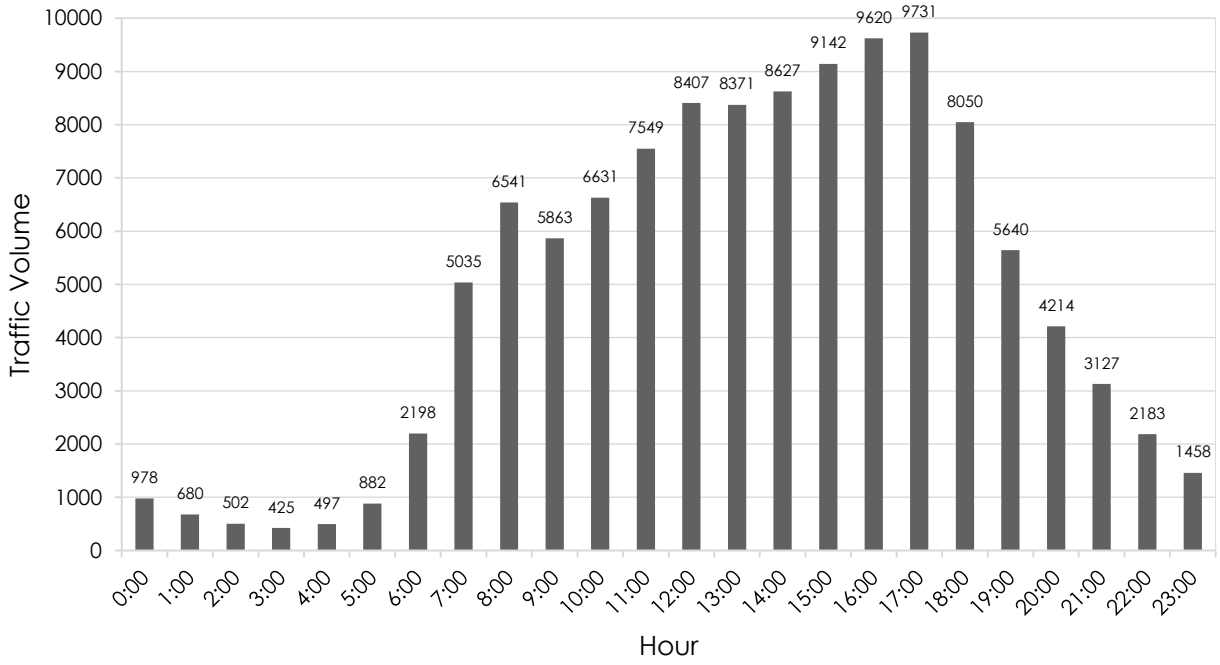


Figure 4: Traffic Volume by Hour of Day, Town of Colma, 2017[2]

Source: Kittelson & Associates, and Quality Counts Data, 2017.

- Crashes peaked from 11:00 AM through 6:00 PM, with higher crash frequency around the midday hours and again during the 6:00 PM hour. This trend corresponds to expected levels of traffic throughout the day, shown in Figure 4.

[2] The traffic volume information by hour of day was collected by KAI from October 31, 2017 to November 6, 2017 at all the study segments and intersections. The average values for traffic volumes throughout the week were shown in Figure 4memb.

5.2 TOWNWIDE RANKING

California's Office of Transportation Safety (OTS) maintains a ranking system to compare traffic safety statistics among similarly sized California cities and towns. The comparison allows cities to identify local safety performance relative to peers. Townwide (or citywide) rankings are based on population, daily vehicle miles traveled, crash records, and crash trends. OTS uses data from from SWITRS, Caltrans, California Department of Justice, and the Department of Finance. A number 1 in ranking in a category is the worst performer relative to other peers in the group. This section presents findings from the most recently published OTS rankings, from 2015. Given of the 121 reported crashes in Colma for this study only 46% were included in SWITRS, the OTS ranking for Colma is likely to show Colma performing better among its peers than the Town may actually be performing. OTS rankings are limited to consider crash data from SWITRS.

In 2015, Colma was one of twelve "Group G" towns/cities, which have a population of 1,000 – 2,500 people.

Findings

The Town of Colma has a composite OTS ranking of 12 out of the 12 cities in its grouping from 2015, ranking it the relative best in its category of peer cities. This composite ranking shows improvement over 2013, when the Town was ranked eleventh (out of 12 cities) among peer cities. This composite score, i.e. relative ranking is an aggregate of several rankings and indicates overall traffic safety. However, as noted above, there is an underreporting of crash issue in Colma that is greater than Kittelson has encountered for other jurisdictions. Therefore, actual performance relative to peers could be worse than what is shown in Table 5.

- Based on SWITRS data only, in 2015, the Town of Colma performed better than peer cities per the California OTS composite ranking, and was in the 25th percentile of peer cities in every category.
- From 2013 to 2015, the Town of Colma ranked in the lower third of peer cities in the following:
  - Bicyclist safety (2014)
  - Drivers aged 21-34 under the influence of alcohol (2013)
  - Hit and run (2013 and 2014)

Table 5: Town of Colma California Office of Traffic Safety Rankings

2015 OTS Category	2013 OTS	2014 OTS	2015 OTS
Composite	9/19	13/14	12/12
Total Fatal and Injury	19/19	11/14	11/12
Pedestrians	6/19	8/14	9/12
Pedestrians <15	7/19	8/14	10/12
Pedestrians 65+	18/19	13/14	11/12
Bicyclists	19/19	**2/14**	12/12
Bicyclists <15	14/19	11/14	11/12
Motorcycles	18/19	14/14	12/12
Alcohol Involved	2/19	12/14	12/12
Had Been Drinking, Driver <21	17/19	13/14	12/12
Had Been Drinking, Driver 21-34	**2/19**	14/14	12/12
Speed Related	18/19	13/14	12/12
Nighttime (9:00pm – 2:59am)	9/19	11/14	12/12
Hit and Run	**5/19**	**5/14**	12/12

Source: California Office of Traffic Safety

5.3 STUDY CORRIDOR-SPECIFIC TREND ANALYSIS FINDINGS

This section includes findings and discussion of the study corridor-specific crash trend analysis as it relates to townwide findings.

This section discusses crash trends along the key study corridors and highlights differences between patterns on a specific corridor and the townwide patterns already discussed. The analysis includes the following considerations:

- Crash severity by corridor;
- Crash type by corridor; and
- Crash contributing factor by corridor.

Crash Severity by Corridor

Figure 5 presents corridor findings by crash severity.

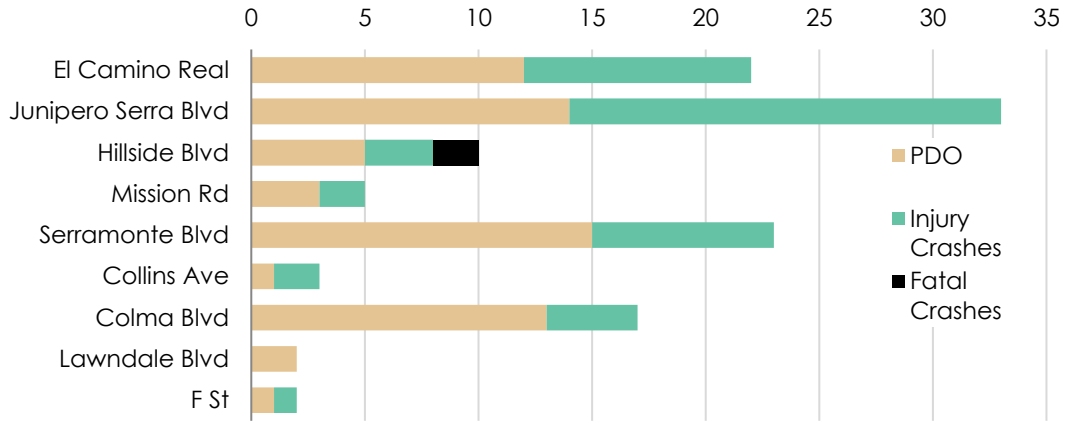


Figure 5: Crash Severity by Corridor, Town of Colma, 2011 - 2016

Source: Town of Colma, SWITRS, Kittelson 2018.

- Fifty-eight percent (58%) of reported crashes on Junipero Serra Boulevard and 50% of reported crashes on Hillside Boulevard resulted in injury, compared to 43% of a townwide reported crashes.

Crash Type by Corridor

Figure 6 presents corridor findings by reported crash type.

- Sixty-five percent (65%) of reported crashes on Colma Boulevard were rear end crashes, compared to 24% townwide.
- Forty percent (40%) of reported crashes on Hillside Boulevard were sideswipe crashes, compared to 21% townwide.

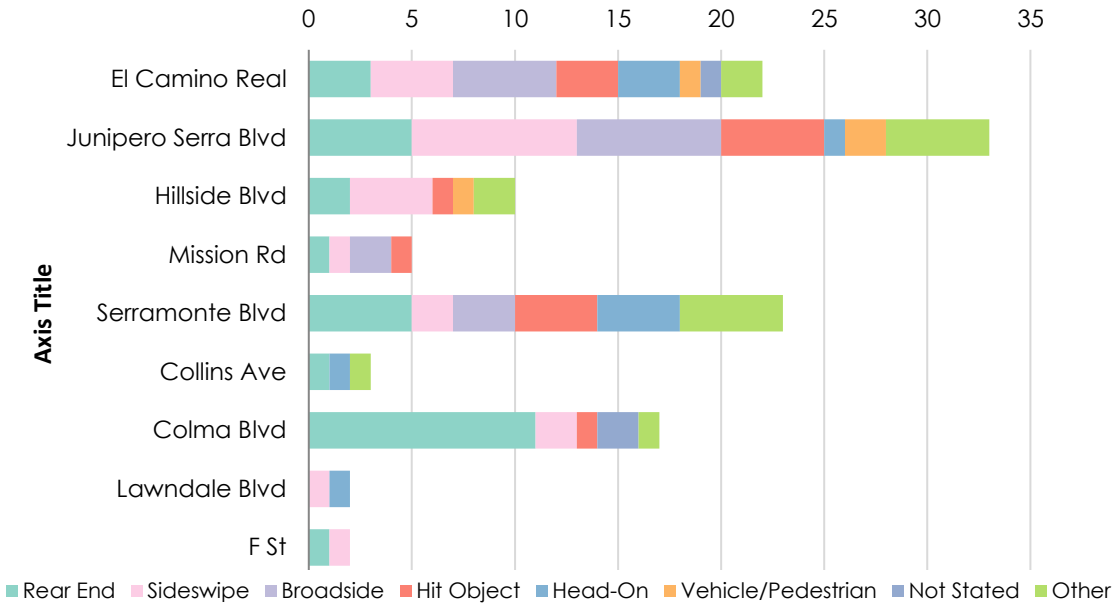


Figure 6: Crash Type by Corridor, Town of Colma, 2011 - 2016

Source: Town of Colma, SWITRS, Kittelson 2018.

Contributing Factor by Corridor

Table 6 presents corridor findings by primary contributing factors.

Table 6: Contributing Factors Rates by Study Corridor

Study Corridor	Reported Primary Collision Factor as Percent of Reported Crashes			
	Driving or Bicycling under the Influence of Alcohol or Drugs	Automobile Right of Way[1]	Unsafe Speed	Improper Turning
Junipero Serra Boulevard (33 crashes)	3%	18%	9%	39%
Serramonte Boulevard (23 crashes)	4%	22%	30%	9%
El Camino Real (22 crashes)	14%	18%	14%	18%
Colma Boulevard (17 crashes)	0%	0%	29%	18%
Hillside Boulevard (10 crashes)	40%	0%	20%	0%
Townwide Trends (121 crashes)	**8%**	**12%**	**19%**	**22%**

[1]*Automobile Right of Way* refers to a crash resulting from one motorist's failure to yield to another motorist who had the right of way.

Note: Corridors with ten or more crashes are included in this comparison. Similarly, the most frequently cited contributing factors townwide are presented. Shaded cells represent considerable deviation from the townwide rate. Source: Town of Colma, SWITRS, Kittelson 2018

- Thirty-nine percent (39%) of reported crashes on Junipero Serra Boulevard included improper turning as the PCF, compared to 22% townwide.
- Thirty percent (30%) of reported crashes on Serramonte Boulevard and 29% of reported crashes on Colma Boulevard were attributed to unsafe speeds. Serramonte Boulevard has a posted speed of 30 miles per hour throughout, and Colma Boulevard has a posted speed of 25 miles per hour.
- Forty percent (40%) of reported crashes on Hillside Boulevard involved a person under the influence of alcohol or drugs, compared to 8% townwide.

Key findings include the following:

- Fifty-eight percent (58%) of reported crashes on Junipero Serra Boulevard and 50% of reported crashes on Hillside Boulevard resulted in injury, compared to a townwide fatal/injury rate of 43%.
- Two reported fatal crashes took place on Hillside Boulevard.
- Sixty-five percent (65%) of reported crashes on Colma Boulevard were rear end crashes, compared to 24% townwide.
- Thirty percent (30%) of reported crashes on Serramonte Boulevard and 29% of reported crashes on Colma Boulevard were attributed to unsafe speeds.

Kittelson identified reported crashes on the study corridors; crashes at an intersection of two corridors were coded as occurring on the reported primary road to avoid double counting. That extraction process yielded 117 crashes, with the highest crash frequencies on the following corridors:

- Junipero Serra Boulevard – 33 reported crashes (27% of total);
- Serramonte Boulevard – 23 reported crashes (19% of total); and,
- El Camino Real – 22 reported crashes (18% of total).

5.4 NETWORK SCREENING AND SYSTEMIC FINDINGS

This section describes the network screening and systemic evaluation of the Town of Colma roadway network.

IN THIS SECTION>>

- Data and approach used for the network screening and systemic analysis
- Identification of potential risk factors and additional locations for consideration.

Data and Approach

Kittelson identified the high-priority safety intersections and roadway segments using the Equivalent Property Damage Only (EPDO) and Crash Rate network screening performance measures from the *Highway Safety Manual* (HSM). The EPDO screening was performed for reported crashes at intersections and along roadway segments. The Crash Rate screening was performed for the roadway segments where vehicle volume data was collected as part of this project. The two performance measures are described below.

Equivalent Property Damage Only

The EPDO performance measure assigns weighting factors to crashes by severity relative to property damage only (PDO) crashes. The weighting factors used for the network screening are based on the crash costs by severity used for Caltrans' Highway Safety Improvement Program Benefit Calculator Tool. The crash costs vary based on the location type: signalized intersection, unsignalized intersection, or roadway. The weights for each crash severity by location type are shown in Table 7.

Table 7: Crash Weights by Severity and Location Type

Location Type	Crash Weights by Severity				
	Fatal	Severe Injury	Other Visible Injury	Complaint of Pain Injury	Property Damage Only
Signalized Intersection	126	126	10.86	6.13	1
Unsignalized Intersection	200	200	10.86	6.13	1
Roadway	173	173	10.86	6.13	1

Source: Caltrans Highway Safety Improvement Program Benefit Calculator Tool, 2016

The weights generally reflect an order of magnitude difference between the societal costs of fatal and severe injury collisions versus non-severe injury collisions. The weighting factors intentionally weigh fatal and severe injuries equally to recognize that the difference between a severe injury crash versus a fatal crash are often more of a function of the individuals involved – therefore, both represent locations where the Town may want to prioritize improvements. The crash weights vary by location type due to the relative costs associated with the crash severity at those location types. Hence, fatal or severe crashes at an unsignalized intersection location result in more persons injured or more severely injured in a fatal or severe injury crash and, as a result, have a higher average cost than at a signalized intersection or roadway location. As a result, unsignalized intersections have higher weights for those severities than the other two location types.

Crash Rate

The crash rate performance measure normalizes the number of crashes relative to traffic volume. This performance measure is calculated by dividing the total number of crashes by the traffic volume, typically measured in crashes per million vehicle miles for segments and for total entering volume for intersections.

Intersection Analysis Methodology

Kittelson first coded reported crashes by severity. Crashes within 250 feet of an intersection were then spatially joined and summarized in ArcGIS to develop the total number of crashes by severity at each intersection.

Where intersections were less than 500 feet from each other, we assigned crashes to the nearest intersection. Crashes occurring more than 250 feet from any intersection were held out for the segment analysis discussed below.

Kittelson calculated the EPDO score for intersections by multiplying each crash severity total by its associated weight (by intersection type) and summing the results, using the following formula:

*EPDO Score = Fatal weight * # of fatal crashes + severe injury weight * # of severe injury crashes + other visible injury weight * # of other visible injury crashes + complaint of pain injury weight * # of complaint of pain injury weight crashes + PDO crashes*

We annualized the EPDO score by dividing the score by the number of years (6) of crash data used in the analysis. Similarly, we determined the crash rate for each by dividing the spatially joined crashes associated with each intersection by the total entering vehicular traffic in the PM peak hour at that location.

Segment Analysis Methodology

Following the approach used for intersection analysis, Kittelson first coded reported crashes by severity using a Python script in ArcGIS. This segmented the Town of Colma street network into one-fourth (1/4) of a mile segments, incrementing the segments by one-tenth (1/8) of a mile. This methodology helps to identify portions of roadways with the greatest potential for safety improvements.

Once the roadway segments were created, the script spatially joined crashes to the corridor segment (excluding those identified with intersections as described above). Similar to the intersection methodology above, we summarized the crashes by severity, and multiplied the totals by the EPDO weights for roadway segments. The weighted crashes were then summed and annualized by dividing the score by the number of years of crash data (6) to generate an annualized EPDO score. Additionally, for the corridors where volume data was available, we calculated crash rates (per million vehicle miles).

Risk Factor Identification

Kittelson applied a risk-based analysis of the top quartile of locations identified through the intersection and roadway segment network screening. Risk is defined in this instance as common traffic or physical characteristics shared by the top quartile of corridors and intersections. Based on this commonality, their presence is indicative of a potentially higher risk for crashes within the Town of Colma[3]. The risk factors will be used during the field visit to confirm the previously identified program areas and assist in identifying treatments to reduce the frequency and severity of crashes within the Town. These risk factors can also be used to identify additional locations where crashes have not yet been reported to make proactive low-cost improvements to those locations to further reduce the potential for future crashes.

Kittelson reviewed the following roadway characteristics for top quartile sites to help determine potential risk factors for intersections and roadway corridors:

- Roadway geometry;
- Number of vehicle lanes;
- Posted speed;
- On-street parking presence;
- Median presence;
- Driveway and curb cut presence;
- Traffic signal locations;

[3] Note: This commonality does not prove causality; it suggests a potential connection or contributing factor.

- Dedicated left- or right-turn lane presence;
- Intersection density (i.e., closely spaced intersections or access points);
- Transit stop presence;
- Intersection geometry (e.g., presence of offset approaches, intersection skew);
- Presence of marked crosswalks; and,
- Street Lighting

The roadway characteristic data was obtained via a combination of data provided by the Town of Colma and SamTrans (e.g., roadway alignment, transit stop location) as well as characteristics identified by field review and review of aerial imagery of the high-scoring segments and intersections (e.g., median presence, posted speed, driveways, on-street parking presence, number of approaches, right- and left-turn lane configuration). The combination of these sources provides a strong basis for determining common characteristics across sites.

Kittelson identified trends that were consistently present across the top locations and could be tied to a roadway characteristic. That characteristic was identified and documented as a risk factor. Segment and intersection potential crash risk factors are discussed in the Findings section.

Findings

Kittelson identified priority intersections and segments using the annualized EPDO scores as well as crash rates for segments where volumes were available. For intersection locations, the EPDO scores ranged from zero (no crashes occurring during the six-year time frame analyzed) to 36.8. For roadway segments, the EPDO scores ranged from zero (no reported crashes occurred during the six-year time frame analyzed) to 61.3.
Figure 7 and Figure 8 show the results of the EPDO scoring by quartile for roadway segment and intersection locations, respectively. Figure 9 shows the crash rate by quartile for roadway corridors where volume data was available. Intersections or segments shown as not falling within one of the quartiles indicates that there were no reported crashes at that location.

Figure 7

Town of Colma
CIP 993 Systemic Safety Analysis Project
Roadway Segment Equivalent PDO Score

KITTELSON & ASSOCIATES

Coordinate System: NAD 1983 StatePlane California III FIPS 0403 Feet
Data Source: Town of Colma, San Mateo County

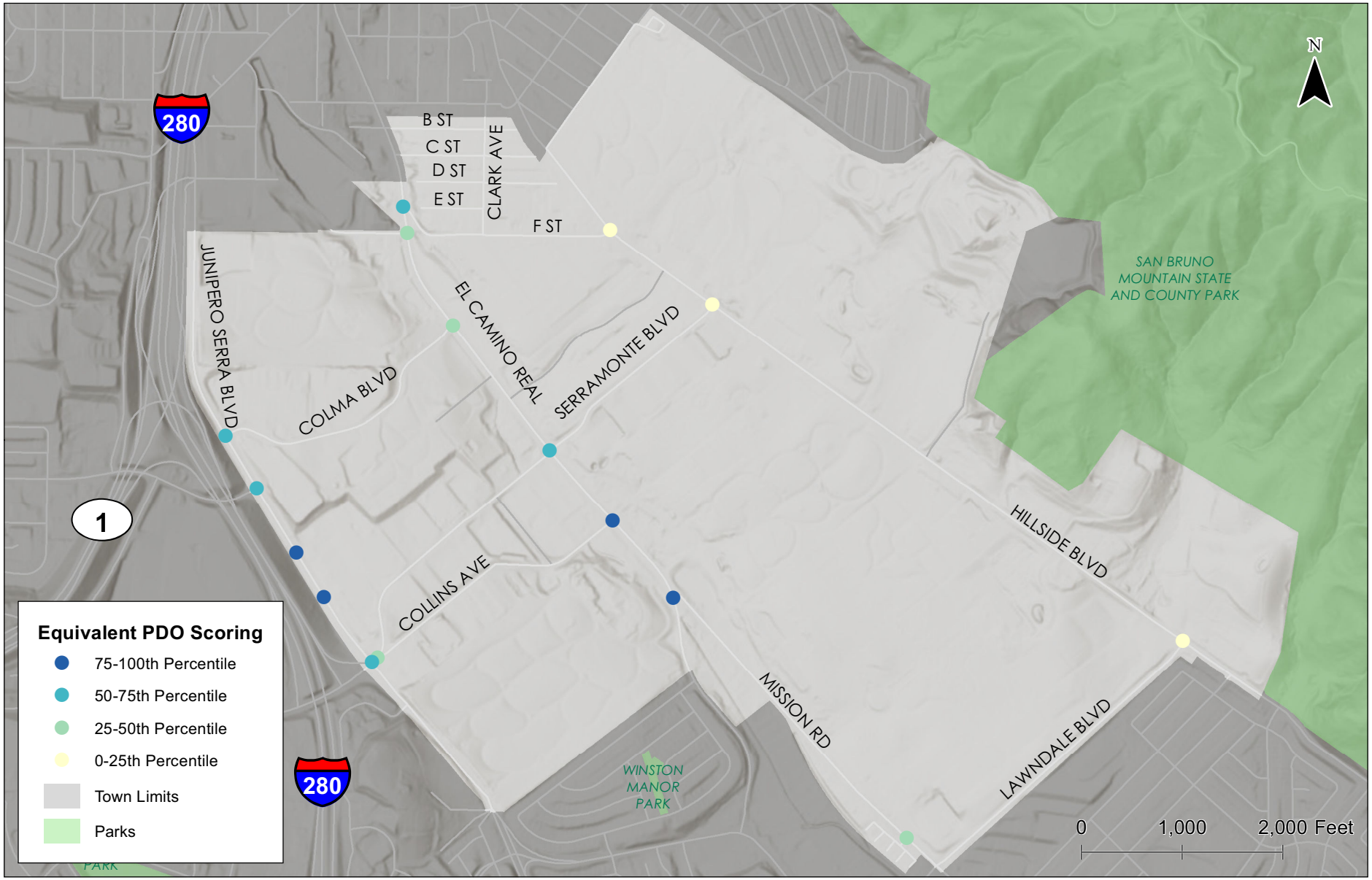


Figure 8

Town of Colma
CIP 993 Systemic Safety Analysis Project
Intersection Equivalent PDO Score

KITTELSON & ASSOCIATES

Coordinate System: NAD 1983 StatePlane California III FIPS 0403 Feet
Data Source: Town of Colma, San Mateo County

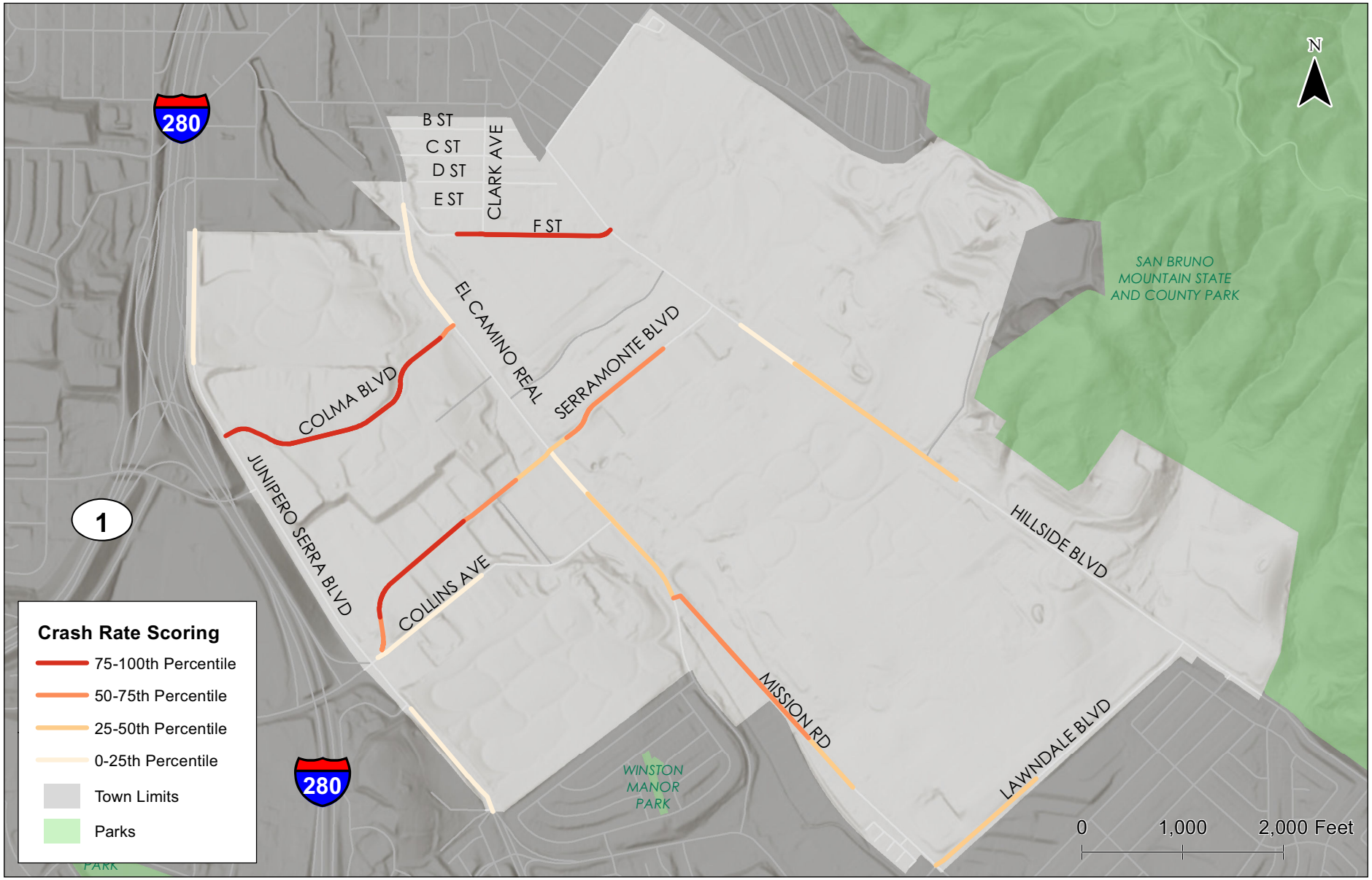


Figure 9

Town of Colma
CIP 993 Systemic Safety Analysis Project
Roadway Segment Crash Rates

KITTELSON & ASSOCIATES

Coordinate System: NAD 1983 StatePlane California III FIPS 0403 Feet
Data Source: Town of Colma, San Mateo County

Roadway Segment Screening Findings

Based on the EPDO scoring results shown in Figure 7, the top quartile of roadway segments with a reported crash history are located on the study corridors identified by the Town of Colma in their SSARP grant application. Table 8 indicates segments that may be considered for safety improvements.

