Amador and Alpine Counties

Systemic Safety Analysis Report

October 17, 2018

Presented to:

Provided by:

Final Report

Signing and stamping this Systemic Safety Analysis Report, the engineer is attesting to this report's technical information and engineering data upon which local agency's recommendations, conclusions, and decisions are made.

Prepared by:

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ACRONYMS

ACTC	Amador County Transportation Commission
ADT	Average Daily Traffic
AADT	Annual Average Daily Traffic
B/C	Benefit Cost Ratio
BUI	Bicycling Under the Influence of Alcohol/Drugs
Caltrans	California Department of Transportation
CHP	California Highway Patrol
CMF	Crash Modification Factor
CRF	Crash Reduction Factor
DUI	Driving Under the Influence of Alcohol/Drugs
GIS	Geographic Information System
HSIP	Highway Safety Improvement Program
LRSM	Local Roadway Safety Manual
MPH	Miles per Hour
PCF	Primary Collision Factor
RSSA	Roadway Safety and Signing Audit
SHSP	Strategic Highway Safety Plan
SR	State Route
SSAR	Systemic Safety Analysis Report
SSARP	Systemic Safety Analysis Report Program
SWITRS	Statewide Integrated Traffic Records System
TIMS	Transportation Injury Mapping System

EXECUTIVE SUMMARY

The purpose of the Systemic Safety Analysis Report Program (SSARP) is to help local agencies identify safety projects that could receive future Highway Safety Improvement Program (HSIP) funding. This report covers both Amador and Alpine County roadways. The Counties' main focus with the SSAR is analyzing collision history to identify those most critical locations and crash trends on the roadway network, ultimately taking a step in preemptively addressing these top safety concerns.

Data was gathered from two online resources, TIMS and SWITRS, and refined to include only collisions caused by existing facility conditions. The mapping and addition of property damage only collisions were crucial for the analysis since only 45% of the total crashes for Amador County and 44% of the total crashes for Alpine County resulted in an injury. The most frequently occurring collision type in both counties was 'hit object', meaning a vehicle departed the travel lane and struck an object on the side of the road such as an embankment, fence, guardrail, tree or other structure. 'Wrong Side of the Road' and 'Unsafe Speeds' were determined to be the most frequent factors in Amador County collisions. 'Improper turning' and 'Unsafe Speeds' were determined to be the most frequent factors in Alpine County collisions.

Further investigation into the data led to identifying 15 roadway segments and 3 intersections where there were concentrations of collisions. These focus locations were selected based on rankings of 3 different criteria: total collisions, crash rate, and crash cost, and based on input from the local agencies and public from comments provided on the project website at safertricountyroads.com. Each of the focus locations were analyzed to determine appropriate countermeasures to address each area's safety concerns based on the historical data and trends. Some of the top countermeasures identified for potential safety improvement projects were upgrading existing roadside signs to improve curve warnings, edge delineation and nighttime visibility, adding high friction surface treatments to improve traction and skid resistance in high incident curves, improving roadway segment lighting, upgrading existing guardrails, and pedestrian crossing upgrades. While it is a main concern of local jurisdictions, maintenance activities for existing facilities, such as roadway pavement rehabilitation and restriping, is not eligible for federal safety funding.

Viable safety projects identified in this SSAR for potential HSIP Cycle 9 grant applications include widening the intersection of Ridge Road and Running Gold Road to install a left turn lane, installing street lighting in the City of Jackson, conducting a Roadway Safety and Signing Audit (RSSA) to upgrade signs on County roads, and improving the visibility of pedestrian crosswalks with hi-visibility pavement markings and signs.

1. BACKGROUND

1.1 Project Location

Amador and Alpine Counties are primarily rural neighboring counties located in the foothill and mountainous region of the Sierra Nevada Mountains between Sacramento, Lake Tahoe, and Yosemite Valley. The counties' elevations range from 100 feet to 11,500 feet with popular scenic highways that connect residents and visitors to historic downtowns and recreational opportunities in Eldorado, Stanislaus, and Humboldt-Toiyabe National Forests. There is a total of 867 lane miles and 287 lane miles of roadways in Amador and Alpine Counties, respectively.

