

Road Safety Audit Report



Pescadero Creek Road

San Mateo County, CA
August 23-25, 2022

Executive Summary

Pescadero Creek Road Road Safety Audit Report

*Prepared for
San Mateo County Department of Public Works*

*Prepared by
Road Safety Audit Team
December 22, 2022*

Executive Summary At-a-Glance

For San Mateo County Department of Public Works (SMCDPW)

WHAT: Pescadero Creek Rd. (PCR) Road Safety Audit (RSA)

WHERE: San Mateo County (SMC), California

RSA Team:

Basic Roadway Information

- From CA State Route 1(Cabrillo Rd.) to LaHonda Rd.
- Length: 14.5 miles
- Configuration of Pavement: 2 lanes, 2 way,
- Functional Class: Major Collector
- Statutory Speed: 55 MPH
- AADT Range: 800-3,000
- Three Distinct Maintenance Sections (west to east): Pescadero, Loma Mar, LaHonda

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Political Boundary:

San Mateo
County Board of
Supervisors
District 3

RSA Date:

Aug 23-25, 2022

RSA Weather:

Mostly Clear, high
clouds, mild
temperatures

Road Safety Audit Defined A Road Safety Audit (RSA) is a formal review of a road or street conducted by a multi-disciplinary, independent group to identify safety concerns and solutions. A RSA may be performed at any stage of the lifecycle of a road or street, from preliminary design, through construction, to in-service status.

Road Safety Audit Steps: 1) Identify Project 2) Select RSA Team 3) Conduct Start-up Meeting 4) Perform Field Review 5) Conduct Analysis and Prepare Report 6) Present Findings to Project Owner 7) Prepare Formal Response 8) Incorporate Findings

PCR Road Safety Audit Summary Opportunities exist to improve overall safety for road users, including pedestrians and bicyclists, by implementing safety countermeasures. Generally, these countermeasures are targeted to decrease occurrence of errors and/or user conflicts in addition to the frequency and severity of crashes. Observations, concerns, and suggested improvements are not comprehensive; other treatments aside from those identified in the report may be considered and could potentially yield similar or better results. Some primary areas of concern noted by the Team: crash frequency, crash type, speeding, lane departures, roadside design, signing, and markings needs, traffic control device needs for curves and intersections, and multimodal conflicts. Suggested improvements focus on one or more of the following: modifying driver behavior, compliance with traffic control devices, the occurrence of lane departures and likelihood of recovery and reducing speed (primarily in curves, multimodal conflict areas, etc.). Suggested improvements include but are not limited to intersection control and warning signs, curve treatment signing and markings, visibility enhancements, intersection channelization, conspicuous bike lanes and bike signing and markings, Share the Road signs, various signs and markings, and new bike passing lanes. A comprehensive pedestrian plan is suggested using this RSA Report and past pedestrian study recommendations. The next step in the RSA process is the SMCDPW evaluates a course of action considering all data, studies, and recommendations and suggestions and develops an implementation plan for selected treatments and actions. This plan then becomes a part of the project files for PCR.

Project Owner and Report Recipient:

Khoa Vo, Deputy Director
Road Services, Department of Public Works
San Mateo County California

Disposition of RSA for PCR:

This Executive Summary, including the Report, having been submitted to SMC, completes Step 6 of the PCR RSA and hence the work of the RSA Team

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The San Mateo County Department of Public Works (SMCDPW) can implement numerous cost-effective countermeasures and treatments including speed management strategies aimed at reducing the number and severity of roadway crashes and improving the safety of all road users. These suggested improvements, along with the observations and findings, from the Road Safety Audit Team are provided in this report.

Background & Need

The SMCDPW requested assistance of the Federal Highway Administration (FHWA) to assess safety concerns on Pescadero Creek Road early in 2022. A road safety audit team was agreed upon by the County and included county and Fhwa personnel and a bicycle safety advocate. Initially, primary concerns were identified to be speed, multimodal user conflicts, motorcycle crashes, and roadway alignment and associated studies both recent and forthcoming. For the field review of over fourteen miles, the road was sectioned off in keeping with the San Mateo County maintenance sections identified as Pescadero, Loma Mar, and La Honda. Each section contained four segments.

Data and Roadway Review

The SMCDPW supplied an abundant resource of information to draw upon, notably speed studies, crash reports, video files, recent project work, permits and future planned work. The nature of the RSA was broadly scoped, covering many aspects of roadway safety and the length of the route presented the RSA Team with challenges in the six to eight hours allotted to the review.

The field work consisted of reviewing site conditions, observing operations, and noting safety concerns. The data provided was used in combination with the field review notes.

Observations and Suggested Improvements

Observations, safety concerns and suggested improvements are presented in the report as applicable to 1) the entire route, 2) specific to certain maintenance section(s)/segment(s), or 3) one or more specific location(s). A general list of concerns follows:

- Speed of traffic
- Conflicts of motorized and bicycle or pedestrian traffic
- Absence of speed zones and speed limit postings
- Absence of curve signs and delineation
- Number of motorcycle crashes and curve crashes
- Geometric alignment - Grades, short tangents, sharp curves
- Narrow recovery areas and steep front slopes
- Pavement use allocation (width of lane, presence of paved shoulder, width of longitudinal markings)
- Intersection conspicuity, absence of advance guide signs
- Intersection sight distance
- Varying standards in application of striping and other markings
- Junction of trails or paths with the roadway (inc. parking areas) & bike lane and roadway use signing & markings
- Points of change in alignment and recovery areas
- General user awareness of rules of the road

A general list of suggested safety improvements is:

- ✓ Conduct speed studies with liberal posting of warranted speed zones
- ✓ Install advisory horizontal alignment warning signs and delineation consistent with the above conducted speed studies and the completed contract curve assessment work

- ✓ Provide bicycle safety improvements at intersections to promote separation of movement from motorized vehicle and clearly defining presence and limits of lanes and use areas
- ✓ Provide bicycle safety improvements with passing lanes at appropriate locations and Share the Road or similar warning signs
- ✓ Provide safety improvements for all road users by repurposing the pavement to narrow travel lanes and add or widen paved shoulders, widen the overall centerline footprint and edgeline markings, and improve transitions from edge of paved shoulder to soil shoulder
- ✓ Improve pedestrian access in the Town of Pescadero near Stage Rd.
- ✓ Evaluate need for pedestrian crossing safety improvements at PCR and State Hwy 1
- ✓ Improve intersection guide signs on major road (PCR) and conspicuity of intersection control signs and markings on minor road approaches
- ✓ Perform guardrail assessment or barrier assessment at key locations with steep front slopes, mitigate sites with appropriate lane departure countermeasures where fixed barrier is not feasible
- ✓ Evaluate the need to provide improved intersection traffic movement at Alpine Rd. considering overall geometry, design, traffic control device use; evaluate existing approach and departure lane use for each leg and existing intersection traffic control type
- ✓ Provide markings and supplemental signing to improve sight distance and separate through and turning traffic at applicable intersections
- ✓ Provide advance warning signs for transitions into sharp and switchback curve sections where alignment and road conditions change notably
- ✓ Consider the designation of the route as a state safety corridor

Summary

The SMCPWD has an opportunity to improve safety for all users on Pescadero Creek Rd. using a diverse set of safety strategies and treatments. The selection, prioritization, and application as well any modification and subsequent implementation of one or more of these suggested improvements is the sole discretion of the County. Next steps towards design and construction or installation will depend upon the County's evaluation of the suggested improvements, resources and coordination with any authorities and agencies governing such action.

To complete the RSA Steps, the County should review the report and evaluate a course of action related to these suggested improvements and overall safety, known as a Response Letter. The Response Letter should be retained in the SMC project file. Changes or alterations to the planned work should be added to the file noting details of such change.

Finally, the PCR RSA Team is committed to further assistance as may be necessary to advance road safety for the County.

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I. Introduction and Background

In 2021, San Mateo County Department of Public Works (SMCDPW) initiated a request of the California Division (CADIV) of the Federal Highway Administration (FHWA) for technical assistance concerning the safety of all roadway users on Pescadero Creek Road (PCR) in southern San Mateo County, CA. The Safety and Design Team (SDT) of the FHWA Resource Center and other safety professionals were brought in to determine the best path forward to improve safety on PCR. Ultimately, this led to the SMCDPW request to conduct a Road Safety Audit (RSA) facilitated by the SDT.

The FHWA Office of Safety established RSAs to improve the overall safety performance of roadways. An RSA is a comprehensive, formal safety performance evaluation on an existing or planned road segment or intersection conducted by an independent and multidisciplinary team. RSAs are a low-cost proactive approach to safety that considers all road users and identifies opportunities to enhance safety and reduce the number and severity of crashes.

The RSA was initiated to provide both a safety scoping assessment and opportunity to assess several key safety observations. A primary observation for SMCDPW was the speed of traffic and the low number of posted speed limit signs. The statutory speed of 55 MPH, per CA statute for 2 lane rural roads is not posted anywhere on the route. One speed zone of 25MPH is posted at Loma Mar and another speed zone of 35MPH is posted in and around the Town of Pescadero. Except for a few short segments and long tangents, the statutory speed of 55 MPH was observed to be more than a reasonably safe speed. Caltrans has reportedly postponed new studies for the entire year awaiting promulgation of the new statutes and any subsequent proposals. Conducting speed studies is key to safety of the roadway in as much as speed profiles influence not only the posted speed, but both horizontal alignment signing and advisory speeds posting. Details on speeds and speed limits are covered in Parts III. and IV. of this report.