Table 8: Network Screening Segment Results, Ranked

Roadway Segment and Extents	Highest Annualized Equivalent PDO Score Along Segment	Equivalent PDO Percentile Among Segments with Crashes	Crash Rate Percentile Among Segments with Crashes
Hillside Boulevard, Serramonte Boulevard to Sand Hill Road	61.3	Top 25th	Top 75th
Colma Boulevard, Junipero Serra Boulevard to El Camino Real	30.5	Top 25th	Top 25th
Serramonte Boulevard, Junipero Serra Boulevard to Hillside Boulevard	4.62	Top 25th	Top 25th
Collins Avenue, Serramonte Boulevard to Serramonte Ford Body Shop	1.8	Top 50th	Bottom 25th
Mission Road, El Camino Real to Holy Cross Catholic Cemetery	1.2	Top 50th	Top 50th
El Camino Real, northern town limits to Colma Boulevard	1.0	Top 75th	Bottom 25th
Junipero Serra Boulevard, northern town limits to Colma Boulevard	1.0	Top 75th	Bottom 25th
F Street, west of Clark Avenue to Hillside Boulevard	0.2	Bottom 25th	Top 25th
Southern half of Lawndale Boulevard	0.2	Bottom 25th	Top 50th
El Camino Real, Serramonte Boulevard to Mission Road	0.2	Bottom 25th	Top 75th

[1]Traffic volumes not collected for this segment; thus, no crash rate analysis was conducted.

Source: Town of Colma, SWITRS, Kittelson 2018

Roadway Segment Risk Factors

Kittelson identified the following characteristics as risk factors:

- Relatively high density of major access points[4] (greater than 2 per 1,000 feet);
- Undivided roadways; and,
- Horizontally curved roadway segments.

The risk factors identified for intersections and roadway corridors were used as part of the field reviews to help better understand potential contributing factors to crashes and treatments.

Intersection Screening Findings

Based on the EPDO scoring and crash rate results, the top quartile of intersections segments with a reported crash history are located on the study corridors identified by the Town of Colma in their SSARP grant application. Table 9 indicates intersections that may be considered for safety improvements.

[4] Major driveways or access points, as defined by the *Highway Safety Manual*, serve sites with 50 or more parking spaces.

Table 9: Network Screening Intersection Results, ranked

Intersection	Signalized	Annualized Equivalent PDO Score	Equivalent PDO Percentile Among Intersections with Crashes	Crash Rate Percentile Among Intersections with Crashes
Junipero Serra Boulevard & Serra Center (North)	No	36.8	Top 25th	N/A[1]
El Camino Real & Collins Avenue	No	34.5	Top 25th	Top 75th
El Camino Real & Mission Road	No	33.3	Top 25th	Bottom 25th
Junipero Serra Boulevard & Serra Center	Yes	28.3	Top 25th	N/A[1]
El Camino Real & F Street	Yes	24.0	Top 50th	Top 75th
Junipero Serra Boulevard & Serramonte Boulevard	Yes	11.8	Top 50th	Top 25th
El Camino Real & Serramonte Boulevard	Yes	6.0	Top 50th	Top 50th
Junipero Serra Boulevard & Colma Boulevard	Yes	5.3	Top 50th	Top 25th
Junipero Serra Boulevard & Southgate Avenue	Yes	4.8	Top 50th	Top 50th
El Camino Real & Colma Boulevard	Yes	3.6	Top 75th	Bottom 25th
Collins Avenue & Serramonte Boulevard	No	2.0	Top 75th	Bottom 25th
Mission Road & Isabelle Way	No	2.0	Top 75th	N/A[1]
Serramonte Boulevard & Hillside Boulevard	Yes	0.7	Bottom 25th	Top 25th
Hillside Boulevard & F Street	No	0.3	Bottom 25th	Top 50th

[1]Turning movement counts not collected for this intersection; thus, no crash rate analysis was conducted.

Source: Town of Colma, SWITRS, Kittelson 2018

Intersection Risk Factors

Kittelson identified the following risk factors based on roadway characteristics that were consistently present across the top quintile of intersection locations:

- Side-street stop control onto a major (4+ lane) roadway;
- Closely spaced intersections, or intersections close to major access points (under 300 feet); and,
- Complex geometry or horizontally curved roadway segment at an intersection[5].

Summary

Kittelson has identified the following potential roadway segments for further study:

- Hillside Boulevard, Serramonte Boulevard to Sand Hill Road;
- Colma Boulevard, Junipero Serra Boulevard to El Camino Real;

[5]Complex intersections refer to locations with large intersection footprints, atypical approaches, and/or large median islands present for free movements or separating turn lanes from through traffic.

- Serramonte Boulevard, Junipero Serra Boulevard to Hillside Boulevard;
- Collins Avenue, Serramonte Boulevard to the Serramonte Ford Body Shop;
- El Camino Real, northern town limits to Colma Boulevard; and,
- Junipero Serra Boulevard, northern town limits to Colma Boulevard.

Kittelson identified the following potential intersections for further study:

- Junipero Serra Boulevard & Serra Center Entrance (North);
- El Camino Real & Collins Avenue;
- El Camino Real & Mission Road;
- Junipero Serra Boulevard & Serra Center (South);
- El Camino Real & F Street; and,
- Serramonte Boulevard & Junipero Serra Boulevard.

Risk factors identified through analysis of the potential priority locations include:

- Presence of at least two major access points within 1,000 feet;
- Two- and four-lane undivided roadways;
- Horizontally curved roadway segments;
- Side-street stop controlled intersections onto a major roadway;
- Closely spaced intersections and/or access points (under 300 feet); and,
- Complex or curved roadway geometry at intersections (large intersection footprints, atypical approaches, and/or large median islands present for free movements or separating turn lanes from through traffic.).

6.0 HIGHEST OCCURRING CRASH TYPES

6.1 TOP CRASH TYPES

Figure 10 presents findings by crash frequency, severity, and type.

- Seventeen percent (17%) of crash types were either coded with crash type "Other" (including one fatal crash) or were not stated. These crashes were present in both SWITRS and town-provided crash data and relate to crashes that cannot be categorized into the other crash types (shown in the figure above) or do not have enough information to categorize it to a specific crash type.
- Rear end (24%), sideswipe (21%), and broadside crashes (14%) represent the largest shares of reported crash types.
- Broadside crashes (71%), vehicle/pedestrian crashes (67%), and head-on crashes (50%) resulted in the highest proportion of injuries.
- The reported crash types resulting in fatalities were vehicle/pedestrian crashes (1) and "other or not stated"(1) crashes. Severe injury crashes were associated with broadside (2), head-on (1), vehicle/pedestrian (2), and "other or not stated"(1) crash types.

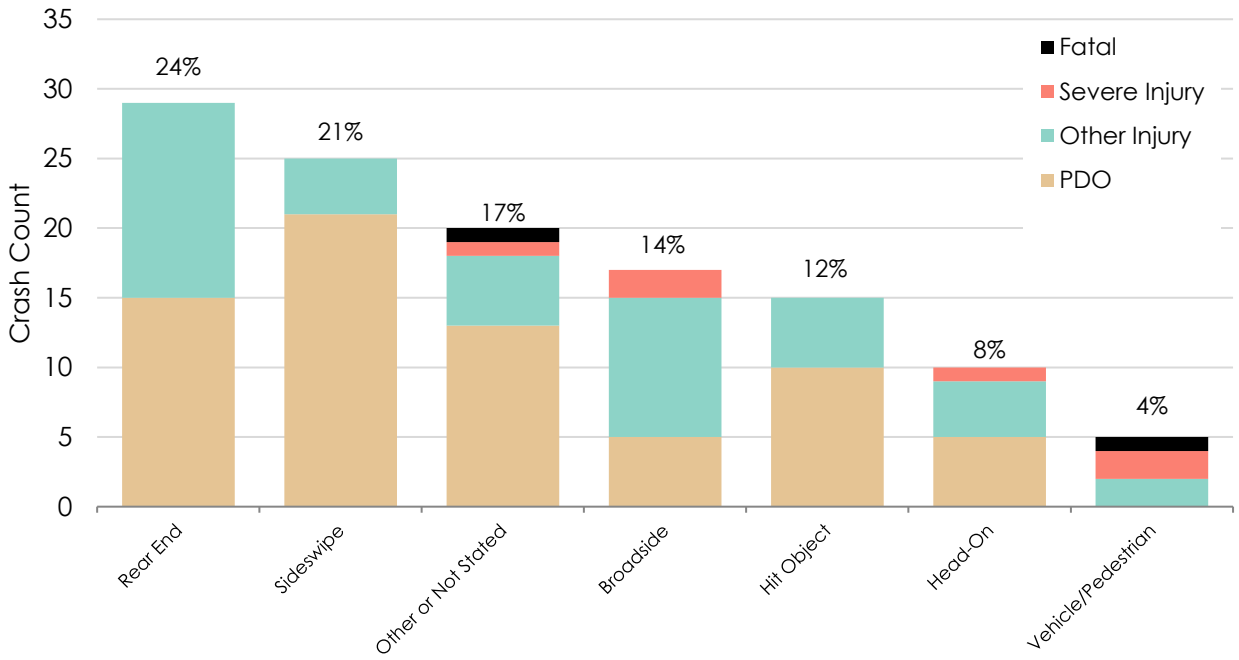


Figure 10: Crashes by Type and Severity, Town of Colma 2011 - 2016

Sources: Town of Colma, SWITRS, Kittelson 2018

6.2 RISK FACTORS

Intersection Risk Factors

Kittelson identified the following risk factors based on roadway characteristics that were consistently present across the top quintile of intersection locations:

- Side-street stop control onto a major (4+ lane) roadway;
- Closely spaced intersections, or intersections close to major access points (under 300 feet); and,
- Complex geometry or horizontally curved roadway segment at an intersection[6].

Roadway Segment Risk Factors

Kittelson identified the following characteristics as risk factors:

- Relatively high density of major access points[7] (greater than 2 per 1,000 feet);
- Undivided roadways; and,
- Horizontally curved roadway segments.

The risk factors identified for intersections and roadway corridors were used as part of the field reviews to help better understand potential contributing factors to crashes and treatments.

[6]Complex intersections refer to locations with large intersection footprints, atypical approaches, and/or large median islands present for free movements or separating turn lanes from through traffic.

[7] Major driveways or access points, as defined by the *Highway Safety Manual*, serve sites with 50 or more parking spaces.

7.0 HIGH-RISK CORRIDORS AND INTERSECTIONS (CRASH HISTORY AND ROADWAY CHARACTERISTICS)

7.1 HIGH RISK CORRIDORS

This section discusses the high-risk corridors and intersections based on crash history and roadway characteristics. The following segments were identified as the priority locations (i.e., high risk locations):

- Hillside Boulevard, Serramonte Boulevard to Sand Hill Road;
- Colma Boulevard, Junipero Serra Boulevard to El Camino Real;
- Serramonte Boulevard, Junipero Serra Boulevard to Hillside Boulevard;
- Collins Avenue, Serramonte Boulevard to the Serramonte Ford Body Shop;
- El Camino Real, northern town limits to Colma Boulevard; and,
- Junipero Serra Boulevard, northern town limits to Colma Boulevard.

7.2 HIGH RISK INTERSECTIONS

Kittelson identified the following intersections as the priority locations (i.e., high risk locations). The intersections **in bold** are located along a segment above:

- Junipero Serra Boulevard & Serra Center Entrance (North);
- El Camino Real & Collins Avenue;
- El Camino Real & Mission Road;
- Junipero Serra Boulevard & Serra Center (South);
- **El Camino Real & F Street**; and,
- **Serramonte Boulevard & Junipero Serra Boulevard**.

The high risk corridors and intersections are shown in Figure 11.

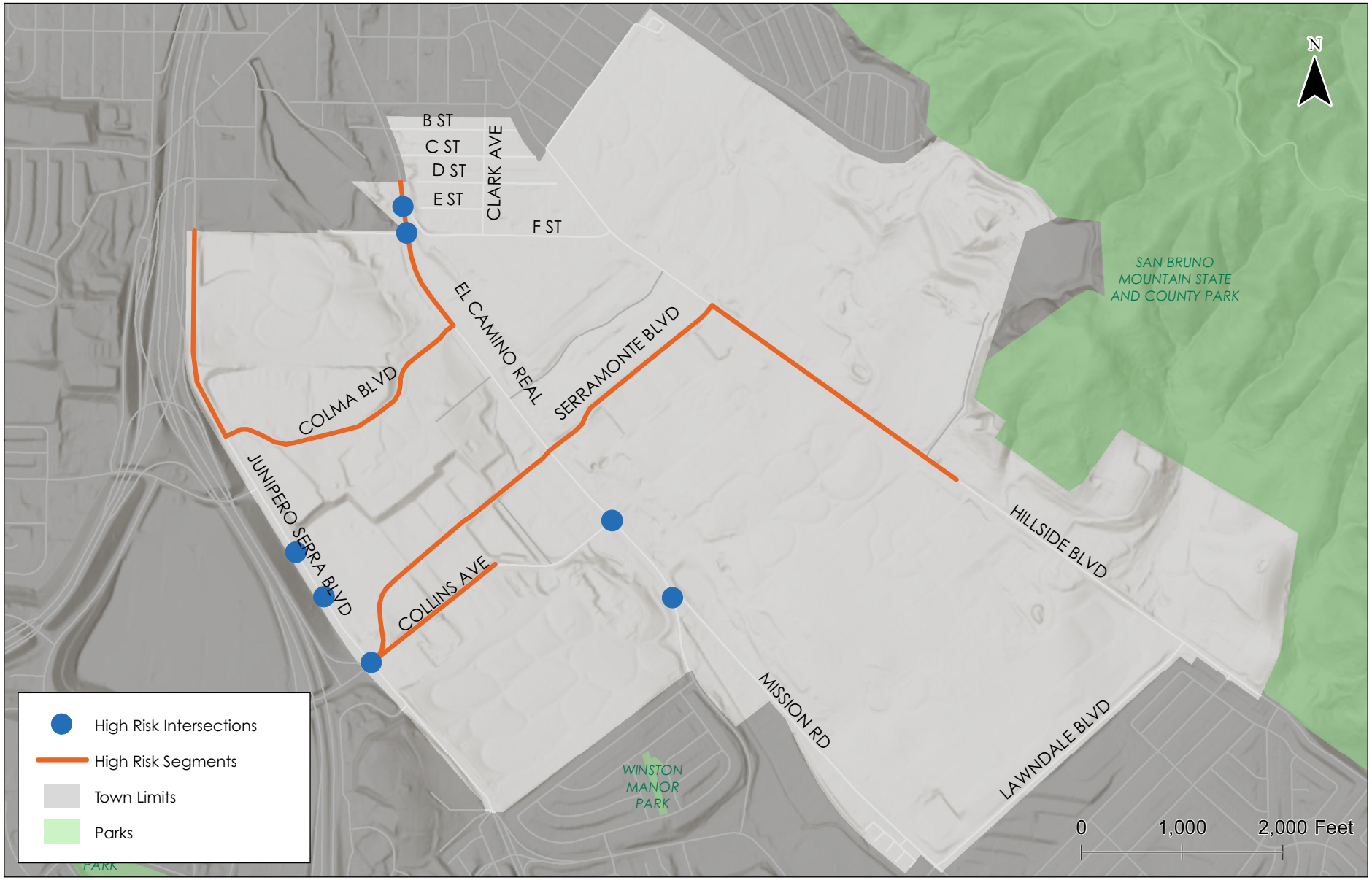


Figure 11

Town of Colma
CIP 993 Systemic Safety Analysis Project
High Risk Corridors and Intersections

KITTELSON & ASSOCIATES

Coordinate System: NAD 1983 StatePlane California III FIPS 0403 Feet
Data Source: Town of Colma, San Mateo County

8.0 COUNTERMEASURES IDENTIFIED TO ADDRESS THE SAFETY ISSUES

This section summarizes the systemic treatments that could be implemented across the Town, potential location-specific projects, roadway safety-related policies the Town could adopt, and education and enforcement strategies that could complement engineering projects to reduce severe crashes and crash risk. The countermeasures are identified based on the corroboration between field observations and crash data analysis. The crash reduction factors associated with the countermeasures are also specified in this section, to provide a quantitative safety improvement related to each countermeasure.

The following sub-sections summarize the study corridors; systemic treatments identified for Colma; location-specific improvements; roadway safety related policies; and education and enforcement strategies.

8.1 STUDY CORRIDORS FIELD REVIEW

Kittelson performed field reviews for the study corridors identified below. The field reviews were informed by the crash and roadway data analysis conducted in January 2018.
Study corridors:

- El Camino Real (State Highway 82);
- Junipero Serra Boulevard;
- Hillside Boulevard ;
- Mission Road;
- Serramonte Boulevard;
- Collins Avenue;
- Colma Boulevard;
- Lawndale Boulevard; and
- F Street.

Kittelson also conducted field visits at the following intersections, in addition to the above corridors:

- Junipero Serra Boulevard & Serra Center Entrance (North);
- Junipero Serra Boulevard & Serra Center Entrance (South);
- El Camino Real & Collins Avenue;
- El Camino Real & Mission Road;
- El Camino Real & F Street;
- Serramonte Boulevard & Junipero Serra Boulevard; and
- Serramonte Boulevard & Collins Avenue.

Systemic Treatments

Based on the systemic safety analysis approach outlined by Federal Highway Administration (FHWA) and field reviews to priority locations, Kittelson identified the following systemic treatments as those most likely to help reduce crash frequency and/or severity. Table 10 provides a summary of the systemic treatments, planning-level cost range, and potential safety effectiveness of the treatment in the form of crash modification factor (CMF).

KEY TERMS>>

- **Systemic Treatments –** Treatments that could be implemented at locations across the Town with similar physical characteristics and regardless of crash history. Implementing such treatments in a proactive manner could help further reduce crashes in the future.
- **Location-Specific Projects –** Potential projects, unique to specific locations that are intended reduce the likelihood of crashes.
- **Roadway Safety Related Policies –** Potential new policies the Town of Colma could adopt to further support reducing the frequency and/or severity of crashes
- **Education and Enforcement Strategies –** Non-engineering strategies targeting road user education and/or enforcement of traffic laws to help reduce the likelihood of risky road user behavior and related crashes.

Table 10: Summary of the Systemic Treatments and the Related Information

Caltrans LRSM[8] ID	Treatment	Cost Range	Year, and Source for Costs	CMF [Percent Crash Reduction]		Eligibility for Federal Funding
				National Research	Caltrans LRSM	
	At Signalized Intersections					
S8	a) Intersection Pavement Marking Delineation	$1.50 - $2.00 per linear foot	2018, Town of Colma	0.55 - 0.82 [18% - 45%]	0.90 [10%]	100%
S2	b) Backplates with Retroreflective Borders	$6,000 - $12,000 (per intersection)	2014, Virginia DOT	0.85 [15%]	0.85 [15%]	100%
NA.	c) Green Pavement Markings for Bicycle-Vehicle Conflicts	$5 - $10 per square foot	2018, Town of Colma	NA.	NA.	No
NA.	d) Leading Pedestrian Intervals at Traffic Signals	$1,000 - $2,000	2017, City of Oakland, Pedestrian Master Plan	0.41 [59%] for ped-veh crashes	NA.	100%
NA.	e) No Right-Turn on Red	$500 - $5000 (per approach)	2017, City of Oakland, Pedestrian Master Plan	NA.	NA.	No
	At unsignalized intersections and roadway segments					
	f) Enhanced Pedestrian Crossings					
NS17	High Visibility Markings	$2,000 - $8,000	2018, Town of Colma	0.81 [19%]	0.75 [25%]	100%
NS16	Pedestrian Refuge Island	$15,000 - $25,000	2017, City of Oakland, Pedestrian Master Plan 2017, Virginia DOT	0.74 [26%]	0.55 [45%]	90%
NS17	Pedestrian Crossing Warning Signs	$450-$1,020		NA.	0.75 [25%]	100%
NS8	Flashing Beacons	$15,000 - $40,000		NA.	0.70 [30%]	100%
NA.	Blinker Beacons	NA.	2018, Town of Colma NA.	NA.	NA.	No

[8] Caltrans Local Road Safety Manual

Caltrans LRSM[8] ID	Treatment	Cost Range	Year, and Source for Costs	CMF [Percent Crash Reduction]		Eligibility for Federal Funding
				National Research	Caltrans LRSM	
NA.	g) Pedestrian Hybrid Beacons (PHB) at Uncontrolled Marked Crossings	$75,000 - $150,000	2018, Town of Colma	0.43 [57%] for ped-veh crashes 0.88 [12%] for veh-veh crashes	NA.	No
R37	h) Sidewalks	$15 - $20 per square foot	2018, Town of Colma	NA.	0.20 [80%]	90%
R36	i) Bicycle Lanes (Class II)	$10 - $15 per linear foot	2018, Town of Colma	0.40 [60%] for ped-veh crashes 0.73 [27%] for veh-veh crashes	0.65 [35%]	90%
R30	j) Speed Feedback Signs	$2,000 - $11,000	2014, Hallmark & Hawkins	0.93 – 0.95 [5% - 7%]	0.70 [30%]	100%
NS10	k) Sight Distance Improvements	Varies	NA.	0.44 – 0.89 [11% - 56%]	0.80 [20%]	90%
R15	l) Road Diets (Roadway Reconfiguration)	$6- $10 per linear foot (changes to pavement marking only)	2018, Town of Colma	0.53 – 0.71 [29% - 47%]	0.70 [30%]	90%
R32	m) Road Segment Edgelines	$1.50 - $2.00 per linear foot	2018, Town of Colma	0.55 [45%]	0.75 [25%]	100%
NA.	n) Upgrade Street Name Signs	$750 - $1,250 per sign	2018, Town of Colma	0.98 [2%]	NA.	No
NA.	o) Gateway Treatments	Varies	NA.	NA.	NA.	No
NS5	p) Upgrade Regulatory and Warning Signs	$450 - $1,020 (per sign)	2017 Virginia DOT	0.66 – 0.70 [30% - 34%]	0.85 [15%]	100%
NA.	q) Access Management	Varies	NA.	0.93 [7%]	NA.	No
NS1/R1	r) Street Lighting	$5,000 - $10,000	2018, Town of Colma	0.63 [37%]	0.60 – 0.65 [35% - 40%]	100%

Location-Specific Projects

Kittelson identified the following locations and corresponding potential unique, projects as a means to further help reduce the potential for crash frequency and/or severity. Some of the locations also were identified as candidates to receive one or more of the systemic treatments. These locations were identified for additional location-specific projects because either the existing geometry and/or crash patterns indicated a greater potential for safety improvement if investment beyond the systemic treatments were made. The list of locations and brief explanation of the potential location-specific projects is provided below.

a. Intersection control evaluation at Mission Road/El Camino Real intersection;
b. Reconfiguring roadway cross-section on Hillside Boulevard from Serramonte Boulevard/Hillside Boulevard Intersection to Hillside Boulevard/Lawndale Boulevard Intersection;
c. Consistency in All Way Stop Control on Colma Boulevard;
d. Reconfiguring Junipero Serra Boulevard/Serramonte Boulevard Intersection;
e. Reconfiguring Serramonte Boulevard/Collins Avenue Intersection; and
f. Intersection control evaluation at Collins Avenue/El Camino Real intersection.

Safety Policies, Education & Enforcement Strategies

The following summarizes potential roadway related safety policies, education and enforcement strategies identified to complement and support the systemic treatments and location-specific projects.

Roadway Safety Related Policies

Kittelson previously reviewed the existing Town policies as part of a broader Document Review Memorandum. Based on that review as well as the results from the crash and roadway data analysis findings, we recommend the Town consider developing and adopting a Vision Zero policy. The purpose of such a policy is to serve as a call for action and enable collaboration across Town functions.

Education Strategies

Education strategies are focused on teaching road users traffic safety. The Town could apply for grants to help develop the content for these strategies. There are also materials readily available and distributed for free through national resources such as the National Highway Traffic Safety Administration (NHTSA). Some of these resources include interactive activities, teaching notes, and information on road safety messages and concepts that can be taught at school or in the off-school activities. The recommended strategies are as follows:

- Road Safety Education to Children;
- Speed Monitoring Awareness Radar Trailer; and
- Vulnerable Road User Education.

Enforcement Strategies

Kittelson recommends the enhanced police enforcement be deployed on roadway segments with speeding-related crashes and driving under the influence of alcohol related crashes at the specific locations and during the recurring time periods identified from the crash data. The strategies recommended are as follows:

- Enhanced Police Enforcement;
- Photo Enforcement; and
- Speed Survey and Enforcement Campaigns.

8.2 SYSTEMIC TREATMENTS

IN THIS SECTION>>

- Description of systemic treatments
- Potential locations for systemic treatments to be implemented

The following presents the systemic treatments identified for the Town of Colma. These treatments were selected based on the crash patterns and trends from the systemic safety analysis, observations from field reviews, and professional resources such as the Caltrans Local Road Safety Manual, American Association of State Highway and Transportation Officials (AASHTO), the California Manual on Uniform Traffic Control Devices (CA MUTCD), and the National Association of City Transportation Officials (NACTO) regarding systemic safety. Some treatments are inexpensive retrofits, pavement markings, and signage that can be changed and quickly implemented. Some require greater study, coordination, and funding. Some of these countermeasures have been studied and/or researched extensively and have an associated crash modification factor (CMF).

The first section below discusses each systemic treatment, describing the treatment, the types of locations it is intended to be used at, and why it was selected for the Town of Colma. The following section identifies locations within the Town of Colma where each systemic treatment could be implemented.

KEY TERM>>

- Crash Modification Factor (CMF): This is a numerical value that indicates how effective a treatment is at reducing crashes.
- CMF Clearing House: This is a comprehensive and searchable online database of CMFs along with guidance and resources on using CMFs in road safety studies.
- When a CMF value is available for a treatment, it is noted below. Following that value in [brackets] is the corresponding estimated percent reduction in crashes.
- Crash Reduction Factor (CRF): This is the percentage crash reduction that might be expected after implementing a given treatment.

a) Intersection Pavement Marking Delineation (S8)

Planning-Level Cost Estimate: $1.50 - $2.00 per linear foot (Town of Colma, 2018).

Eligible for Federal Funding (Source: Caltrans Road Safety Manual): Yes (100%)

Potential Effectiveness at Reducing Crash Frequency and/or Severity: CMF = 0.55 – 0.82 [18% - 45% crash reduction] (CMF Clearing House, 2018).

Brief Description: This treatment accentuates traffic lines, pavement markings, and channelization used to direct traffic on the roadway. Kittelson proposes this treatment in places where intersections having multiple adjacent turning lanes, more than four legs, and/or are skewed. Pavement marking delineation can help guide motorists to choose and stay in the proper lane and can also be used to visually narrow the lane in support of reduced speeds. An example of the treatment is shown in Figure 12.

Figure 12: Example of Marking Delineation

Why was this selected for Town of Colma?
This treatment was selected for the Town of Colma for the wide, complex intersections with multiple adjacent turn lanes (e.g., Junipero Serra Boulevard). Installing this treatment at these intersections will help guide drivers into the appropriate lane in the through and turning movement maneuvers.

b) Backplates with Retroreflective Borders (S2)

Planning-Level Cost Estimate: $6,000 - $12,000 per intersection (VDOT, 2018).

Eligible for Federal Funding (*Source: Caltrans Road Safety Manual*): Yes (100%)

Potential Effectiveness at Reducing Crash Frequency and/or Severity: CMF = 0.85 [15% crash reduction] (CMF Clearing House, 2018).

Brief Description: This treatment improves the visibility of the illuminated face of the signal by introducing a controlled-contrast background. Signal heads with backplates equipped with retroreflective borders are more visible in daytime and nighttime conditions. This treatment is more effective when it is adopted as a standard treatment for signalized intersections across the town or jurisdiction (FHWA, 2018). Kittelson proposes this treatment to improve the visibility during the daytime (to help address glare from the sunlight) as well as nighttime. An example of the treatment is shown in Figure 13.

Figure13: Example of Signal Backplate with a Retroreflective Border
Source: (FHWA, 2018).

Why was this selected for Town of Colma?
This treatment was selected for the Town of Colma to help improve visibility of traffic signal heads particularly for motorists traveling through the larger signalized intersections where the distance across the intersection to view the signal head is greater. The retroreflective backplates are intended to help reduce drivers' unintentional running of red lights, and other violations of traffic signals.

c) Green Pavement Markings for Bicycle-Vehicle Conflicts

Planning-Level Cost Estimate: $5 - $10 per square foot (Town of Colma, 2018).

Eligible for Federal Funding (*Source: Caltrans Road Safety Manual*): No

Potential Effectiveness at Reducing Crash Frequency and/or Severity: NA.

Brief Description: This treatment places the green pavement markings in 'conflict zones' where motor vehicles cross the bicycle lanes to move into dedicated right-turn lanes at intersections. This treatment makes the driver aware of the bicyclists on the road at the intersection. An example of this treatment is shown in Figure 14.

Figure 14: Example of Green Pavement Markings
Source: (City of Milwaukee, 2018).