Amador County is located on the west side of the Sierra Nevada Mountains of California, approximately 45 miles southeast of Sacramento as shown in Figure 1.1. According to the United States Census Bureau, the county has a population of 38,626 people as of July of 2017 across approximately 595 square miles of land. There are also 12 square miles of water including Lake Amador, Lake Camanche, Pardee Reservoir, Silver Lake, Sutter Creek, Cosumnes River, Mokelumne River, and Jackson Creek. Major State Routes through Amador County include 49, 16, 88, and 26.

Figure 1.1- Amador County Map

Alpine County is located on the east side of the Sierra Nevada Mountains in California, to the east of Amador and Calaveras Counties as seen in Figure 1.2. According to the United States Census Bureau, the county has a population of 1,120 people as of July of 2017, across approximately 738 square miles of land. There are also 4.8 square miles of water including Lake Alpine, Caples Lake,

Red Lake, Winnemucca Lake, Round Top Lake, and several other small lakes and reservoirs. Major State Routes through Alpine County include 88, 89, and 4.

Figure 1.2- Alpine County Map

1.2 Project Background

The Regional Transportation Planning Agencies for the counties of Amador (ACTC) and Calaveras (CCOG), and Alpine County have teamed together to study roadway safety throughout the region. The goal of this Systemic Safety Analysis Report (SSAR) is to identify systemic safety measures that could prevent life threatening crashes by applying the 4 E's: Education, Enforcement, Engineering, and Emergency Response. Conceptual projects will be developed based upon the findings and selection of cost effective engineering countermeasures.

The SSAR Program was initiated by the California Department of Transportation (Caltrans) to help local agencies take a more proactive approach to identifying safety improvement projects by completing a system-wide, data-driven, analysis of vehicular collisions to identify potential safety issues on the roadway network throughout each jurisdiction. The SSAR evaluation includes analyzing available collision records, reviewing high crash concentration areas to identify potential safety issues, and compiling a list of appropriate countermeasures that can be applied systemically to reduce collisions throughout the jurisdiction rather than at a single location.

The intent of this SSAR is to help participating local agencies focus on key safety activities with the objective of reducing the number and severity of crashes within their jurisdiction and to help position them to secure federal safety funding.

Federal funds are available to reduce fatal and severe injuries on roadways through the Highway Safety Improvement Program (HSIP), which is administered in Caltrans. On April 30, 2018, Caltrans announced the HSIP Cycle 9 Call for Projects. The total federal funds available for HSIP Cycle 9 is estimated at approximately $140 million to $160 million (actual funding amount will depend on the delivery of the active HSIP projects). The deadline to submit an application under HSIP Cycle 9 was August 31, 2018. HSIP Cycle 10 has not yet been announced.

1.3 Key Tasks

The systemic analysis of the roadway networks in Amador and Alpine Counties involved the following steps:

Step 1 – Data Gathering – Collision data was compiled for each county and summary statistics were determined for the most frequent collision type and factors. Collision data was collected from SafeTREC Transportation Injury Mapping System (TIMS), an internet-based tool developed by UC Berkeley to access California Highway Patrol's Statewide Integrated Traffic Records System (SWITRS) database and local law enforcement crash reports and citations. The collected collision data was analyzed for crash frequency and crash rates to identify locations with a high frequency of similar crash types. Physical characteristics of the roadway network, roadway infrastructure and current design standards were also considered.

Step 2 – Priority Location Selection – The selection process was data driven; priority locations were identified from the collision data, stakeholder agency input and field assessments. Public notifications of safety concerns were evaluated to refine the prioritization.

Step 3 – Identify Countermeasures – An initial list of countermeasures was selected from the approved list of safety countermeasures included in 'Local Road Safety, A Manual for California's Local Road Owners' (LRSM), published by Caltrans in April 2018. The selected countermeasures were evaluated utilizing a systemic approach (i.e., across the roadway network) and spot location approach (i.e., at high crash concentration locations). Prevention of the highest occurring crash type and cost-effectiveness were also considered.