Other concerns included in the RSA scope were lack of cycle and cyclists' safety. Horizontal alignment treatments for curves were another important aspect of the RSA. A recently completed curve study was provided to Team members and summarized the appropriate treatments per the study results and the MUTCD (Chapter 2C), which includes the recommended and required signs, plaques, and delineation. Roadway departure crashes, intersection focused reviews, roadway flooding, pedestrian safety and accommodations were also part of the scope of work for the RSA. With such a broad scope and a lengthy route, the Team was challenged to develop a schedule, plan the review, and address the number of observations whether known or discovered during the maximum time allowable for the review. Hence, as with any RSA, the observations and findings and the developed suggested Improvements are limited.

Road Safety Audit Team

The RSA Team was selected and formed jointly by SMCDPW and SDST. It should be noted that a representative from CALTRANS had agreed to participate but had to cancel due to other work

interference . The Team determined to proceed primarily due to anticipated rescheduling delays
The RSA Team members are listed below:

San Mateo County:

Selena Gonzales, *Stormwater/Environmental Specialist*

Ryan Rasmussen, *Road Mgr. (La Honda District)*

Diana Shu, *Sr. Civil Engineer, Road Services*

Krzysztof Lisaj, *Principal Civil Engineer, Design/Engineering*

Hanieh Houshmandi, *Associate Civil Engineer, Roadway Traffic Services*

Harry Yip, *Associate Civil Engineer*

BPAC:

*Susan Doherty, *Bicycle and Pedestrian Advisory Committee*

FHWA

Timothy Taylor, *RSA Team Leader, Sr. Highway Safety Engineer*

David Petrucci, *Sr. Highway Safety Engineer*

*Participation began on day two of audit.

RSA Location and Description

Pescadero Creek Road (PCR) is a major collector carrying between 800-2200 vehicles per day. It is approximately 14.5 miles in length and has either a bituminous wearing surface or an aggregate surface treatment. The right of way varies in width, typically ranging from 60 ft to 120 ft. The town of Pescadero is on the western end and the community of Loma Mar is near the midpoint of the route.

The road traverses three unique topographical and developed sections: From northeast to southwest the sections are La Honda, Loma Mar, and Pescadero. The La Honda section is on the northeast portion; it is heavily forested, few driveways, sharp and frequent changes in horizontal alignment and moderate vertical grades; much of the roadway section hugs the sides of wooded foothills and the banks of Pescadero Creek. A significant portion of this section is largely shaded throughout the day. The Loma Mar section can be described as a transitional section. It is the middle section and is moderately forested but with more access points or

Image 1: PCR divided into 3 Sections for Field Review



driveways, more points of interest/activities, more tangents and flatter curves compared to La Honda; Loma Mar section appears more populated with higher traffic volumes. The western end of the section transitions to more agricultural and commercial use of the surrounding property and continues into the Pescadero Section. More open fields and cleared land is evidence continuing westerly towards the coast. The Pescadero Section, the southwestern portion of the route, has wider pavement, some bike lanes and paved shoulders, wider right of way and gentle curves and longer tangent sections compared to the other two. An increased number of access points serves businesses, residents, and agricultural fields. The entire route is popular for touring, whether by car, bicycle, or motorcycle, because of its environmental diversity, accessibility to trails, recreation and its western begin point, Pescadero State Beach.

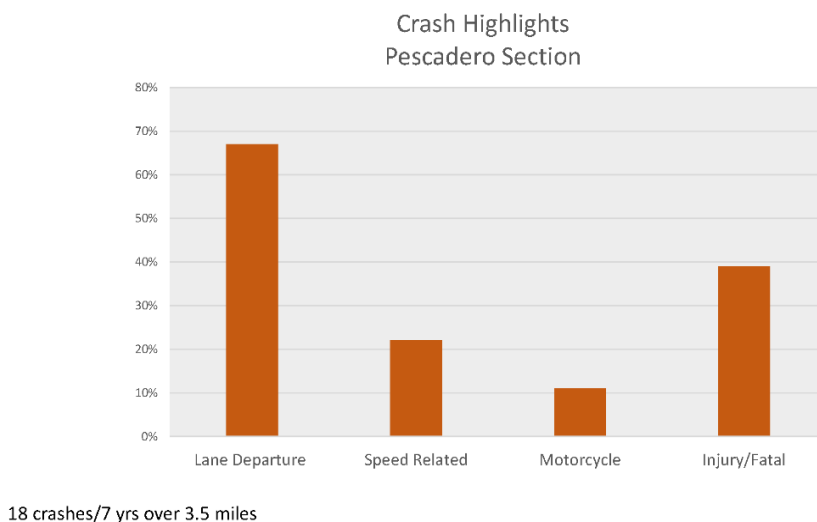
San Mateo County Preliminary Work

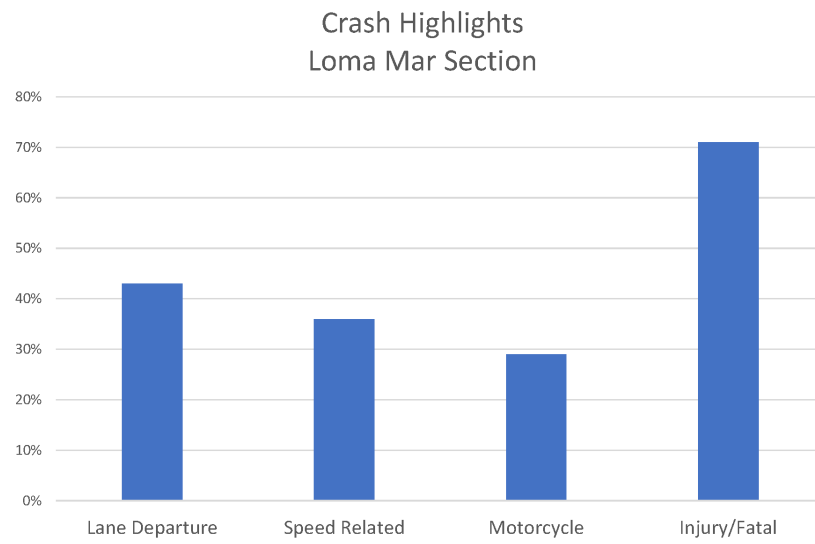
The entire Team is indebted to the work of SMCDPW personnel to collect, summarize and deliver an abundance of data before the Team began work on August 23rd. Most importantly, this allowed Team members to review and study the data before convening at the location as a Team. This included not only crash data, but individual crash reports summaries, speed study information, records of access permits, speed zoning practices, recent changes to CA motor vehicle laws (speed zoning), sign inventory, striping upgrade work, traffic counts, and a video ride-through the entire route. It cannot be overstated how this preliminary work was invaluable to the work and efficiency of the Team during the review process.

Safety Performance

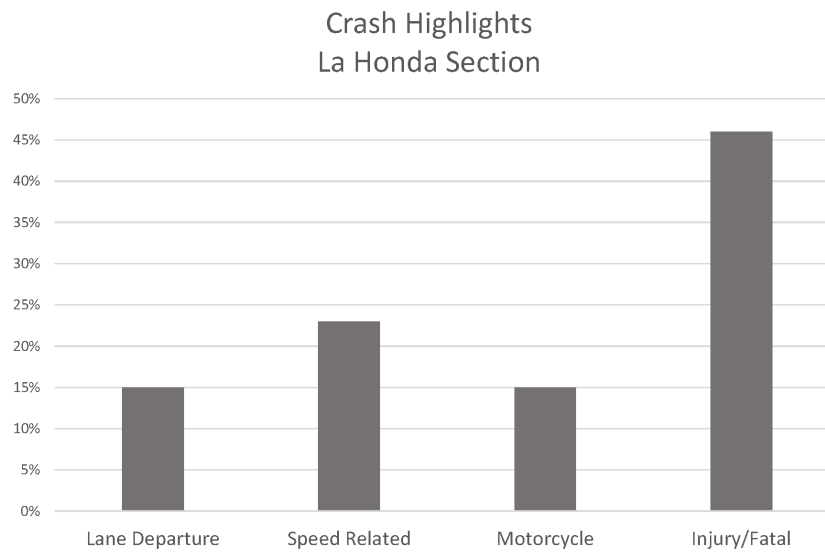
SMCDPW has taken steps to improve safety on PCR over the years. Temporary and targeted use of Driver Feedback Signs, adding advisory speed limit plaques, signing and markings upgrades, an engineering study to determine appropriate curve warning signs, and dredging of Butano Creek to mitigate roadway flooding near the Town of Pescadero are examples of such work. The roadway crash study period covered years 2014 to 2021. This period had 58 crashes. The crash types and mode involvement

highlight are detailed for each section, Pescadero, Loma Mar and LaHonda, beginning with Pescadero (right). The Loma Mar and LaHonda sections are shown on the next page.





14 crashes/7 years over 6.1 miles



26 crashes/7 years over 5.2 miles

II. RSA Schedule and Team Events

.Kickoff Meeting

The RSA was conducted over a period of three days, August 23-25, 2022. The kickoff meeting was held at SMCDPW Grant Yard facility in Redwood, CA. This meeting was also attended by Khoa Vo, Deputy Director of SMCDPW.