Why was this selected for Town of Colma?
This treatment was selected for the Town of Colma at intersections where motorists need to cross the bicycle lane to enter a right-turn lane. This treatment improves the visibility of bicycle lanes, helps raise motorists' awareness of potential bicyclists, and makes clear to bicyclists where they are expected to be at an intersection.

d) Leading Pedestrian Intervals at Traffic Signals

Planning-Level Cost Estimate: $1,000 - $2,000 (City of Oakland, 2017).

Eligible for Federal Funding (*Source: Caltrans Road Safety Manual*): Yes (100%)

Potential Effectiveness at Reducing Crash Frequency and/or Severity: CMF = 0.41 [59% crash reduction] for pedestrian-vehicle crashes (CMF Clearinghouse, 2018).

Brief Description: This treatment typically gives pedestrians a 3 to 7 second head start when crossing an intersection. The pedestrian "Walk" sign is giving in advance of the motorists green signal in the same direction of travel. The intent is to allow pedestrians to start crossing the intersection in advance of allowing motorists to turn; this makes pedestrians more visible to turning motorists to help avoid turning vehicles – pedestrian crashes. An example of this treatment is shown in Figure 15.

Figure 15: Example of Leading Pedestrian Interval
Source: Kittelson & Associates, Inc.

Why was this selected for Town of Colma?

This treatment was selected for the Town of Colma signalized intersections particularly at use near transit stops and intersections with multiple vehicle-turn lanes. This treatment enhances the visibility of pedestrians at intersections and reinforces their right-of-way over turning vehicles.

e) No Right-Turn on Red

Planning-Level Cost Estimate: $500 - $5000 (per approach) (City of Oakland, 2017).

Eligible for Federal Funding (*Source: Caltrans Road Safety Manual*): No

Potential Effectiveness at Reducing Crash Frequency and/or Severity: NA.

Figure 16: Example of No Right-Turn on Red
Source: (Flickr, 2018).

Brief Description: This treatment prohibits vehicles from turning right when pedestrians have the right-of-way to cross the adjacent street. In combination with thoughtful signal phasing, this can reduce or eliminate the conflict of turning-vehicles and pedestrians crossing the street. An example of an intersection with right-turn on red prohibited is shown in Figure 16. The no right-turn on red is a dynamic restriction that occurs only when the pedestrian push button is activated.

Why was this selected for Town of Colma?

This treatment was selected to reduce the number of motorists turning right into the path of people crossing the street. This was recommended in areas where the drivers have been observed and reported as not yielding.

f) Enhanced Pedestrian Crossings (NS8, NS16, NS17)

Planning-Level Cost Estimate:

High visibility markings	$2,000 - $8,000 (Town of Colma, 2018)
Pedestrian refuge island	$15,000 - $25,000 (City of Oakland, 2017)
Pedestrian crossing warning signs	$450 - $1,020 per sign, assuming 7' sign post (VDOT, 2018)
Flashing beacons	$15,000 - $40,000 (Town of Colma, 2018)
Blinker beacons	NA.

Eligible for Federal Funding (*Source: Caltrans Road Safety Manual*): Yes (90%,100%).

Potential Effectiveness at Reducing Crash Frequency and/or Severity: CMF = 0.74 – 0.81 [19% - 26% crash reduction] (CMF Clearing House, 2018); (City of Bristol, 2018).

Brief Description: Enhanced pedestrian crossing treatments are for uncontrolled, marked crosswalks that cross multilane arterials or collectors. The enhanced crossing alerts the drivers of crossing pedestrian by way of high visibility markings, warning signs, flashing beacons, and by providing pedestrian refuge islands. The pedestrian refuge island allows people to cross in two stages – the first stage looking for a safe gap in traffic or vehicles to yield in one direction and then the second stage to look for a safe gap in traffic or vehicles to yield in the other direction. An example of the treatment is shown in Figure 17.

Why was this selected for Town of Colma?

There are several multilane streets within Colma along which there are transit stops and other pedestrian origins/destinations. Enhanced pedestrian crossings at such locations can help increase motorists' yielding behavior and reduce the risk of pedestrian-vehicle crashes.

Figure 17: Example of Enhanced Pedestrian Crossing

Source: (NACTO, 2013).

g) Pedestrian Hybrid Beacons

Planning-Level Cost Estimate: $75,000 - $150,000 (Town of Colma, 2018).

Eligible for Federal Funding (*Source: Caltrans Road Safety Manual*): No

Potential Effectiveness at Reducing Crash Frequency and/or Severity: CMF = 0.43 [57% crash reduction] for pedestrian-vehicle crashes and CMF = 0.88 [12% crash reduction] for vehicle-vehicle crashes (CMF Clearinghouse, 2018)

Brief Description: This treatment is designed to help pedestrians safely cross multilane streets and/or higher-speed roadways at uncontrolled, marked crosswalks. The beacon head consists of three lenses. The beacon is activated by pedestrians wanting to cross the street. Once pedestrian has crossed the street, the hybrid beacon turns dark. An example of pedestrian hybrid beacon mounted on a mast arm is shown in Figure 18.

Figure 18: Example of a Pedestrian Hybrid Beacon Mounted on a Mast Arm

Source: (FHWA, 2015).

Why was this selected for Town of Colma?

There are two marked, uncontrolled pedestrian crosswalks across El Camino Real which is a multilane roadway with higher vehicle speeds. Kittelson recommends implementing at Pedestrian Hybrid Beacon at those two locations. The Town could also consider them for other locations with similar characteristics.

h) Install Sidewalks (R37)

Planning-Level Cost Estimate: $15 - $20 per square foot (Town of Colma, 2018).

Eligible for Federal Funding (Source: Caltrans Road Safety Manual): Yes (90%).

Potential Effectiveness at Reducing Crash Frequency and/or Severity: CMF = 0.20 [80%].

Brief Description: This treatment provides a separate, protected space for pedestrians to walk along the roadway. It helps to increase comfort, increase visibility of pedestrians to motorists, and can help prevent vehicles from departing the roadway and striking pedestrians. An example sidewalk is shown in Figure 19.

Why was this selected for Town of Colma?

This treatment was selected for the Town of Colma along the corridors on one side or both sides where there sidewalk facilities are not present, and there is a greater potential for or existing pedestrian activity.

Figure 19: Example of Sidewalk along Corridor

i) Install Bicycle Lanes [Class II] (R36)

Planning-Level Cost Estimate: $10 - $15 per linear foot (Town of Colma, 2018).

Eligible for Federal Funding (Source: Caltrans Road Safety Manual): Yes (90%).

Potential Effectiveness at Reducing Crash Frequency and/or Severity: CMF = 0.40 – 0.73 [27% - 60% crash reduction] (CMF Clearing House, 2018).

Brief Description: This treatment defines specific space within the street cross-section for bicyclists. It can increase driver awareness of the bicyclists along a street. An example bicycle lane is shown in Figure 20.

Why was this selected for Town of Colma?

To address gaps in bicycle facilities within Colma. Larger streets, with multiple vehicle lanes, should consider buffered bicycle lanes, separated bicycle lanes, or parallel multiuse paths. These could be implemented through road diets (see treatment "m" further below).

Figure 20: Example of Bike Lane on the Roadway

j) Speed Feedback Signs (R30)

Planning-Level Cost Estimate: $2,000 - $11,000 per sign (Hallmark & Hawkins, 2014).

Eligible for Federal Funding (Source: Caltrans Road Safety Manual): Yes (100%).

Potential Effectiveness at Reducing Crash Frequency and/or Severity: CMF = 0.93 – 0.95 [5% - 7% crash reduction] (CMF Clearing House, 2018).

Brief Description: This treatment is designed to provide a message to drivers exceeding a certain speed threshold. They are also known as dynamic warning signs, radar speed/message signs, and dynamic speed display signs. An example speed feedback sign is shown in Figure 21.

Figure 21: Example of a Speed Feedback Sign
Source: http://images.policemag.com/articles/M-TrafficEnforcement.jpg

Why was this selected for Town of Colma?
Colma has several multilane streets that appear designed for peak shopping hours on the weekend. Throughout much of the weekday and other off-peak periods, the multilane streets enable motorists to travel speeds exceeding the speed limit. This is one of several systemic treatments identified to try to manage speeds during off-peak periods.

k) Sight Distance Improvements (NS10)

Planning-Level Cost Estimate: Varies

Eligible for Federal Funding (Source: Caltrans Road Safety Manual): Yes (90%).

Potential Effectiveness at Reducing Crash Frequency and/or Severity: CMF = 0.44 – 0.89 [11% - 56% crash reduction] (CMF Clearing House, 2018).

Brief Description: Sight distance improvements can often be achieved by clearing sight triangles to restore sight distance obstructed by vegetation, roadside appurtenances, buildings, bus stations, and other objects which are in the right-of-way. The other strategy to improve sight distance is to eliminate on-street parking that restricts sight distance especially on approach to or adjacent to intersections. Figure 22 is an example of a sight triangle for an intersection.

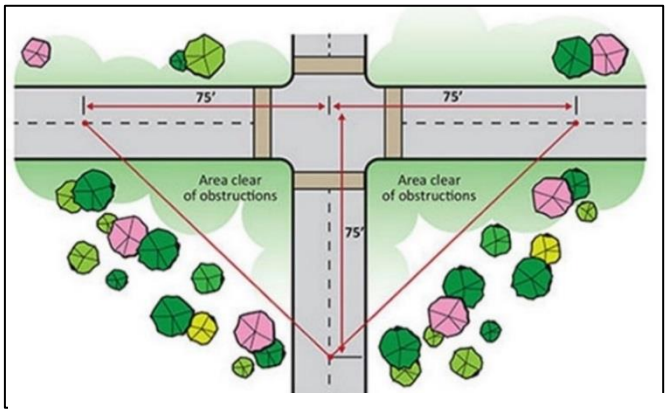


Figure 22: Example of Intersection Sight Distance
Source: http://www.mikeontraffic.com/sight-distance-explained/

Why was this selected for Town of Colma?
This treatment was selected for the Town of Colma based on community comments and Kittelson field observations that some locations within Colma may be easier for road users to navigate if sight distance was increased.

l) Road Diets (R15)

Planning-Level Cost Estimate: $6 - $10 per linear foot (changes to pavement marking only) (Town of Colma, 2018).

Eligible for Federal Funding (*Source: Caltrans Road Safety Manual*): Yes (90%).

Potential Effectiveness at Reducing Crash Frequency and/or Severity: CMF = 0.53 – 0.71 [29% - 47% crash reduction] (CMF Clearing House, 2018).

Brief Description: Reduce the number of vehicle lanes on a roadway to manage vehicle speeds and reduce risk of crashes for all road users. A common road diet is to convert a four-lane undivided roadway to a three-lane cross-section, with one lane in each direction and a two-way center left turn lane. This enables space for bicycle lanes and sidewalks. An example three-lane cross-section, i.e. road diet is shown in Figure 23.

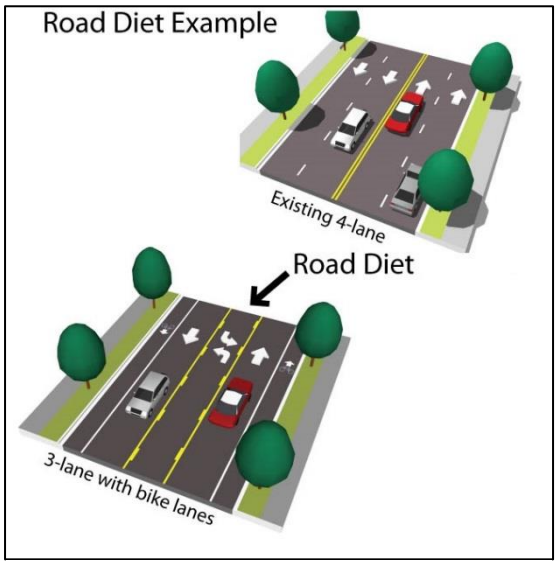


Figure 23: Road Diet Example

Why was this selected for Town of Colma?

Colma has several multilane streets that appear designed for peak shopping hours on the weekend. Throughout much of the weekday and other off-peak periods, the multilane streets enable motorists to travel speeds exceeding the speed limit. This is one of several systemic treatments identified that would reduce motorists' speeds, provide additional space for bicyclists and/or pedestrians, and help provide vehicular access for turning into and out of commercial and business driveways along streets such as Colma Boulevard and Serramonte Boulevard.

The resulting benefits of road diets include a crash frequency and/or severity reduction, reduced vehicle speed differential, improved mobility and access for all types of users, and integration of roadway into surrounding uses that enhance the quality of life of people living in the community.

m) Road Segment Edgelines (R32)

Planning-Level Cost Estimate: $1.50 - $2.00 per linear foot (Town of Colma, 2018).

Eligible for Federal Funding (Source: Caltrans Road Safety Manual): Yes (100%)

Potential Effectiveness at Reducing Crash Frequency and/or Severity: CMF = 0.55 [45% crash reduction] (CMF Clearing House, 2018).

Brief Description: This treatment involves installing/marking the edge lines of the roadway along the corridors. Kittelson proposes this treatment in places where the lanes are wide and edge lines can help narrow the travel lanes in support of reduced speeds. An example of the treatment is shown in Figure 24.

Figure 24: Example of Edgelines

Why was this selected for Town of Colma?

This treatment was selected for the Town of Colma to help manage vehicle speeds on roadways throughout the Town.

n) Upgrade Street name Signs

Planning-Level Cost Estimate: $750 - $1,250 per sign, assuming 10' long and 2' tall on average (Town of Colma, 2018).

Eligible for Federal Funding (*Source: Caltrans Road Safety Manual*): No

Potential Effectiveness at Reducing Crash Frequency and/or Severity: CMF = 0.98 [2% crash reduction] (CMF Clearing House, 2018).

Brief Description: At intersections with multiple lanes coming together across the two intersecting streets, larger street name signs posted on mast arms help improve wayfinding. An example of larger street name signs for such contexts is shown in Figure 25.

Why was this selected for Town of Colma?
Given some of the large intersections, increased street names could help ease wayfinding for road users.

Figure 25: Example of Larger Street Name Sign
Source: City of Windsor, Ontario

o) Gateway Treatments

Planning-Level Cost Estimate: Varies

Eligible for Federal Funding (*Source: Caltrans Road Safety Manual*): No

Potential Effectiveness at Reducing Crash Frequency and/or Severity: NA.

Brief Description: This treatment involves applying the gateway treatments to the Town at the entrance and exits, i.e. boundaries and is intended to mark the transition to the town. An example gateway treatment is shown in Figure 26.

Why was this selected for Town of Colma?
There are a number of entry points to Colma along major arterials. This treatment was selected as an example of potential scale of such gateways given the scale of the roadways providing access to Colma.

Figure 26: Example Gateway Treatment
Source: City of Rochester, NY

p) Upgrade Stop Signs, Warning and Regulatory Signs (NS5)

Planning-Level Cost Estimate: $450 - $1,020 per sign, assuming 7' sign post (VDOT, 2018).

Eligible for Federal Funding (*Source: Caltrans Road Safety Manual*): Yes (100%)

Potential Effectiveness at Reducing Crash Frequency and/or Severity: CMF = 0.66 – 0.70 [30% - 24% crash reduction] (FHWA Office of Safety, 2018).

Brief Description: This treatment improves stop, warning and regulatory sign visibility at intersections and/or intersection approaches. An example of a regulatory is shown in Figure 27.

Why was this selected for Town of Colma?

During field reviews, Kittelson observed a few locations where sign height could be increased to improve visibility and sign type could be improved to clarify the messages for motorists.

Figure 27: Example of a Stop Sign
Source: (FHWA Office of Safety, 2018).

q) Access Management

Planning-Level Cost Estimate: Highly variable.

Eligible for Federal Funding (*Source: Caltrans Road Safety Manual*): No

Potential Effectiveness at Reducing Crash Frequency and/or Severity: CMF = 0.93 [7% crash reduction] (CMF Clearing House, 2018).

Brief Description: This treatment improves access management on the corridors by implementing driveway consolidations and driveway relocations. This treatment also involves implementing driveway turn restrictions along the corridors. This is done to decrease the vehicle conflicts, while helping to clarify access to businesses.

Why was this selected for Town of Colma?

This treatment was selected for the Town of Colma because there are some corridors along which the businesses have multiple driveways and accesses that are in close proximity to each other.

r) Street Lighting (NS1/R1)

Planning-Level Cost Estimate: $5,000 - $10,000 (Town of Colma, 2018).

Eligible for Federal Funding (Source: Caltrans Road Safety Manual): Yes (100%)

Potential Effectiveness at Reducing Crash Frequency and/or Severity: CMF = 0.63 [37% crash reduction] (CMF Clearing House, 2018).

Brief Description: This treatment involves installing lighting on roadway segments and at unsignalized intersections. This is done to increase the visibility of non-motorized users to drivers and decrease the crashes.

Why was this selected for Town of Colma?

This treatment was selected for the Town of Colma because there are some roadway segments and unsignalized intersections that have crashes due to non-motorized users not being visible to the drivers, especially during the night time.

8.3 POTENTIAL LOCATIONS FOR SYSTEMIC TREATMENTS

Kittelson identified the following locations as candidates for receiving one or more of the systemic treatments. These locations were identified based on their crash patterns and trends, roadway characteristics present, and observations from the field reviews. Figure 28 through Figure 30 show the different locations at which the above discussed systemic treatments could be implemented in the Town.

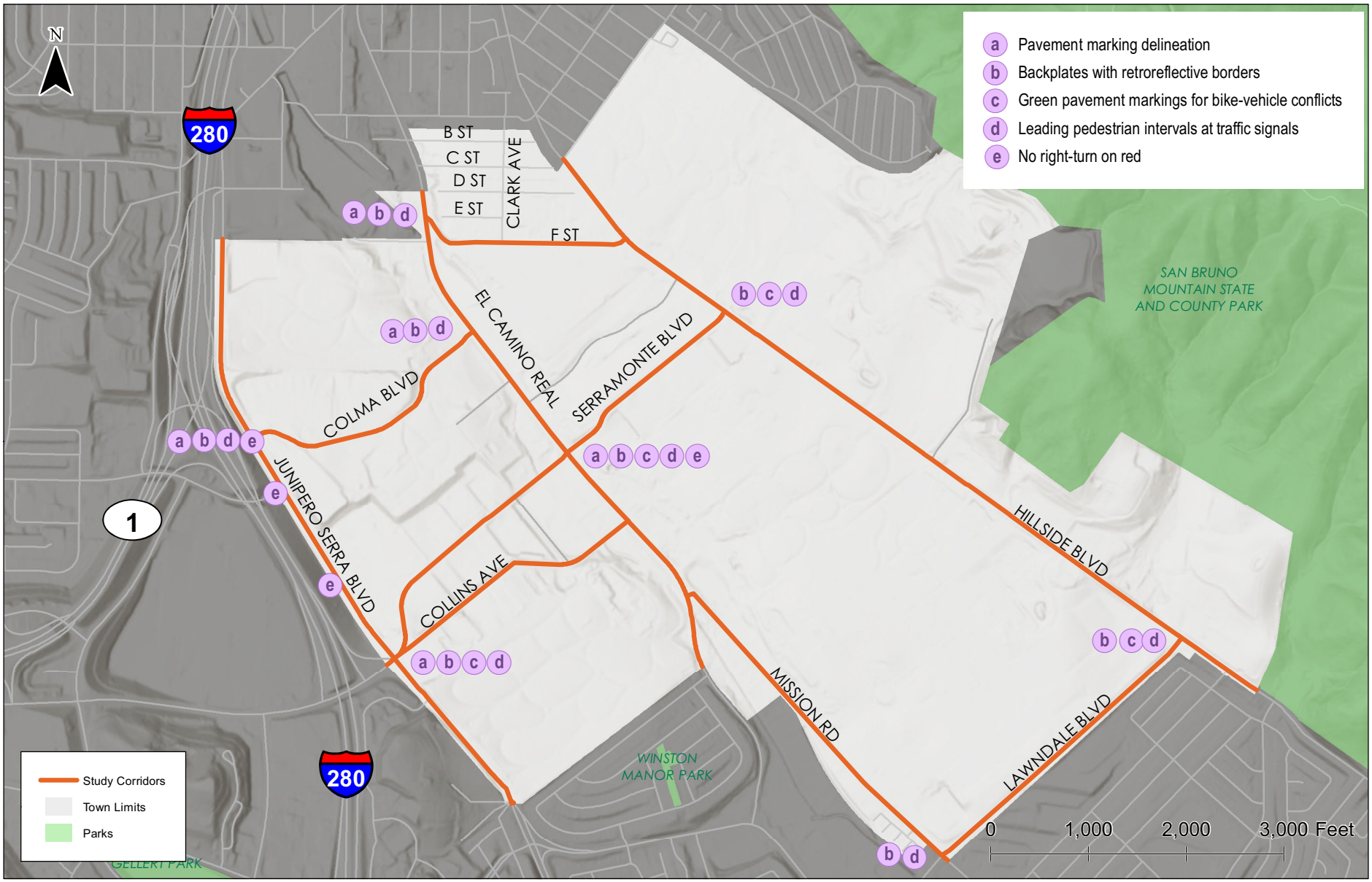
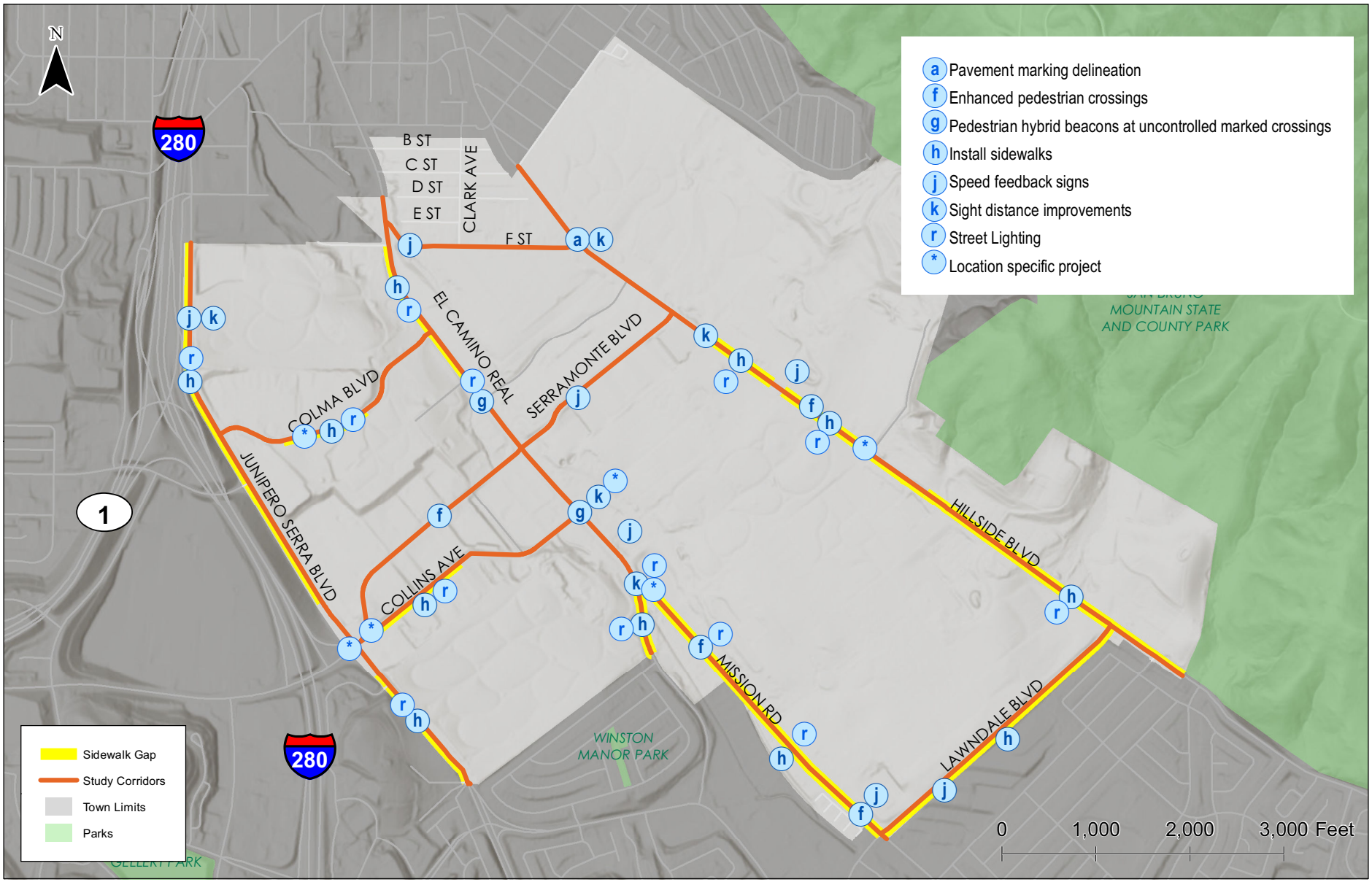


Figure 28

Town of Colma
CIP 993 Systemic Safety Analysis Report Project
Systemic Treatments at Signalized Intersections

KITTELSON & ASSOCIATES

Coordinate System: NAD 1983 StatePlane California III FIPS 0403 Feet
Data Source: Town of Colma, San Mateo County



Town of Colma
CIP 993 Systemic Safety Analysis Report Project
Systemic Treatments at Unsignalized Intersections and Segments

Figure 29

KITTELSON & ASSOCIATES

Coordinate System: NAD 1983 StatePlane California III FIPS 0403 Feet
Data Source: Town of Colma, San Mateo County

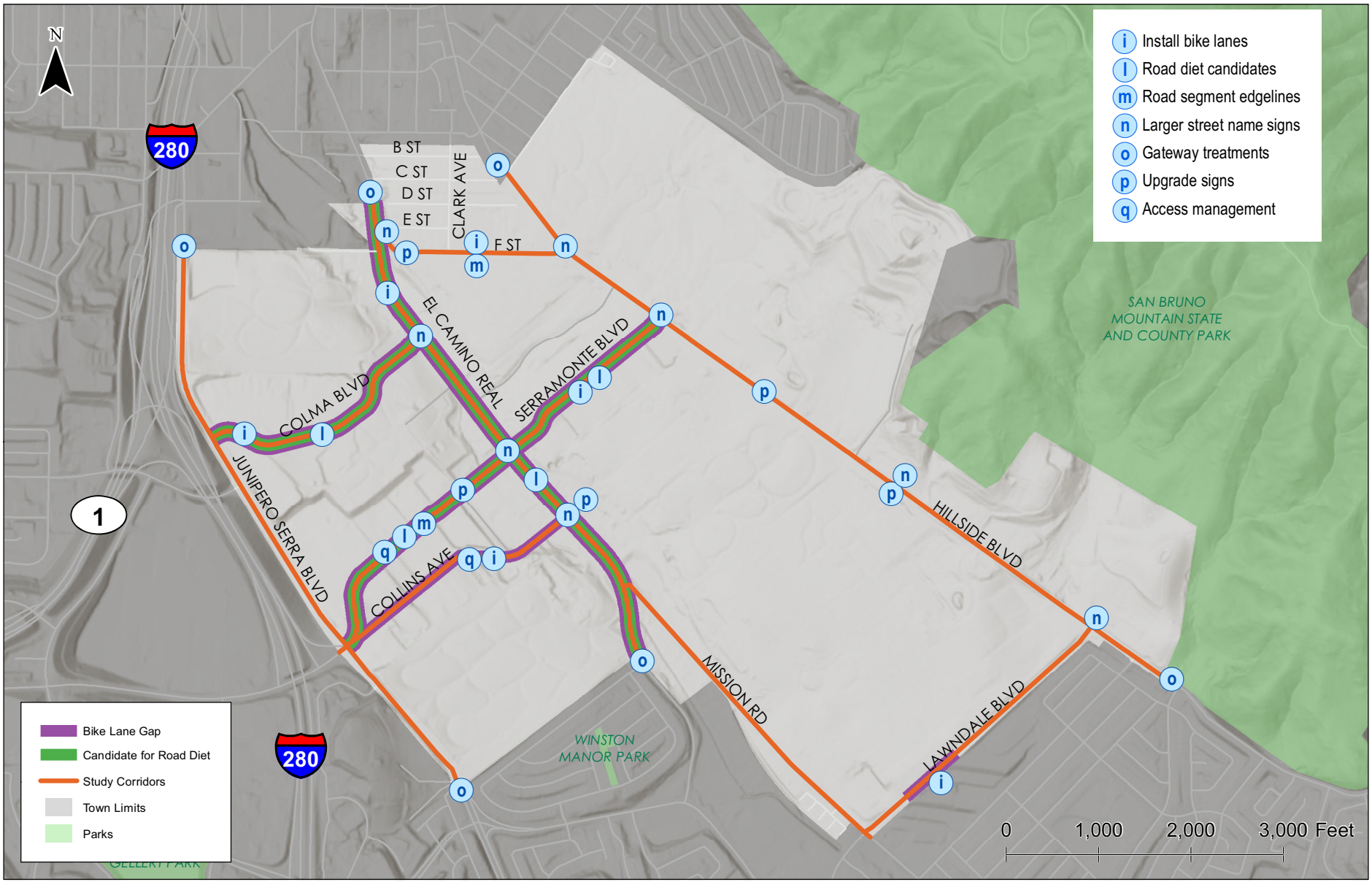


Figure 30

Town of Colma
CIP 993 Systemic Safety Analysis Report Project
Systemic Treatments at Unsignalized Intersections and Segments

KITTELSON & ASSOCIATES

Coordinate System: NAD 1983 StatePlane California III FIPS 0403 Feet
Data Source: Town of Colma, San Mateo County

Summary

The following are key points regarding the systemic treatments:

- Systemic treatments are a proactive way to help reduce the potential for crashes throughout the Town.
- Systemic treatments could be first applied at priority corridors and intersections.
- The planning level cost estimates, and the estimated safety effectiveness included for each systemic treatment can inform implementation at the study corridors while serving as a basis to implement treatments at non-study locations.

