Tesla Road Safety Study

REPORT

Prepared for

Public Works Agency
Alameda County

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1. INTRODUCTION

In 2014 the Alameda County Public Works Agency (County) conducted a safety study to identify the roadway safety needs on Tesla Road from Greenville Road to the Alameda/San Joaquin County Line, a distance of approximately 9.6 miles. Tesla Road is rural two lane arterial connecting I-580 near Tracy with the City of Livermore. The roadway is used by residents and by motorists visiting the Livermore wineries, Livermore National Laboratory and the Carnegie State Vehicular Recreation Area. The roadway includes multi-modal traffic uses such as autos, trucks, bicycles, motorcycles, and pedestrians.

The collision history on Tesla Road has prompted the County to conduct this safety study. The primary goal of the safety study is to identify and prioritize the needed safety measures that will potentially make the roadway safer for the residents along Tesla Road and other road-users. As part of the safety study, existing roadway features, current and projected future traffic volumes, collision statistics were studied to propose countermeasures that could be implemented either in the near-term, mid-term or long-term. The safety study report enables the County to compete for highly sought after State, federal and other funding grants when they become available to implement the proposed safety measures.

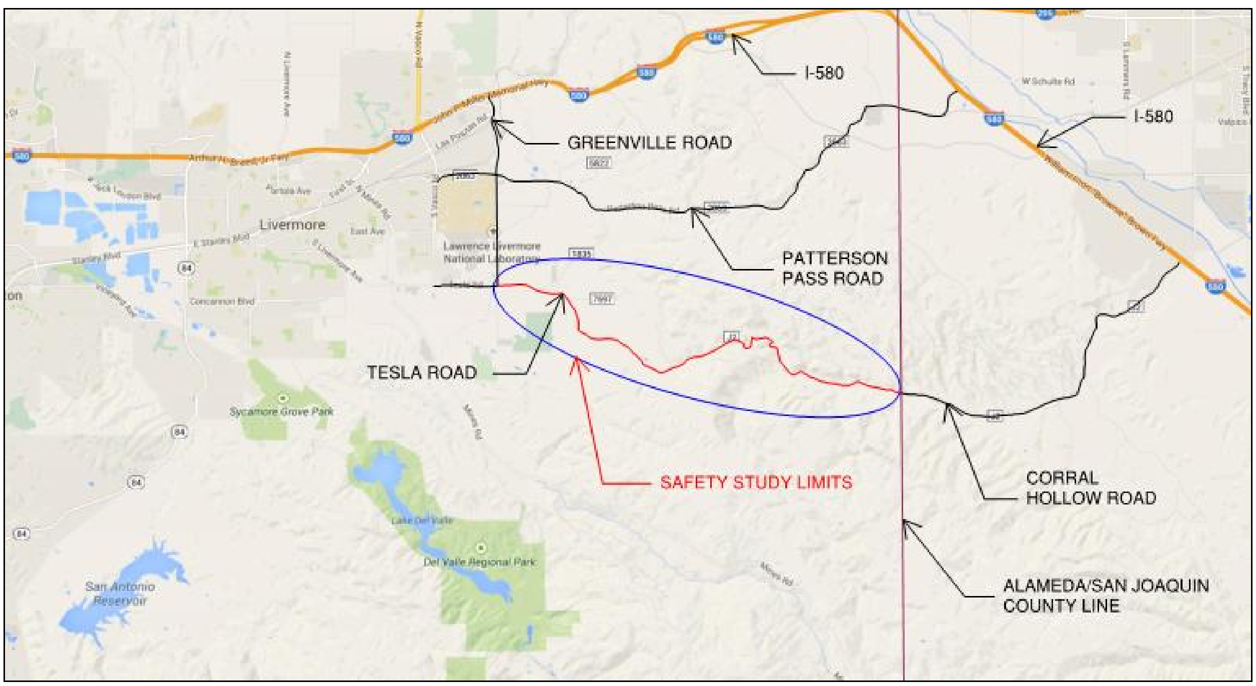


Figure 1 Vicinity Map

2. BACKGROUND

The corridor of Tesla Road investigated as part of the safety study is in an area of rural residential development with agricultural uses such as pasture lands, dry crops, and orchards. The roadway is characterized by tight curves and blind spots, reduced roadway widths and limited shoulders, and limited recovery area and visibility. The roadway is bordered by soft shoulders, power poles, trees, intermittent ditches and steep slopes. Topography surrounding the roadway ranges from open grassland areas to mountainous terrain with deep precipices. The roadway crosses several small to medium sized creeks that originate in the hills east of Livermore, California. The majority of the creeks in the vicinity of the study area remain in natural channels, entering closed culverts at roadway crossings.

The roadway itself has been open for more than a century and primarily served the coal miners in the region to get their product to the market. Reports indicate that horse-drawn carriages were not uncommon even ten to fifteen years ago. Today, Tesla Road has become a heavily traveled two-lane route with traffic volumes ranging from 2,700 to 5,200 vehicles per day. The increase in vehicular traffic on this roadway, which was not designed to serve high volumes of fast moving motorists, has resulted in an increase of collisions on Tesla Road over the last decade. Additionally, the roadway conditions are generally unsafe for bicyclists and mail carrier trucks as well. Bicyclists tend to bike along the edge stripe due to lack of bike lanes and paved shoulders, and mail carrier trucks tend to encroach onto the travel lane when they stop to deliver the mail.

Tesla Road is not the only roadway in Alameda County to experience such a transformation – spike in traffic volumes and collisions – in the recent times. Collision reports on Patterson Pass Road, a rural arterial roadway that runs parallel to Tesla Road connecting the Cities of Tracy and Livermore, and Crow Canyon Road, a rural arterial roadway connecting Alameda County and Contra Costa County, necessitated safety studies to investigate the cause of collisions and propose potential solutions to alleviate the problem.

3. PURPOSE AND NEED

The primary goal of this study is to identify and prioritize potential safety measures that could improve safety along the roadway corridor for the motorists, the residents along Tesla Road, and for other road-users such as mail carriers and bicyclists. This study included an investigation of the existing roadway features, the traffic characteristics - both current and projected traffic volumes- and the collision history along the roadway to identify potential safety measures along Tesla Road. The report prioritizes, based on the ease and cost of implementation, the strategies to mitigate the collisions as near-term, mid-term and long-term countermeasures. The prioritization, along with the cost break-down, of the strategies enables the County to apply for federal or other funding when it becomes available.

The safety study was performed primarily because of the increase in the number of collisions on the roadway. A total of 54 collisions had been reported between 2009 and 2012. Residents along Tesla Road have indicated that additional unreported collisions have occurred at various locations along the corridor. The secondary reason for the safety study stems from the fact that the roadway was not designed for the purpose for which it is being currently used – carrying high volumes of vehicles traveling between the Central Valley and the Livermore Valley. The increasing number of collisions justifies the need to study the roadway characteristics in conjunction with the traffic volumes and collision types and frequencies to address the safety issues on the roadway. Description of the existing roadway features, traffic characteristics and collision statistics are presented in the following sections of the report.

4. EXISTING ROADWAY CONDITIONS

The existing roadway characteristics play a critical role in all decisions taken by the driver, including those that result in collisions. Properly engineered roadways could potentially offset the relatively minor mistakes by the drivers and thus significantly improve the safety of the roadway. A detailed investigation of the existing conditions along Tesla Road was conducted as a part of this study. The study team conducted multiple field reviews to study the existing roadway conditions and traffic operations.

Tesla Road is classified as a principal rural arterial. According to the functional classification by Federal Highway Administration (FHWA), arterial roadways serve corridor movements having trip length and travel density characteristics indicative of substantial statewide or interstate travel. Arterials are relatively high mobility and high capacity roadways that accommodate intra-community travel and connect the rest of the countywide collector system.

As part of the safety study, project specific design criteria were established for Tesla Road based on the American Association of State Highway and Transportation Officials (AASHTO) and Caltrans guidelines for arterial roadways. The established project specific design criteria for Tesla Road, along with the relevant AASHTO and Caltrans guidelines, are presented in Table 1. These criteria were used to identify the existing roadway features that could potentially cause unsafe travel conditions, and these roadway features are described in the following section of the report.