Hanieh Houshmandi presented an overview of the corridor and scope of the forthcoming audit. Timothy Taylor presented the goals and purpose of the audit and the potential benefit to future audits, on-the-job training, and safety initiatives.

Field Review, Develop Suggested Improvements, Report Out

The field review duration was approximately ten hours spanning two days (Tues. and Wed.) The weather was mild and clear to partly cloudy each day.

The field review was conducted as a group and participants were able to ride in one van supplied by SMCDPW. The Team determined to prioritize time in the field even if such resulted in a continuation of the analysis and Suggested Improvements step after the in-person review (August 23-25, 2022)

Following the Field Review, the team reconvened on Wednesday afternoon to begin prioritizing observations and concerns. This process entered Thursday, Day 3. The Report Out Meeting was conducted on the afternoon of Day 3. Due to time constraints and the enormity of the task of consolidating notes and information on a 14-mile road, the work proceeded after the Report Out Meeting to finalize the Suggested Improvements and categorize the risks and Observations.

III. Observations and Suggested Improvements

Overall, the roadbed and riding surface is in good condition. Neither base nor sub-base failures are evident. Drainage ditches, inlets, curbing, and gutters appear to be functional and in good condition also. Generally, front slopes are stable and soil-based shoulders are in satisfactory condition and appropriate in height allowing surface water to drain off and away from the pavement. The pavement type varies, either aggregate surface treatment or bituminous wearing surface. Except for horizontal alignment signing and others as noted herein, the overall signing is adequate, and most signs are in a



Photo 2 - Curve Signing La Honda Section (Credit SMC video)

serviceable condition. Many street and road names are marked by street name signs. Some sections recently received new markings using updated standards for center line markings.

The Observations and Suggested Improvements consists of three sections:

- A. Primary Observations and Suggested Improvements
- B. Site Specific Observations and Suggested Improvements
- C. General Concerns

A. Primary Observations and Suggested Improvements

Several general observations were made during the field visit and review of data. The Primary observations below also include Suggested Improvements where applicable. Specific locations of observations and Suggested Improvements are provided in the next section B. The general Suggested Improvements provided in A. below should also be considered when reviewing and making decisions on implementation of specific location Suggested Improvements as appropriate. Appearing alphabetically, the Primary Observations and Suggested Improvements are:

Curves

Generally, curves are consistently over-represented locations for roadway departure crashes. Many curves on PCR are not presently signed with horizontal alignment signs. The MUTCD provides guidance and standards on signing curves based upon a safe and comfortable travel speed. SMCDPW has moved forward on curve signing by initiating a contract to determine through a study the need for curve signing. This recently completed curve analysis study and the suggested improvement to establish speed zones (see Speed, p. 10) should be integrated to derive the appropriate curve warning and delineation treatment for all curves. Another observation was certain sections of road where down-grade travel combined with a long tangent coming into a curve could present opportunity for speeding and thus approaching the curve too fast. Suggested improvements are to supplement the curve warning and delineation treatment with additional upstream signing. See the Appendix, item #2 & 3). Another suggested improvement is the select use of fluorescent yellow (such as ASTM Types 7, 8, 9, or 11) for curve warning signs. The fluorescent properties of the sheeting can benefit road user identification of the sign presence and message in periods of reduced ambient light. Frequent shaded pavement, low clouds, fog, and heavy ocean mist make PCR a very good candidate for fluorescent yellow retroreflective sheeting use. Post mounted delineators were observed in a few curves. This stand-alone treatment is recommended for curves on PCR where horizontal alignment signs are not required. A comprehensive treatment plan for curves should be developed which not only uses the MUTCD based signs, chevrons, and plaques, but incorporates the use of select materials and other traffic control device applications. These could include but not be limited to 1) use of fluorescent yellow on select curve warning signs, 2) use of post mounted delineators in gentle curves, 3) wider edge lines and centerlines on approaches and through curves, and 4) use of rumble stripe centerline

and/or edge line on curves and approaches. A sample chart depicting some of these treatments are shown in the Appendix, item 4.

Intersections

Intersections are planned points of conflict and are necessary given the need for access to other roads, connectivity, and routing. Several intersection designs are present along the route. Some are channelized for different movements and provide desirable separation and a reduced number of conflicts compared to traditional layouts without channelization. Others are simple 3- or 4-way intersections without channelized lanes. Some private driveways have sight distance challenges as do



Photo 3 - Example of a supplemental STOP sign mounted on left in a splitter island.
Location and photo credit unknown

some intersections. Specific observations and Suggested Improvements are provided for the following intersecting roads with PCR: Alpine Road, Redwood Dr., Cloverdale Rd., North St., Stage Rd., Butano Cut-off Rd., and Highway 1. See Observations #1, 2, and 7. Intersection problems typically revolve around speed, number and type of conflict points, geometry, and providing necessary guidance to motorists through traffic control devices. The RSA Team noted several general observations: Conspicuity of intersection control signs was noted at intersections with a skew angle greater than approx. 15 to 20 degrees. Some intersection characteristics presented difficulty in assessing gaps in oncoming traffic. A need for more advance guide information (major and minor approaches) and warning signs were also noted.

Intersection consistency in use of Stop lines or Yield lines was also noted. Some markings were worn and in need of replacement. The Team noted some recent restriping and was advised of more to be scheduled. Some intersections are without Stop signs near Pescadero. Upon random checks of sign retroreflectivity, the Team found readings near the threshold for replacement. Some signs are positioned and aimed such that they are not perpendicular to the approach; this condition was also noted as an observation. The Team also recommends upgrading/replacing signs per SMC's Minimum Sign Retroreflectivity Maintenance Plan; develop criteria for use of advance street name signs or intersection warning signs with intersection street name plaques and advisory speed as determined by study; Striping upgrades should be completed to provide uniformity and improved retroreflectivity.

Lane Departure

Many sections of PCR are characterized by tree lined shoulders, narrow shoulders, fixed objects near the roadway, and steep front slopes. While other sections, particularly in portions of the Pescadero section, have gentle slopes, adequate shoulders, and greater clear zones. The natural environment and terrain in most of the Loma Mar and La Honda sections create challenges for attaining and maintaining a favorable clear zone. ¹A clear zone is “the unobstructed, traversable area provided beyond the edge of the through traveled way for the recovery of errant vehicles.” Less forgiving roadsides means fewer options for reducing roadway departure crashes. Lane departures are typically associated with motor vehicles, but cyclists can encounter the same mishap. Treatments to reduce harmful lane departures are first and foremost to keep motorists in their proper lane. For lane departure occurrences, a recovery area is desirable to allow the road user to return safely to the travel lane (such as a generous all-weather shoulder). Warning signs and object markers should be used to alert road users of lack of recovery areas. For mishaps where the user is not able to return to the traveled way, provide a safe area to reduce speed and stop without the likelihood of further harm from overturning or hitting a fixed object. In a forgiving clear zone, slopes are typically 3-1/2:1 or flatter. The described tiered approach to minimizing the occurrences of and mitigating the consequences of a lane departure should be used throughout the corridor to improve safety. But more importantly, this tiered approach explanation brings to light the limitation of available options for treatment on PCR. Candidate locations for treatment will be dependent upon the cross-section, ROW availability and influencing topography including the shoulders and slopes. Photo 4 illustrates a more desirable recovery area (Top Photo): presence of a paved shoulder, wider front slope, edge drop-off 2 inches or less, good shoulder height and no man-made fixed objects. Photo #5 depicts a less desirable recovery area, edge drop-off, utility pole, and less shoulder than the previous.



Photos 4 & 5 Loma Mar Section-Top photo 4: some recovery area on approach to curve, shoulder widening. Bottom photo 5: fixed object, no all-weather shoulder, edge drop-off. Photo credit: FHWA



¹ Roadside Design Guide, 4th Ed. 2011

Sample treatments for consideration in the development of such an approach are shown below in Table IIIA-2.

Table IIIA-2 Potential Countermeasures for Lane Departures		
<i>Tiered Approach Level</i>	<i>Countermeasure by ¹Primary Location</i>	
	<i>Curves and Tangents</i>	<i>Approaches to and in Curves</i>
I. Keep Road User in Lane	Provide all-weather shoulder, ² reallocate paved travel lane	Lane widening, Shoulder widening, Rumble stripe or profiled markings, wider longitudinal markings, wider space between double yellow centerline, all-weather markings or reflective elements, supplement edge line markings with RPMs; horizontal alignment signing per MUTCD, ³ delineator for curves 5 mph or less; high friction surface treatment or non-polishing aggregate; provide permanent solar powered driver feedback signs at selected curves
II. Provide for a safe return onto pavement if departure begins	Maintain adequate shoulder 2 inch or less below edge of pavement;	Provide all-weather shoulder; use recommended and optional traffic control devices for horizontal alignment signing per MUTCD; use signing enhancement at select locations (MUTCD 2A.15)
III. Provide safe area for run-out and stopping	Remove fixed objects in clear zone, relocate fixed objects, flatten slopes	Remove fixed objects in clear zone, relocate fixed objects, flatten slopes
IV. Minimize harm	Shield non-removable fixed objects, delineate/mark fixed objects	Install appropriate barrier for condition and need; Delineate fixed objects (example: utility poles), narrow shoulders, etc. with Type 2 or 3 Object Markers

¹Treatments may be implemented systematically along entire corridors or regions, systemically based upon risk factors and crash type or by spot location. ²Example: Given a 12 ft lane, change striping layout to produce say a 11.5 ft or 10.5 ft lane with the balance used as a paved shoulder ³For curves where the difference between the posted or 85th percentile speed and curve advisory speed is 5MPH or less

Where front slopes are steep and shoulders cannot feasibly be widened to accept guardrail or barrier, Type 2 or 3 Object Markers can supplement horizontal curve alignment signing if space permits.