8.4 LOCATION-SPECIFIC PROJECTS

Kittelson identified locations that could benefit from specific, unique (non-systemic) location-specific projects to help reduce the potential for crashes. This section identifies those locations and describes those potential improvements. These locations were identified based on their crash patterns and trends, roadway characteristics present, and observations from the field reviews. The following sections outline the existing conditions at the locations and the potential location-specific projects (that are different than the systemic treatments discussed in the previous section).

IN THIS SECTION>>

- Locations identified as potentially benefiting from additional improvements
- Potential location-specific projects to help reduce crash frequency and/or severity

Mission Road/El Camino Real Intersection

Existing Conditions

Kittelson observed the El Camino Real (ECR) intersection is an unusual configuration with Mission Road intersecting ECR at a skew and free flow northbound movement from Mission Road to ECR. The skew results in long crossings of conflicting movements and the 40 mph posted speed limits gaps for drivers negotiating the stop controlled movements. The free flow movement creates a weaving section northbound for Mission Road drivers that are destined for Collins Avenue and/or the cemetary or commercial uses located south of Collins Avenue on the western side of ECR.

Proposed Location-Specific Projects

a) Consider Intersection Control Evaluation

Kittelson recommends the Town evaluate the existing intersection to consider changes in the traffic control. The intersection control evaluation (ICE) should consider geometric modifications and possible applications of stop, yield (roundabout), or signalized control. This is shown in Figure 31.

Figure 31: Location along Mission Road In Need of Traffic Control.

For a Stop Control:

Planning-Level Cost Estimate: $450 - $1,020 per sign, assuming 7' sign post (VDOT, 2018).

Eligible for Federal Funding (*Source: Caltrans Road Safety Manual*): Yes (100%).

Potential Effectiveness at Reducing Crash Frequency and/or Severity: 0.49 [51% crash reduction] (CMF Clearing House, 2018).

For a Yield Control (Roundabout):

Planning-Level Cost Estimate: $194,000 - $500,000 (FHWA, 2018)

Eligible for Federal Funding (*Source: Caltrans Road Safety Manual*): Yes (100%).

Potential Effectiveness at Reducing Crash Frequency and/or Severity: 0.54 – 0.87 [13% - 46% crash reduction] (CMF Clearing House, 2018).

For a Signal Control:

Planning-Level Cost Estimate: $50,000 - $200,000 (ITE, 2018).

Eligible for Federal Funding (*Source: Caltrans Road Safety Manual*): Yes (100%).

Potential Effectiveness at Reducing Crash Frequency and/or Severity: 0.56 - 0.65 [35% - 44% crash reduction] (CMF Clearing House, 2018).

Hillside Boulevard from Serramonte Boulevard Intersection to Lawndale Boulevard Intersection

Existing Conditions

Kittelson observed people walking and biking along Hillside Boulevard in the area between Serramonte/Hillside Bouldevard intersection and Hillside/Lawndale Boulevard Intersection. It was evident that some of the activity was the result of the businesses and cemetries along Hillside. Countermeasures that accommodate these travel patterns and road users along and crossing Hillside Boulevard (including the Serramonte/Hillside Bouldevard intersection)could be implemented. The existing roadway configuration is shown in Figure 32.

Figure 32: Existing Roadway Configuration on Hillside Boulevard

Proposed Location-Specific Projects

b) Reconfiguring roadway cross-section to install sidewalk and striped bike lanes

Kittelson recommends the Town consider installing sidewalk and bicycle facility along the corridor where these facilities are not present. There could be sufficient space to provide an adjacent, raised multiuse path for portions of this segment. Alternative configurations could be considered to determine the most optimal given the on-street parking needs and walking/biking needs to access the businesses and cemeteries. These changes would help increase driver awareness and visibility of the non-motorized users and reduce motorist speeds along the corridor. The planning level cost estimate and potential effectiveness of such changes would depend on the preferred roadway cross-section configuration selected.

All Way Stop Control Consistency on Colma Boulevard

Existing Conditions

Kittelson observed that the Colma Boulevard corridor has inconsistency in the stop control. At the intersection near Best Buy, the intersection has an all-way stop control. At the immediate intersection westbound on Colma Boulevard towards Junipero Serra Boulevard, there is stop control only on the driveway to the shopping center. This inconsistency could violate driver expectancy while traveling along Colma Boulevard.

Proposed Location-Specific Projects

c) Consider all way stop control consistency

Kittelson recommends the Town consider evaluating the two intersections to determine if all-way stop control or two-way stop control are the most appropriate. The information on planning level cost estimates, funding eligibility, and the potential safety effectiveness for stop control are discussed above as part of Mission Road ICE project discussion.

Reconfiguring Junipero Serra Boulevard/Serramonte Boulevard Intersection

Existing Conditions

The Junipero Serra Boulevard/Serramonte Boulevard intersection is controlled by a traffic signal and includes access to the I-280 on-ramp. Figure 33 shows in an aerial of the five-legged Junipero Serra Boulevard/Serramonte Boulevard intersection.

Figure 33: Junipero Serra Boulevard/Serramonte Boulevard and Serramonte Boulevard/Collins Avenue Intersections

Source: Google Earth, 2018.

Serramonte Boulevard curves horizontally through the intersection with Collins Avenue and in the eastbound direction beings to drop down vertically. As a result, the current alignment creates sight distance challenges for turning motorists as well as limited time to react to the different movements and activities occurring at the intersection. The multiple legs of the intersection and access to I-280 also requires multiple lanes, overhead signs, and pavement markings on the northbound and eastbound approaches to pre-segregate motor vehicles into the proper lanes based on motorists' desired destinations.

Proposed Location-Specific Projects

d) Reconfiguring Junipero Serra Boulevard/Serramonte Boulevard Intersection

The Town could consider options to simplify the Junipero Serra Boulevard/Serramonte Boulevard intersection to reduce the amount of decisions that drivers need to make to successfully navigate the intersection. For example, one option that could be explored, would be to eliminate the connection to I-280 that occurs at the intersection and instead have motorists use the ramp access on Serramonte Boulevard that is approximately 250 feet to the west of the intersection. Signal coordination adjustments may need to be made with that adjacent signal; however, such a change would simplify the intersection and help simplify and reduce conflicts at the adjacent Serramonte Boulevard/Collins Avenue intersection as well.

Reconfiguring Serramonte Boulevard/Collins Avenue Intersection

Existing Conditions

The Serramonte Boulevard/Collins Avenue intersection is stop controlled on the Collins Avenue approach. Figure 25 shows an aerial that includes the Serramonte Boulevard/Collins Avenue intersection (intersection to the right in the figure). In addition to the sight distance challenges on Serramonte Boulevard for motorists because of the horizontal curve alignment, the Serramonte Boulevard/Collins Avenue intersection is also missing a marked pedestrian crossing across the Collins Avenue approach.

Proposed Location-Specific Projects

e) Reconfiguring Serramonte Boulevard/Collins Avenue Intersection

Kittelson recommends the Town explore options to realign the Serramonte Boulevard/Collins Avenue intersection to try to improve sight distance, add a pedestrian marked crosswalk across Collins Avenue, and minimize the pedestrian crossing distance across Collins Avenue. The reconfiguration would need to take into account and design for the necessary large vehicles that need to access the businesses along Collins Avenue.

Collins Avenue/El Camino Real Intersection

Existing Conditions

The El Camino Real (ECR)/Collins Avenue intersection is situated between ECR/Mission Road intersection and ECR/Serramonte Boulevard intersection. There is an existing, marked, uncontrolled crosswalk at this locaiton for pedestrians to cross ECR. On-street parking is permitted on approach to the intersection along ECR. There are three vehicle lanes southbound at the intersection, one of which is marked as being eliminated as it passes through the intersection. There are also three lanes northbound through the intersection and a center median. Figure 34 shows an aerial of the intersection.

Figure 34: Collins Avenue/El Camino Real Intersection

Source: Google Earth, 2018.

If the need for intersection control at ECR/Mission Road is realized, it would be better to consider some intersection control at the ECR/Collins Avenue intersection as well. The additional lanes on ECR approaching Collins Avenue need to be tapered to reduce the pedestrian crossing distance at the intersection.

Proposed Location-Specific Projects

f) Consider Additoinal Intersection Enhancements

As part of the treatments, Kittelson suggests considering implementing a traffic signal at this location to meet the intended outcomes at this intersection. To further reduce the potential risk for crashes at this location, the Town could also consider:

- Eliminating the southbound lane drop thorugh the intersection so the lane is dropped north of the intersection to arrive at two southbound through lanes;
- Eliminating one of the northbound through lanes to shorten the crossing distance;
- Further restricting on-street parking adjacent to the crosswalk and intersection to increase the available sight distance for motorists on Collins Avenue and pedestrians waiting to cross ECR;

Figure 35 identifies the locations for the potential unique, location-specific projects that could be implemented across the Town.

Figure 35

Town of Colma
CIP 993 Systemic Safety Analysis Report Project
Location Specific Improvements

KITTELSON & ASSOCIATES

Coordinate System: NAD 1983 StatePlane California III FIPS 0403 Feet
Data Source: Town of Colma, San Mateo County

Summary of Locations

Table 11 provides a summary of the location, brief description of the potential location-specific projects, planning-level cost range, and potential effectiveness at reducing crash frequency and/or severity.

Table 11: Summary of the Location Specific Projects and the Related Information

Treatment (With Location)	Cost Range	CMF [% Crash Reduction]
a) Intersection Control Evaluation at Mission Road/El Camino Real ▪ Stop Control ▪ Yield Control (Roundabout) ▪ Signal Control	$450 - $1,020 per sign, assuming 7' sign post $194,000 - $500,000 $50,000 - $200,000	0.49 [51%] 0.54-0.87 [13% - 46%] 0.56–0.65 [35% - 44%]
b) Reconfiguring Roadway Cross-section on Hillside Boulevard from Serramonte Boulevard to Sand Hill Road ▪ Sidewalks ▪ Bike lane striping	$8.04 - $9.90 (per square-foot) $250 - $270 (per stencil)	NA. NA.
c) All Way Stop Control consistency on Colma Boulevard	$450 - $1,020 per sign, assuming 7' sign post	0.49 [51%]
d) Reconfiguring Junipero Serra Boulevard/Serramonte Boulevard Intersection	Varies	NA.
e) Reconfiguring Serramonte Boulevard/Collins Avenue Intersection	Varies	NA.
f) Intersection Control Evaluation at Collins Avenue/El Camino Real ▪ Signal Control	$50,000 - $200,000	0.56–0.65 [35% - 44%]

Summary

The following are key points regarding location-specific treatments:

- Location-specific projects address potential changes that are unique from the systemic treatments.
- These projects are intended to help further reduce the potential of crashes for road users.

Table 12 provides a summary of the location, and brief description of the potential systemic and location-specific projects for each corridor in the town.

Table 12: Summary of the Systemic and Location Specific Projects for each Corridor

Corridor	Systemic Treatments	Location-specific Treatment
El Camino Real	▪ Pavement marking delineation ▪ Backplates with retroreflective borders ▪ Green pavement markings for bike-vehicle conflicts ▪ LPIs at traffic signals ▪ Install sidewalks ▪ Install PHBs at uncontrolled marked crossings ▪ Sight-distance improvements ▪ Speed-feedback signs ▪ Gateway treatments ▪ Larger street-name signs ▪ Install bike lanes ▪ Road-diet candidate ▪ Street lighting ▪ Upgrade signs ▪ No right-turn on red	▪ Intersection Control Evaluation at Mission Road/El Camino Real ▪ Intersection Control Evaluation at Collins Avenue/El Camino Real
Junipero Serra Boulevard	▪ Pavement marking delineation ▪ Backplates with retroreflective borders ▪ Green pavement markings for bike-vehicle conflicts ▪ LPIs at traffic signals ▪ No right-turn on red ▪ Install sidewalks ▪ Sight-distance improvements ▪ Speed-feedback signs ▪ Gateway treatments ▪ No right-turn on red ▪ Street lighting	▪ Reconfiguring Junipero Serra Boulevard/Serramonte Boulevard/ Intersection

Corridor	Systemic Treatments	Location-specific Treatment
Hillside Boulevard	▪ Pavement marking delineation ▪ Backplates with retroreflective borders ▪ Green pavement markings for bike-vehicle conflicts ▪ LPIs at traffic signals ▪ Install sidewalks ▪ Sight-distance improvements ▪ Speed feedback signs ▪ Enhanced pedestrian crossings ▪ Larger street-name signs ▪ Upgrade signs ▪ Gateway treatments ▪ Street lighting ▪ Mid-Block pedestrian crossings	▪ Reconfiguring roadway cross-section from Serramonte Boulevard Intersection to Lawndale Boulevard Intersection
Mission Road	▪ Backplates with retroreflective borders ▪ LPIs at traffic signals ▪ Sight-distance improvements ▪ Speed feedback signs ▪ Mid-Block pedestrian crossings	▪ Intersection Control Evaluation at Mission Road/El Camino Real
Serramonte Boulevard	▪ Pavement marking delineation ▪ Backplates with retroreflective borders ▪ Green pavement markings for bike-vehicle conflicts ▪ LPIs at traffic signals ▪ No right-turn on red ▪ Larger street-name signs ▪ Enhanced Pedestrian Crossings ▪ Install bike lanes ▪ Road-diet candidate ▪ Upgrade signs ▪ Access management ▪ Road segment Edgelines ▪ Mid-Block pedestrian crossings ▪ Street lighting	▪ Reconfiguring Serramonte Boulevard/Collins Avenue Intersection ▪ Reconfiguring Junipero Serra Boulevard/Serramonte Boulevard/ Intersection
Collins Avenue	▪ Pavement marking delineation ▪ Backplates with retroreflective borders ▪ Green pavement markings for bike-vehicle conflicts ▪ LPIs at traffic signals ▪ Install sidewalks ▪ Larger street-name signs ▪ Install bike lanes ▪ Upgrade signs ▪ Access management ▪ Sight-distance improvements ▪ Street lighting	▪ Reconfiguring Serramonte Boulevard/Collins Avenue Intersection ▪ Intersection Control Evaluation at Collins Avenue/El Camino Real

Corridor	Systemic Treatments	Location-specific Treatment
Colma Boulevard	▪ Pavement marking delineation ▪ Backplates with retroreflective borders ▪ LPIs at traffic signals ▪ No right-turn on red ▪ Install sidewalks ▪ Larger street-name signs ▪ Install bike lanes ▪ Road-diet candidate ▪ Street lighting	▪ Consistency in All Way Stop Control
Lawndale Boulevard	▪ Backplates with retroreflective borders ▪ Green pavement markings for bike-vehicle conflicts ▪ LPIs at traffic signals ▪ Install sidewalks ▪ Speed-feedback signs ▪ Close bike lane gap ▪ Larger street name signs ▪ Mid-Block pedestrian crossings at the school entrance	NA.
F Street	▪ Pavement marking delineation ▪ Backplates with retroreflective borders ▪ LPIs at traffic signals ▪ Sight-distance improvements ▪ Speed-feedback signs ▪ Larger street-name signs ▪ Install bike lanes ▪ Road segment edgelines ▪ Upgrade signs ▪ Intersection/Road segment street lighting	NA.

8.5 POLICY, EDUCATION, & ENFORCEMENT STRATEGIES

Kittelson identified the following potential roaday safety related policies; education strateiges; and enforcement strategies to complement engineering treatments and projects discussed above.

IN THIS SECTION>>

Potential policy, education, and enforcement strategies that could be pursued by the Town

Roadway Safety Related Policies

Kittelson recommends the Town of Colma consider establishing a Vision Zero policy to emphasize improving roadway safety.

'Vision Zero' Policy

The goal of Vision Zero is based on the institutionalized, system-level change for the Town of Colma. This Vision Zero policy will build safety and livability into the streets of the Town of Colma, protecting the people who move about the Town every day. The key priorities for road safety culture in the Town of Colma include:

- Eliminating the fatal and severe injury crashes, and promoting safe road user behavior throughout the Town;
- Protecting non-motorized users, pedestrians and bicyclists, through infrastructure improvements;
- Using different forms of education to inform road users of the risks posed to the non-motorized users;
- Using education and enforcement strategies to discourage motorists from driving under the influence of alcohol, dangerous drugs, or other substances; and
- Using roadway design and enforcement strategies to encourage motorists to travel the posted speeds or slower on the roadways.

An example Vision Zero purpose statement that the Town of Colma can modify or develop further is below.

"The Town of Colma's commitment to Vision Zero is based on the principle of Crash Severity, i.e. fatalities and serious injuries on our roadways, which are not acceptable and preventable. The Town of Colma and its partner jurisdictions commit to achieve a vision of zero fatalities and serious injuries on our roadways. This will be accomplished through developing, implementing and monitoring a comprehensive and multidisciplinary Transportation Safety Action Plan that is data informed and facilitates routine investment in roadway safety improvements."

Education Strategies

Education strategies are focused on teaching road users road safety principles. These strategies can be developed to include interactive activities, comprehensive teaching notes, and information on road safety messages and concepts that can be taught at school or in the off-school activities.

a) Road Safety Education to Children

The road safety education to children includes strategies such as safe routes to school, walking school bus, and bicycle trains that promote road safety to all users, particularly the non-motorized users. A 'safe routes to school' program encourages and enables children to walk and bike to school. This can improve their health, well-being, and safety. This also results in less traffic congestion and emissions caused by school-related travel. Walking school buses and bicycle trains encourage groups of children walking or biking to school, with one or more adults. The walking school buses and bicycle trains have been put into practice by some of the schools in Sacramento, California; Chapel Hill, North Carolina; and Duluth, Georgia (SRTS Guide, 2018). These strategies or practices have shown communities and families that walking, and biking can be a viable and safe transportation option, and thus can be incorporated into their own daily travel patterns.

b) Speed Monitoring Awareness Radar Trailer

The speed trailer is an educational device that helps drivers become more aware of their speed in relation to the posted speed. This awareness tool can also help residents survey the traffic speeds in their own neighborhood. This trailer is usually deployed in a street or neighborhood for a few days so the residents can monitor the speeds on their own streets and become aware of their own driving behaviors.

c) Vulnerable Road User Education

The road safety education regarding vulnerable road users like pedestrians, bicyclists, and motorcyclists includes strategies involving education from police officer. If the driver encroaches into the bike lane or fails to yield to the pedestrian at the crossing, the police officer pulls the driver over and hands them a flyer that has the information for drivers to adapt their behavior towards all road users; this can be in addition to a citation.

Enforcement Strategies

Crash data can help identify the priority locations and/or road segments and the times of the day when the crashes have occurred. This information can inform and guide the type of enforcement strategy to be selected at the most appropriate locations and time periods. Kittelson suggests the Town consider three types of enforcement strategies. They are as follows:

a) Enhanced Police Enforcement

Deploy enhanced police enforcement on Hillside Boulevard near Hillside/Serramonte Boulevard intersection. The crash data showed 40% of crashes on Hillside Boulevard were classified as driving under the influence of alcohol or drugs (DUI). There were two fatal crashes over the last five years along this corridor, and one of them was associated with a DUI. Enhanced police enforcement in this corridor and other corridors with speeding-related crashes, may reduce fatal and severe injury crashes.

b) Photo Enforcement

Deploy safety cameras solely to assist in reducing fatal and severe injury related crashes. The Town of Colma could use camera enforcement at traffic signals to detect drivers' red light running or along priority corridors to identify speeding-drivers.

c) Speed Survey and Enforcement Campaigns

Focus enforcement using data to pinpoint streets exhibiting speeding and crashes with non-motorized users. The Town could launch a campaign with a series of radio or television advertisements to raise awareness about the dangers of speeding and encourage safe driving behavior.

Summary

The following are the potential education and enforcement strategies:

- Vision Zero Policy
    - Encourage and enable consistent, intentional investment in reducing the risk of crashes
    - Monitor progress to be able to continually reassess and adjust, as needed
- Education Strategies
    - Road Safety Education to Children; and
    - Speed Monitoring Awareness Radar Trailer; and
    - Vulnerable Road User Education.
- Enforcement Strategies

9.0 VIABLE PROJECT SCOPES AND PRIORITIZED LIST OF SAFETY PROJECTS

Using the above findings and through discussion with the Town, Kittelson developed the following projects the Town could implement to reduce the risk of crashes across all mode of travel. These projects are based on the list of countermeasures and priority locations from the previous work from this project. This list of projects was further prioritized based on the annual EPDO scores, crash types and severities, feasibility of the project given field conditions, discussions with the Town staff, community concerns and feedback, and recently implemented projects in the project vicinity.

Project scopes

Kittelson worked with the Town to identify twelve priority projects to reduce the risk of crashes in the Town of Colma. Each project scope describes the project location, type of improvements, reasoning for the project, and the concept design for the project. The twelve locations are listed below.

1. Hillside Boulevard from Serramonte Boulevard to Lawndale Boulevard Intersection
2. El Camino Real/Mission Road Intersection
3. Junipero Serra Boulevard/Serramonte Boulevard Intersection
4. Junipero Serra Boulevard from Colma Boulevard to Serramonte Boulevard Intersection
5. Colma Boulevard from El Camino Real to Junipero Serra Boulevard Intersection
6. El Camino Real/F Street Intersection
7. El Camino Real/Serramonte Boulevard Intersection
8. El Camino Real/Colma Boulevard Intersection
9. Collins Avenue from El Camino Real to Serramonte Boulevard Intersection
10. El Camino Real/Collins Avenue Intersection
11. Serramonte Boulevard from El Camino Real to Hillside Boulevard Intersection
12. Lawndale Boulevard from Mission Road to Hillside Boulevard Intersection

Table 13 summarizes the projects for each priority location and the related information. Figure 36 shows the map of safety project locations in the Town of Colma.

Table 13: Summary of the Projects and the Related Information

S.No.	Priority Location	Projects and Related Information
1	Hillside Boulevard from Serramonte Boulevard to Lawndale Boulevard Intersection	This project aims to improve pedestrian and bicycle safety along the corridor within the existing right-of-way. ▪ Extending the curb return to shadow the southbound right-turn at Serramonte/Hillside Boulevard intersection and widening the sidewalk along the corridor on Hillside. ▪ Installing pedestrian crossing enhancements, i.e. rectangular rapid flashing beacons (RRFBs) on the already existing pedestrian crosswalk at Eternity Memorial park driveway. ▪ Installing flush median with a pedestrian cut-through at the Lucky Chances Casino driveway on Hillside Boulevard. ▪ Installing mid-block pedestrian crossing and RRFBs on Hillside Boulevard near the Golf Course Access Road intersection. ▪ Transitioning to a single lane in each direction from two-lanes near Hillside Boulevard and Lawndale Boulevard Intersection. ▪ Install street lighting at multiple locations on Hillside Boulevard.
2	El Camino Real/Mission Road Intersection	This project aims to improve vehicular, non-motorized safety and operations. ▪ Installing a traffic signal to meet the intended outcomes at this intersection. ▪ Eliminating the overlapping southbound left turn lanes and delineating the southbound Mission Road left turn lane south of Cypress Avenue. ▪ Maintaining two northbound lanes on ECR by removing northbound lane addition at Mission Road. ▪ Creating two continuous southbound lanes on ECR south of Collins Avenue intersection. The upstream two-lane section could be associated with the possible ECR/Collins Avenue intersection treatments. ▪ Channelizing this intersection with traffic separators, traffic islands, and pavement markings. ▪ Installing street lighting, and pedestrian crosswalks at the intersection. ▪ Adding a complementary northbound left turn lane and angling the southbound left turn to Cypress Avenue. ▪ Adding bike lanes on ECR in the northbound and southbound directions.

S.No.	Priority Location	Projects and Related Information
3	Junipero Serra Boulevard/Serramonte Boulevard Intersection	This project aims to improve bicycle safety and vehicle operations. ▪ Eliminating the fifth intersection leg, i.e. the diagonal on ramp stem from Junipero Serra Boulevard. ▪ Widening westbound Serramonte Boulevard from Junipero Serra Boulevard to the new two lanes on ramp connection to eastbound I-280. ▪ Modifying eastbound on ramp connection to match the existing ramp south of the ramp meter. ▪ Using striping to clearly define the two northbound lanes on Junipero Serra Boulevard departing the intersection. ▪ Striping bike lanes approaching the intersection including treatments at right-turn lanes. ▪ Modifying signing and pavement markings to eliminate the 'soft' left and right turns and modify the 'hard' left and right turns.
4	Junipero Serra Boulevard from Colma Boulevard to Serramonte Boulevard Intersection	This project aims to improve bicycle safety, pedestrian safety and vehicle operations. ▪ Installing raised median island for pedestrian refuge on the westbound approach of Junipero Serra Boulevard and Colma Boulevard intersection. ▪ Striping out the outside receiving lane on the northbound approach of the Junipero Serra Boulevard at the Colma Boulevard intersection to shadow right-turn lane from Colma Boulevard and better delineate bike lane. ▪ Narrowing to two receiving lanes on the eastbound approach at the Colma Boulevard intersection and delineate southbound left-turns through the intersection. ▪ Installing green bike lane transition markings at the right-turn lanes at intersections along the corridor. ▪ Installing bike box with green bike lane markings at the Serra center driveway intersection on the corridor. ▪ Eliminating the median nose for improved pedestrian access at the Serra center driveway intersection. ▪ Implementing leading pedestrian intervals at traffic signals and restricting right-turns on red at the intersections.

S.No.	Priority Location	Projects and Related Information
5	Colma Boulevard from El Camino Real to Junipero Serra Boulevard Intersection	This project aims to improve pedestrian and bicyclist safety along the corridor. ▪ Installing raised median to shadow left turn lane on westbound approach to Junipero Serra Boulevard. ▪ Transitioning from the current lane configuration on Colma Boulevard to three lane cross section (i.e. one lane on either side of the roadway with a two-way center turn lane), and bike lanes on both sides of the roadway. ▪ This reconfiguration includes sidewalk on one side of the roadway.
6	El Camino Real/F Street Intersection	This project aims to improve pedestrian safety and vehicle operations at this intersection. ▪ Reconfiguring access to Woodlawn Cemetery to right-in only, i.e. entrance only and not exit. ▪ Squaring up the F street northbound right-turn lane. ▪ Removing parking on northbound El Camino Real between F streets north and south of Bay Area Rapid Transit (BART) overcrossing and widening the sidewalk and curb. ▪ Widening the sidewalk and the north F street intersection crosswalk along El Camino Real. ▪ Striping a defined southbound right-turn lane and striping out the extra wide shoulder at the Woodlawn Memorial Park driveway. ▪ Closing the median opening in front of the north F street intersection. ▪ Consider closing or modifying the Woodlawn Memorial Park driveway near the south F street intersection. ▪ Widening the median on El Camino Real so that the left turn lanes to the south F street intersection begins after the Woodlawn Memorial Park driveway. ▪ Adding bike lanes on both sides of ECR, with two travel lanes in each direction.
7	El Camino Real/Serramonte Boulevard Intersection	This project aims to improve pedestrian safety and vehicle operations. ▪ Reducing curb return radii, adjusting and defining sidewalks. ▪ Creating angled left-turn lanes on El Camino Real to improve sight lines and facilitate turning movements. ▪ Defining better on street parking on El Camino Real outside the intersection area.