Table 1 Tesla Road Design Criteria

	AASHTO (6th Edition 2011)	Caltrans Highway Design Manual (HDM) 6th Edition 2012	Alameda County Design Criteria for Tesla Road
Classification	**Section 1.3.3** Rural Arterial Roadway	**HDM 62.3 (4)** Major Highway/Arterial Highway	Rural Arterial Roadway
Function	**Section 1.3.3** ▪ Suitable for statewide travel ▪ Travel between Urban Areas ▪ Routes that may warrant multi-lane improvements	**HDM 62.3 (4)** ▪ Geometric design and traffic control measures used to expedite the safe movement of through traffic. ▪ Through travel on a continuous route. ▪ At grade intersections. ▪ Direct access to abutting properties.	▪ Travel between San Joaquin County and Alameda County ▪ Access to abutting properties including residences, businesses, and recreational facilities.
Design Speed	**Section 2.3.6** Recommended – 30 to 60 mph	**HDM 101.1** Use AASHTO for local facilities.	45 mph (existing speed limit)
Design Vehicle	**Section 2.1.1** WB-62 or WB 67	**HDM 404.4 (2)** California Legal Design Vehicle (65 feet tractor-semitrailer combination).	California Legal Design Vehicle (65 feet tractor-semitrailer combination).
Min Traveled Way Width:	**Section 7.2.3** **Table 7-3** AT 45 mph and more than 2000 vpd: Two 12 foot wide lanes preferred (24 feet total width). * On roadways to be reconstructed an existing 22 foot traveled way (two 11 foot lanes) may be retained where alignment is satisfactory and there is no crash pattern suggesting the need for widening.	**HDM 301.1** Lane width of 12 feet. **HDM 308** Follow AASHTO Standards for roads under other jurisdictions. **HDM 310.1** 32 feet (two 12 foot lanes and two 4 foot shoulders) or 30 feet (two 11 foot lanes and two 4 foot shoulders).	**Lane Width** 12 feet recommended 11 feet minimum

	AASHTO (6th Edition 2011)	Caltrans Highway Design Manual (HDM) 6th Edition 2012	Alameda County Design Criteria for Tesla Road
Shoulder Width:	**Section 7.2.3** **Table 7-3** Minimum width of 8 feet in each direction. * Where volumes are low or a narrow section is needed to reduce construction impacts, the paved shoulder width may be a min of 2 feet provided that bicycle use is not intended to be accommodated on the shoulder.	**HDM 302.1** 4 feet for ADT less than 400. 8 feet for ADT above 400. Minimum of 3 feet to the right of a raised rumble strip. **HDM 308** Follow AASHTO Standards for roads under other jurisdictions. **HDM 310.1** For frontage roads shoulder width is 4 feet minimum.	10 feet desired 8 feet recommended 4 feet minimum 2 feet in restrictive conditions
Sight Distance (for 45 mph):	**Section 7.2.2** **Table 7-1** Minimum Stopping Sight Distance is 360 feet. Passing Sight Distance is 700 feet.	**HDM 201.2 and 201.3** Minimum Stopping Sight Distance is 360 feet. Passing Sight Distance is 1,650 feet.	Minimum Stopping Sight Distance is 360 feet. Passing not allowed
Intersection Corner Sight Distance (for 45 mph):	**Section 9.5.3** **Table 9-6** At Intersections with Traffic Control: Length of Sight Triangle Leg = 360 feet minimum.	**HDM 405.1 (2)** 495 feet for 45 mph. A minimum of 360 feet (stopping sight distance) when restrictive conditions exist.	495 feet for 45 mph. A minimum of 360 feet (stopping sight distance) when restrictive conditions exist.

	AASHTO (6th Edition 2011)	Caltrans Highway Design Manual (HDM) 6th Edition 2012	Alameda County Design Criteria for Tesla Road
Driveway Sight Distance	**Section 9.5.3** **Table 9-6** At Intersections with Traffic Control: Length of Sight Triangle Leg = 360 feet minimum.	**HDM 405.1 (2)(c)** Minimum Stopping Sight Distance of 360 feet.	Minimum Stopping Sight Distance of 360 feet.
Grades (for 45 mph):	**Section 7.2.2** **Table 7-2** Level: 5% maximum Rolling: 6% maximum Mountainous: 7% maximum	**HDM 204.3** For Rural Highway: Level: 4% maximum Rolling: 5% maximum Mountainous: 7% maximum **HDM 204.1** For local facilities follow AASHTO Standards.	Level: 5% maximum Rolling: 6% maximum Mountainous: 7% maximum
Cross Slope:	**Section 7.2.2** **Page 7-4** 1.5% to 2% (2% is most prevalent).	**HDM 301.3 (2)(a)** 2% for new construction. 1.5% to 3% for roadway widening and/or resurfacing.	2% for new construction. 1.5% to 3% for roadway widening and/or resurfacing.

	AASHTO **(6th Edition 2011)**	**Caltrans Highway Design Manual (HDM)** **6th Edition 2012**	**Alameda County Design Criteria for Tesla Road**
Superelevation Rates:	**Section 3.3.3** Base on speed and curve radius - 12% maximum.	**HDM 202.2** For a 2 lane conventional highway or frontage road the superelevation rate is base on speed and curve radius - 12% maximum. **HDM 202.7** For county roads follow AASHTO Standards.	12% Maximum
Cross Section:	**Section 7.2.3** Normally crowned to drain away from centerline except where superelevation is provided.	**HDM 202.2** Superelevation should be on the same plane for the full width of the roadway except on transitions. **HDM 301.3 (2)** The high point of the crown should be centered on the pavement and the pavement sloped toward the edges.	The high point of the crown should be centered on the pavement and the pavement sloped toward the edges except where super elevation is provided.
Lateral Offset:	**Section 7.2.4** With a shoulder less than 4 feet wide, the minimum lateral offset to an obstruction should be 4 feet from edge of traveled way.	**HDM 309.1 (2)** 20 foot Clear Recovery Zone for conventional highways. **HDM 309.1 (3)(c)** On county roads the minimum horizontal clearance shall be the standard shoulder width.	With a shoulder less than 4 feet wide, the minimum lateral offset to an obstruction should be 4 feet from edge of traveled way

	AASHTO (6th Edition 2011)	Caltrans Highway Design Manual (HDM) 6th Edition 2012	Alameda County Design Criteria for Tesla Road
Vertical Clearances:	**Section 7.2.5** 16 feet minimum for structures (bridges). 17 feet minimum for pedestrian bridges and overhead sign structures.	HDM 309.2 (1)(a) 15 feet minimum for structures (bridges) **HDM 309.2 (2)** 17 feet minimum for pedestrian bridges. 18 feet minimum for overhead sign structures.	15 feet minimum for structures (bridges) 17 feet minimum for pedestrian bridges. 18 feet minimum for overhead sign structures.
Traffic Control Devices:	**Section 7.2.6** Sign, pavement delineation, and pavement marking should conform to the California MUTCD. Placement of these items should be considered early in the design stage while adjustments to the alignment and intersection design can be easily considered.	**Division of Traffic Operations** Sign, pavement delineation, and pavement marking should conform to the California MUTCD.	Sign, pavement delineation, and pavement marking should conform to the California MUTCD.
Erosion Control:	**Section 7.2.7** Provide features to control erosion and protect from siltation and other harmful effects.	**HDM 110.2 (2)(c)** Provide erosion control to all areas disturbed by construction.	Provide erosion control to all areas disturbed by construction.

	AASHTO (6th Edition 2011)	Caltrans Highway Design Manual (HDM) 6th Edition 2012	Alameda County Design Criteria for Tesla Road
Provision for Passing:	**Section 7.2.8** Provide adequate passing sight distance over as large a proportion of the highway length as practical. Truck climbing lanes provide opportunities for passing in areas where passing would not otherwise be permitted. A usable shoulder width of 4 feet or greater is acceptable for truck climbing lanes	**HDM 204.5 (3)** Climbing and passing lanes are most effective on uphill grades and curving alignment where the speed differential among vehicles is significant. Where the ADT exceeds 5000 4 lane passing sections may be considered. **HDM 204.5 (4)** Turnouts may be constructed in hilly or mountainous terrain or on winding roads in other areas.	Turnouts may be constructed in hilly or mountainous terrain or on winding roads
Driveway Paving	**Not Covered**	**HDM 205.4** Driveways shall be paved a minimum of 33 feet or to the right of way line, whichever is less.	Driveways shall be paved to the right of way line

4.1 Alignment

Portions of Tesla Road have horizontal and vertical curves with limited sight distance. There are also reverse curves, also known as S-curves, along the roadway that do not meet current design standards and have limited sight distance. At some locations there are warning signs that do not meet current sign standards. There are also a limited number of warning signs to warn the drivers of the impending sharp curves. Drivers who enter the horizontal curves above the posted speed limit may not observe the signs warning the sharpness of the curve, and fail to negotiate the curve safely. Figure 2 is a typical example of a curve along Tesla Road with limited sight distance.

Figure 2 Typical horizontal curve with limited sight distance on Tesla Road

4.2 Lane Widths and Shoulder Widths

Tesla Road consists of one lane in each direction. The lane widths vary from 10 to 12 feet with the lane widths predominantly being 11 feet along most of the study corridor. The preferred lane width per the Design Criteria established for Tesla Road is 12 feet, and the minimum lane width is 11 feet.

Tesla Road also has narrow paved shoulders on both sides of roadway with widths varying from one to four feet. Per the Tesla Road Design Criteria, the minimum shoulder width is four feet. In restrictive conditions, such as mountainous terrain, the Design Criteria allows a minimum shoulder width of two feet. Typically, the shoulder width for most of the study corridor, including non-restrictive locations, is approximately two feet or less.