Speed

Speeds along PCR was a primary concern and helped to identify the route as a RSA candidate. Speed is a major factor in crash severity. The Team determined to collect and review as much information as possible related to determining, posting, revising, and enforcing lawful speed. Past speed studies consistently show speeds which are too fast for the conditions.

Currently the promulgation of the new CA statute concerning speed studies and posting of lawful speeds is working its way through CalTrans. Additionally, an amended version of the new CA statute may be likely in the legislative session starting in 2023. An opportunity may exist in the CA statute to designate PCR or portions thereof as a 'safety corridor.' See CA Statute Section 22358.7 - Reducing Speed Limits. Due to the uncertainties in the promulgation of the latest statute and the Team's observations and concerns for overall corridor safety improvements, SMC should proceed with studies to address the need for new or revised speed zones using current procedures and requirements. The following are aimed at managing speed:

Suggested Improvements:

- 1) Conduct traffic engineering speed studies to assess where speed zones or revisions are warranted (previously stated)
- 2) Determine appropriate speeds based upon results of studies in 1) and the consideration of other factors (crashes, user group conflicts, sight distance limitations, risk of severe injury, etc. as applicable and proceed under authority and counsel to post such speeds resulting from the study; speed limit signs should be posted downstream of principal intersecting streets or roads, at change points, or at a minimum every 2 miles
- 3) Post the appropriate horizontal alignment warning signs: Using the recently completed study by contractor, incorporate new limits or 85th percentile speed from 1) or 2) above as appropriate to select or revise horizontal alignment warning sign and delineation devices
- 4) Review installations of warning signs where advisory plaques are used (Ex. W13-1) and update these installations to be consistent with posting action in 2) above and
- 5) As resources permit, modify existing and new designs of geometric and traffic control device features to new posted limits consistent with 1) or 2) above. These include but are not limited to auxiliary lanes, driveway or access permits, lane reduction and turn lane tapers, advance preview distance for warning signs

B. Site Specific Observations and Suggested Improvements

Aside from the General Observations and Suggested Improvements several key sites or specific needs rose to the top to be addressed. The corridor length and the breadth of known safety concerns was a significant Team challenge in executing the RSA. Hence, time did not permit the Team's attention to every detail of intersection, curve, or road user need. Because the Review and Analysis portion of the RSA was constrained by time, the focus was on completing the Observation sheets for specific concerns and Suggested Improvements. Observations and concerns with specific locations should certainly be considered and evaluated to determine application at similar locations. Combining treatments may also be feasible as part of a selective approach. Future RSAs or internal safety assessments should focus on specific sites and observations related to Primary Observations and Suggested Improvements which were not specifically dealt with in this RSA.

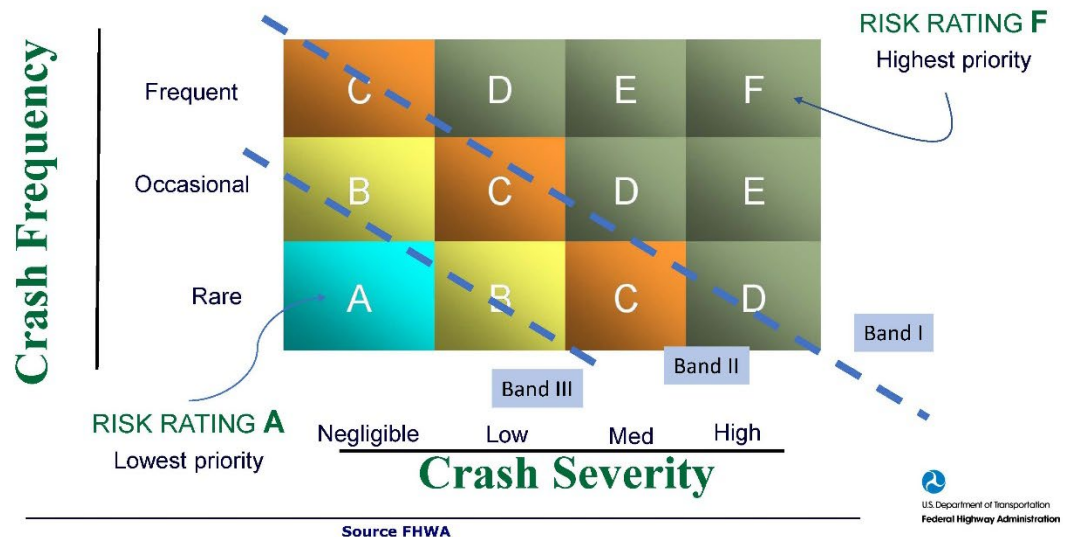
The following section consists of Observation Sheets and Suggested Improvements for specific sites or common roadway features. The title and page number for each Observation is listed below. A legend or key to various portions of the Observation Sheet can be found in the Appendix, Part I.

Table of Contents of Specific Observations

Title/Content	Primary or General Observation	Observation Sheet #	Page #
Pedestrian Accommodations	Intersection	1	13
Redwood Drive	Intersection	2	14
Trailheads and Crossings	Vulnerable Road Users and Facilities	3	15
Pescadero Crk Bridge	Lane Departures	4	16
Steep Front slopes/Barriers	Lane Departures	5	17
Butano Crk Floodwater	Road User Services	6	18
Alpine Road	Intersections	7	19
Advance Warning Signs	Curves/Lane Departures	8	21
Guide Signing	Intersections	9	22
Marking and Signing	Corridor General	10	23
Horizontal Curves	Lane Departures/Curves	11	24
Ped/Bike Conflicts with Other Traffic	Vulnerable Road Users and Facilities	12	25

A Risk Matrix Chart was used (shown below) to subjectively rate and rank various concerns

Risk Matrix Chart



Exception to Source: Bands added

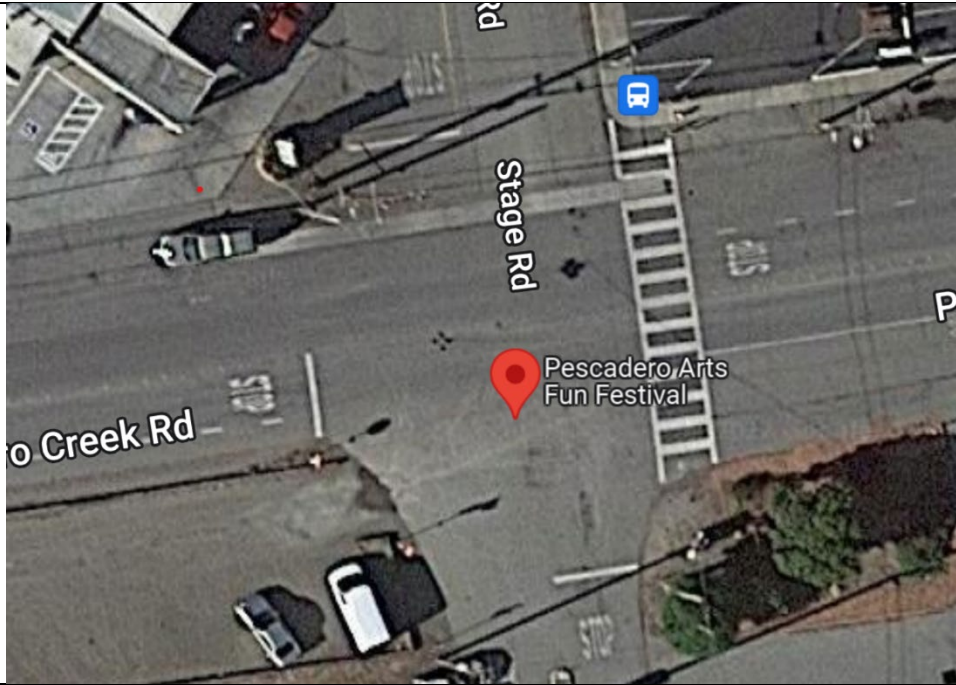


Image credit: Google Maps

CATEGORY LINK	Observation # 1	
Intersections	Ped Accommodations at significant use intersections	
SITE SPECIFIC Locations	North St., Stage Rd., and Loma Mar	
Alignment	TANGENT ☐ CURVE ☐	
MAINTENANCE SECTION	SECTION Pescadero- Loma Mar	
	SEGMENT 2 - 8	
FREQUENCY	SEVERITY	RISK RATING
Low	High	E
BAND I		

Observations: Crosswalks – The sole crosswalk on PCR is at Stage Road. Pedestrians have other destinations near schools, bus stops, churches, Post Office, restaurants, markets which require them to cross PCR.