S.No.	Priority Location	Projects and Related Information
		▪ Restriping westbound Serramonte Boulevard to maintain two through lanes through the horizontal curves. The right-turn lane would be added in the tangent section approaching the intersection. ▪ Considering an eastbound left-turn lane from Serramonte Boulevard to the Town of Colma Police complex. A median in any form reduces the roadway to four lanes in this location and will support vehicle speed management down the hill. ▪ Adding bike lanes on both sides of ECR, with two travel lanes in each direction along the entire corridor.
8	El Camino Real/Colma Boulevard Intersection	This project aims to improve pedestrian and bicyclist safety. ▪ Reconfiguring ECR to two travel lanes in each direction, with buffered bike lanes on northbound and southbound El Camino Real. ▪ Extending the median to provide a pedestrian refuge area for the El Camino Real crossing. ▪ Providing angled left-turn lanes to adjacent driveways north of Colma Boulevard. ▪ Considering closing the driveway from the Greek Orthodox Memorial Park at Colma Boulevard or converting this access to one way outbound only.
9	Collins Avenue from El Camino Real to Serramonte Boulevard Intersection	This project aims at improving the vehicle operations along the corridor. ▪ Installing speed feedback signs at the location of existing speed limit signs. ▪ Restriping the corridor to delineate outer edges with parking and no parking areas. ▪ Narrowing the lanes to 11ft wide and including centerline with raised pavement markers. ▪ Providing continuous sidewalk along the corridor, i.e. providing sidewalk links to the existing sidewalk through the driveway area. ▪ Reconfiguring Collins Avenue/Serramonte Boulevard intersection. ▪ Installing a traffic signal at El Camino Real/Collins Avenue to meet the intended outcomes at this intersection.
10	El Camino Real/Collins Avenue Intersection	The project aims at improving pedestrian safety and vehicle operations at the intersection. ▪ Dropping the third southbound lane on ECR, thereby eliminating the lane drop downstream of the intersection.

S.No.	Priority Location	Projects and Related Information
		▪ The upstream two-lane section on ECR could be associated with the possible ECR/Mission Road lane configuration and the intersection treatments that eliminate the added third lane at Mission Road. ▪ Reconfiguring ECR with two travel lanes in each direction, and with bike lanes on both sides of the roadway. ▪ Extending the curb returns on the west side of the intersection and converting the third northbound lane into on-street parking. ▪ Extending the median to create a separated pedestrian refuge island. Enhance the existing pedestrian crossings on the west and north sides of the intersection. ▪ Adding painted channelizing island at angled northbound left turn lane on ECR to Collins Avenue to better channelize intersection movements. ▪ Installing a traffic signal to meet the intended outcomes at this intersection.
11	Serramonte Boulevard from El Camino Real to Hillside Boulevard Intersection	The project aims at improving pedestrian and bicyclist safety along the corridor. ▪ Transitioning from the current lane configuration on Serramonte Boulevard to three lane cross section, i.e. one lane on either side of the roadway with a two-way center turn lane. ▪ This reconfiguration includes adding bike lanes on both sides of the roadway.
12	Lawndale Boulevard from Mission Road to Hillside Boulevard Intersection	This project aims at improving the non-motorized travel along the corridor. ▪ Providing bike lane links to the existing bike lane, by closing the bike lane gap near the ECR High School driveway. ▪ Aligning and extending the curb along the travel lane near the ECR High School driveway to eliminate the entry and exit tapered curb width sections and provide a consistent cross section along the corridor. ▪ Installing mid-block pedestrian crossing at the ECR High School driveway entrance. The path across the median is designed to help with visually impaired wayfinding to traverse the street and align with receiving ADA ramps. ▪ Installing pedestrian crossing enhancements, i.e. RRFBs on the mid-block pedestrian crossing at the ECR High School driveway entrance.

Figure 36

Town of Colma
CIP 993 Systemic Safety Analysis Report Project
Map of Safety Project Locations

KITTELSON & ASSOCIATES

Coordinate System: NAD 1983 StatePlane California III FIPS 0403 Feet
Data Source: Town of Colma, San Mateo County

9.1 PROJECT SCOPES

The following presents projects scopes for the top ten locations. This list of locations was identified from crash patterns, roadway characteristics, and risk factors, community input through the interactive map and community engagement meetings served as the initial list of the projects. The project locations were then further prioritized based on the discussions with Town staff, the community concerns in the town, and other on-going or recently implemented projects in the project vicinity.

IN THIS SECTION>>

- Detailed project scopes for 10 locations
- Description of project need

Observations from field reviews and professional resources such as the Caltrans Local Road Safety Manual and the Federal Highway Administration's resources regarding systemic safety, and discussions with the Town staff aided in developing the scopes of the projects.

The following project scopes include the project location, description of the project, and reasoning for why that location and why the respective countermeasures were selected.

Project descriptions

The following presents information for the top ten projects prioritized for the Town of Colma. These were prioritized based on crash history at the location as well as through discussions with Town Staff and consideration of community input. Of these, the project team developed 30 percent concept designs for five locations. A brief discussion on the respective projects being competitive for Highway Safety Improvement Program (HSIP) funding is also included at the end of each project scope and description. This decision was primarily based on the benefit-cost ratio values for the project scopes.

The benefit-cost ratio expresses benefits in monetary terms, which requires an estimate of the number of crashes avoided as a result of the countermeasures proposed in the project scope, and the monetary value of each avoided crash on the corridor or at an intersection. For the countermeasures proposed in the project scopes that are eligible for HSIP benefit, the crash modification factors (CMFs) are provided in the Caltrans Local Road Safety Manual. Kittelson used these CMFs to calculate the expected reduction in crashes and convert that to a monetary value. Kittelson used the monetary value of the expected benefit divided by the estimated project cost to arrive at the benefit-cost ratio. As per HSIP guidelines, Kittelson used five years of crash data, i.e. years 2011-2015 for calculating benefit-cost ratios in HSIP Analyzer, for priority projects in the Town of Colma. This methodology is consistent with the Caltrans' HSIP Cycle 9 HSIP Analyzer tool used to calculate benefit cost ratios for the purpose of prioritizing proposed HSIP projects.

Project #1: Reconfiguring Roadway Cross-Section on Hillside Boulevard

Project Description

This project includes reconfiguring the roadway cross-section on Hillside Boulevard by installing sidewalk and bicycle facility along the corridor where these facilities are not present, providing sufficient space for all the road users to utilize the facility. The project would restrict parking on the corridor to one side of the road, where available on both sides in the existing conditions. This project would focus on improvements that reduce the vehicle speeds on the corridor and improve the roadway conditions for non-motorized users within the existing right-of-way. Kittelson team suggests the Town consider widening the sidewalk, and installing enhanced pedestrian crossing facilities, that improve the safety of pedestrians walking along the corridor. Kittelson suggests the Town consider the following:

- Extending the curb return to shadow the southbound right-turn at Serramonte/Hillside Boulevard intersection and widening the sidewalk along the corridor on Hillside.
- Installing pedestrian crossing enhancements, i.e. rectangular rapid flashing beacons (RRFBs) on the already existing pedestrian crosswalk at Eternity Memorial park driveway.
- Installing flush median with a pedestrian cut-through at the Lucky Chances Casino driveway on Hillside Boulevard.
- Installing mid-block pedestrian crossing and RRFBs on Hillside Boulevard near the Golf Course Access Road intersection.
- Transitioning to a single lane in each direction from two-lanes near Hillside Boulevard and Lawndale Boulevard Intersection.
- Installing street lighting at multiple locations on Hillside Boulevard.

Kittelson recognizes removing on-street parking can be contentious. In this location, removing on-street parking from one side of the street is necessary to provide sidewalk on side of the street and adequate bicycle lanes in each direction. If the Town found it infeasible to remove parking on one side of the street, a sidewalk could still be added; however, bicyclists would either need to share the lane with motor vehicles in one direction of travel or a narrow bicycle lane could be provided. Those conditions (narrow bicycle lane or bicycles sharing a motor vehicle lane at this location) are less ideal from a safety perspective. Figure 37 shows the project scope for this location. The estimated cost for this project is $ 3,531,000, and the benefit-cost ratio is 2.00.

Figure 37

Hillside Boulevard from Serramonte Boulevard to Lawndale Boulevard

Estimated Cost: $3,531,000 **Benefit/Cost Ratio: 2.00**

COLMA TRANSPORTATION SAFETY ACTION PLAN

Existing Conditions

- The corridor is a minor arterial and used by traffic traveling between Colma and Daly City (as alternative route to El Camino Real, and Junipero Serra Boulevard).
- There is walking and biking activity along the corridor.
- There are some businesses and cemeteries along the corridor that generate non-motorized traffic.
- There is a casino near the Hillside Boulevard/Serramonte Boulevard intersection.

Crash Summary

Crash Type and Contributing Factors

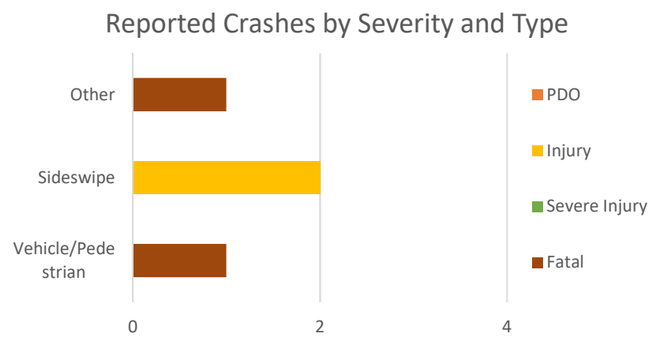
- 1 vehicle/pedestrian crash, pedestrian violation
- 2 sideswipe crashes; DUI, vehicle violation
- 1 DUI (other) crash

Crash Severity

- 2 fatal crashes (pedestrian violation, DUI)
- 2 other visible injury crashes (DUI, vehicle violation)

Crash Severity Score **73.54**

Number of Crashes **4**



Project Description

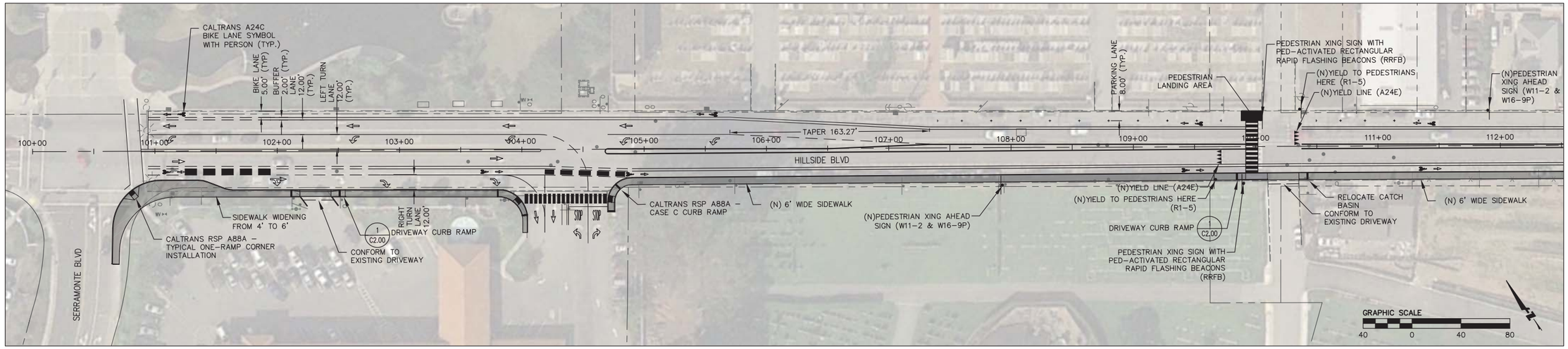
This concept sketch illustrates an approach to improve pedestrian and bicycle safety along the corridor within the existing right-of-way. Key items from the concept include:

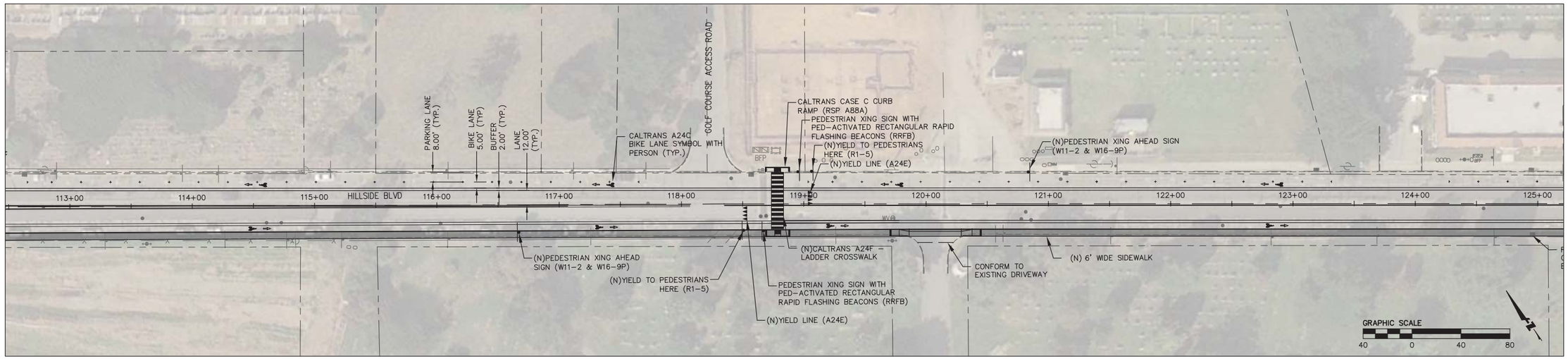
- Extending the curb return to shadow the southbound right-turn at Serramonte/Hillside Boulevard intersection and widening the sidewalk along the corridor on Hillside.
- Installing pedestrian crossing enhancements, i.e. rectangular rapid flashing beacons (RRFBs) on the already existing pedestrian crosswalk at Eternity Memorial park driveway.
- Installing flush median with a pedestrian cut-through at the Lucky Chances Casino driveway on Hillside Boulevard.
- Installing mid-block pedestrian crossing and RRFBs on Hillside Boulevard near the Golf Course Access Road intersection.
- Transitioning to a single lane in each direction from two-lanes near Hillside Boulevard and Lawndale Boulevard Intersection.
- Installing street lighting at multiple locations along the corridor.

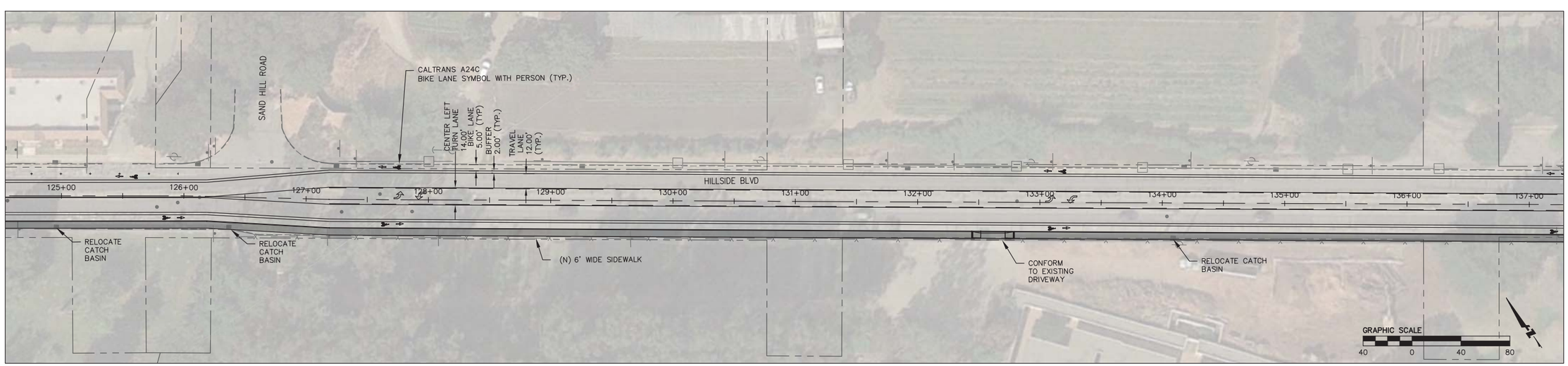
Design Considerations

- This project includes reconfiguring the roadway cross-section on Hillside Boulevard by installing sidewalk and bicycle facility along the corridor where these facilities are not present, providing sufficient space for all the road users to utilize the facility.
- The project would restrict parking on the corridor to one side of the road, where available on both sides in the existing conditions. However, the Town may find it infeasible to remove parking on Hillside Boulevard to accommodate the ideal cross-section proposed by the Kittelson team.

Note: Preliminary Design provided in the next page







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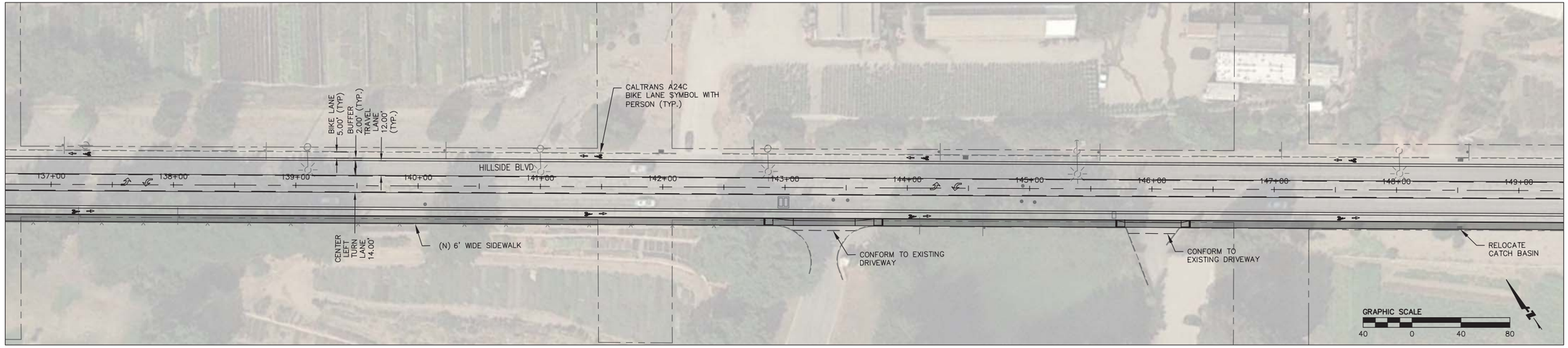

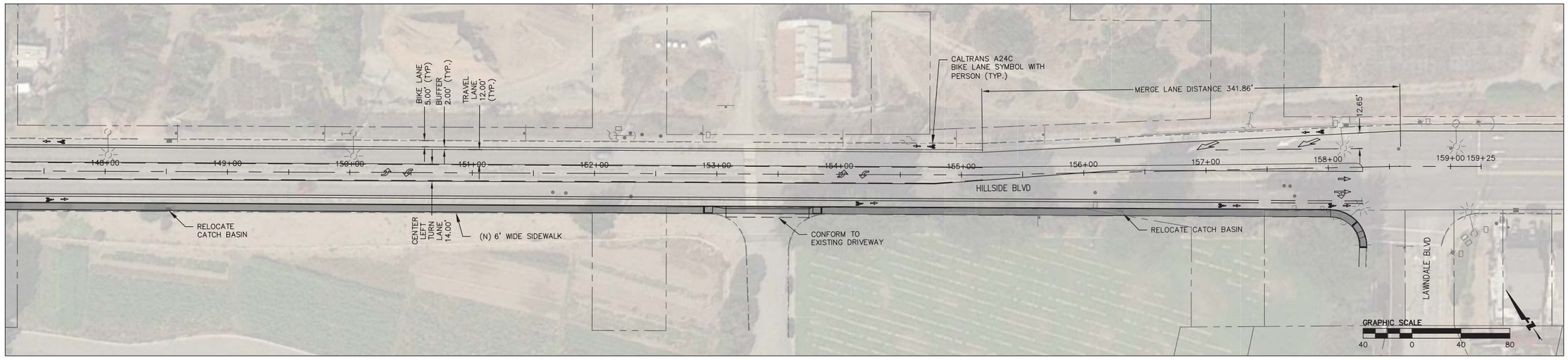

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Existing Conditions

Kittelson observed people walking and biking along Hillside Boulevard in the area between Serramonte/Hillside Bouldevard intersection and Hillside/Lawndale Boulevard Intersection. It was evident that some of the activity was the result of the businesses and cemetries along Hillside. This project would remove the parking on one side of the Hillside Boulevard and accommodate a new sidewalk and widen the existing bike lane on the corridor.The existing roadway configuration is shown in Figure 38.

Figure 38: Existing Roadway Configuration on Hillside Boulevard

Project Needs Identified

Kittelson identified that there were two reported fatal crashes and two injury crashes along this corridor during the years 2011-15. One of the fatal crashes involved a pedestrian violation, two crashes were due to driving under the influence (DUI), and the other crash was due to vehicle violation. Community input, discussions with Town Staff, and input from City Council meetings identified a desire to accommodate walking and biking needs to access businesses and cemeteries. These changes to incorporate non-motorized facilities are developed to increase driver awareness, visibility of the non-motorized users, and reduce motorist speeds along the corridor.

A part of this project would likely be competitive for HSIP funding because the improvements would address past severe crash occurrences. It could also be considered as an application for Active Transportation (ATP) grant funding due to the connections between neighborhoods and key destinations within the Town.

Project #2: El Camino Real/Mission Road Intersection

Project Description

This project would reduce the effects of skew and lack of channelized turning movements at El Camino Real (ECR) and Mission Road intersection. The project design concept uses contemporary intersection features to better define traffic movements and manage vehicle speeds. Kittelson suggests implementing street lighting at this intersection. In addition to this, Kittelson suggests the Town of Colma consider changes in the traffic control to the existing intersection. The intersection control evaluation (ICE) would consider geometric modifications and possible applications of signalized control that meets the intended outcomes at this intersection. Kittelson suggests the Town consider the following:

- Installing a traffic signal to meet the intended outcomes at this intersection.
- Eliminating the overlapping southbound left turn lanes and delineating the southbound Mission Road left turn lane south of Cypress Avenue.
- Maintaining two northbound lanes on ECR by removing northbound lane addition at Mission Road.
- Creating two continuous southbound lanes on ECR south of Collins Avenue intersection. The upstream two-lane section could be associated with the possible ECR/Collins Avenue intersection treatments.
- Channelizing this intersection with traffic separators, traffic islands, and pavement markings.
- Installing street lighting, and pedestrian crosswalks at the intersection.
- Adding a complementary northbound left turn lane and angling the southbound left turn to Cypress Avenue.
- Adding bike lanes on ECR in the northbound and southbound directions.

Figure 39 shows the project scope for this location. The estimated cost for this project is $ 4,125,000, and the benefit-cost ratio is 0.56.

Figure 39

El Camino Real and Mission Road

Estimated Cost: $4,125,000 **Benefit/Cost Ratio: 0.56**

COLMA TRANSPORTATION SAFETY ACTION PLAN

Existing Conditions

- Mission Road intersects El Camino Real at a skew and provides a free flow northbound movement from Mission Road via an added third lane.
- State facility intersection.
- El Camino Real is a four-lane facility to the south of Mission Road. There are two southbound through lanes and a left turn lane to Mission Road. Southbound left turn lanes to Mission are overlap with a southbound left turn lane to Cypress Avenue
- Mission Road is a two lane roadway with bicycle lanes.

Crash Summary

Crash Type and Contributing Factors

- 1 head-on crash, traveling on wrong side of road

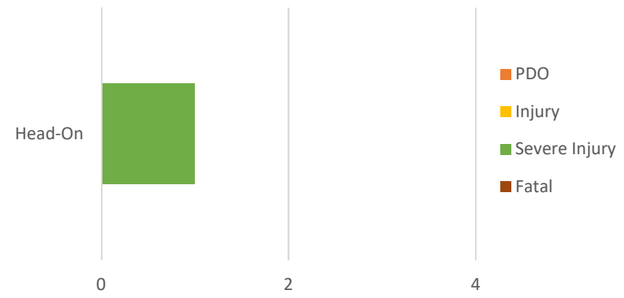
Crash Severity

- 1 severe injury crash (traveling on wrong side of road)

Crash Severity Score **40**

Number of Crashes **1**

Reported Crashes by Severity and Type



Project Description

This concept sketch illustrates an approach to improve vehicular safety and operations. Key items from the concept include:

- Installing a traffic signal to meet the intended outcomes at this intersection.
- Eliminating the overlapping southbound left turn lanes an delineating the southbound Mission Road left turn lane south of Cypress Avenue.
- Maintaining two northbound lanes on El Camino Real by removing the northbound lane addition at Mission Road.
- Creating two contiguous southbound lanes on El Camino Real south of Collins Ave. The upstream two lane section could be associated with possible El Camino Real/Collins Avenue intersection treatments that drop the southbound third lane north of Collins Avenue.
- Channelizing the Mission Road intersection with traffic separators, traffic islands, and pavement marking.
- Adding bike lanes on ECR on both sides of the roadway, and a complementary NB left turn lane to Cypress Avenue.

Design Considerations

- The basis of this design is reducing countering the effects of skew and lack of channelized turning movements. The intersection geometry is a result of a former rail line along a Collins Road alignment. At the time the intersection was created, vehicle volumes an speeds were much lower than today. The design should fundamentally consider contemporary intersection features to better define traffic movements and manage speeds. Studies should include evaluating southbound El Camino Real lane drop options in advance of Collins Ave. and possibly revising the northbound Mission Rd. movement to a conventional right turn lane with no lane addition.
- Since El Camino Real is a Caltrans facility, a Step 1 Intersection Control Evaluation (ICE) could be a first step. Given the proximity and relationship with Collins Avenue, the ICE could include both intersections.

Note: Preliminary Design provided in the next page

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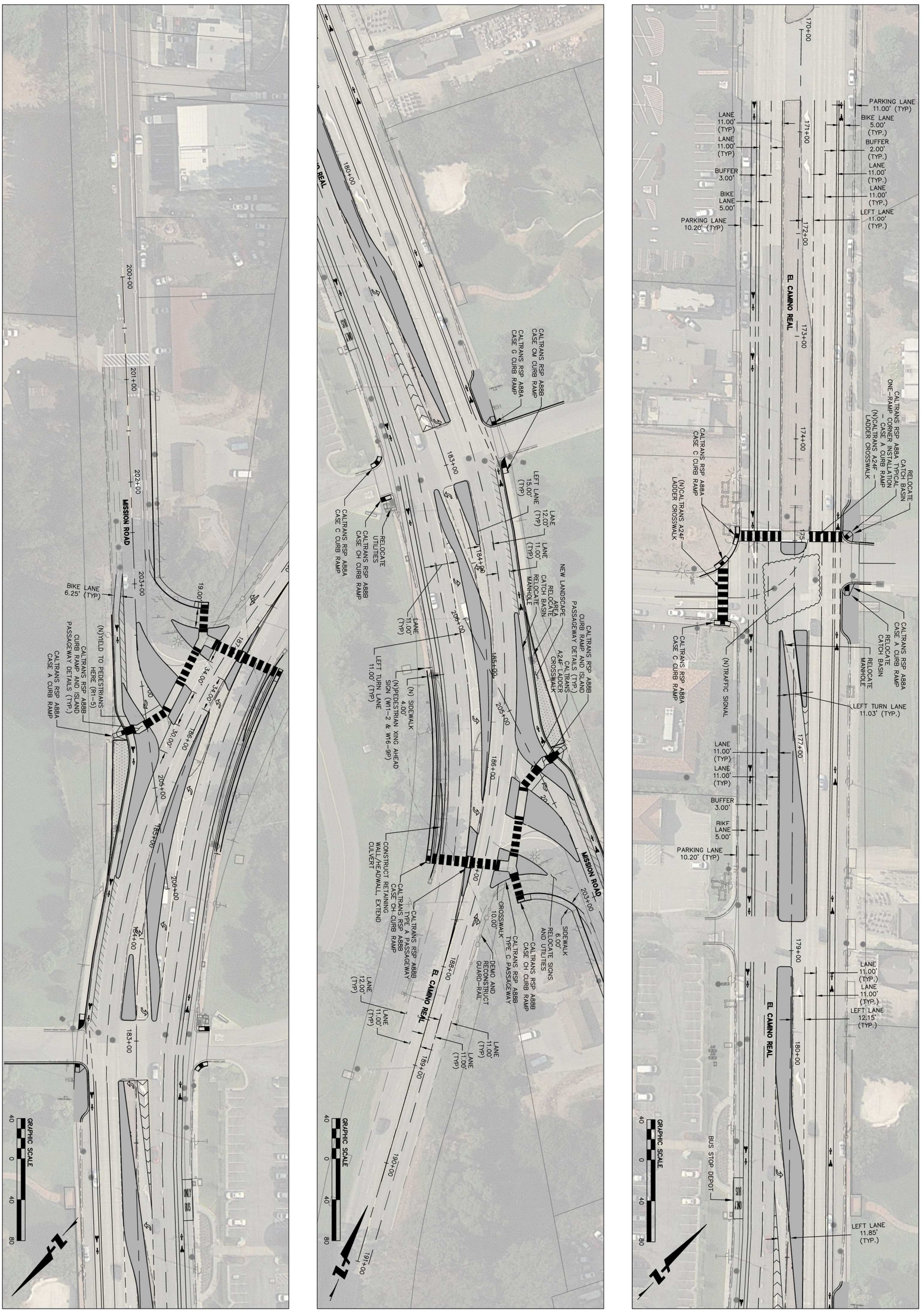

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Existing Conditions

Kittelson observed the ECR intersection is an uncommon configuration with Mission Road intersecting ECR at a skew and free flow northbound movement from Mission Road to ECR via an added third lane. The skew results in long crossings of conflicting movements and the 40 mph posted speed limits gaps for drivers negotiating the stop controlled movements. The free flow movement creates a weaving section northbound for Mission Road drivers that are destined for Collins Avenue and/or the cemetary or commercial uses located south of Collins Avenue on the western side of ECR.