Limited shoulder width can affect the safety of the roadway because of the following reasons:

1. Shoulders of a roadway are an integral part of the Clear Recovery Zone (CRZ). The CRZ allows the driver of a vehicle that runs off the road to safely recover. CRZ also allows drivers to take evasive action to prevent a potential head-on collision when a vehicle going in the opposite direction crosses the center line.

2. Lack of paved shoulders hinders effective speed enforcement.

3. Shoulders provide a safe refuge for vehicles that break down.

4. Paved shoulders improve driveway ingress and egress safety.

5. Paved shoulders provide an area for bicyclists to safely travel along the corridor.

6. The ability of emergency vehicles to respond to crashes is compromised without adequate shoulders. Traffic management during crashes can also be negatively impacted without shoulders.

4.3 Roadside Conditions

Roadside conditions can have a significant impact on the safety of the roadway as the roadside conditions influence the drivers' ability to safely recover and reenter the travel way when the vehicle exits the roadway. The roadside conditions can also affect the severity of a crash if the vehicle exits the roadway.

4.3.1 Shoulder Drop-Offs and Soft Shoulders

There are several locations along the corridor where there are shoulder drop-offs. Shoulder drop-off is a situation where there is an elevation difference between the edge of pavement or edge of traveled way and the unpaved shoulder. An example of a shoulder drop-off on Tesla Road is shown in Figure 3. On Tesla Road, the drop-offs vary in height and exceed four inches at some locations. For most of the corridor, the narrow shoulders are bordered by dirt, loose gravel or loose rock that has been placed for drainage purposes. Shoulder drop-offs coupled with very soft shoulders or loose rock can result in the driver losing control of the vehicle once the vehicle is off the paved road and greatly reduce the chance of recovery.

Figure 3 Shoulder drop-off with loose gravel

4.3.2 Guard Rail Replacement

Guard Rails are recommended where the severity of damage to an errant vehicle striking the guard rail is less than the damage to a vehicle running off of the road. There are several locations along the Tesla Road corridor where the existing guard rails need to be replaced as they do not meet the current design standards for guard rails. Figure 4 shows a typical example of a location where guard rail needs to be replaced because of non-standard height.

Figure 4 Guard rail with non-standard height

4.4 Signs and Markings

Signs and pavement markings are used to provide positive guidance to drivers and enable them to safely navigate the roadway alignment. Signs and markings are also used to alert motorists of impending roadway features that they need to be aware of.

As mentioned in section 4.1 of this report, there are several sharp horizontal and vertical curves along the roadway within the project study limits. At numerous locations warning signs indicating reduced advisory speeds have been installed. However, many of the signs are old and there are not sufficient warning signs such as chevrons at these locations to adequately warn the drivers of the sharp curves and reduced speeds. This is evident from the fact that collisions are usually clustered around these curves. Collision statistics are presented in the later sections of this report. It appears that most of the signs along the roadway do not meet the current reflectivity criteria.

Currently, the roadway has four-inch wide white edge stripes indicating the outer edge of the traveled way. During site visits the study team noticed certain locations where the edge stripes are only two to three inches wide and are fading away resulting in reduced visibility. Due to the existing shoulder conditions along the project corridor (narrow shoulders, shoulder drop-offs, steep roadside slopes) the current edge striping is inadequate. More conspicuous edge stripes that are visible in all weather conditions should be installed along the project corridor.

4.5 Driveway Access

There are several driveways on both sides of Tesla Road, especially in the western portion of the roadway, between Greenville Road and Eagles Run Road. Ingress and egress at the driveways can be challenging if there is a continuous flow of traffic moving at 45 mph or faster.

Additionally, there are numerous trees along both sides of the roadway. At some locations, these trees reduce the sight distance of drivers exiting these driveways. The minimum required sight distance for Tesla Road, per the Caltrans Highway Design Manual and the Tesla Road Project Design Criteria, is 360 feet. Figure 5 shows a typical example of a driveway where trees obstruct the line of sight of the driver entering the roadway. There are several driveways along Tesla Road that are on a horizontal curve alignment. The sight distance at some of these locations is also limited due to cut slopes and trees adjacent to the roadway.

Figure 5 Example of driveway with reduced sight distance because of trees

5. TRAFFIC

An evaluation of the existing and future year traffic conditions, bicycle counts, collision history and rates, speeds, travel times and existing and future traffic operations was performed as part of the safety study.

For the purpose of the safety study, the project study limits were broken down into the following segments based on the topographical features and existing traffic characteristics of the roadway:

- Segment 1: Greenville Road to Cross Road, a 0.8 mile segment.
- Segment 2: Cross Road to Eagles Run Road, a 3.6 mile segment.
- Segment 3: Eagles Run Road to the Alameda/San Joaquin County Line, a 5.2 mile segment.

5.1 Traffic Volumes

Traffic counts for each of the three study segments were collected by the study team for 48 consecutive hours in November and December 2012. Daily traffic volumes for each of the segments are summarized in Table 2. Bicycle counts were also conducted in November and December 2012 as part of the study in Segments 1 and 2. It was observed that there is a spike in bicycle activity at midday. During the two days when bicycle counts were taken, a total of 57 bicyclists in both directions combined were observed on the first day and 40 bicyclists in both directions combined were observed on the second day.

Table 2 Corridor Average Daily Traffic

Seg No.	Location	Dir	# of Lanes	Posted Speed Limit (miles per hour)	Average Daily Traffic
1	Greenville Rd to Cross Rd	EB/WB	2	45	5,182
2	Cross Rd to Eagles Run Rd	EB/WB	2	45	3,967
3	Eagles Run Rd to San Joaquin County Line	EB/WB	2	45	2,699

Figure 6 Bicyclists on Tesla Road

The study team reviewed expected growth to year 2035 as projected by the Alameda County and San Joaquin County travel demand models and also considered experience with historical traffic growth on the congested Interstate 580/Altamont Pass corridor. Based on these considerations, approximately two percent annual growth is anticipated on Tesla Road, which is similar to the parallel I-580 corridor. This growth factor when applied to existing daily volumes on Tesla Road resulted in a 2035 forecast ranging from 4,266 to 8,216 vehicles per day, with the highest volumes expected along the western-most segment between Greenville Road and Cross Road. These traffic projections combined with the typical capacity of 8,000 to 10,000 vehicles per day for a two-lane rural roadway indicate that the current two-lane roadway will provide sufficient capacity for Tesla Road for the foreseeable future.

The study also evaluated the traffic conditions, current and future, and Level of Service[1] (LOS) at the following two study intersections along the Tesla Road corridor:

- Tesla Road and Greenville Road intersection: This intersection is currently operating at LOS F during both peak hours, which would exceed Alameda County's acceptable threshold of LOS D. The LOS is primarily affected by westbound through vehicles during the a.m. peak and by eastbound through vehicles during the p.m. peak. The Manual for Uniform Traffic Control Devices (MUTCD) peak hour signal warrant would be met at this intersection under both peak hours.
- Tesla Road and Cross Road intersection: The minor southbound approach is currently operating at LOS D during the a.m. peak hour and LOS B during the p.m. peak hour. Therefore, this intersection is expected to continue operating within acceptable service levels of LOS D or better based on County thresholds of significance in 2035.

5.2 Speed

The posted speed limit throughout the corridor is 45 miles per hour (mph). There are reduced speed warning signs at some of the horizontal curves along the roadway.

Excessive speed is identified as the primary cause for most of the collisions along the corridor. Excessive speeds are determined as speeds that are unsafe for the prevailing conditions at the time of travel and are independent of posted speed limits, including speeds less than the posted speed limit.

Along with the traffic counts, presented in the previous section, speeds along the corridor were also measured. The observed speed data for all the three segments is summarized in Table 3 and Figure 7.

[1] Level of Service represents the range of operating conditions and the driver's perception of these conditions. There are six levels of service designated with letters from A to F. LOS A represents the best operating conditions and LOS F represents the worst operating conditions.

Table 3 Observed Speed along the corridor

Seg No.	Location	Dir	# of Lanes	Posted Speed Limit (mph)	Average Speed (mph)	85%ile Speed (mph)
1	Greenville Rd to Cross Rd	EB/WB	2	45	41	50
2	Cross Rd to Eagles Run Rd	EB/WB	2	45	47	53
3	Eagles Run Rd to San Joaquin County Line	EB/WB	2	45	56	61

Table 3 identifies the posted speed limit along Tesla Road with statistical speeds on all the segments of the roadway. Figure 7 provides further breakdown of speeds on the three segments showing that a great majority of motorists in segments 1 and 2 are traveling at speeds no more than 5 mph above the posted speed limit. However, in segment 3, only 40% of motorists are traveling at speeds no more than 10 mph above the speed limit.