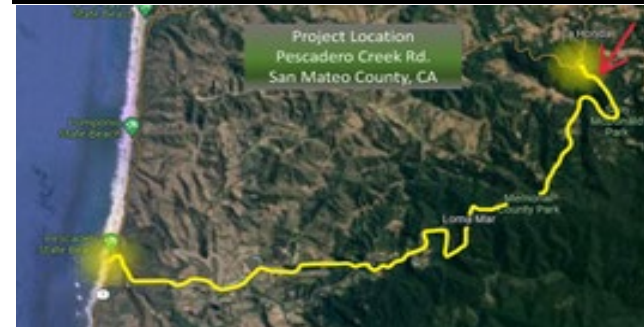
Suggested Improvements: Conduct needs study using at a minimum the “Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations.” The Guide provides guidance on the use of multiple treatments including HI-Vis Crosswalk markings, raised crosswalks, refuge islands, Rectangular Rapid Flashing Beacons (RRFB). Consider pedestrian facilities at key locations in addition to North, Stage, and Loma Mar.

Note: Town of Pescadero school has requested additional crosswalks at Stage and new installation at North St. based upon needs assessment. Coordinate with Pescadero on a comprehensive plan



Photo Credit: unknown

CATEGORY LINK	OBSERVATION #2	
Intersections	Channelization, Intersection Site Distance, Placement of markings	
SITE SPECIFIC Location	Redwood Drive	
Horiz. Alignment	TANGENT ☐ CURVE ☒	
MAINTENANCE SECTION	SECTION La Honda	
	SEGMENT 11	
FREQUENCY	SEVERITY	RISK RATING
Low	Medium	C
BAND II		



Observations: Redwood Drive T-intersection (1 motorcycle crash) - wide throat intersection, lack of channelization, shoulder encroachment, wide pavement, bikes likely use shoulder of 4-6 ft., stop line setback is 10-12 ft from projected edgeline, limiting sight distance looking west, and concern regarding gap acceptance and exposure time to turning traffic leading to intersection conflicts

Suggested Improvements: Relocate stop line 5 ft from projected 11 ft. Edgeline. Mark a shorter turn radius and eliminate long tapered edgeline. Double post R1-1 STOP. Consider use of concrete or painted splitter island. Use barrel wrap (black/yellow) around post of splitter island installed STOP. Accommodate transition if needed for shoulder (bike traffic) Effect: Reduce exposure time of turning vehicles, improve sight lines (See Appendix # 7.).



Photo credit: unknown

CATEGORY LINK	OBSERVATION # 3	
Vulnerable User Conflicts and Facilities Needs	Trail Connectivity, Parking, Advance Guide/User Services Signing	
SITE SPECIFIC Location	Trailheads and Other Crossings of PCR; (inc. Butano Crk., Memorial Pk., Sam McDonald Pk.)	
Horiz. Alignment	TANGENT ☐ CURVE ☐	
MAINTENANCE SECTION	SECTION Pescadero - La Honda	
	SEGMENT 1 8 & 10 known; others likely	
FREQUENCY Low	SEVERITY High	RISK RATING C
BAND II		

NOTE INFORMATION: See overall guide sign needs in OBSERVATION #9

Observations: Driveways and trail heads are located at various locations along PCR. Some locations have advanced warning signs, other do not. Need consistent signage to designate locations for pedestrian, equestrian, or vehicle access or crossings if from one side of PCR to the other.

Suggested Improvements: Work with Parks Department to develop better wayfinding signs along the roadway. Need consistent signage to designate locations for pedestrian, equestrian, or vehicle access or for crossings if the trail starts on one side of PCR but ends on the other side of PCR further down the road. Signs should include name of trailhead, distance to trailhead from sign placement (ex. 500 FT) with directional arrow. Use of recreational background (Brown) should also be considered to distinguish from other generators. A system of recreational signing should be considered to include destinations other than trailheads. Need consistent signage to designate locations for pedestrian, equestrian, or vehicle access or crossings if from one side of PCR to the other. Signs should include name of trailhead, distance to trailhead from sign placement (ex. 500 FT)

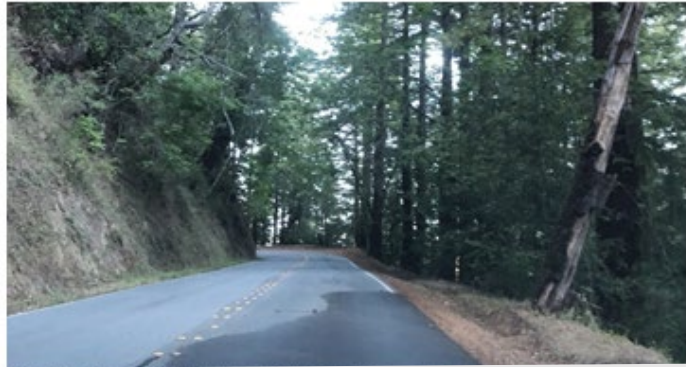


Pescadero Creek Bridge looking westbound (photo credit FHWA)

CATEGORY LINK	OBSERVATION # 4	
Lane Departures	Bridge End Exposure	
SITE SPECIFIC Location	Pescadero Crk Bridge	
Horiz. Alignment	TANGENT ☒ CURVE ☐	
MAINTENANCE SECTION	SECTION Loma Mar	
	SEGMENT 7	
FREQUENCY Medium	SEVERITY Medium	RISK RATING C
BAND II		

Observations: Neither end of the bridge has a crash attenuator to shield the curb or handrail. Delineation is missing or in poor condition. EB approach is in a curve and lacks delineation for curve.

Suggested Improvements: Use bridge post mounted delineators; upgrade hazard markers (placement should be edge of sign parallel with edge of hazard); use fluorescent yellow sheeting; review site for crash attenuators; review need for narrow bridge warning signs and centerline and edgeline supplemental retroreflective, raised pavement markers.



Photos credit: unknown

CATEGORY LINK	OBSERVATION # 5	
Lane Departures	Steep Front slopes Lack of Barriers	
SITE SPECIFIC Location	Various	
Horiz. Alignment	TANGENT ☐ CURVE ☐	
MAINTENANCE SECTION	SECTION Loma Mar-La Honda SEGMENT 5-12	
FREQUENCY Low	SEVERITY High	RISK RATING F
BAND I		

NOTES/INFORMATION: Approximate locations for barrier needs review are in Segment 5: ¼ mi SW and ¼ NE of Native Sons Rd, 50 ft NE of Native Sons Rd. near to Roy Gulch and in Segment #6: 4 sites between Forever Bloom Farms and Buena Vista
See maps highlighted in Red for candidate sites in Appendix, 6.

Generally, the stepped approach to combat roadway departure is to keep vehicles in their lane, provide opportunity to recover, improve clear zone, reduce chances of loss of control or overturning, remove fixed objects, make fixed object breakaway, shield objects, delineate objects. Since many of these options are not available given the roadway and the environment, it is imperative to do all to keep vehicles on the roadway. Hence, rumble stripe, raised pavement markers, roadside delineators, reducing speed, adding narrow shoulder, etc. and similar countermeasures are prioritized.

Observations: PCR follows Pescadero Creek which leads to areas where the roadway has steep drop-offs to the creek. These areas do not have any recovery areas. Also due to the topography of the road, there are numerous curves which need to be negotiated. Other curves which may otherwise warrant barrier have berms. Some sites have very steep slopes and practically no shoulder with ravines of visually observed to be about 15-30 ft deep at the toe of about 60-80-degree slope. Others are more forgiving in terms of slope grade.

Suggested Improvements: Conduct guardrail needs assessment study. Delineate edge of roadway on outside of curves strongly: Use of raised pavement markers, rumble stripes, post mounted delineators. Since cyclist will likely resist profiled markings, demonstration of greater risk of severe crash accompanies the roadside environment. Profile marking use should be limited to approach and to point of tangent of the curve. Raised pavement markers should be considered at severe curves as a special treatment. Known study locations are shown in Appendix # 6. Reduce speed – add advisory speeds consistent with horizontal alignment study results for posting of correct advisory speed. Investigate bicycle-friendly options that can help prevent lane departures and off-tracking.



(Photo Credit: Ryan Rasmussen)

CATEGORY LINK	OBSERVATION # 6	
Vulnerable User Conflicts and Facilities Needs	Flooding of PCR at Butano Creek. Road Closures/Denied Access	
SITE SPECIFIC Location	Flooding of PCR at Butano Creek. Western end of Town of Pescadero	
Horiz. Alignment	TANGENT ☒ CURVE ☐	
MAINTENANCE SECTION	SECTION Pescadero	
	SEGMENT 2	
FREQUENCY	SEVERITY	RISK RATING
Low	Low	A
BAND III		

Observations: Pescadero Creek Road floods near Butano Creek making it undriveable. As a result:

- Residents of the town of Pescadero would need to use alternate routes during flood events.
- Vehicles may be stalled in the water
- Fire services may not be able to reach town
- Dredging in creek is limited due to presence of endangered species

Suggested Improvements: Change roadway profile; Create and/or sign alternate routes in case of flooding; Revisit use of automated warning signs to ensure latest technology is employed (battery backup, fail-safe, and redundant systems). At bridge replacement schedule consider raising the bridge.