ECR is a four-lane facility to the south of the Mission Road. There are two southbound through lanes and a left turn lane to Mission Road. Southbound left turn lanes to Mission overlap with a southbound left turn lane to Cypress Avenue. Mission Road is a two-lane roadway with bicycle lanes. Figure 40 shows the Mission Road/ECR intersection in the existing conditions.

Figure 40: Location along Mission Road in Need of Traffic Control.

Project Needs Identified

Kittelson identified that there was one reported severe injury crash at this intersection, which was with a vehicle traveling on wrong side of the road during the years 2011-15. The discussions with Town Staff, it's uncommon configuration, and the proximity of this intersection to the southern end of the Town limits led to considering a project for this intersection.

Given the crash history, the project may be competitive for HSIP funding. However, based on HSIP Cycle 9 requirements, it is not feasible to install a traffic signal at the intersection using HSIP funding.

Project #3: Reconfiguring Junipero Serra Boulevard/Serramonte Boulevard Intersection

Project Description

This project would consider improving the bicycle safety and vehicle operations at this intersection. The major part of this project is to simplify the Junipero Serra Boulevard/Serramonte Boulevard intersection to reduce the amount of decisions that drivers need to make to successfully navigate the intersection. Kittelson suggests the Town consider working with Caltrans to remove the access to I-280 on ramp from Junipero Serra boulevard and modifying the I-280 on ramp configuration from Serramonte Boulevard to make it a four-legged intersection. The modified ramp would operate as it does today with the revised ramp configuration matching prior to the ramp meter. The various movements to I-280 would remain the same as they are today, and the lane numbers and arrangements are essentially the same. Kittelson suggests the Town consider the following:

- Eliminating the fifth intersection leg, i.e. the diagonal on ramp stem from Junipero Serra Boulevard.
- Widening westbound Serramonte Boulevard from Junipero Serra Boulevard to the new two-lane on ramp connection to eastbound I-280.
- Modifying eastbound on ramp connection to match the existing ramp south of the ramp meter.
- Using striping to clearly define the two northbound lanes on Junipero Serra Boulevard departing the intersection.
- Striping bike lanes approaching the intersection including treatments at right-turn lanes.
- Modifying signing and pavement markings to eliminate the 'soft' left and right turns and modify the 'hard' left and right turns.

Figure 41 shows the project scope for this priority location. The estimated cost for this project is $ 2,815,400, and the benefit-cost ratio is 0.10.

Figure 41

Junipero Serra Boulevard and Serramonte Boulevard

Estimated Cost: $2,815,400 **Benefit/Cost Ratio: 0.1**

COLMA TRANSPORTATION SAFETY ACTION PLAN

Existing Conditions

- The five-legged intersection is controlled by a traffic signal and includes access to I-280 on-ramp.
- The configuration creates “hard” and “soft” left and right turns on various movements creating conflicting travel paths.
- Serramonte Boulevard curves horizontally through the intersection, and begins to drop vertically in the eastbound direction.
- Sight distance challenges for turning vehicles.

Crash Summary

Crash Type and Contributing Factors

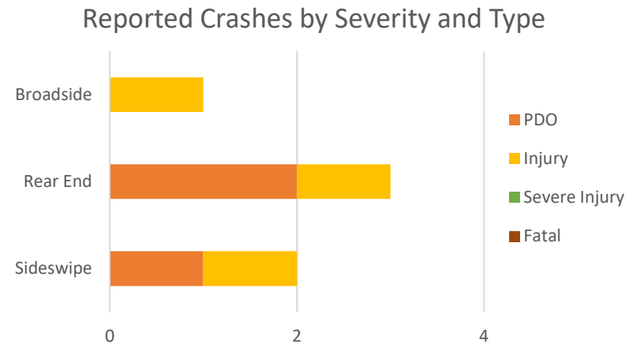
- 2 sideswipe crashes; improper turning
- 3 rear-end crashes; following too closely, improper turning, unsafe speed)
- 1 broadside crash (automobile right-of-way)

Crash Severity

- 1 Other Visible Injury crash (improper turning)
- 2 Complaint of Pain Injury crashes (following too closely, automobile right-of-way)
- 3 PDO crashes (2 improper turning, 1 unsafe speed)

Crash Severity Score **5.22**

Number of Crashes **6**



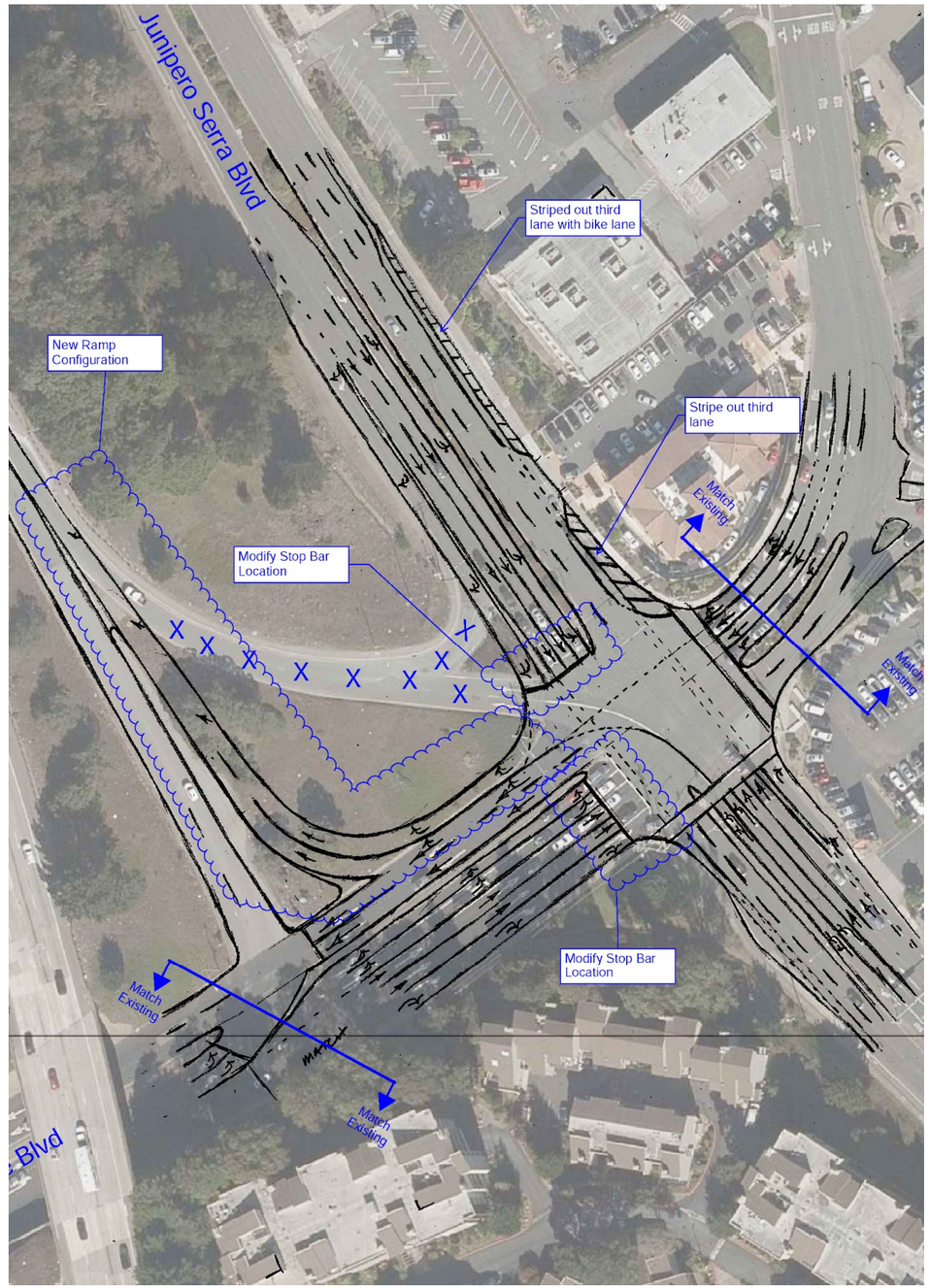
Project Description

This concept sketch illustrates an approach to improve bicycle safety and vehicle operations. Key items from the concept include:

- Eliminating the 5th intersection leg (the diagonal ramp stem from Junipero Serra Boulevard.)
- Widening westbound Serramonte Blvd from Junipero Serra Blvd to the new two lane ramp connection to eastbound I-280.
- Modifying the eastbound ramp connection to match the existing ramp south of the ramp meter.
- Using striping to clearly define the two northbound Junipero Serra Blvd. lanes departing the intersection.
- Striping bike lanes approaching an through the intersection including treatments at right turn lanes.
- Modifying signing and pavement marking to eliminate the “soft” left and right turns and modify the “hard” left and right turns.

Design Considerations

- The basis of this design is to eliminate the fifth intersection leg and locate the I-280 on-ramp movement with the existing ramp terminal intersection on Serramonte Blvd. The modified ramp would operate as it does today with the revised ramp configuration matching prior to the ramp meter. The various movements to I-280 remain essentially as they are today and the lane numbers and arrangements are the same. Eliminating the fifth leg removes ambiguity of movements from each leg without fundamentally changing approach lane numbers and arrangements.
- As the intersection modifies a Caltrans’ facility, coordination with District 4 staff would be a positive early step.
- The Collins Avenue corridor could include treatments that affect the Collins Avenue/Serramonte Blvd. intersection. Given the close proximity to Juniper Serra Blvd, intersection treatments at Junipero Serra Boulevard could potentially include the Collins Avenue intersection.



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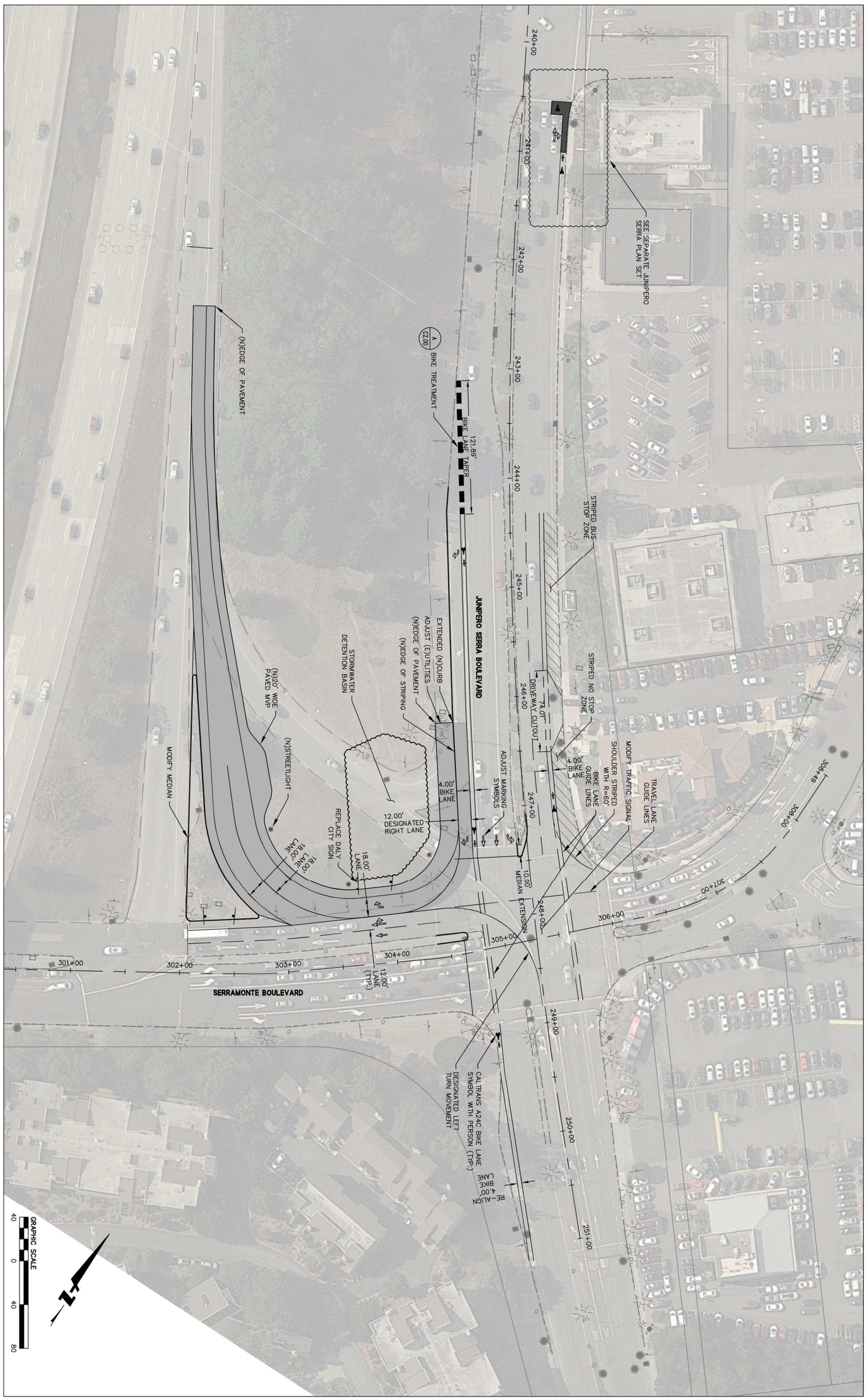

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Existing Conditions

The Junipero Serra Boulevard/Serramonte Boulevard is a five-legged intersection, is controlled by a traffic signal and includes access to the I-280 on-ramp. This configuration creates 'hard' and 'soft' left and right turns on various movements creating conflicting travel paths. Figure 42 shows an aerial of the Junipero Serra Boulevard/Serramonte Boulevard intersection. Serramonte Boulevard curves horizontally through the intersection with Collins Avenue and beings to drop vertically in the eastbound direction. As a result, the current alignment creates sight distance challenges for turning motorists as well as limited time to react to the different movements and activities occurring at the intersection. The multiple legs of the intersection and access to I-280 also requires multiple lanes, overhead signs, and pavement markings on the northbound and eastbound approaches to pre-segregate motor vehicles into the proper lanes based on motorists' desired destinations.

Figure 42: Junipero Serra Boulevard/Serramonte Boulevard and Serramonte Boulevard/Collins Avenue Intersections

Source: Google Earth, 2018.

Project Needs Identified

Kittelson identified that there were six reported crashes at this intersection (1 other visible injury, 2 complaint of pain injuries, and 3 property damage only (PDO)) crashes, during the years 2011-15. The complex and closely-spaced intersection form, access to shopping center and I-280, and the discussions with Town staff identified a desire to reconfigure this intersection. While the intersection provides access to I-280, it is also an important intersection for people walking or biking to access transit stops on Junipero Serra Boulevard as well as to access the commercial uses on Junipero Serra Boulevard and Serramonte Boulevard. Improvements at this location would need to be coordinated with Caltrans. Given the crash history, the project would not be competitive for HSIP funding.

Project #4: Junipero Serra Boulevard from Colma Boulevard to Serramonte Boulevard

Project Description

This project would consider improving bicyclist safety, pedestrian safety and vehicle operations along the corridor. The basis for the project is to improve bike facilities along the corridor, improve pedestrian access, and better delineate the pavement markings for vehicle movements and operations. Town staff has also received concerns from residents that motorists do not properly yield ot people crossing the street in the crosswalks. Kittelson suggests the Town consider the following:

- Installing leading pedestrian intervals or restricting right-turns on red to address the concern that motor vehicles do not yield properly to people crossing the street.
- Installing raised median island for pedestrian refuge on the westbound approach of Junipero Serra Boulevard and Colma Boulevard intersection.
- Striping out the outside receiving lane on the northbound approach of the Junipero Serra Boulevard at the Colma Boulevard intersection to shadow right-turn lane from Colma Boulevard and better delineate bike lane.
- Narrowing to two receiving lanes on the eastbound approach at the Colma Boulevard intersection and delineate southbound left-turns through the intersection.
- Install green bike lane transition markings at the right-turn lanes at intersections along the corridor.
- Install bike box with green bike lane markings at the Serra center driveway intersection on the corridor. This is a good treatment for non-motorized traffic traveling through the corridor.
- Eliminating the median nose for improved pedestrian access at the Serra center driveway intersection.

Figure 43 shows the project scope for the corridor. The estimated cost for this project is $ 335,000, and the benefit-cost ratio is 0.90.

Figure 43

Junipero Serra Boulevard from Colma Boulevard to Serramonte Boulevard

Estimated Cost: $335,000 **Benefit/Cost Ratio: 0.9**

COLMA TRANSPORTATION SAFETY ACTION PLAN

Existing Conditions

- Junipero Serra Boulevard is a north-south study corridor running in parallel to ECR and I-280.
- Corridor segment has a rolling grade with up and down grades.
- The corridor has sidewalk on the east side of the corridor until the Serramonte/Junipero Serra Boulevard intersection.
- Serramonte Boulevard interchanges with I-280 providing a freeway connection to the town through this corridor.

Crash Severity Score **4.08**

Number of Crashes **5**

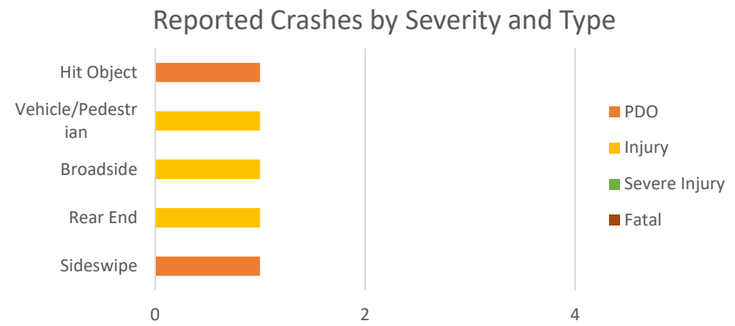
Crash Summary

Crash Type and Contributing Factors

- 1 broadside crash, automobile right of way
- 1 rear-end crash, following too closely
- 1 vehicle/pedestrian crash, pedestrian right-of-way
- 1 sideswipe crash, improper turning
- 1 hit object crash, unsafe lane change

Crash Severity

- 3 Complaint of Pain Injury crashes
- 2 PDO crashes (improper turning, unsafe lane change)



Project Description

This concept sketch illustrates an approach to improve bicycle safety, pedestrian safety and vehicle operations.

- Installing raised median island for pedestrian refuge on the westbound approach of Junipero Serra Boulevard and Colma Boulevard intersection.
- Striping out the outside receiving lane on the northbound approach of the Junipero Serra Boulevard at the Colma Boulevard intersection to shadow right-turn lane from Colma Boulevard and better delineate bike lane.
- Narrowing to two receiving lanes on the eastbound approach at the Colma Boulevard intersection and delineate southbound left-turns through the intersection.
- Installing green bike lane transition markings at the right-turn lanes at intersections along the corridor.
- Installing bike box with green bike lane markings at the Serra center driveway intersection on the corridor.
- Eliminating the median nose for improved pedestrian access at the Serra center driveway intersection.

Design Considerations

- This project would consider improving bicyclist safety, pedestrian safety and vehicle operations along the corridor.
- The basis for the project is to improve bike facilities along the corridor, improve pedestrian access, and better delineate the pavement markings for vehicle movements and operations.
- Kittelson suggested implementing leading pedestrian intervals at traffic signals and restricting the right-turns on red at the intersections.

Note: Preliminary Design provided in the next page

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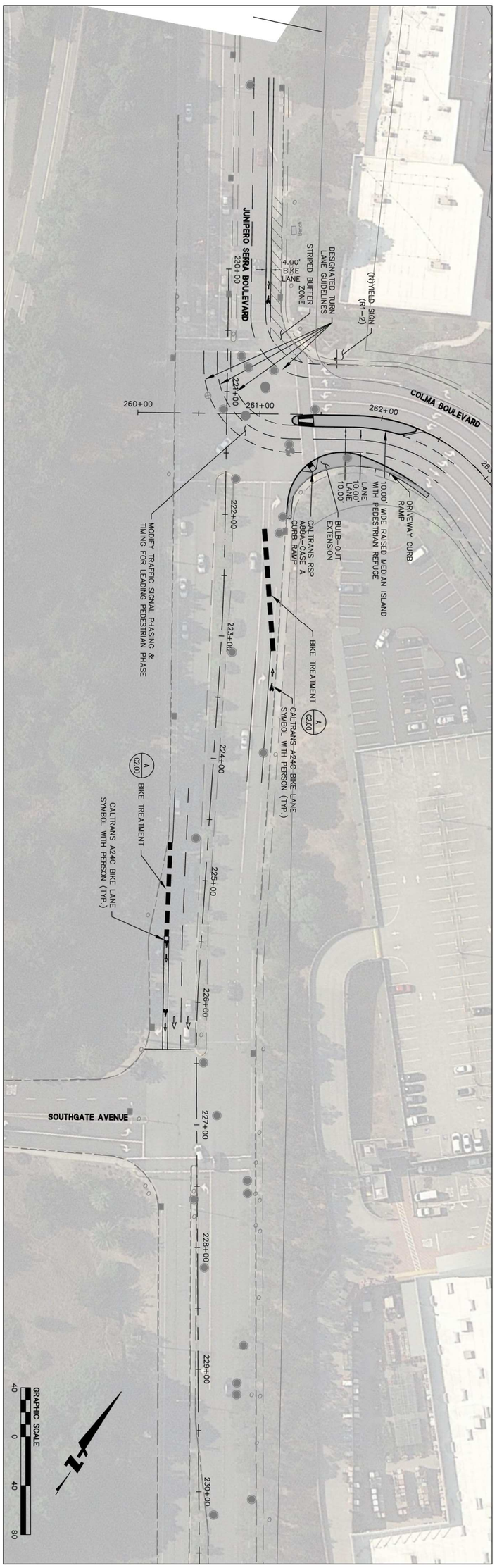

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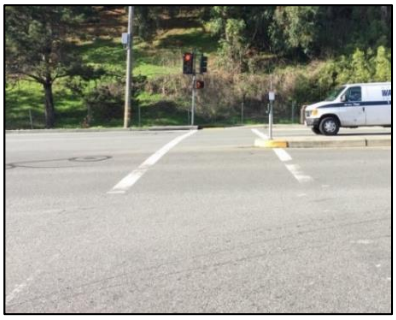
Existing Conditions

Junipero Serra Boulevard (JSB) is a north-south study corridor running in parallel to ECR and I-280, between the northern and southern town limits . The corridor has commercial development at the Serramonte Center. Serramonte Boulevard interchanges with I-280 providing a freeway connection to the town. The corridor segment has a rolling grade with up and downgrades. The corridor has sidewalk on the east side of the corridor until the Serramonte Boulevard/JSB intersection. Figure 44 shows the existing conditions on the corridor.



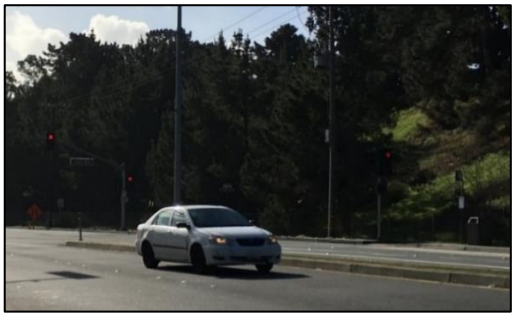


Figure 44: Existing Conditions on JSB Corridor

Project Needs Identified

Kittelson identified that there were 5 reported crashes on the corridor from Colma Boulevard to Collins Avenue intersection on JSB, during the years 2011-15. The discussions with Town Staff, proximity to the commercial development, and access to I-280 identified a desire to consider improvements on the JSB corridor. The crash history would not lead to a competitive HSIP application. Town staff and community input indicate there is pedestrian and bicyclist activity along the corridor, especially at the JSB/Colma Boulevard intersection, and general concern about drivers not yielding to pedestrians crossing the street at this intersection. Low cost countermeasures such as implementing 'Leading Pedestrian Intervals' or 'No Right-Turn on Red' at the signalized intersections could be implemented by the Town in the near-term.

Project #5: Reconfiguring Colma Boulevard from El Camino Real to Junipero Serra Boulevard

Project Description

This project would consider converting the current cross-section on Colma Boulevard from ECR to the driveway near Burger King to a road-diet, with bike lane on both sides of the roadway, and sidewalk on one side of the roadway. This change could align with the driver expectancy while traveling along this corridor. The project team suggests installing street lights along the corridor. Kittelson suggests the Town consider the following:

- Installing raised median to shadow left turn lane on westbound approach to Junipero Serra Boulevard.
- Transitioning from the current lane configuration on Colma Boulevard to three lane cross section (i.e. one lane on either side of the roadway with a two-way center turn lane), and bike lanes on both sides of the roadway, with sidewalk on one side of the roadway.

Figure 45 shows the project scope for this location. The estimated cost for this project is $ 956,250, and the benefit-cost ratio is 0.43.

Figure 45

Colma Boulevard from El Camino Real to Junipero Serra Boulevard

Estimated Cost: $956,250 **Benefit/Cost Ratio:0.43**

COLMA TRANSPORTATION SAFETY ACTION PLAN

Existing Conditions

- Colma Boulevard is an east-west study corridor running in between El Camino Real and Junipero Serra Boulevard.
- The corridor has cemeteries near El Camino Real intersection and commercial development to the west approaching Junipero Serra Boulevard.
- The corridor has higher vehicle speeds traveling east, because of the downgrade towards El Camino Real.

Crash Severity Score **3.45**

Number of Crashes **7**

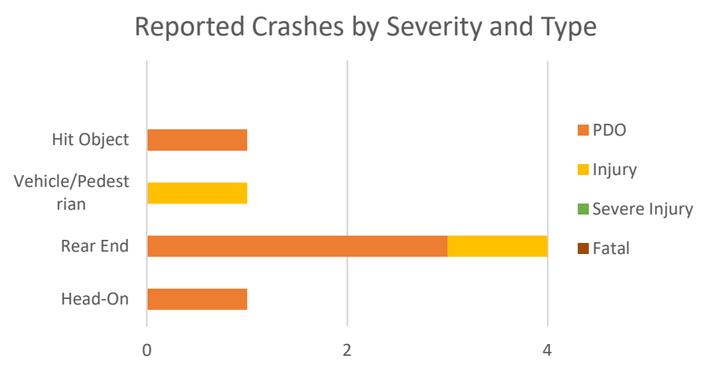
Crash Summary

Crash Type and Contributing Factors

- 4 rear-end crashes; improper turning, unsafe speed
- 1 vehicle/pedestrian crash, unsafe starting and backing
- 1 hit object crash, improper turning
- 1 head-on crash, lane change

Crash Severity

- 2 Complaint of Pain Injury crashes (improper turning, unsafe starting and backing)
- 5 PDO crashes (unsafe speed, improper turning, lane change)



Project Description

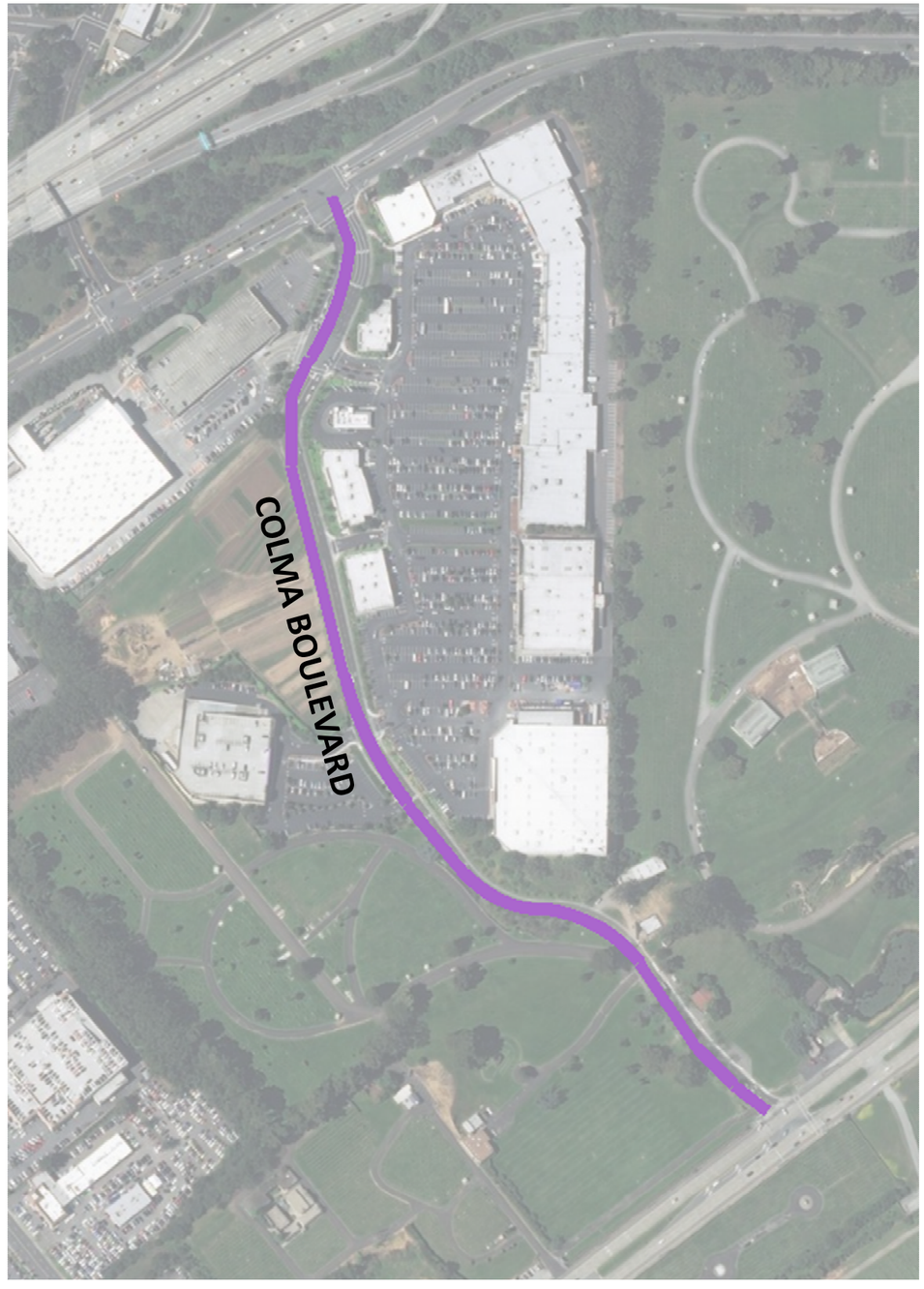
This concept sketch illustrates an approach to improve bicycle safety, pedestrian safety. Key items from the concept include:

- Installing raised median to shadow left turn lane on westbound approach to Junipero Serra Boulevard.
- Transitioning from the current lane configuration on Colma Boulevard to three lane cross-section (i.e. one lane on either side of the roadway with a two-way center turn lane), and bike lanes on both sides of the roadway, with sidewalk on one side of the roadway.
- This reconfiguration includes sidewalk on one side of the roadway.