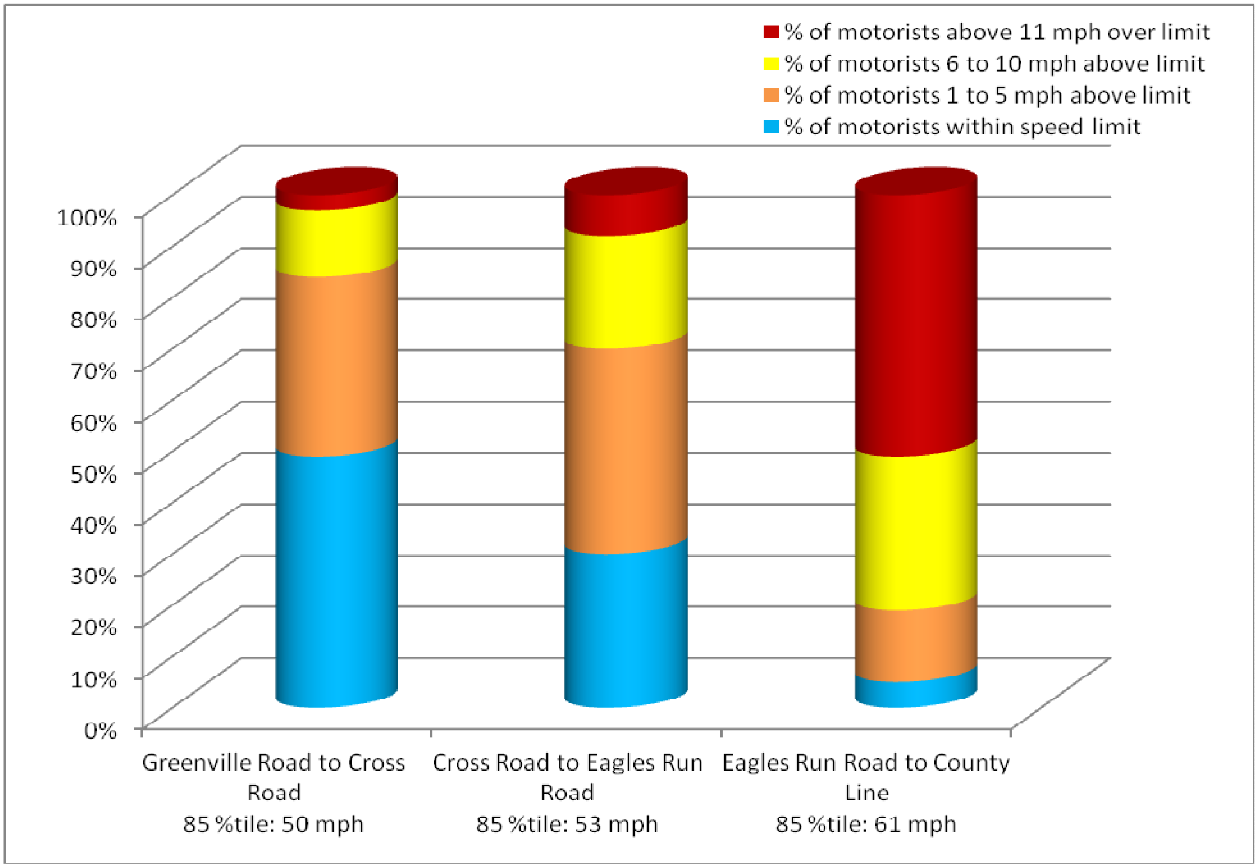
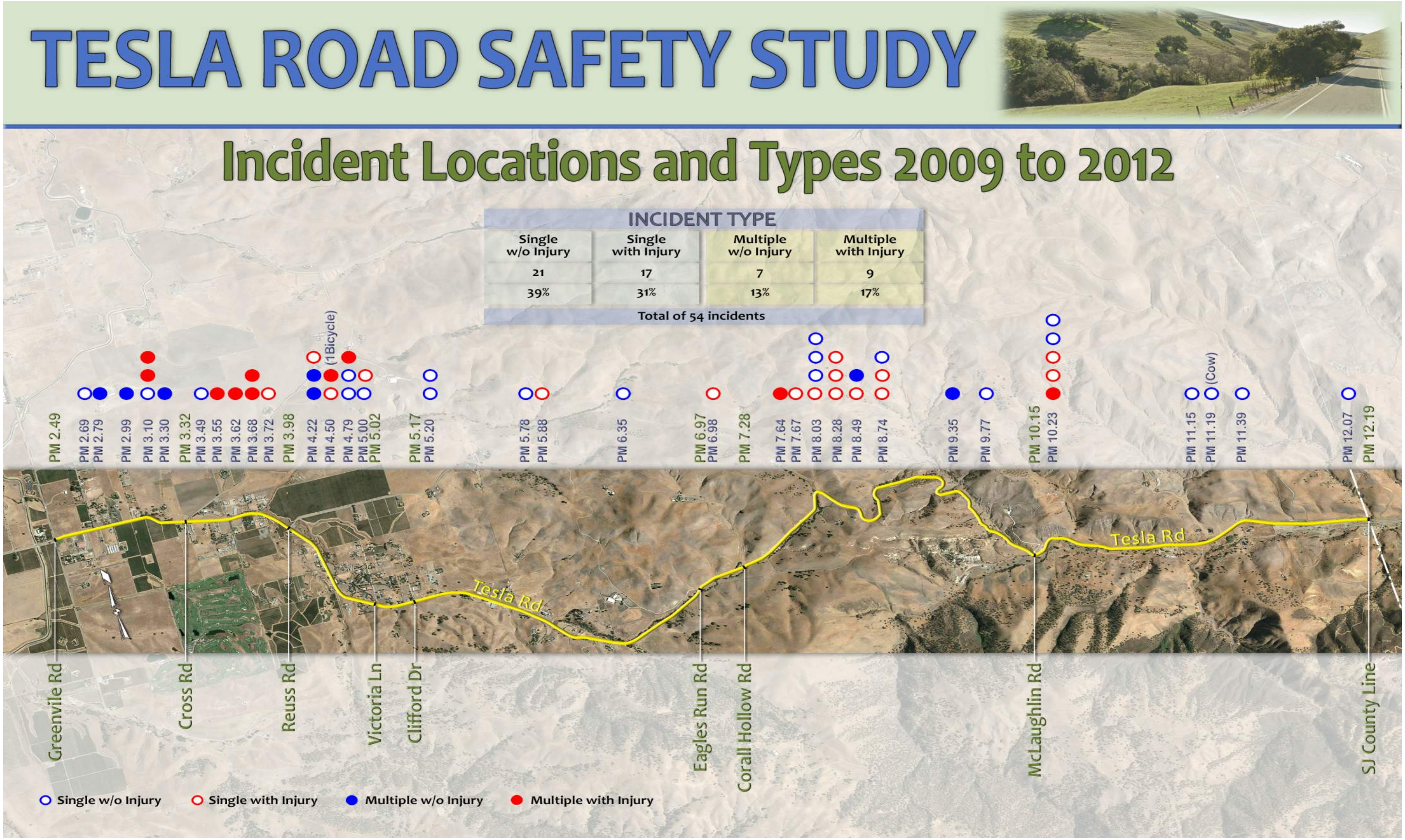


Figure 7 Speed Summary

6. COLLISION STATISTICS

Identifying collision locations, types and frequencies helps identify roadway characteristics that cause the driver to make an error or increase the severity of crash when errors do occur. Also, identifying the locations where collisions happen frequently is helpful in recommending localized improvements. Towards this end, collision data from 2009 through 2012 was reviewed. The collision data was provided by the County and comes from the California Highway Patrol (CHP) collision database. A detailed description of the collision statistics is presented in the traffic report, "Tesla Road Safety Study from Greenville Road to the San Joaquin County Line", prepared for the County. A brief synopsis of the collision data and statistics is presented in this section.

A total of 54 collisions occurred within the project study limits during the 2009 to 2012 analysis period. None of these collisions were fatal. Table 4 shows the collision data broken down by segments and type of the collisions. It can be seen from Table 4 that "Hit Object" constitutes about 50% of the collisions indicating that vehicles running off the road is the most common problem along the roadway. This underscores the need for an adequate clear zone for errant vehicles to recover and for clear markings and signs to reduce the number of vehicles straying off of the pavement. Figure 8 shows collisions plotted along the length of the corridor.



Single w/o Injury	Single with Injury	Multiple w/o Injury	Multiple with Injury
21	17	7	9
39%	31%	13%	17%
Total of 54 incidents			

Figure 8 Collision locations along the Tesla Road corridor

Table 5 shows the collision rate within each segment and the comparison with the statewide average. It can be seen that the collision rates within the corridor are on par with or slightly above the statewide average.