(Photo credit FHWA) View of connector road to Alpine Road just downstream of point of curve of PCR (EB)

CATEGORY LINK	OBSERVATION # 7	
Intersections	various	
SITE SPECIFIC Location	Alpine Road @ PCR	
Horiz. Alignment	TANGENT ☐ CURVE ☒	
Note: Alpine legs at Point of Curve and Point of Tangent		
MAINTENANCE SECTION	SECTION La Honda SEGMENT 12	
FREQUENCY Medium	SEVERITY High	RISK RATING E
BAND I		

Note: See additional views on next page.

Observations: 1) Signing needs. 2) Reducing radii; 3) Enhancements to control type and who has right of way; 4) advanced preview distance; 5) atypical geometry for intersection, high conflict points; 6) increased potential for improper turns or direction of travel; 7) Intersection sight distance

Suggested Improvements: Alpine Road intersection should be reevaluated to include changes in geometry and traffic control (change an approach or more to Stop control, one way on a leg, eliminate a leg, etc.); Properly select and install signs per standard; provide advance notice, satisfy driver and user expectations. (Ex. Sign in photo should be on right shoulder; may supplement or double post with sign on left as shown) Other suggestions: Redesign intersection to accommodate both types of movements better. Consider using the southern leg for traffic exiting PCR onto Alpine only to mitigate left turn conflicts from PCR to Alpine Road. Consider using the northern leg for traffic continuing on PCR from Hwy 84 to Hwy 1 only; Redesign signage so that it helps the traveler understand this intersection; Update striping and legends; update chevrons increase number and size of signs. Enhance bike lane designations; add sharrows, add bike signage; Add Directional sign indicating PCR keeps right and Alpine Rd. stays straight. Evaluate need for right turn lane. Assess road name change from Hwy 84 to Alpine Road as Alpine Road (segment 12) instead of Pescadero Creek Road to simplify road name signs. Stripe Bike Lane, add begin, end, add sharrows and bike may use full lane signage where feasible. Clear trees to improve sight triangles and lines of sight. Consider signal warrant study with community support; Note change of roadway characteristics from wide road to narrow road Clear trees for better sightlines.

CATEGORY LINK	OBSERVATION # 7 - continued
SITE SPECIFIC Location	Alpine Road @ PCR



Photo credits: Google Maps

Left: On Alpine looking north at intersection with PCR (Google map showing “Pescadero”) legend is incorrect. PCR is in the background making sharp curve (blue arrow).

Bottom: On PCR looking southeast with Alpine Rd going straight into T-intersection and PCR making sharp turn to left heading east-northeast on PCR (blue arrow)





Photo credit: FHWA

Butano Cut-off Rd. (foreground) looking east downstream on Pescadero. Just east of here the horizontal curve radii reduce substantially, tangents are much shorter, pace speeds decrease, roadway narrows

CATEGORY LINK		OBSERVATION # 8	
Curves		Advance Notice Signing	
SITE SPECIFIC Location		(See Suggested Improvements)	
Horiz. Alignment		TANGENT ☐ CURVE ☐	
MAINTENANCE SECTION		SECTION Pescadero - La Honda SEGMENT 5 - 11	
FREQUENCY	Medium	SEVERITY High	RISK RATING E
BAND I			

See Appendix # 2. Roadway Alignment Changes and # 3. Supplemental Advance Warning Signs for Curve Approaches

Observations: Motorists may not have sufficient information to know where the roadway alignment and roadside conditions are about to change over a long section of the route. There are places where the roadside clear zone, degree of curvature, superelevation, tangent lengths between curves, etc. change significantly. Drivers can become accustomed to a certain look and feel of the road for more forgiving conditions such as long tangents, large curve radii, generous clear zones, etc. and then not adjust their driving in a timely fashion to compensate for changes to less forgiving roadway/roadside wherever this occurs. In addition, some approaches to sharp curves are longer downgrade tangent sections

Suggested Improvements: Consider the use of section or corridor warning signs where the driver receives advance and reminder notices. Depending on the location this could be a change in speed limit, advisory speed, series of sharp curves or winding road. A system of these corridor warning signs should be incorporated with specific warning and regulatory signing to include but not be limited to horizontal curve signing, lane/pavement width transitions, shoulder narrowing or elimination, edge drop-offs, etc. Notable sections: EB travel beginning at Butano Cut-off and WB travel beginning at Alpine Road (and similarly at the change points for these sections for WB travel and EB travel respectively). Consider repeat signing as appropriate every 2 miles and posting distances on all signing. For downgrade tangent sections, consider use of additional upstream warning signs (See Appendix # 3).



Photo Credits: unknown



CATEGORY LINK	OBSERVATION # 9	
Intersections	Signing	
Site Specific Treatment	Informational/Tourist Oriented/Recreational Signs	
Horiz. Alignment	TANGENT ☐ CURVE ☐	
MAINTENANCE SECTION	Pescadero - La Honda	
FREQUENCY Low	SEVERITY Medium	RISK RATING C
BAND II		

Observations: Many intersections lack basic distance, directional guide signs. This includes numbered routes and named streets and roads. Advance street name and route junction signs and directional signs provide motorists with awareness of an intersection and the possibility of slowing/turning traffic signs (see photos). Traffic generator signs are missing or in poor condition

Suggested Improvements: Develop a system of 1) intersecting street name signing plans; 2) intersecting numbered route signing plan, and 3) traffic generator signing road (public/private) plans. Development of system for different destination types will lead to upgrade of these locations. Any other locations not fitting one of the three would also be included for upgrading. Consider use of Uppercase and lower case for all directional and street name signs for improved legibility. Tourist Oriented Directional Signs (TODS) may also be considered as a corridor treatment. Refer to Observation #3, Trailheads and Other Crossings of PCR.

Caltrans Responsibility: Improve Street Name Signage – update to latest standards; layouts consistent with SMCDPW plan.



Photo credit: (Left)

H. Yip Noting narrow space between yellow solid lines

(Below) FHWA

Stop sign mounted on utility pole



CATEGORY LINK		OBSERVATION # 10	
Markings and Signing		Corridor Needs-Consistency and Uniformity	
General			
Horiz. Alignment		TANGENT ☐ CURVE ☐	
MAINTENANCE SECTION		SECTION Pescadero - La Honda	
FREQUENCY Medium		SEVERITY Medium	RISK RATING D
BAND II			

Observations: Many of the markings, longitudinal lines i.e., are in very good condition. Some segments on the western half were recently upgraded. But in some locations the edge lines are flush with the edge of the roadway. Centerline markings consist of raised reflective markers, non-reflective markers, or water-borne traffic stripe. Some sections appear to have a variance in the space between the two yellow centerline markings. Specific and site related observations and suggested improvements are contained in this report.

Suggested Improvements: Establish a corridor applied design for edgeline and centerline markings which promote durability, consistency, and longevity. Standard placements should be reviewed to determine if edge lines can be placed closer to the centerline; this will give the appearance of a narrower lane and prevent the striping materials from running off the edge of pavement. For centerlines a space less than the width of the line should be avoided (see photo above) If the standard is 4" solid lines, then consider a 4"- 4"- 4" pattern or 4"- 6"- 4" for further lane narrowing perception. The MUTCD simply calls for a discernable space, not specifying a width. Signing plans for guide signs and intersection signing have been address in other Observations (#3, 7, 9). Regulatory signs, R2-1 series, is addressed in Observation #2. Again, a systematic signing plan for the corridor will promote safety and consistency for the users. A signing plan should address the need assessment and use of warning, regulatory and guide signs where safety observations are common and/or known to exist.



Photo Credit FHWA
Eastbound view
near Pescadero Crk.

NOTE: Accurate curve signing depends on proper use of the 85th percentile approach speed or the posted speed. Posted speed should be based on SMCDPW speed studies

CATEGORY LINK		OBSERVATION # 11	
Markings and Signing			
Specific		Horizontal Curves	
Horiz. Alignment		TANGENT ☐ CURVE ☒	
MAINTENANCE SECTION		SECTION Pescadero - La Honda SEGMENT 5-12	
FREQUENCY Medium		SEVERITY High	RISK RATING E
BAND I			

OTHER DESCRIPTIVE INFORMATION: Primarily impacts sections beginning at Butano Cut-off to Alpine Road. A recent study of the entire corridor produced the necessary information to correctly sign the route's horizontal curves.

Observations: Inconsistent or absence of signs on horizontal curves. Just a few curves out of dozens are signed. Some curves are delineated well using post mounted delineators.

Suggested Improvements: Establish a standard horizontal curve warning treatment plan. When certain safety performance criteria (crash frequency, crash rate, fatalities, etc.) pace speed, potential for conflicts and higher risk of injury or crashes, consider the use of substantive safety treatments. Two examples of these are: For curves warranting no horizontal alignment signs per the MUTCD Table 2C-5 or state supplement, the use of post mounted delineators provide both daytime and nighttime guidance (consider retroreflective highway sheeting which is fluorescent yellow on delineators), use wider markings in curves, etc. Refer to other mitigation treatments in the section on Lane Departure and an Example Delineation Plan in the Appendix #4.