Design Considerations

- This project would consider converting the current cross-section on Colma Boulevard from ECR to the driveway near Burger King to a road-diet, with bike lane on both sides of the roadway. This change could align with the driver expectancy while traveling along this corridor.

Note: Preliminary Design provided in the next page



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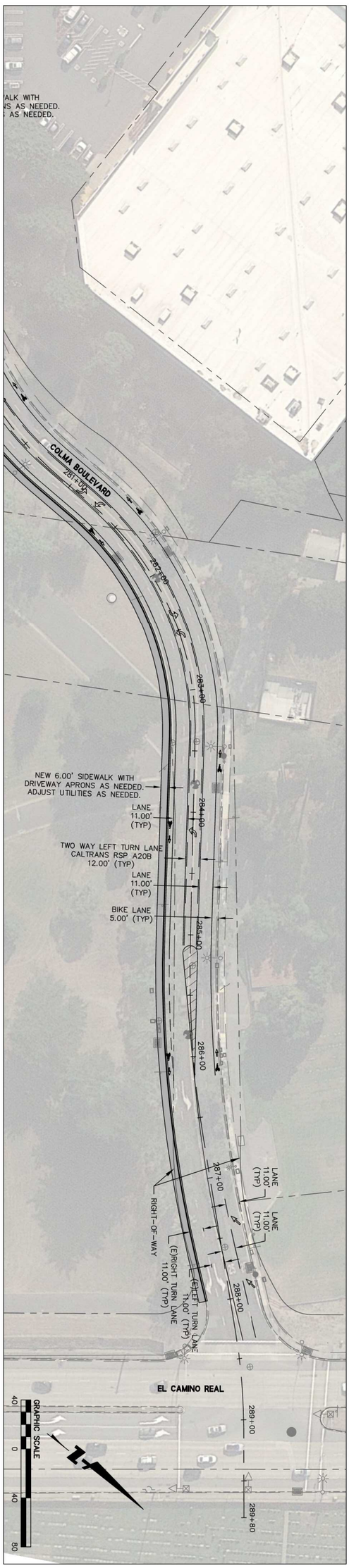

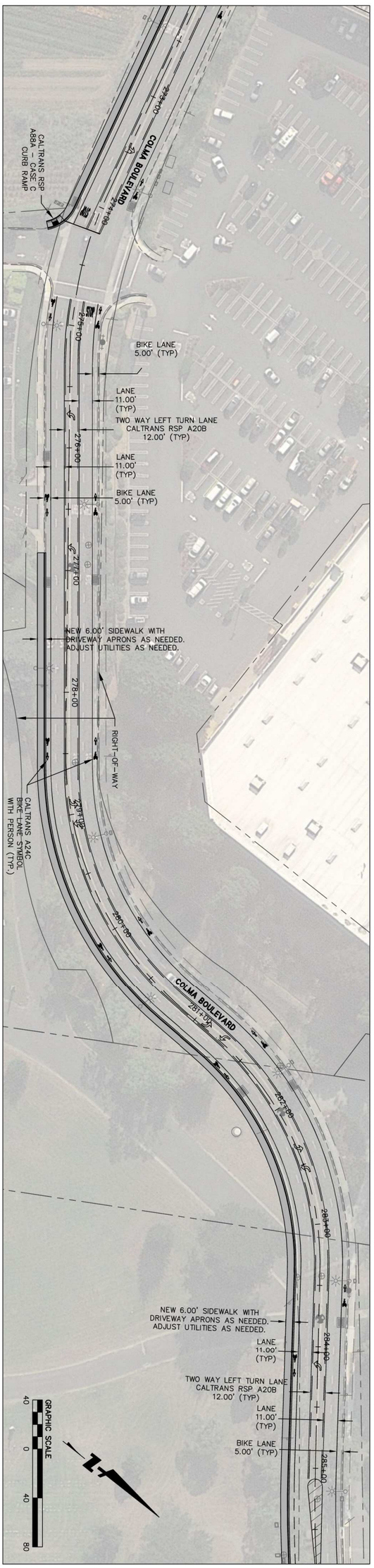

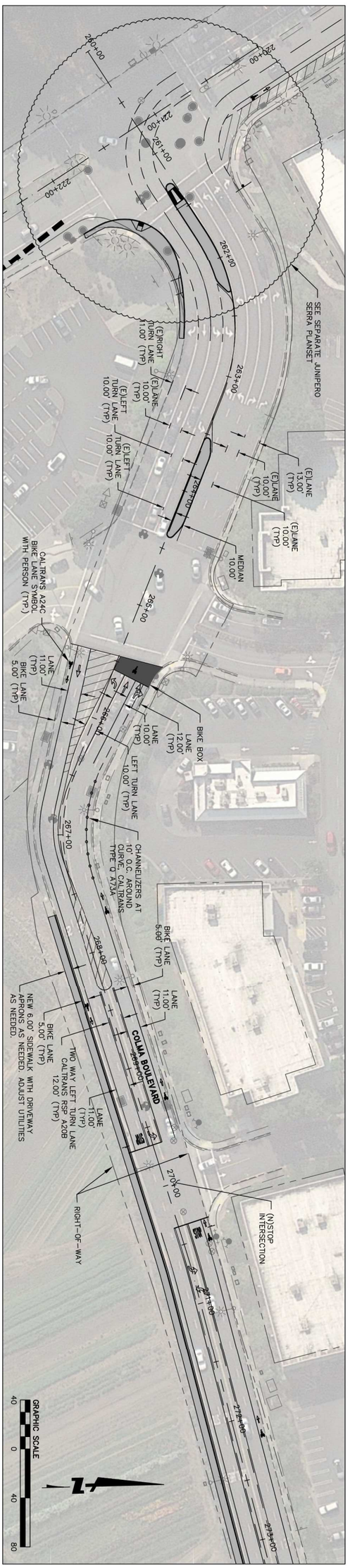

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COLMA BLVD
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30% CONCEPT PLANS

Existing Conditions

Colma Boulevard is an east-west study corridor between ECR and JSB . The corridor has cemeteries near the ECR intersection and commercial development to the west approaching JSB. The corridor has four lanes at ECR that widens at the JSB intersection. The roadway is inclined going west from ECR and vehicle speeds are higher traveling east, down hill toward ECR. The corridor has sidewalk on the north side the entire length of the corridor and on both sides from the commercial development westward. Figure 46 shows existing conditions on Colma Boulevard.

Figure 46: Existing Conditions on Colma Boulevard

Project Needs Identified

Kittelson identified that there were seven reported crashes along the corridor, of which two were complaint of pain injuries, and five were PDO crashes, during the years 2011-15. The presence of commercial development on the westside of the corridor, proximity/connection to two major corridors in town (i.e. ECR and JSB) and discussions with Town Staff identified a desire to reconfigure the cross-section on the corridor. The crash history along this corridor would not lead to a competitive HSIP application. However, the risk factors related to the non-motorized users, community concerns regarding the drivers not yielding to pedestrians at the Colma Boulevard/JSB intersection, and retail centers along the corridor may help the Town pursue Caltrans ATP or Transportation Planning grant program funding for improvements on the corridor.

Project #6: El Camino Real/F Street Intersection

Project Description

The project would consider improving pedestrian safety and vehicle operations at this intersection. The basis of this design is to improve sight lines at the north F street intersection by squaring up the westbound approach, eliminating parking, and widening sidewalk under the BART overcrossing. The project concept would simplify the south F street intersection by well defining and modifying access to the Woodlawn Memorial Park. Kittelson suggests that the access to Woodlawn Cemetery should be right-in only, i.e. entrance only and not exit. In addition to this, Kittelson also suggests installing speed feedback signs near the ECR/F Street intersection approach to reduce westbound vehicle speeds. Kittelson suggests the Town consider the following at this intersection:

- Squaring up the F street northbound right-turn lane.
- Removing parking on northbound ECR between F streets north and south of Bay Area Rapid Transit (BART) overcrossing and widening the sidewalk and curb.
- Widening the sidewalk and the north F street intersection crosswalk along ECR.
- Striping a defined southbound right-turn lane and striping out the extra wide shoulder at the Woodlawn Memorial Park driveway.
- Closing the median opening in front of the north F street intersection.
- Consider closing or modifying the Woodlawn Memorial Park driveway near the south F street intersection.
- Widening the median on ECR so that the left turn lanes to the south F street intersection begins after the Woodlawn Memorial Park driveway.
- Adding bike lanes on both sides of the roadway, with two travel lanes in each direction of the ECR corridor.

Figure 47 shows the project scope for this priority location. The estimated cost for this project is $ 342,100, and the benefit-cost ratio is 0.30.

Figure 47

El Camino Real and F Street (Eastern Intersection)

Estimated Cost: $342,100 **Benefit/Cost Ratio:0.3**

COLMA TRANSPORTATION SAFETY ACTION PLAN

Existing Conditions

- F street branches off El Camino Real with a steep upgrade and then levels off to the north side.
- Parked cars on northbound El Camino Real decrease intersection sight distance from F street.
- A gentle right turn curb return results in poor sightlines to northbound El Camino Real.
- State facility intersection.
- El Camino Real is a six-lane facility with a median.
- Two northbound left-turn lanes at the south F Street leg increases the pedestrian crossing distance across El Camino Real.

Crash Severity Score **3.40**

Number of Crashes **2**

Reported Crashes by Severity and Type

Crash Summary

Crash Type and Contributing Factors

- 1 broadside crash, traffic signals and signs violation
- 1 rear-end crash, unsafe speed

Crash Severity

- 1 Other Visible Injury crash (traffic signals and signs violation)
- 1 Complaint of Pain Injury crash (unsafe speed)

Project Description

This concept sketch illustrates an approach to improve pedestrian safety and vehicle operations. Key items from the concept include:

- Squaring up the F street northbound right-turn lane
- Removing parking on northbound El Camino Real between F Streets north and south of the BART overcrossing and widening the sidewalk and curb.
- Widening the sidewalk and the north F Street intersection cross walk along El Camino Real.
- Striping a defined southbound right-turn lane to and striping out the extra wide shoulder at the Woodlawn Memorial Park driveway.
- Closing the median opening in front of the north F Street intersection.
- Consider closing or modifying the Woodlawn Memorial Park driveway near the south F Street intersection.
- Widening the median so that the left turn lanes to the south F Street intersection begins after the Woodlawn Memorial Park driveway.

Design Considerations

- The basis of this design is to improve sight lines at the north F Street intersection by squaring up the westbound approach and eliminating parking and widening the sidewalk under the BART overcrossing. The concept could simplify the south F Street intersection defining and possibly modifying access to Woodlawn Memorial Park.
- The concept identifies opportunities to better define access to the Woodlawn Memorial Park facility. Future study activities should include understanding facility operations and working cooperatively with the facility staff.
- Investigating treatments for the north and south F Street intersections should include considering access and circulation at the Woodlawn Memorial Park facility.
- As the intersection modifies a Caltrans' facility, coordination with District 4 staff would be a positive early step.
- Adding bike lanes on both sides of the roadway, with two travel lanes in each direction of ECR.

Existing Conditions

Kittelson observed that there are cemeteries near this intersection, and F street branches off ECR with a steep upgrade and then levels off to the north side. ECR has 40 mph posted speed limit in the Town of Colma, and has pedestrian crosswalk at the southern end of the intersection. Parked cars on northound ECR decrease intersection sight distance from F street. A gentle right turn curb return results in poor sightlines to northbound ECR. ECR has three through travel lanes on both sides of the roadway and two northbound left-turn lanes at the south F street intersection leg, which increases pedestrian crossing distance across ECR. Figure 48 shows the existing conditions at ECR/F Street intersection.

Figure 48: Existing Conditions at El Camino Real/F Street Intersection.

Project Needs Identified

Kittelson identified that there were two reported crashes at this intersection, one other visible injury and the other was complaint of pain injury during the years 2011-15. The discussions with town staff, community input, and the intersection being in residential area identified a desire to consider improvements to this intersection.

Given the crash history, and the improvements identified, this project would not be eligible for HSIP funding. With the nature of the improvements, we also do not think it would be a competitive ATP grant application. For changes at this intersection, the Town would need to coordinate with Caltrans about potential improvements.

Project #7: El Camino Real/Serramonte Boulevard Intersection

Project Description

This project would consider improving pedestrian safety and vehicle operations at the intersection. The basis of this design is to reduce curb radii and enhance pedestrian crossings at the ECR intersection. Each roadway has multiple lanes each direction and that width could potentially serve large trucks. Serramonte Boulevard has a downgrade approaching ECR, and the downgrade contributes to westbound speeds. This project proposed median in any form that narrows the roadway to four lanes in this location and would contribute to speed management down the hill. Kittelson suggests the Town consider the following:

- Reducing curb return radii, adjusting and defining sidewalks.
- Creating angled left-turn lanes on El Camino Real to improve sight lines and facilitate turning movements.
- Defining better on street parking on El Camino Real outside the intersection area.
- Restriping westbound Serramonte Boulevard to maintain two through lanes through the horizontal curves. The right-turn lane would be added in the tangent section approaching the intersection.
- Considering an eastbound left-turn lane from Serramonte Boulevard to the Town of Colma Police complex. A median in any form reduces the roadway to four lanes in this location and will support vehicle speed management down the hill.
- Adding bike lanes on both sides of ECR, with two travel lanes in each direction along the entire corridor.

Figure 49 shows the project scope for this priority location. The estimated cost for this project is $ 335,900, and the benefit-cost ratio is 0.20.

Figure 49

El Camino Real and Serramonte Boulevard

Estimated Cost: $335,900 **Benefit/Cost Ratio:0.2**

COLMA TRANSPORTATION SAFETY ACTION PLAN

Existing Conditions

- This intersection is a four-legged intersection with skewed crosswalks on the north and south legs of the intersection.
- Turn lanes are developed on westbound Serramonte at a horizontal curve creating undefined travel paths near adjacent driveways
- State facility intersection.
- El Camino Real is a six-lane facility with a wide median.
- Serramonte Boulevard is a four lane roadway, with auto dealerships and commercial development along the corridor.

Crash Summary

Crash Type and Contributing Factors

- 1 hit-object crash, improper turning
- 1 rear end crash, unsafe speed
- 1 other crash, unknown

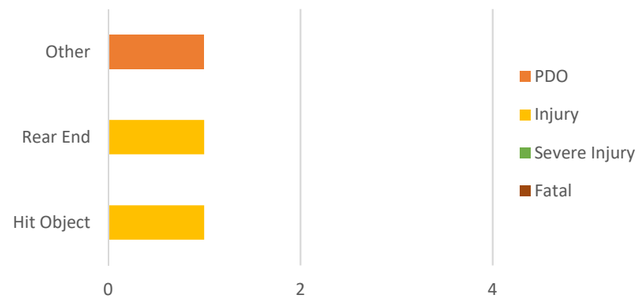
Crash Severity

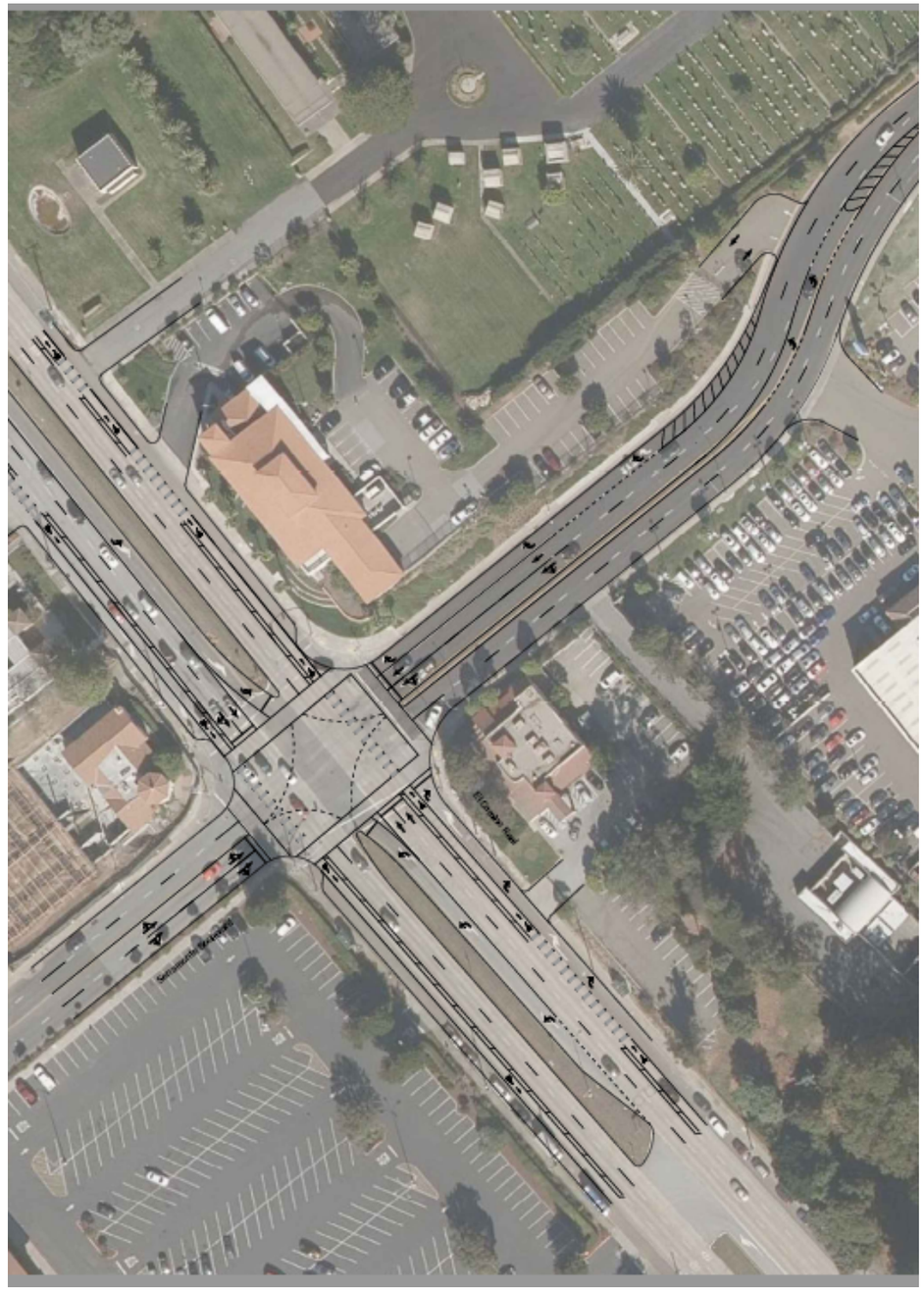
- 2 Complaint of Pain Injury crashes (improper turning, unsafe speed)
- 1 PDO crash (unknown)

Crash Severity Score **2.65**

Number of Crashes **3**

Reported Crashes by Severity and Type





Project Description

This concept sketch illustrates an approach to improve pedestrian safety and vehicle operations. Key items from the concept include:

- Reducing curb return radii adjusting and defining sidewalks.
- Creating angled left turn lanes on El Camino Real to improve sight lines and facilitate turning movements.
- Better defining on street parking on El Camino Real outside the intersection area.
- Restriping westbound Serramonte Boulevard to maintain two through lanes through the horizontal curves. The right turn lane would be added in the tangent section approaching the intersection.
- Considering an eastbound left turn lane from Serramonte Blvd. to the Town of Colma Police complex. A median in any form narrows the roadway to four lanes in this location and support speed management down the hill.
- Adding bike lanes on both sides of ECR, with two travel lanes in each direction along the entire corridor.

Design Considerations

- The basis of this design is to reduce curb return radii and enhance pedestrian crossings at the El Camino Real intersection. Each roadway has multiple lanes each direction and that width could potentially serve large trucks.
- Serramonte Blvd has a down grade approaching El Camino Real. The down grade contributes to westbound speeds. The northbound right turn lane is added in the horizontal curve contributing to a wider, undefined roadway near the Town Police facility and auto sales complex. Access and circulation at these locations should be investigated to optimize configurations . Developing the northbound right turn lane after the horizontal curve separates conflicts from the through and turning movements to the driveways.
- Design vehicle needs for each movement will need to be evaluated.
- As the intersection modifies a Caltrans' facility, coordination with District 4 staff would be a positive early step.

Existing Conditions

ECR/Serramonte Boulevard is a four-legged intersection with skewed crosswalks on the north and south legs of the intersection. ECR is a six-lane facility with a wide median. Turn lanes are developed on westbound Serramonte at a horizontal curve creating undefined travel paths near adjacent driveways. Serramonte Boulevard is a four-lane roadway, with auto dealerships and commercial development along the corridor. Figure 50 shows existing conditions at this intersection.

Figure 50: Existing Conditions at El Camino Real and Serramonte Boulevard Intersection.

Project Needs Identified

Kittelson identified that there were three reported crashes (one PDO and two complaint of pain injury crashes) during the years, 2011-15 at this intersection. Because of the proximity of this location to several auto dealerships, and commercial development, the Town of Colma identified a desire to make necessary improvements to this intersection, and to improve the walking facilities at the intersection. Given the crash history and the improvements identified, this project would not be eligible for HSIP funding. Changes to ECR would require coordination with Caltrans.

Project #8: El Camino Real/Colma Boulevard Intersection

Project Description

This project would consider improving pedestrian and bicyclist safety. The basis of this design is to better define and delineate pedestrian crossing treatments across ECR and Colma Boulevard and providing buffered bike lanes along ECR. This project would consider investigating and proposing changes to the Greek Orthodox Memorial Garden access at Colma Boulevard, which will require coordinating with the facility and understanding access and circulation needs. Kittelson suggests the Town consider the following:

- Reconfiguring ECR to two travel lanes in each direction, with buffered bike lanes on both sides of the roadway.
- Extending the median to provide a pedestrian refuge area for the El Camino Real crossing.
- Providing angled left-turn lanes to adjacent driveways north of Colma Boulevard.
- Considering closing the driveway from the Greek Orthodox Memorial Park at Colma Boulevard or converting this access to one way outbound only.

Figure 51 shows the project scope for this intersection. The estimated cost for this project is $ 126,400, and the benefit-cost ratio is 0.50.

Figure 51

El Camino Real and Colma Boulevard

Estimated Cost: $126,400 **Benefit/Cost Ratio:0.5**

COLMA TRANSPORTATION SAFETY ACTION PLAN

Existing Conditions

- Colma Boulevard has a significant downgrade eastbound approaching El Camino Real. The downgrade increases vehicles speeds approaching El Camino Real .
- State facility intersection.
- El Camino Real is a six-lane facility with a wide median.
- Colma is a four lane roadway.
- There is currently a standard crosswalk on the north leg of the intersection.
- Near-side transit stops are on either side of Colman Boulevard

Crash Summary

Crash Type and Contributing Factors

- 1 head-on crash, traffic signals and signs violation

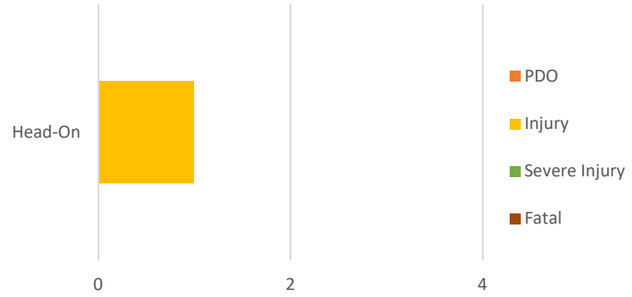
Crash Severity

- 1 Other Visible Injury crash (traffic signals and signs violation)

Crash Severity Score **2.17**

Number of Crashes **1**

Reported Crashes by Severity and Type



Project Description

This concept sketch illustrates an approach to improve pedestrian and bicyclist safety. Key items from the concept include:

- Reconfiguring ECR to two travel lanes in each direction, with buffered bike lanes on either sides of the roadway.
- Extending the median to provide a pedestrian refuge area for the El Camino Real crossing.
- Providing angled left-turn lanes to adjacent driveways north of Colma Blvd.
- Considering closing the driveway from the Greek Orthodox Memorial Park at Colma Blvd or converting this access to one way outbound only.

Design Considerations

- The basis of this design is to better define and delineate pedestrian crossing treatments across El Camino Real and Colma Blvd and providing buffered bike lanes along El Camino Real.
- Investigating changes to the Greek Orthodox Memorial Garden access at Colma Blvd will require coordinating with the facility to understand access and circulation needs.
- The sidewalk on the south side of Colma Blvd terminates at a stair case. Studies of the potential driveway closure or modification should consider ADA compatible approaches to serving pedestrians at this location.
- As the intersection modifies a Caltrans' facility, coordination with District 4 staff would be a positive early step.

Existing Conditions

Colma Boulevard has a significant downgrade eastbound approaching ECR, and Kittelson observed higher vehicle travel speeds approaching ECR. Colma Boulevard has sidewalk on the north side of the corridor and is a four-lane roadway. Near-side transit stops are on either side of Colma Boulevard. Figure 52 shows the existing conditions on Colma Boulevard/ECR intersection.

Figure 52: Existing Conditions at Colma Boulevard/ECR.

Project Needs Identified

Kittelson identified that there was one reported other visible injury crash at this intersection, which was a head-on crash during the years 2011-15. The discussions with the Town staff, field observations, and the community concerns identified a desire to consider improvements at this intersection. Given the crash history, and the improvements, the project would not be competitive for HSIP funding. Changes on ECR would require coordination with Caltrans.

Project #9: Collins Avenue from El Camino Real to Serramonte Boulevard

Project Description

The project would consider improving vehicle operations along the corridor. The basis for the project is to facilitate slower vehicle speeds along the corridor, and to provide pedestrian accommodations continuously throughout the corridor. Kittelson suggests implementing street lighting along the entire corridor. Kittelson suggest the Town consider the following:

- Installing speed feedback sign at the location of existing speed limit sign.
- Restriping the corridor to delineate outer edges with parking and no parking areas.
- Narrowing the lanes to 11ft wide and including centerline with raised pavement markers.
- Providing continuous sidewalk along the corridor, i.e. providing sidewalk links to the existing sidewalk through the driveway area.
- Reconfiguring Collins Avenue/Serramonte Boulevard intersection.
- Installing a traffic signal at Collins Avenue/El Camino Real intersection, to meet the intended outcomes at this intersection.