Step 4 – Develop Priority Projects – Priority locations were evaluated using a Benefit and Cost (B/C ratio) methodology. Specific formulas have been developed by Caltrans for use in evaluating HSIP projects. The B/C ratio formulas are based on Crash Reduction Factors (CRF) and Crash Mitigation Factors (CMF) determined by the FHWA. CRF and CMF included in this report were obtained from the LRSM. B/C ratios for potential projects were refined by analyzing the countermeasure cost and/or changing the mix of countermeasures. Identifying locations with similar characteristics for implementation of countermeasures was considered as part of the SSAR approach.

Step 5 – Prepare Final SSAR – Findings from the above tasks have been incorporated into this report, which is submitted to ACTC, Alpine County and partner agencies for review. Once comments from ACTC, Alpine County and the partner agencies are incorporated into the SSAR, the Final Report will be submitted for approval by the implementing agencies.

1.4 Report Limitations

This report is intended to be used for systemic safety planning purposes only. All work presented in this report is in accordance with generally accepted engineering practices and has been prepared under the guidance of a professional engineer. Recommendations, results and conclusions in this report are professional opinions, and are contingent upon assumptions stated in this report.

2. SAFETY DATA UTILIZED (CRASH, VOLUME, ROADWAY)

2.1 Crash and Volume Data

Crash record information used to prepare the SSAR was collected from online statewide databases and from local law enforcement agencies for the 5-year period from January 1, 2013 to December 31, 2017. The primary source of data was from the online TIMS and SWITRS databases, which compiles collision records from the California Highway Patrol (CHP) and local law enforcement agencies. While there is an overlap in information between the two sources, TIMS does not include property damage collisions, while SWITRS does. The combination of both databases was important for Amador and Alpine counties due to the relatively low percentage of fatal and severe injury crashes compared to property damage only crashes. Additional crash records were provided by local law enforcement agencies and were incorporated to the analysis where TIMS and SWITRS data was not available. Additional collision records were obtained from the following agencies:

- CHP offices in South Lake Tahoe and Jackson
- Amador County Sheriff's Department
- Police Departments in the Cities of Jackson, Ione, and Sutter Creek.

2.2 Roadway Data

Roadway alignments and jurisdictional boundaries were obtained from Amador County's GIS files. This data was supplemented by field assessments and the use of Google Earth to gain insight on the existing roadway configuration and existing safety infrastructure. These visual evaluations included information such as roadway geometry and cross section, pavement condition, lane configurations, and existing traffic control devices.

Maps showing the locations of crashes throughout Amador and Alpine Counties are shown in Section 3. Additional countywide maps are provided in Appendix A.

3. DATA ANALYSIS TECHNIQUES AND RESULTS

Analysis of crash records is the most critical step in the evaluations of roadway safety. It pinpoints specific areas that have the most severe safety issues and exposes patterns in the data allowing for more informed decisions when it comes to countermeasure selection. Both a systemic and spot location approach are needed so that there is not only a focus on identifying the most critical locations, but also a widespread look at the entire network to prevent future incidents at locations with similar attributes.

3.1 Countywide Crash Data

The preliminary analysis included a countywide assessment of crash trends and statistics. Figures 3.1 and 3.2 show all the segments analyzed in Amador and Alpine Counties, respectively and the total number of collisions on each segment. Table 3.1 presents the total number of collisions and fatalities reported through SWITRS for each year included in the study.