Table 4 Corridor Collision History - 2009 to 2012

Segment	*Location*	*# of Collisions*	*Rear-End*	*Sideswipe*	*Head-On*	*Overturned*	*Broadside*	*Hit Object*	*Vehicle-Pedestrian*	*Bike-Pedestrian*	*Other*
1	Greenville Rd to Cross Rd	7	2	2	1	0	0	2	0	0	0
2	Cross Rd to Eagles Run Rd	21	1	2	2	1	2	11	0	1	1
3	Eagles Run Rd to San Joaquin County Line	26	0	2	2	6	0	15	0	0	1
Total		**54**	**3**	**6**	**5**	**7**	**2**	**28**	**0**	**1**	**2**

Table 5 Collision Data Summary and Collision Rates

Segment	*Location*	*Posted Speed Limit (mph)*	*ADT*	*Collisions*			
				Number of Collisions (Jan 09 - Dec 12)	*Length (mi)*	*Segment Collision Rate (R_{SE})*	*Statewide Average Collision Rate (R_{SE})*
1	Tesla Rd between Greenville Rd and Cross Rd	45	5,182	7	0.82	**1.13**	1.03
2	Tesla Rd between Cross Rd and Eagles Run Rd	45	3,967	21	3.6	1.01	1.03
3	Tesla Rd just between Eagles Run Rd and San Joaquin County Line	45	2,699	26	5.18	**1.27**	1.03

Note: R_{SE} = 1000000*A/(365*T*ADT*L), R_{SE}= Observed collision rate; # of acc./mil. Vehicle miles, A = Number of collisions over study period, T = Total number of years over which intersection collisions were collected; Jan 09 - Dec 12 = 4 years, ADT = Average Daily Traffic, L = Length of study corridor (in miles).

6.1 Time Distribution of Collisions

The general belief of the residents along the Tesla Road is that the majority of collisions along the corridor are the result of commuters exceeding speed limit as they travel to and from work between Tracy and Livermore and that the roadway doesn't need any safety enhancements. A review of the collision frequency by the time of day, shown in Figure 9, shows that 41% of the collisions happen during the peak traffic hours, which for the purpose of this study are assumed to be from 6AM to 9AM and from 3PM to 6PM. However, 59% of collisions happen during non-peak hours indicating that a significant number of collisions also occur during non-peak hours.

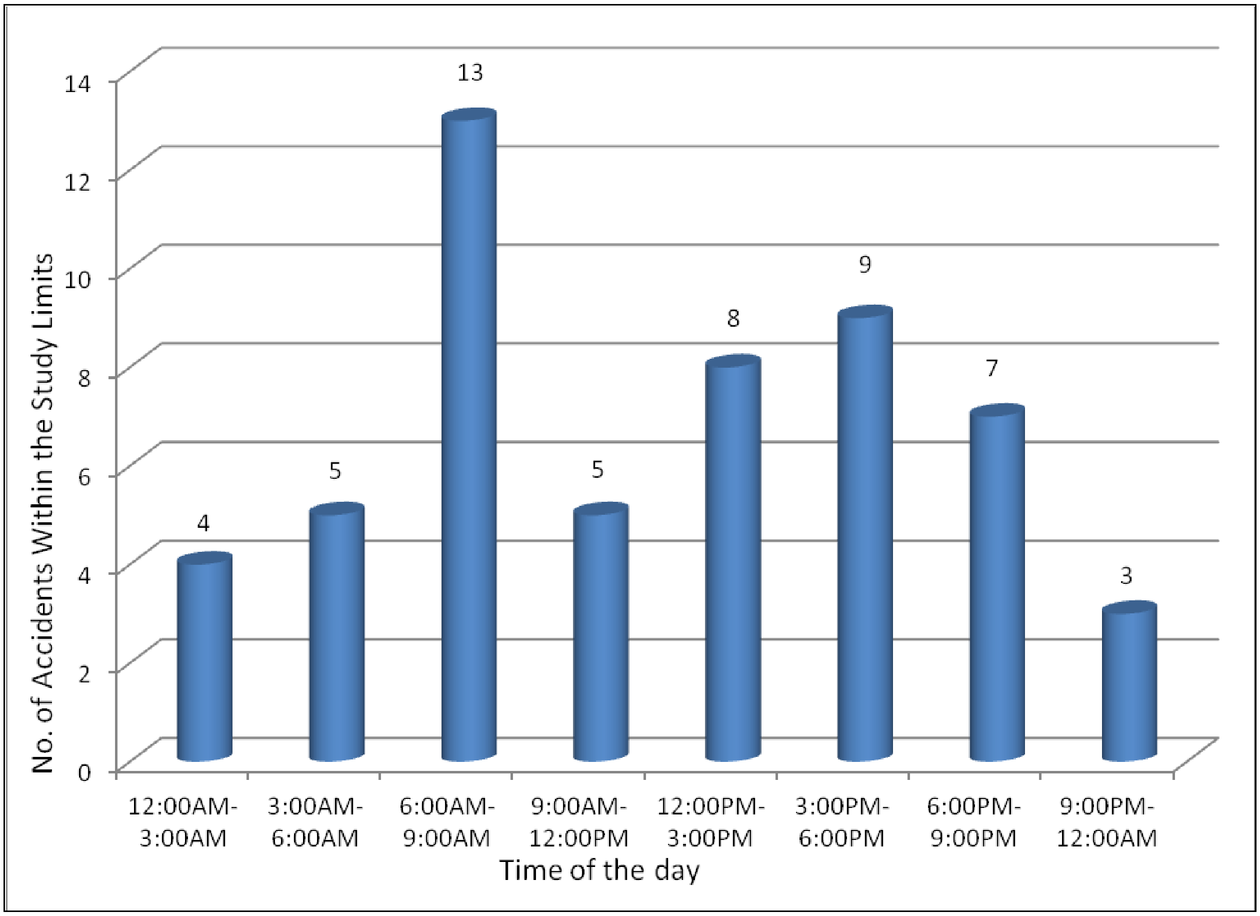


Figure 9 Frequency of collisions by time of day

7. SAFETY COUNTERMEASURES

After analyzing the existing roadway characteristics and collision locations and types, safety countermeasures were developed that could improve the safety along the roadway corridor. These alternatives are intended not only to improve the safety at specific locations with a history of frequent collisions, but also improve the safety along the entire corridor. The safety countermeasures are categorized as near-term, mid-term and long-term based on the ease of implementation, which includes factors such as required right of way acquisitions, environmental impacts, and construction impacts and costs.

Countermeasures that could be implemented in the near future (two to four years) at modest costs with either very minimal or no right of way or environmental impacts are classified as near-term countermeasures.

Mid-term countermeasures are intended to be implemented within four to ten years. These countermeasures could require engineering design and preparation of an environmental document to address any environmental impacts before being implemented in the field. Mid-term countermeasures could have some right of way and environmental impacts and mitigation costs, and would likely require a funding source.

Long-term countermeasures are typically larger projects with a higher construction cost. These projects would require preparation of design plans and specifications and an environmental document prior to implementation. These projects could have substantial environmental impacts and require the acquisition of right of way and construction easements prior to implementation. These projects would require a source of funding for the improvements and could take 10 years or more to implement.

The specific details of the near-term, mid-term and long-term countermeasures are described in the following sections.

7.1 Near-Term Countermeasures

7.1.1 Signage

Description and Location

Installation and replacement of signage aims to improve safety along the entire roadway corridor. Collision patterns within the study limits indicate that signage along the roadway may not be providing sufficient positive guidance to the drivers on Tesla Road. During the site visits, the study team observed that many of the existing signs along the roadway appear to be old and some of the signs may not meet the current sign standards as defined in the 2014 California Manual on Uniform Traffic Control Devices (MUTCD). There are several locations along the roadway where additional warning signs are warranted. The placement and location of some of the existing signs could be modified to provide additional warning to motorists in advance of curves and locations of limited sight distance. These improvements could help motorists safely traverse the roadway corridor.

This countermeasure includes replacing all the existing signs along the corridor that do not meet the current sign legend, placement, and/or retroreflectivity standards per the 2014 California MUTCD. Additional warning signs alerting the motorists of impending sharp curves, limited sight distance, and reduced speeds would also be installed.

Figure 10 shows an example of warning signs along the outside edge of a sharp curve. Warning signs similar to those shown on Figure 10 are recommended along certain horizontal curves on Tesla Road to help drivers safely negotiate these curves. Exhibit 1 shows both the existing signs and proposed new signs along the roadway corridor.

Figure 10 Chevrons along a sharp curve

Environmental Issues

There are no environmental issues associated with this countermeasure.

Right of Way Impacts

There are no right of way acquisitions or other right of way impacts associated with this countermeasure.

Permits

There are no permits required for installing new signs or replacing the existing signs.

7.1.2 Speed Feedback Signs

Description and Location

Speed feedback signs, as shown in Figure 11, are intended to influence the issue of excessive speeding along Tesla Road corridor. Alameda County officials, law enforcement personnel, and the residents along Tesla Road consider excessive speed as a major safety concern along Tesla Road corridor. This concern is supported by the collision data reviewed as part of this study, which indicates that excessive speed was a contributing factor in many of the collisions along the corridor.