Figure 53 shows the project scope for the corridor from ECR to JSB intersection. The estimated cost for this project is $ 1,470,000, and the benefit-cost ratio is 0.10.

Figure 53

Collins Avenue from El Camino Real to Serramonte Boulevard

Estimated Cost: $1,470,000 **Benefit/Cost Ratio: 0.1**

COLMA TRANSPORTATION SAFETY ACTION PLAN

Existing Conditions

- Collins Avenue is an east-west study corridor running in between El Camino Real and Junipero Serra Boulevard.
- El Camino Real is a state facility.
- The corridor has industrial development with car dealerships near Serramonte Boulevard on the south side.
- The corridor has shopping center near the El Camino Real/Collins Avenue intersection on the north side.
- There is on-street parking on the west side of the corridor, and on both sides near the Serramonte Ford Body Shop.

Crash Severity Score **2.18**

Number of Crashes **1**

Reported Crashes by Severity and Type

Crash Summary

Crash Type and Contributing Factors

- 1 head-on, improper turning crash

Crash Severity

- 1 Other Visible Injury crash (improper turning)

Project Description

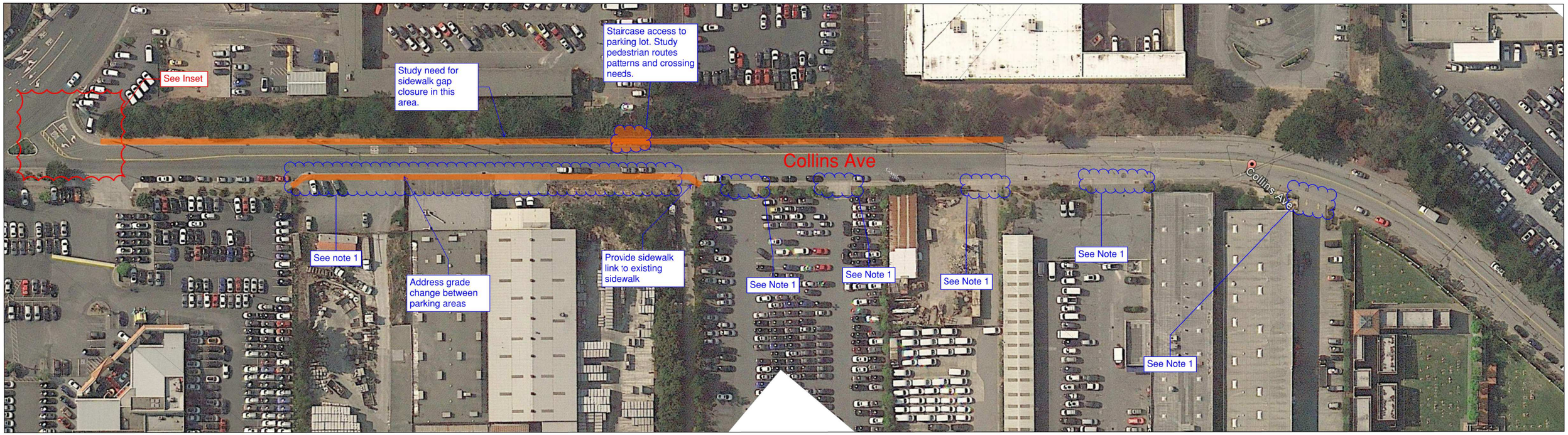
This concept sketch illustrates an approach to improve vehicle operations along the corridor. Key items from the concept include:

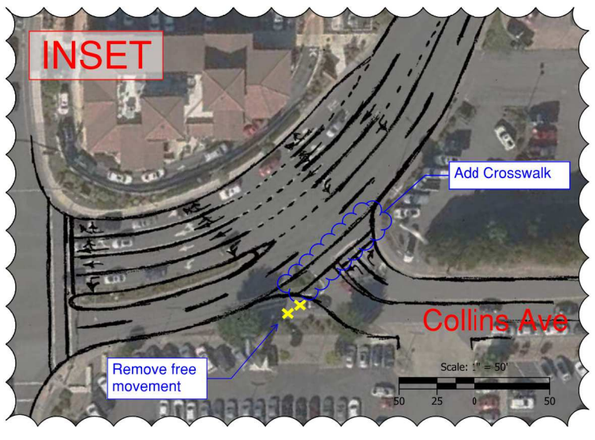
- Installing speed feedback signs at the location of existing speed limit sign.
- Restriping the corridor to delineate outer edges with parking and no parking areas.
- Narrowing the lanes to 11ft wide and including centerline with raised pavement markers.
- Providing continuous sidewalk along the corridor, i.e. providing sidewalk links to the existing sidewalk through the driveway area.
- Reconfiguring Collins Avenue/Serramonte Boulevard intersection.
- Installing a traffic signal at Collins Avenue/El Camino Real intersection, to meet the intended outcomes at the intersection.

Design Considerations

- The project would consider improving vehicle operations along the corridor. The basis for the project is to facilitate slower vehicle speeds along the corridor, and to provide pedestrian accommodations continuously throughout the corridor.

Note: Concept provided in the next page

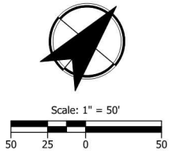


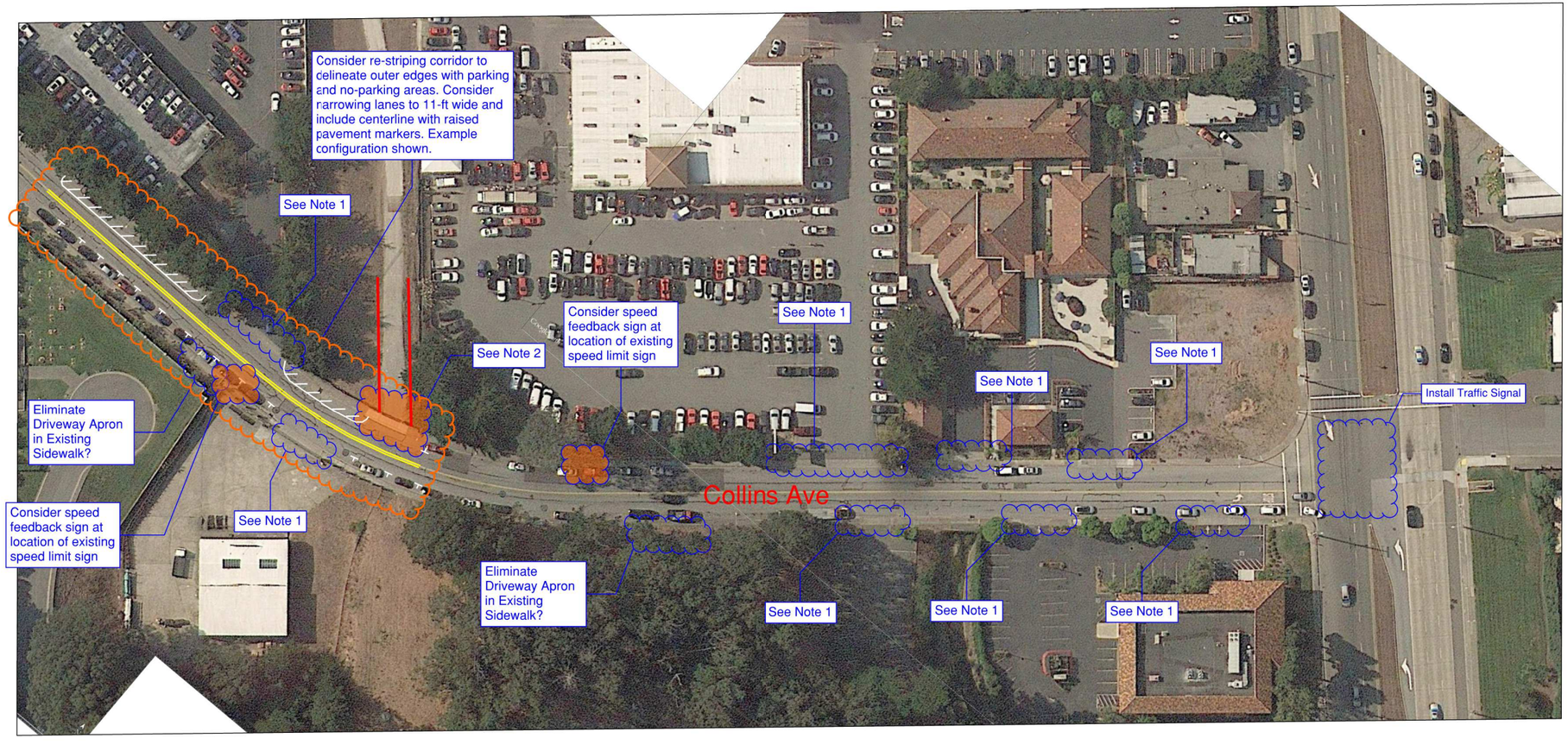


Notes:

1. Study and consider improvements to continuity of accessible sidewalk path through driveway area.

2. Possible future street connection. If constructed:
   -Maintain adequate intersection sight distance (additional parking restrictions may be required).
   -Consider needs for marked pedestrian crossing as well as need for pedestrian activated warning lights (i.e. rectangular rapid flashing beacon). Consider curb extensions/bulb-outs to increase pedestrian visibility.





Existing Conditions

Collins Avenue is an east-west study corridor between Serramonte Boulevard and ECR. The corridor has industrial development with car dealerships near Serramonte Boulevard on the south side, and some car dealerships and a shopping center (i.e. Kohl's) near the ECR/Collins Avenue intersection on the north side of the corridor. There is on-street parking on one side of the corridor on the west side, and on both sides near the Serramonte Ford Body Shop along the Collins Avenue corridor. Figure 54 shows the existing conditions on Collins Avenue corridor.

Figure 54: Existing Conditions along Collins Avenue

Source: Google Street View, 2018.

Project Needs Identified

Kittelson identified that there was one other visible injury along this corridor, which was a head-on crash, during the years 2011-15. The discussions with Town staff, and the unusual configuration of the Collins Avenue/Serramonte Boulevard intersection combined with the cross-section of the corridor identified a desire to make improvements to this corridor. Given the crash history, and the improvements, the project would not be competitive for HSIP funding. Improvements could be integrated into the Town's on-going Serramonte-Collins Master Plan project.

Project #10: El Camino Real/Collins Avenue Intersection

Project Description

This project would consider improving pedestrian safety and vehicle operations at the intersection. The basis of this project is reducing the number of lanes on ECR south of Serramonte Boulevard intersection, and maintaining two lanes in each direction on ECR until the north of Collins Avenue intersection. The key items include dropping the southbound lane on ECR, adding a northbound lane downstream of the intersection on ECR, and enhancing pedestrian crossing treatments at the intersection. To further reduce the potential risk for crashes at this location, Kittelson suggests the Town consider the following:

- Dropping the third southbound lane on ECR, thereby eliminating the lane drop downstream of the intersection.
- The upstream two-lane section on ECR could be associated with the possible ECR/Mission Road lane configuration and the intersection treatments that eliminate the added third lane at Mission Road.
- Extending the curb returns on the west side of the intersection and converting the third northbound lane into on-street parking.
- Extending the median to create a separated pedestrian refuge island. Enhance the existing pedestrian crossings on the west and north sides of the intersection.
- Adding painted channelizing island at angled northbound left turn lane on ECR to Collins Avenue to better channelize intersection movements.
- Reconfiguring ECR with two travel lanes in each direction, and with bike lanes on both sides of the roadway.
- Installing a traffic signal to meet the intended outcomes at this intersection.

Figure 55 shows the project scope at this intersection. The estimated cost for this project is $ 2,688,000, and the benefit-cost ratio is 0.03.

Figure 55

El Camino Real and Collins Avenue

Estimated Cost: $2,688,000 Benefit/Cost Ratio:0.033

COLMA TRANSPORTATION SAFETY ACTION PLAN

Existing Conditions

- The intersection is a three-legged intersection with a slightly offset driveway access on the west side of the intersection.
- State facility intersection.
- El Camino Real is a four-lane facility to the south and six-lane facility to the north with a wide median.
- Collins is a two lane roadway.
- There are currently standard striped crosswalks on the west and north legs of the intersection.

Crash Summary

Crash Type and Contributing Factors

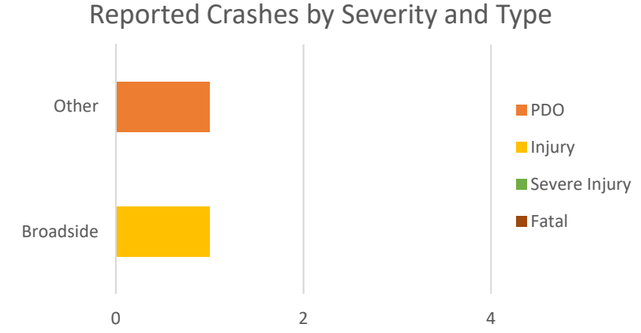
- 1 improper turning crash, other
- 1 broadside, automobile right-of-way crash

Crash Severity

- 1 complaint of pain injury crash (automobile right-of-way)
- 1 property damage only crash (other)

Crash Severity Score **1.43**

Number of Crashes **2**



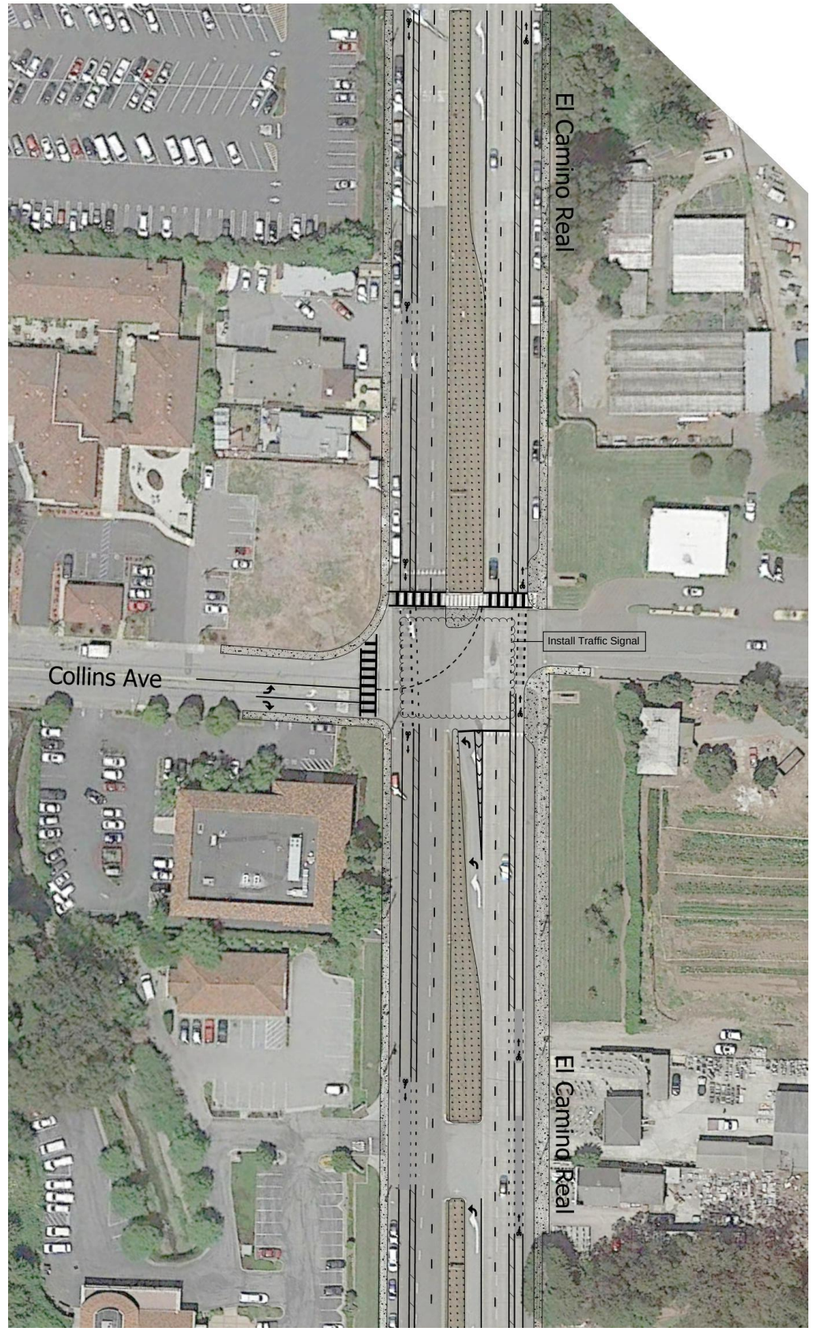
Project Description

This concept sketch illustrates an approach to improve pedestrian safety and vehicle operations. Key items from the concept include:

- Dropping the third southbound lane on El Camino Real at Collins and, therefore, eliminating the lane drop downstream of Collins
- The upstream two lane section could be associated with possible El Camino Real/Mission Road intersection treatments that eliminate added third lane at Mission Road.
- Reconfiguring ECR with two travel lanes in each direction, and with bike lanes on both sides of the roadway.
- Extending curbs on the west side of the intersection and convert third northbound lane into parking.
- Extending the median to create a separated pedestrian refuge.
- Adding painted channelizing island at angled northbound left turn lane to Collins Avenue to better channelize intersection movements.
- Installing a traffic signal to meet the intended outcomes at this intersection.

Design Considerations

- The basis of this design is reducing the number of lanes on El Camino Real south of the Serramonte Blvd. intersection and maintaining two El Camino Real lanes in each direction until north of Collins Ave. Presently, signing and marking of the third southbound lane begins south of Serramonte Blvd. and within the Collins Ave. intersection. This creates undefined vehicular paths and places the lane drop activity within the pedestrian crossing. Studies should include evaluating lane drop options in advance of Collins Ave. in addition to dropping the lane at Collins Ave. The third El Camino Real lane is presently added at Mission Rd. The third lane should be studied as a possible lane drop north of Cypress Ave. or as part of a Mission Rd. study to consider revising the northbound Mission Rd. movement to a conventional right turn lane with no lane addition.
- Since El Camino Real is a Caltrans facility, a Step 1 Intersection Control Evaluation (ICE) could be a first step. Given the proximity and relationship with Mission Rd, the ICE could include both intersections.



Existing Conditions

The ECR/Collins Avenue intersection is situated between ECR/Mission Road intersection and ECR/Serramonte Boulevard intersection. The intersection is a three-legged intersection with a slightly offset driveway access on the east side of the intersection. This is a state facility intersection, because ECR is a Caltrans facility. Collins Avenue is a two-lane roadway. There are currently standard striped crosswalks on the west and north legs of the intersection. On-street parking is permitted on approach to the intersection along ECR. There are three vehicle lanes southbound at the intersection, one of which is marked as being eliminated as it passes through the intersection. There are also three lanes northbound through the intersection and a center median. Figure 56 shows an aerial of the intersection.

If a taffic signal at ECR/Mission Road is constructed, the Town could consider a traffic signal at ECR/Collins to further help to coordinate traffic flow and manage speeds on ECR. The additional lanes on ECR approaching Collins Avenue are tapered as part of this project to reduce the pedestrian crossing distance at the intersection.

Figure 56: Existing Conditions at Collins Avenue/El Camino Real Intersection

Source: Google Earth, 2018.

Project Needs Identified

There were two reported crashes at this intersection, one complaint of pain, and the other PDO crash, during the years 2011-15. The discussions with Town staff, and placement of intersection between Mission Road and Serramonte Boulevard on ECR identified a desire to consider changes in the cross-section and configuration of the intersection. Given the crash history, and the improvements, the project may not be competitive for HSIP funding. Changes implemented on ECR would require coordination with Caltrans.

Project #11: Serramonte Boulevard from El Camino Real to Hillside Boulevard

Project Description

This project would consider converting the current cross-section on Serramonte Boulevard from driveway near Acura Car dealership to Hillside Boulevard to a road-diet, with bike lane on both sides of the roadway. This change could align with the driver expectancy while traveling along this corridor. Kittelson suggests the Town consider the following:

- Transitioning from the current lane configuration on Serramonte Boulevard to three lane cross section, i.e. one lane on either side of the roadway with a two-way center turn lane.
- This reconfiguration includes adding bike lanes on both sides of the roadway.

Figure 57 shows the project scope at this intersection. The estimated cost for this project is $ 50,000, and the benefit-cost ratio is 2.30.

Figure 57

Serramonte Boulevard from El Camino Real to Hillside Boulevard

Estimated Cost: $50,000 **Benefit/Cost Ratio: 2.3**

COLMA TRANSPORTATION SAFETY ACTION PLAN

Existing Conditions

- Serramonte Boulevard is an east-west corridor running in between El Camino Real and Hillside Boulevard.
- El Camino Real is a state facility.
- The corridor has cemeteries on the north side and industrial development with car dealerships on the south side.
- There is a casino at the intersection of Serramonte and Hillside Boulevard.

Crash Severity Score **7.99**

Number of Crashes **10**

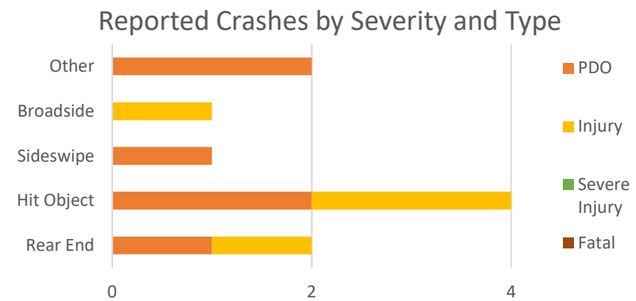
Crash Summary

Crash Type and Contributing Factors

- 2 rear-end, unsafe speed crashes
- 4 hit object, improper turning, 2 DUI, unsafe speed crashes
- 1 sideswipe, DUI crash
- 1 broadside, automobile right-of-way crash
- 2 other, unsafe speed, and unknown crashes

Crash Severity

- 6 PDO crashes (3 unsafe speed, 2 DUI, unknown)
- 2 complaint of pain injury crashes (unsafe speed, improper turning)
- 2 other visible injury crashes (DUI, automobile right-of-way)



Project Description

This concept sketch illustrates an approach to improve bicycle safety, and pedestrian safety. Key items from the concept include:

- Transitioning from the current lane configuration on Serramonte Boulevard to three lane cross-section (i.e. one lane on either side of the roadway with a two-way center turn lane).
- This reconfiguration includes adding bike lanes on both sides of the roadway.

Design Considerations

- This project would consider converting the current cross-section on Serramonte Boulevard from driveway near Acura Car dealership to Hillside Boulevard to a road-diet, with bike lane on both sides of the roadway. This change could align with the driver expectancy while traveling along this corridor.

Note: Concept provided in the next page

Scale: 1" = 40'

40 20 0 40

Existing Conditions

Serramonte Boulevard is an east-west study corridor between ECR and Hillside Boulevard. The corridor has cemeteries on the north side and industrial development with car dealerships on the south side. The corridor has four lanes at Hillside Boulevard that widens at the ECR intersection. The roadway is inclined going west onto ECR and vehicle speeds are higher traveling west, down hill toward ECR. The corridor has sidewalk on the south side the entire length of the corridor and partially on the north side of the corridor. Figure 58 shows existing conditions on Serramonte Boulevard.

Figure 58: Existing Conditions on Serramonte Boulevard

Source: Google Street View, 2018.

Project Needs Identified

Kittelson identified that there were ten reported crashes along the corridor, of which two were other visible injury crashes, two were complaint of pain injuries, and six were PDO crashes, during the years 2011-15. The presence of car dealerships on the south side of the corridor, proximity/connection to two major corridors in town (i.e. ECR and Hillside Boulevard) and discussions with Town Staff identified a desire to reconfigure the cross-section on the corridor. The crash history along this corridor would not lead to a competitive HSIP application. However, the risk factors related to the non-motorized users may help the Town pursue Caltrans ATP or Transportation Planning grant program funding for improvements on the corridor.

Project #12: Lawndale Boulevard from Mission Road to Hillside Boulevard

Project Description

This project would consider improving non-motorized travel along the corridor. The basis for this project is to provide pedestrian and bicycle accommodations continuously throughout the corridor. Kittelson suggests the Town consider the following:

- Providing bike lane links to the existing bike lane, by closing the bike lane gap near the ECR High School driveway.
- Aligning and extending the curb along the travel lane near the ECR High School driveway to eliminate the entry and exit tapered curb width sections and provide a consistent cross section along the corridor.
- Installing mid-block pedestrian crossing at the ECR High School driveway entrance. The path across the median is designed to help with visually impaired wayfinding to traverse the street and align with receiving ADA ramps.
- Installing pedestrian crossing enhancements, i.e. rectangular rapid flashing beacons (RRFBs) on the mid-block pedestrian crossing at the ECR High School driveway entrance.

Figure 59 shows the project scope at this intersection. The estimated cost for this project is $ 175,000, and the benefit-cost ratio is 0.03.

Figure 59

Lawndale Boulevard from Mission Road to Hillside Boulevard

Estimated Cost: $175,000 **Benefit/Cost Ratio: 0.03**

COLMA TRANSPORTATION SAFETY ACTION PLAN

Existing Conditions

- Lawndale Boulevard is an east-west study corridor running in between Mission Road and Hillside Boulevard.
- The corridor has residential development for about quarter length of the corridor and school for the other part of the corridor.
- ECR High School is on the south side near Mission Road.
- The roadway segment has a downgrade from Hillside Boulevard to Mission Road.

Crash Severity Score **0.60**

Number of Crashes **3**

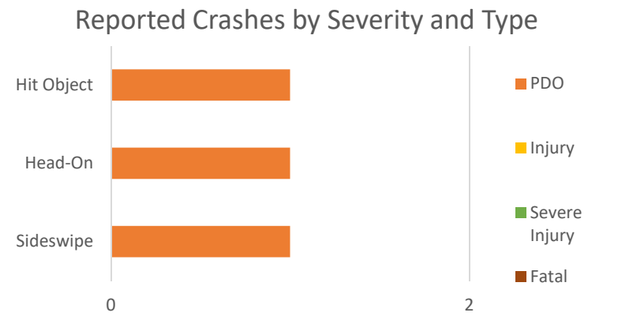
Crash Summary

Crash Type and Contributing Factors

- 1 head-on, vehicle (code) violation crash
- 1 sideswipe, unsafe speed crash
- 1 hit object, unsafe speed crash

Crash Severity

- 3 PDO crashes (vehicle (code) violation, 2 unsafe speed)



Project Description

This concept sketch illustrates an approach to improve non-motorized travel along the corridor. Key items from the concept include:

- Providing bike lane links to the existing bike lane, by closing the bike lane gap near the ECR High School driveway.
- Aligning and extending the curb along the travel lane near the ECR High School driveway to eliminate the entry and exit tapered curb width sections and provide a consistent cross section along the corridor.
- Installing mid-block pedestrian crossing at the ECR High School driveway entrance. The path across the median is designed to help with visually impaired wayfinding to traverse the street and align with receiving ADA ramps.
- Installing pedestrian crossing enhancements, i.e. rectangular rapid flashing beacons (RRFBs) on the mid-block pedestrian crossing at the ECR High School driveway entrance.

Design Considerations

- The project will improve non-motorized travel along the corridor. The basis for the project is to provide pedestrian and bicycle accommodations continuously throughout the corridor.

Note: Concept provided in the next page

Scale: 1" = 20'

20 10 0 20

Existing Conditions

Lawndale Boulevard is an east-west study corridor between Mission Road and Hillside Boulevard. The corridor has residential development for about quarter length of the corridor and school for the other part of the corridor. ECR High School is on the south side near Mission Road. Figure 60 shows existing conditions on Lawndale Boulevard.

Figure 60: Existing Conditions at Lawndale Boulevard

Source: Google Street view, 2018.

Project Needs Identified

Kittelson identified that there were three reported crashes along the corridor, of which all three were PDO crashes, during the years 2011-15. The presence of residential development along the quarter length of the corridor, proximity/connection to two major corridors in town (i.e. Mission Road/ECR and Hillside Boulevard) and discussions with Town Staff identified a desire to accommodate non-motorized facilities along the corridor. The crash history along this corridor would not lead to a competitive HSIP application. However, the risk factors related to the non-motorized users may help the Town pursue Caltrans ATP or Transportation Planning grant program funding for improvements on the corridor.

Summary

The following are key findings regarding project scopes and descriptions:

- Many of projects involve managing vehicle speeds and installing/improving walking and bicycle facilities.
- Many projects focus on reducing conflicting movements of vehicles and thereby could help improve access and circulation as well.
- Some of the projects could be competitive for HSIP grants, ATP grants or other state or regional grant funding opportunities.

10.0 ATTACHMENTS AND SUPPORTING DOCUMENTATION

ATTACHMENT A – TOP FIVE 30 PERCENT DESIGN PLANS AND COST ESTIMATES

ATTACHMENT B – SUMMARY OF TRAFFIC VOLUMES COLLECTED IN 2017

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