CATEGORY LINK	OBSERVATION # 12	
Vulnerable User Conflicts and Facilities Needs		
Sub-topic	Pedestrian and Bicyclists - Conflicts and Facilities Needs	
Horiz. Alignment	TANGENT ☐ CURVE ☐	
MAINTENANCE SECTION	SECTION Pescadero SEGMENT 1& 3	
FREQUENCY Medium	SEVERITY Medium	RISK RATING D
BAND II		

OTHER DESCRIPTIVE INFORMATION: Review performed at US 1 and at Cloverdale (2 Intersections). A link to a map of Bike Routes can be found here: <https://tooledesign.github.io/F0066-San-Mateo-CAG/>

Observations: Lack of markings to alert vehicles of presence of cyclists and pedestrians using the road - need better delineation of where bike and vehicles need to travel. Top photo above shows a location at the interface between State Hwy 1 and PCR. Bike lane ends abruptly. Cyclists find it difficult to turn left from PCR to Hwy 1 and from Hwy 1 to PCR. Similar issues occur at other street intersections: Cloverdale and PCR, Butano Cutoff and PCR, Alpine Road and PCR. Limited parking space on west side of State Hwy 1.

Lack of pedestrian facilities or crosswalk on State Hwy. to get from parking on PCR to beach; abrupt end to bike lane. At Cloverdale (lower photo) channelization for bikes and motor vehicles is wide and lack guidance on path.

Suggested Improvements: Conduct study and consider feasibility of a mid-block or intersection crossing on State Hwy 1 for peds, such as a Ped Hybrid Beacon, Advance warning, or simply ped auto-actuated flashers when peds are in vicinity of crossing. Many potential treatments to consider. Channelize and marking parking area in NE quadrant. For Cloverdale, reduce taper length for EB right turn in channelized area. Restripe and position stop line at optimum offset and bring edgeline through as dotted extension line. Layout should facilitate safe bike traffic in mix of higher speed vehicles. Close coordination with Caltrans at intersections with state routes is needed

C. General Concerns

Human Factors

Most decisions in operation of a motor vehicle or travel by foot or bike are influenced by environmental, psychological, physiological conditions. Further complexity in the decision-making process is found in the physical, cognitive, social, cultural, and emotional factors of humans. Human Factors play a significant part in choice of speed, headway, braking tendencies, and compliance with traffic control devices. Users familiar with the roadway may use a different set of variables or assume more risk when making driving or travel decisions than unfamiliar drivers. Recreational user decisions may also vary from commuter drivers. At-risk users crash rates are typically over-represented in volume; these at-risk users include users of prescription drugs, alcohol, illegal substances, and electronic devices while driving or cycling. Providing positive guidance can reduce the likelihood of road user error and reduce the probability of a crash. A corridor-wide systematic program to use positive guidance principles along with redundancy is recommended: spreading, primacy, and expectancy comprise positive guidance. Examples of these are maintaining standard sign spacing, reducing the amount of sign messages for each installation, prioritizing sign displays, and notifying users of unexpected roadway features. Providing road users with critical information in multiple ways can be achieved by supplementing a warning sign with a similar pavement marking legend. Using a hierarchical approach to install and maintain signs ensuring the most important signs for safety are prioritized, properly placed, easily legible and conspicuous should be considered. A simple example is shown below in Table IIIA.-1:

Table IIIC.-1 Sample Hierarchy of Sign Placement		
Priority Position	Sign Group	Note
1	Regulatory Signs	At Intersections – ROW Control, Lane Use, etc.
2	Location Specific Warning Signs	Warning signs which have a specific preview distance (MUTCD Table 2C-4, Guidelines for Advance Placement of Warning Signs)
3	Guide Signs	Route assembly, Directional, Adv. Street Name, etc.
4	Non-Location Specific Warning Signs	Nature of warning is generally non-specific, non-exact, such as Deer Crossing, Low Shoulder, etc.
5	Other Guide Signs	Traffic Generator Directional, Wayfinding, Tourist Oriented Directional Sign (TODS), etc.

Road User Services

Timely emergency medical services are largely dependent on a reliable phone service network. Portions of the PCR lack reliable service. Commuters and locals likely understand the cell phone coverage limitations. But for tourists, novice bikers, etc. this may come as a surprise at an inopportune time following a crash or other health or public safety emergency. Generally, the Team has identified the following to pursue: Identify areas along the route with acceptable coverage and advise motorist of new or improved pull-offs at these locations, provide signing

which highlights limitation to services, and provide PSAs, media, etc. to educate both familiar and unfamiliar users of PCR of these conditions.

Vulnerable Road Users and Facilities

Motorcycle involvement accounts for approximately 25% of the crash modal type. It is not well understood why the motorcycle class of user has such a significant share of the crashes other than the observation of numerous motorcycles comprising the traffic stream. With only a small portion of the route (Pescadero Section) having a bike lane, the potential for increased conflicts is high due to the nature of the roadway (horizontal and vertical alignment, pavement width, absence of usable shoulder and/or narrow shoulder). Moreover, treatments to reduce crashes for one mode often carry tradeoffs effecting another mode. An example of weighing these tradeoffs could be the negative impact to cyclists if continuous rumble stripes were installed for the edgeline. This could alter the lane positioning decision of some cyclists resulting in decreased comfort, decreased perceived level of safety, increased potential conflicts. Implementation approaches would include a targeted approach aimed at past crash locations and/or a systemic approach aimed at sites with similar risk factors and roadway features. A few potential treatments which could increase the level of comfort and sense of safety for the cyclist are: 1) bicycle passing lanes or short sections of paved shoulder provided to allow motorists to move past slower bicycle traffic as on a positive grade and 2) providing a wider pavement or a paved shoulder in curves to provide greater separation between the modes and account for greater variability in vehicle path. This has benefit for all modes without significant tradeoffs negatively impacting one mode vs. another. Advance signing and markings should be installed where such widening occurs. A few site-specific Suggested Improvements can be found in Observation #12 Vulnerable Road Users. Other treatments relative to bicycle, pedestrian, and motorcycle safety may also be explored. CA statutes, CalTrans policies, and local codes must be followed in consideration of all potential treatments. The Team also suggests the use of Share the Road signs and markings and periodic reminders along the route of the presence various modes and the lawful use of the public right of way.

Appendix

Observation/Concern (O/C) Sheet Key

Denotes an O/C and suggested improvement at specific location (s)

Denotes a linkage if one exists to "Primary" or "Other General" O/C

Observation/Concern (O/C) number

Specific O/C name

Is the specific location or Primary O/C only in tangent or curve section(s)

Risk Rating (see Risk Matrix Chart on p.12)

If a crash occurs or would occur related to the concern, the substantive or likely harm which results.

*Implementation will be based upon SMC resources and other constraints

CATEGORY LINK	Observation #13	
Lane Departures	Steep Front slopes, lack of Barriers	
SITE SPECIFIC Location		
Horizontal Alignment ->	TANGENT ☐ CURVE ☐	
Note: Click or tap here to enter text.		
MAINTENANCE SECTION	SECTION Loma Mar-La Honda	
	SEGMENT 5-12	
FREQUENCY	SEVERITY	RISK RATING
Low	High	F
BAND I		

Special note about the concern information (optional)

In which maintenance section was the O/C found or where does the concern present?

The numbers maintenance segments within the Section identified above

What is the perceived occurrence or repetition or exposure concerning the event, conflict, or roadway feature or operational aspect

*Priority in terms of addressing or mitigating risk or crash frequency or severity. Dependent on Risk Rating. Lower Risk Ratings are Band II and higher risk ratings are Band I.

Appendix items are numbered 1.-7.

1. Bike Passing Lanes

Motorists and bicyclist may both benefit from a passing lane designed for bicycles. Motorist may desire to pass bicyclists at intermittent locations on steep or long positive grades. The photos on the next page shows an approach to a potential bike passing lane in the LaHonda Section. Advance signing to indicate the presence of such a short bike lane is desirable. Example depicted on right. Bicycle warning signs with SHARE THE ROAD plaques is also suggested.



Image A0 Sample
Advance Bike Passing
Lane sign



Photo A1 Above (credit: anonymous) Curve with wider than typical shoulder. Location perhaps suitable for a bike pull off

Photo A2 Below (credit anonymous) Closer view (below) showing photo-edited bike pull-off. Design of bike passing lane TBD by SMCDPW

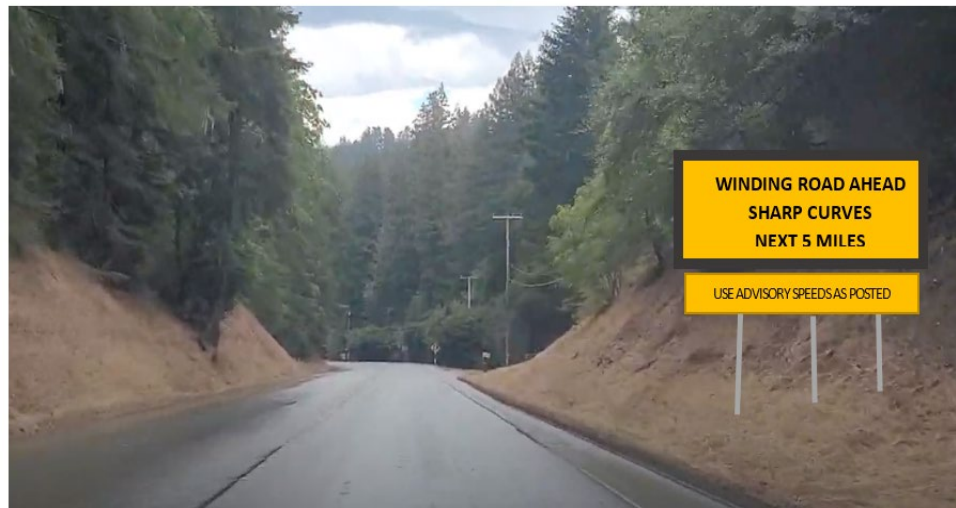


2. Roadway Alignment Changes

Need for supplemental advance warning signs for downgrade long tangent section approaches to sharp curves. In a few locations the change is evident in ROW, shoulder presence/absent, pavement width, curvature, degree of curvature, driveway frequency, intersection sight distance, etc. Drivers are experiencing a few long stretches of tangent sections between sharp curves, where speeds typically increase. A need exists to warn users. Switchback curve warning sign is seen in distant background (photo A4). This is where a warning sign is needed for change in alignment with reminder after switch back in next tangent section. Sign Design,