Installing speed feedback signs is an effective strategy that can help reduce travel speeds along a roadway. Speed feedback signs alert the drivers of their vehicle speed and encourage them not to exceed the posted speed limit. Speed Feedback Signs placed at critical locations, such as on the approach to sharp curve with reduced speed warning signs and at locations with a history of speed related collisions, can reduce the number of collisions at these locations.

A total of six Speed Feedback Signs are being proposed along the corridor. The proposed locations of the Speed Feedback Signs are shown in Exhibit 1.

Figure 11 Speed Feedback Sign

Environmental Issues

There are no environmental issues associated with this countermeasure.

Right of Way Impacts

There are no right of way acquisitions or other right of way impacts associated with this countermeasure. The foundations for the Speed Feedback Signs will be situated within the existing right of way.

Permits

There are no permits required for installing speed feedback signs.

7.1.3 Safety Enforcement Pullout Areas

Description and Location

Safety enforcement pullout areas will assist in providing safe enforcement. Speed feedback signs alone have a limited ability to address excessive speed issues along the corridor. Effective speed enforcement is critical in curbing excessive speeds. Currently efforts to enforce the posted speed limits are constrained due to the lack of adequate paved shoulders on either side of Tesla Road.

Constructing enforcement pullout areas at various locations along the Tesla Road corridor would facilitate speed enforcement and thus improve safety by reducing travel speeds of motorists along the corridor.

Additionally, enforcement pullout areas can provide a safe refuge for vehicles that breakdown. Enforcement pullout areas can also allow slower vehicles to yield to faster vehicles and thus discourage unsafe passing.

A total of 10 enforcement pullout areas, five in each direction, are recommended within the study limits. The enforcement pullout locations were selected where there was adequate right of way to accommodate the enforcement pullout and to minimize the amount of grading and other improvements needed as part of the enforcement area construction.

The locations of the proposed pullout areas are shown on Exhibit 2.

Environmental Issues

Pullout areas will be constructed in such a way as to not impact sensitive habitats, including waterways, wetlands, and migratory birds and other special status species.

Right of Way Impacts

There are no right of way acquisitions or other right of way impacts associated with this countermeasure.

Permits

The locations for pullout areas are chosen such that water bodies and existing drainage system are not affected during construction. Therefore, permits from the regulatory agencies will not be required for constructing the pullout areas. However, if the water bodies and existing drainage system are affected, permits may be required from the U.S. Army Corps of Engineers (Section 404), San Francisco Bay Regional Water Quality Control Board (Section 401), U.S. Fish and Wildlife (Section 7), and California Department of Fish and Wildlife (1601 Streambed Alteration Agreement).

Figure 12 Typical Safety Enforcement Pullout Area

7.1.4 Edge Striping and Pavement Markers

Description and Location

Approximately 50% of the collisions along the Tesla Road corridor involve vehicles running off of the road. Modifying and enhancing pavement striping and markers is a corridor wide countermeasure strategy intended to reduce run off road collisions by better delineating the edge of the existing roadway.

Currently there are four-inch wide white painted edge stripes without any reflective pavement markers to delineate the edge of traveled way along Tesla Road.

Installing eight-inch wide white edge stripes and reflective pavement markers, along the edge line throughout the length of the corridor could potentially reduce the incidents of vehicles running off of the road. Additionally, installing flexible post delineators along the curves provides additional guidance to the drivers improving the safety of the roadway. Examples of eight-inch wide edge stripe, reflective pavement markers and flexible post delineators are shown in Figures 13, 14 and 15, respectively.

A typical plan view showing the edge stripes, pavement reflective markers and flexible post delineators is show in Exhibit 3.

Environmental Issues

There are no environmental issues associated with this countermeasure.

Right of Way Impacts

There are no right of way acquisitions or other right of way impacts associated with this countermeasure.

Permits

There are no permits required for installing edge stripes, pavement reflective markers and flexible post delineators.

Figure 13 8" Wide Edge Stripe

Figure 14 Reflective Pavement Markers

Figure 15 Flexible Post Delineators along Horizontal Curves

7.1.5 Sight Distance Improvements

Description and Location

Improving sight distance at driveways improves safety for motorists accessing the roadway. There are several driveways along Tesla Road with trees and shrubs on either side of the driveway that limit the sight distance of the driver entering the roadway. Trimming or removing these trees and shrubs would increase the sight distance at some of the driveway locations.

There are also trees and shrubs along the curved portions of the roadway that limit the drivers' sight distance around these curves. Trimming or removing these trees and shrubs would increase the sight distance at these locations.

The locations of the trees that could be trimmed or removed to improve the sight distance are shown in Exhibit 4. The trees identified should be evaluated by a certified arborist prior to removal or pruning and comply with local requirements regarding tree preservation ordinances and heritage trees.

Environmental Issues

The removal of trees, some of which may be ordinance size, could impact nesting birds. To avoid impacts to these birds, vegetation capable of supporting nesting birds should be removed between September 1 and February 15, or pre-construction surveys for breeding birds should be completed if removal is outside these dates.

Right of Way Impacts

There are no right of way acquisitions or other right of way impacts associated with this countermeasure.

Permits

If nesting birds are not affected by the project, incidental take permits will not be required.

7.1.6 Pave Existing Driveway Entrances

Description and Location

Entering and exiting the driveways along the Tesla Road corridor can be challenging when vehicles are travelling at 45 miles per hour or faster. Paving the driveway entrances and the shoulders adjacent to the driveways could reduce the likelihood of a collision between vehicles entering and exiting the roadway and those traveling along Tesla Road. Paving the driveways and the shoulders adjacent to the driveways provide an area for drivers to accelerate or decelerate off of the actual traveled way.

The current collision data was reviewed to identify existing driveways with a history of collisions. The collision data indicates that between 2009 and 2012 two collisions were reported involving vehicles entering or exiting driveways. These two driveways are shown in Exhibit 5. It is recommended that in the long run all the driveways along Tesla Road should be improved by paving the driveway approaches and the shoulders adjacent to the driveways.

Additional driveways could be included for paving in the near-term, if there are any collisions related to driveway entry or exit outside the time frame that was considered in this study.

Environmental Issues

There are no environmental issues anticipated with this countermeasure

Right of Way Impacts

There are no right of way acquisitions or other right of way impacts associated with this countermeasure.

Permits

There are no permits required for paving the driveways.

7.1.7 Guard Rail Replacement

Description and Location

Guard rail improves roadway safety by reducing the severity of runoff road type collisions at locations where there is a greater likelihood of this type of collision. Run-off road collisions account for more than 50 percent of the collisions along Tesla Road.

Guard rail was installed at numerous locations along Tesla Road. At several location the existing guard rails do not meet the current standards for guard rails. Two existing guard rails were identified to be replaced in the near-term and are shown in Exhibit 6. Replacing these two guard rails does not require significant excavation, re-grading of the slopes, right of way acquisitions or slope easements. The replaced guard rails will conform to current Caltrans standards.

Environmental Issues

There are no environmental issues anticipated with this countermeasure

Right of Way Impacts

There are no right of way acquisitions, slope easements or other right of way impacts associated with this countermeasure.

Permits

There are no permits required for installing or replacing guard rails.

7.1.8 Transverse Rumble Strips

Description and Location

Transverse rumble strips alert drivers to roadway conditions that may not be apparent by providing both an audible and tactile warning. Transverse rumble strips are a traffic calming measure that encourages motorists to reduce speeds, an example of which is shown in Figure 16. While traffic calming measures are not suitable for roadways with traffic speeds greater than 40 mph, transverse rumble strips may be used effectively at certain locations on Tesla Road.

Installing transverse rumble strips on the approach of a sharp curve with reduced speeds will alert the drivers of the reduced speed warning signs and encourage them to reduce their speed and be cautious as they approach and negotiate the curve. It is recommended that transverse rumble strips be placed at two locations, which are shown on Exhibit 11.

Figure 16 Transverse Rumble Strip

Environmental Issues

There are no environmental issues anticipated with this countermeasure

Right of Way Impacts

There are no right of way acquisitions or other right of way impacts associated with this countermeasure.

Permits

There are no permits required for installing transverse rumble strips.

7.1.9 Shoulder Grading

Description and Location

Pavement edge drop-offs combined with soft shoulders may cause the driver to lose control of the vehicle once the vehicle starts to leave the paved roadway. Shoulder grading could reduce the frequency of run off the road incidents by improving the shoulder sufficiently to allow drivers to recover should they leave the paved roadway. This countermeasure could also reduce the severity of damage when a vehicle does run off the road. A minimum 4-foot wide paved shoulder provides increased recovery area for errant vehicles. In the near term it is recommended that edge drop-offs be eliminated by re-grading and compacting the unpaved shoulders as shown in Figure 17. It is also recommended that pavement edge drop-offs created by future resurfacing of the existing roadway or widening of shoulders be addressed by constructing a beveled 30 to 35 degree asphalt wedge, typically called as a safety edge, at the edge of the paved shoulder.

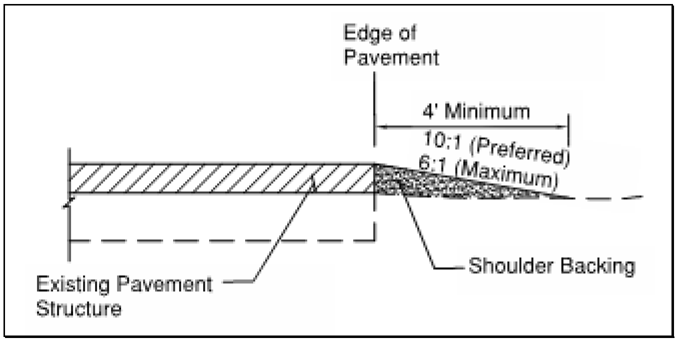


Figure 17 Shoulder Grading

Environmental Issues

Shoulder grading will be accomplished in such a way as to not impact sensitive habitats, including waterways, wetlands, and migratory birds and other special status species.

Right of Way Impacts

There are no right of way acquisitions or other right of way impacts associated with this countermeasure.

Permits

If water bodies and existing drainage systems are not affected during grading, permits from the regulatory agencies will not be required for shoulder grading. If these areas are affected, permits may be required from the U.S. Army Corps of Engineers (Section 404), San Francisco Bay Regional Water Quality Control Board (Section 401), U.S. Fish and Wildlife (Section 7), and California Department of Fish and Wildlife (1601 Streambed Alteration Agreement).

7.2 Medium Term Countermeasures

7.2.1 Paved Shoulders

Description and Location

The highest percentage of collisions occurring along Tesla Road involves vehicles running off of the road. Providing a paved shoulder will provide increased recovery area for vehicles leaving the travel lane and may improve the driver's ability to safely recover and re-enter the travel lane. The shoulder would reduce the risk of a collision occurring when a vehicle leaves the travel lane.

Providing four-foot shoulders could be accommodated with a minimal amount of earthwork and without the need for right of way acquisitions at many locations along the Tesla Road corridor. The locations and the limits of the four foot wide paved shoulder are shown in Exhibit 7. At locations where four foot wide shoulders are provided, some of the existing drainage inlets, utility poles, mail boxes, and guard rails may need to be relocated and some trees may have to be trimmed or removed.

Environmental Issues

Proposed shoulders could potentially impact sensitive habitats, including waterways, wetlands, and migratory birds and other special status species.

Right of Way Impacts

There are no right of way acquisitions or other right of way impacts associated with this countermeasure.

Permits

Permits may be required from the U.S. Army Corps of Engineers (Section 404), San Francisco Bay Regional Water Quality Control Board (Section 401), U.S. Fish and Wildlife (Section 7), and California Department of Fish and Wildlife (1601 Streambed Alteration Agreement).

7.2.2 Centerline Rumble Strips

Description and Location

Centerline rumble strips alert drivers when they are crossing the centerline and help reduce head-on and opposite direction sideswipe collisions. The vibration produced by rumble strips alerts the drivers who are unintentionally crossing the center line when pavement markings are not visible in heavy rain or fog. Research indicates that centerline rumble strips have been effective in reducing collisions associated with vehicles crossing the center line.

Speeding and unsafe passing by drivers to pass slower vehicles are common safety concerns expressed by residents along Tesla Road. This is also supported by the collision data and the observations of local law enforcement officials. Between 2009 and 2012, five head-on collisions were reported within the project study limits.

This countermeasure would install centerline rumble strips throughout the corridor. However, due to the reduced lane widths along most of the corridor, it is recommended that centerline rumble strips be installed along with or after the four foot wide paved shoulders are installed. Exhibit 7 shows a schematic view and limits of the centerline rumble strips; Figure 18 shows an image of a typical centerline rumble strip.

Figure 18 Typical Centerline Rumble Strip

Environmental Issues

There are no environmental issues associated with this countermeasure.

Right of Way Impacts

There are no right of way acquisitions or other right of way impacts associated with this countermeasure.

Permits

There are no permits required for this countermeasure.

7.2.3 Shoulder Rumble Strips

Description and Location

Shoulder rumble strips are an effective way to reduce the run-off road incidents. Shoulder rumble strips alert the drivers when they unintentionally stray from the traveled way. An additional benefit of rumble strips is that they aid navigation in bad weather.

This countermeasure includes the installation of shoulder rumble strips along the entire corridor. Due to narrow width of the existing paved shoulders, these rumble strips would need to be installed along with the construction of four foot wide or eight foot wide paved shoulders, or after the paved shoulders are constructed. Shoulder rumble strips, however, reduce the usable width of the shoulders that bicyclists could use. Exhibit 7 shows a schematic view and limits of the shoulder rumble strips, and Figure 19 shows a sample shoulder rumble strip.

Figure 19 Typical Shoulder Rumble Strip

Environmental Issues

There are no environmental issues associated with this countermeasure.

Right of Way Impacts

There are no right of way acquisitions or other right of way impacts associated with this countermeasure.

Permits

There are no permits required for this countermeasure.

7.2.4 Guard Rail Replacement

Description and Location

Guard rail improves roadway safety by reducing the severity of runoff road type collisions at locations where there is greater likelihood of this type of collision. Run-off road collisions account for more than 50 percent of the collisions along Tesla Road.

Guard rail has been installed at numerous locations along Tesla Road. At several locations along the roadway, existing guard rail does not meet current standards and needs to be replaced adjacent to a steep embankment. Replacing these existing guard rails at certain locations would involve a considerable amount of re-grading of the existing embankments, and thus would have a high construction cost due to the amount of grading required. Eight locations were identified for guard rail replacement in the mid-term, and these locations are shown in Exhibit 8.

Figure 20 Example of guardrail replacement that requires re-grading of embankment

Environmental Issues

Guard rails will be replaced in such a way as to not impact sensitive habitats, including waterways, wetlands, and migratory birds and other special status species.

Right of Way Impacts

There are no right of way acquisitions or other right of way impacts associated with replacement of guard rails.

Permits

If waterbodies are affected during construction, permits from the regulatory agencies will not be required for replacing the guard rails. If these areas are affected, permits may be required from the U.S. Army Corps of Engineers (Section 404), San Francisco Bay Regional Water Quality Control Board (Section 401), U.S. Fish and Wildlife (Section 7), and California Department of Fish and Wildlife (1601 Streambed Alteration Agreement.

7.3 Long Term Countermeasures

7.3.1 Curve Realignment

Description and Location

Collision data indicates numerous collisions occur at some of the sharp horizontal curves along Tesla Road. It is anticipated that the proposed near-term and medium-term countermeasures will improve the safety at these locations. Horizontal curve realignment typically includes right of way acquisitions and high construction costs.

The reverse curve at PM 3.0 was identified as a location to be evaluated for potential realignment in the long term based on the collision history along the corridor and the input received from the community. The proposed re-alignment is illustrated in Exhibit 9. Curve realignment at PM 3.0 involves relocation of power poles and right of way acquisition.

Environmental Issues

Curve realignment will be implemented in such a way as to not impact sensitive habitats, including waterways, wetlands, and migratory birds and other special status species.

Right of Way Impacts

It is anticipated that the curve realignment requires right of way acquisition.

Permits

If waterbodies and drainage systems are not affected during construction, permits from the regulatory agencies will not be required for the curve realignment. If these areas are affected, permits may be required from the U.S. Army Corps of Engineers (Section 404), San Francisco Bay Regional Water Quality Control Board (Section 401), U.S. Fish and Wildlife (Section 7), and California Department of Fish and Wildlife (1601 Streambed Alteration Agreement).

7.3.2 Paved Shoulders

Description and Location

The highest percentage of collisions occurring along Tesla Road involves vehicles running off the road. A paved shoulder will provide increased recovery area for vehicles leaving the travel lane and may improve the driver's ability to safely recover and re-enter the travel lanes. The shoulder would reduce the risk of a collision occurring when a vehicle leaves the travel lane.

The recommended paved shoulder width for rural arterials is eight feet based on the project specific Design Guidelines established for Tesla Road. As a long term countermeasure, it is recommended that eight-foot shoulders be constructed throughout the project limits. The locations and the limits of the eight foot wide paved shoulder are shown in Exhibit 10. However, constructing eight-foot wide paved shoulders requires relocation of drainage inlets and utility poles, removing trees, extension of existing drainage culverts, relocation of existing guard rails, moderate to significant earthwork, construction of retaining walls and potential right of way acquisitions and slope easements. Special consideration should be given to slope stability issues, which are briefly described in Section 11 of this report, while constructing the eight-foot shoulders.

Environmental Issues

Shoulder construction will likely impact sensitive habitats, including waterways, wetlands, and migratory birds and other special status species.