Photo A3 (SMC video; inset FHWA) Above Looking eastbound on PCR just east of Butano Cut-off Rd.; inset @ Butano Cut-off Rd.; Photo A4 (SMC video) Below Looking westbound on PCR approach Alpine Road.



legend, shape, mileage, reminders, etc. are the responsibility of SMCDPW. Superimposed signs shown are for illustrative purposes. If conditions warrant, sign message should be repeated in 2-mile increments. Min. letter size 8 in. Highway D Series. Note: These proposed signs as depicted in Photos A3-A4 would supplement, not replace, the necessary warning signs to be installed according to the curve analysis study recently performed by a contractor and speed studies performed by SMCDPW (See Speed, p. 11, Suggested Improvements 1)-3)).

3. Supplemental advance warning signs for curve approaches

At least two long tangent sections (Lat-Long Coordinates provided below) downgrade can increase the possibility of a lane departure in a curve. Motorists sometimes increase their speed in longer tangent sections between curves on winding roads of considerable length. Provide upstream advance notice. Suggestion SHARP CURVE AHEAD/REDUCE SPEED TO XX MPH. Follow with standard horizontal warning sign at advance preview distance Table 2C-4, MUTCD Fed.

Note: These proposed signs as depicted in Photos A5-A6 would supplement, not replace, the necessary warning signs to be installed according to the curve analysis study recently performed by a contractor. Photos below show suggested type of warning sign superimposed onto photos

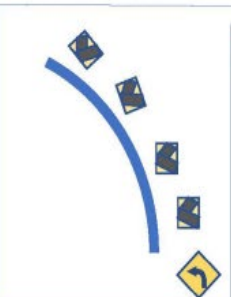
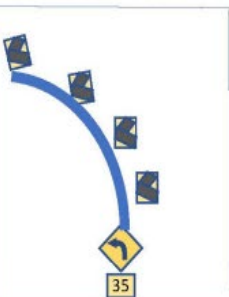
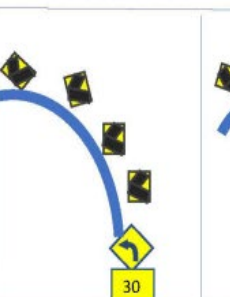
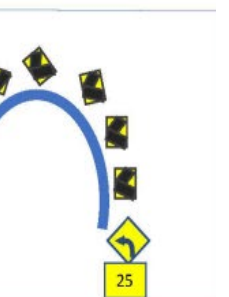


Photo A5 above (Credit SMC video, Reel 2 Horse camp west to Memorial Pk.)
([37.2970327340414](#), -[122.27758575291675](#)).

Photo A6 (Credit: SMC video) below showing the second tangent past the above curve (photo A5) ([37.295097](#), -[122.279332](#))



4. Horizontal Curve Treatment Plan Example

Horizontal Curve Treatment Scenarios					
					
Speed Differential	< 10	10	15	20	25
Sign	n/a	Shall	Shall	Shall	Shall
W13-1 (Plaque)	n/a	Shall	Shall	Shall	Shall
Chevrons (C) or Delineators (D)	D - RSA Recommended	C- Should	Shall	Shall	Shall
Oversized Signs/Chevrons	n/a	n/a	n/a	RSA Recommended	RSA Recommended
Fluorescent Yellow Sheeting	n/a	n/a	n/a	RSA Recommended	RSA Recommended

Note: Blue shaded areas are per MUTCD 2009 Table 2A-5 (5 mph differential column is not shown). Enhancements for curves where the differential is greater than 15 mph are suggested. For differentials < 10 mph, use post mounted MUTCD Type I or III delineators. Enhancements and ranges are suggested; variations of the same may improve safety outcomes.

5. Cloverdale Rd. Improvements

Photo edit showing marking changes suggestions
Photo A7 - Aerial view below (Source Google Maps)



6. Guardrail Needs assessment sites.

Numerous locations were noted during the ride-through portion of the field review. A guardrail/barrier analysis should be conducted to determine how many additional sites may be candidates for redirected barrier. Red areas marked on map indicates sites for barrier or other roadway departure countermeasure consideration. Sections are Loma Mar and LaHonda.

Image A8 - Loma Mar Section , Segment 5,

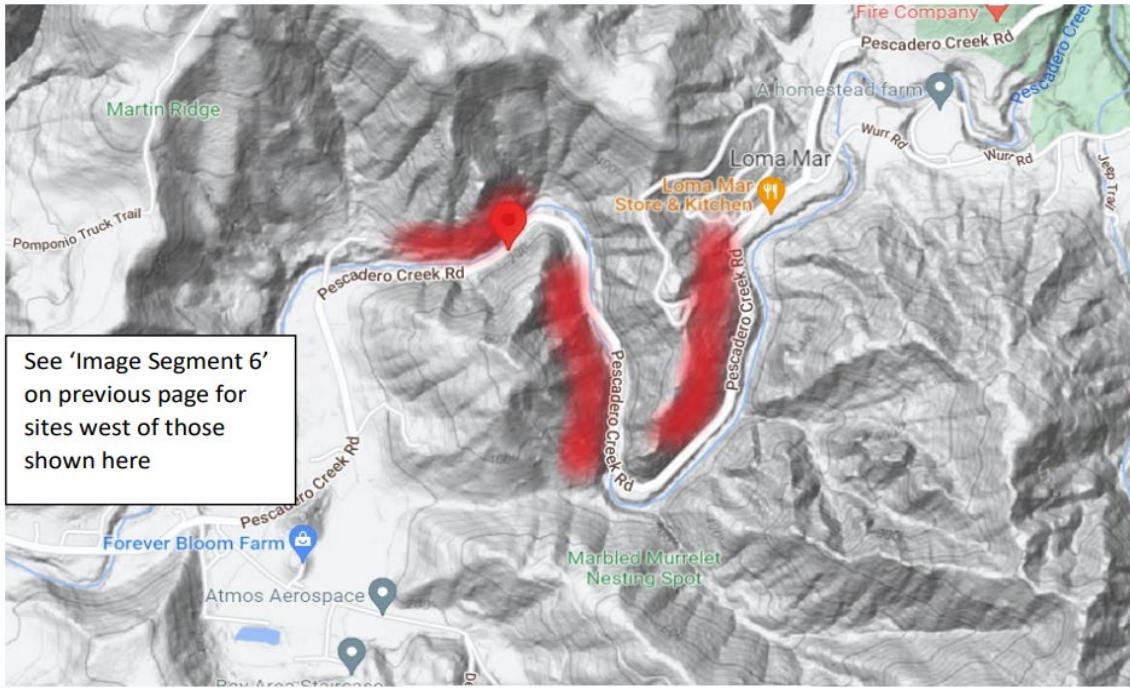


Image A9 - Loma Mar Section, Segment 6,



Images Google Maps

Image A10, Loma Mar Section, Segment 6-7



Bing Maps Image

7. Markings Needs at Redwood Dr.

(Photo A11 credit Google Street view)



Resources

Guide for Improving Safety at Uncontrolled Crossing Locations

https://safety.fhwa.dot.gov/ped_bike/step/docs/STEP_Guide_for_Improving_Ped_Safety_at_Unsig_Loc_3-2018_07_17-508compliant.pdf

Evaluation of Pavement Safety Performance

<http://www.fhwa.dot.gov/publications/research/safety/14065/14065.pdf>

Roadside Design Guide

<https://store.transportation.org/Item/CollectionDetail?ID=105>

Simplifying Delineator and Chevron Spacing for Horizontal Curves

<https://static.tti.tamu.edu/tti.tamu.edu/documents/0-4052-1.pdf>

Manual on Uniform Traffic Control Devices (MUTCD 2009)

<https://mutcd.fhwa.dot.gov/>

Guide for the Development of Bicycle Facilities

<https://nacto.org/references/aashto-guide-for-the-development-of-bicycle-facilities-2012/>

Design and Safety of Pedestrian Facilities

https://safety.fhwa.dot.gov/ped_bike/docs/designsafety.pdf

Speed Management Countermeasures

https://safety.fhwa.dot.gov/speedmgt/ref_mats/fhwasa16077/fhwasa16077.pdf

NCHRP Report 966 Posted Speed Limit Procedure Setting Tool

<https://www.trb.org/Main/Blurbs/182038.aspx>

Crash Modification Factor Clearinghouse

<https://www.cmfclearinghouse.org/>

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