Right of Way Impacts

It is anticipated that construction of 8-foot shoulder requires right of way acquisition and slope easements.

Permits

Permits may be required from the U.S. Army Corps of Engineers (Section 404), San Francisco Bay Regional Water Quality Control Board (Section 401), U.S. Fish and Wildlife (Section 7), and California Department of Fish and Wildlife (1601 Streambed Alteration Agreement).

8. ENVIRONMENTAL SETTINGS AND CONSTRAINTS

As part of the safety study, the existing environmental settings, relevant regulatory framework, and potential environmental constraints were studied for the following elements of the study area: aesthetics, agricultural resources, air quality, biological resources, cultural resources, geology and soils, hazards and hazardous materials, hydrology and water quality, land use, noise, population and housing, public services, recreation, transportation, and utilities and service systems. The findings are documented in the report "Existing Settings and Constraints Report for the Tesla Road Safety Improvements from Greenville Road to the San Joaquin/Alameda County Line" prepared for the County.

Proposed countermeasures would be subjected to California Environmental Quality Act (CEQA) and other regulations discussed in the above-mentioned report. This report also serves as the baseline environmental setting for preparation of a subsequent CEQA document once specific countermeasures are identified for implementation. Regulatory permit requirements are also described in the report.

9. FLOOD PLAIN, STORMWATER QUALITY AND DRAINAGE REQUIREMENTS

Floodplain, storm water quality and drainage requirements are presented in the technical memorandum "Tesla Road Improvement Project – Floodplain, Storm Water Quality and Drainage Requirements

Technical Memorandum". A brief summary of the information presented in the memorandum is presented in this section.

- Flood Plain Assessment: The project corridor spans through three Flood Insurance Rate Maps panels. However, the project corridor does not cross through any of the designated floodplain locations. As a result, no special floodplain related requirements are anticipated for the proposed countermeasures.

- Storm Water Quality Requirements: It is anticipated that a Construction General Permit is not needed for near-term countermeasures, but CGP is anticipated for mid-term and long-term countermeasures. It is anticipated that storm water treatment measures such as bio-retention areas will be needed for some of the proposed long-term countermeasures.

- Drainage Requirements: It is currently anticipated that the primary impact to drainage facilities from the near-term countermeasures would be to existing ditches. Some of the existing ditches would have to be re-graded/aligned to maintain positive drainage. Due to space constraints within the right of way, some culverts under the safety enforcement pullouts may need to be added in order to maintain the existing drainage patterns. Construction of 4-foot and 8-foot shoulders would likely impact existing drainage ditches and cross-culverts. It is anticipated that some of the drainage inlets would have to be relocated and various cross-culverts will need to be repaired and/or extended in order to maintain positive drainage.

10. INITIAL SITE ASSESSMENT

An Initial Site Assessment (ISA) of the project study area was performed in general conformance with the State of California Department of Transportation Initial Site Assessment Checklist for Hazardous Waste. The findings for the ISA and the ISA checklist per Guidelines are presented in the report "Initial Site Assessment. Tesla Road Safety Study Report". A brief summary of the findings of ISA is presented below.

The site reconnaissance and records review did not find documentation or physical evidence of soil or groundwater impairments associated in the study area. A review of the regulatory databases maintained by the County, State, tribal and federal agencies found no documentation of hazardous materials violations or discharge on the study area and did not identify contaminated facilities within the appropriate American Society for Testing and Materials (ASTM) search distances that would reasonably be expected to impact the study area.

Based on the findings of the ISA, the following environmental concerns were observed in the Study area:

- Historical records indicate that Tesla Road began receiving vehicle traffic since at least 1907. Additionally, a railroad line approximately between post miles 7.5 and 9.7 is shown on the 1907 through 1941 topographic maps. Since the proposed countermeasures will involve soil disturbance within the shoulder, a sampling program should be implemented to assess soil impacts from vehicle and railway traffic.

- There are several pole-mounted transformers along the project corridor. If the transformers are to be removed during road construction, the transformers should be tested for Polychlorinated Biphenyls (PCBs) prior to disposal.

- During the site reconnaissance, yellow thermoplastic stripping was observed. Yellow thermoplastic striping can contain lead and if encountered, the material should be tested prior to removal.

11. GEOTECHNICAL CONDITIONS

Geotechnical evaluation of the project corridor was conducted in November 2013 to evaluate and broadly characterize geotechnical conditions along the project corridor, outline associated potential risks, and indicate general remediation options for the proposed countermeasures. The details of the Geotechnical evaluation are documented in the report "Preliminary Geotechnical Evaluation". Key findings from the geotechnical evaluation are presented in this section.

Preliminary geotechnical evaluation indicates that there are areas of existing roadway alignment with high potential for instability from a geotechnical perspective, particularly where there is landslide debris above, under or below the alignment and more so where this debris has been cut to align the road or is being scoured at its base. Landslides that were identified in the field and from reviewing published landslide mapping, topographic mapping and Google Earth imagery are shown in the Geologic Reconnaissance Maps, which are included in the "Preliminary Geotechnical Evaluation" report. Additionally, there are a number of culverts with the project limits that are discharging water close to the road alignment causing local slope scour to regress close to the road. The construction of the existing roadway has destabilized the ground in places and it is recommended that site specific exploration be conducted before implementing any of the proposed countermeasures that involve re-grading of the existing slopes.

12. LANDSCAPE

Landscape adjacent to the roadway has an influence on the roadway safety as it affects the sight distance of the motorists. As part of the safety study, the following goals were developed by Haygood & Associates Landscape Architects to mitigate the current sight distance issues because of landscape adjacent to the roadway and avoid such issues in the future. The near term goal is to mitigate the current sight distance issues discussed in section 7.1.5 of this report.

Near Term Goals:

- Remove trees and shrubs that obstruct line of sight from driveways and along the highway, particularly along inside curves. Trees must be evaluated by a certified arborist prior to removal or pruning. Tree removal must comply with local requirements regarding tree preservation ordinances and heritage trees.

- Prune tree and shrub branches that overhang or encroach upon roadway shoulders.
- Keep grasses and weeds cut down to 6 inches high along inside curves of the highway to improve line of sight.

Mid Term Goals:

- Discuss with local landowners the need to keep trees and shrubs on their property clear of the highway and to cut grasses and weeds so they will not obstruct lines of sight.
- Inform the local landowners of the Alameda County Tree Ordinance which regulates the planting of trees within County Right of way as stated in the Environmental Constraints Analysis.
- The County should develop a program to monitor trees and shrubs along the corridor, including volunteer plants, growing within and adjacent to the County right of way for line of sight obstructions.

Long Term Goals:

- Implement a policy that restricts tree and shrub planting along the highway right of way to improve line of sight and safety as follows:
    - Straight highway sections: Trees and shrubs must be a minimum of "X" feet away from the edge of travel way within the right of way.
        - "X": The ideal setback for trees is 30 feet from the edge of travel way to conform to Caltrans highway standards for clear recovery zones. However, along Tesla Road the right of way is much closer to the highway. Therefore, a review of the possible distances for tree and shrub setbacks will need to be discussed with all interested parties.

    - Inside curve highway sections: No tree and shrub planting within the highway right of way. The distance for excluding tree and shrub planting should be based on the highway design manual design speed along with stopping and decision sight distances on horizontal and vertical curves. Groundcovers in these locations may be considered as long as the plants are no higher than 24 inches measured from the adjacent highway pavement and the groundcovers will not obstruct the line of sight.
    - Tree and shrubs at driveways and intersections must be kept back "X" feet from the edge of paving and for "X" distance so that the line of sight from and to the highway is not obstructed.
        - "X": The distance to keep shrub and tree planting back from driveways and intersections to maintain line of sight from and to the highway will need to be discussed with all interested parties and be based on site conditions.
    - Trees and shrubs on private property must be kept pruned back from the highway so that the branches do not obstruct the line of sight.

13. COMMUNITY INVOLVEMENT

The County held an initial community meeting on March 27, 2013 to inform the community of the proposed corridor safety study for Tesla Road. The purpose and goals of the safety study were presented to the community.

At the meeting, the County received input from the residents and the roadway users. The community's concerns, thoughts and ideas were taken into consideration in determining the safety issues that exist along the corridor and in proposing appropriate countermeasures to address the safety issues. Comments received from the community at the first public meeting and the responses to the comments by the Study team and the County are included in Appendix-B.

A second public meeting was held by the County on September 15, 2014. The initial findings from the Study were presented to the community, which include collision data, potential countermeasures, locations where these countermeasures could be applied, and how these countermeasures would address some of the safety issues along the corridor. Community input regarding the potential countermeasures was received and incorporated into the Study. Comments received from the community at the second public meeting and the responses to the comments by the Study team and the County are included in Appendix-B.

14. APPENDICES

1. Appendix – A : Countermeasure Exhibits (Exhibits 1 through 11)
2. Appendix – B : Responses to comments from Public Meetings 1 and 2