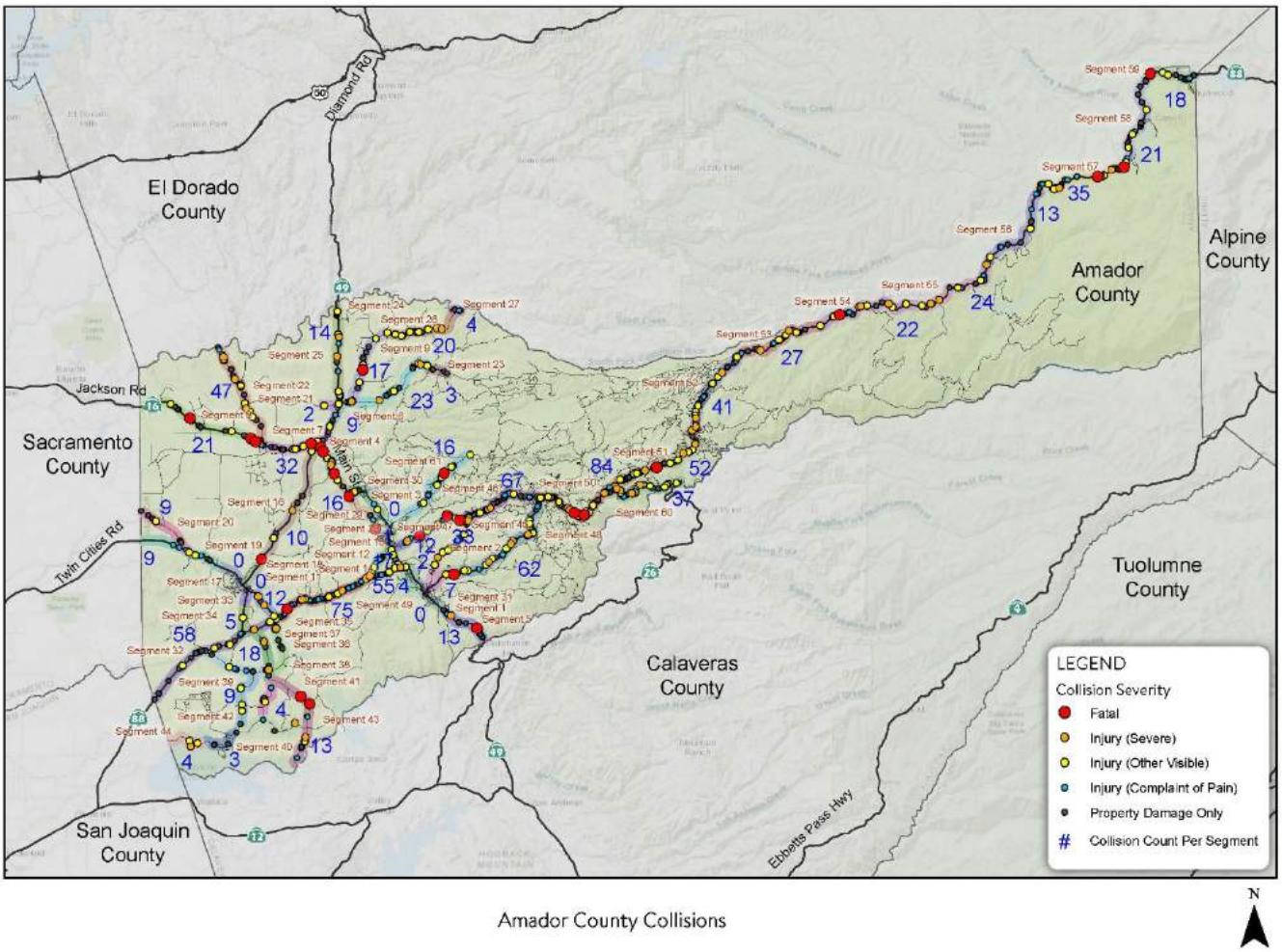

Figure 3.1- Amador County Segment and Collision Overview

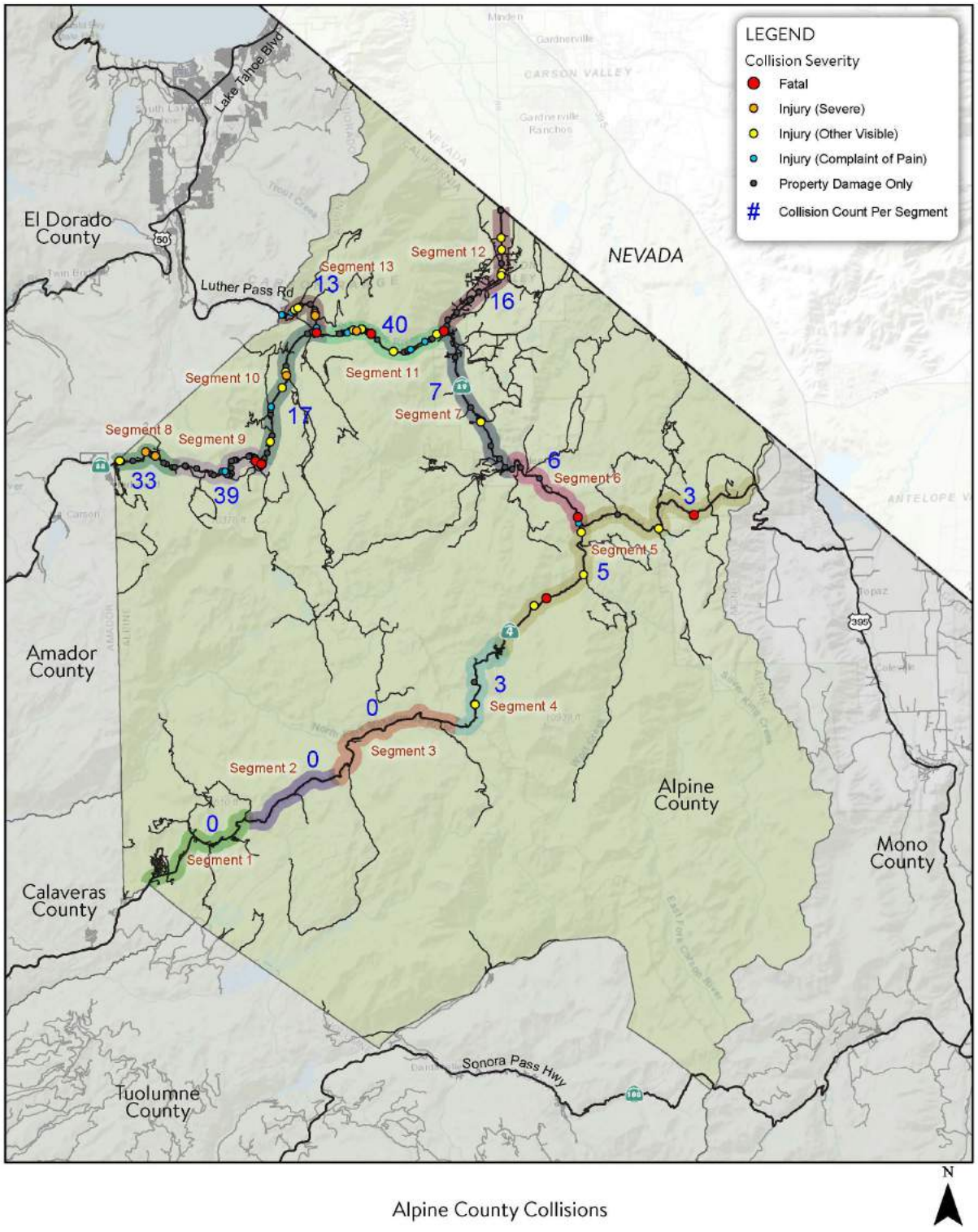

Figure 3.2- Alpine County Segment and Collision Overview

Table 3.1- Total Crashes and Fatalities Broken Out by Year

	2013	2014	2015	2016	2017
Amador County Crashes/Fatalities	330/4	352/7	360/6	410/11	449/9
Alpine County Crashes/Fatalities	64/1	54/1	70/2	95/4	89/4

Following discussion with the partner agencies, several key factors contributing to collisions were determined. The collision analysis included factors such as the frequency of nighttime collisions, collisions involving inclement weather, driving under the influence of alcohol or drugs (DUI), etc. Identification of primary collision factors can aid in countermeasure selection and provide additional insight as to what trends are occurring at the time of collision for each roadway segment and intersection. The frequency for each of the primary collision factors identified for Amador and Alpine County can be found in Table 3.2 below. Maps showing the locations of the specific collision types identified are provided in Appendix A.

Table 3.2-Additional Collision Statistics

	Amador County % of	Alpine County % of	Statewide Comparison*
Speed Related Collisions	24.6% of all injury collisions	31.9% of all injury collisions	18%
Nighttime Collisions	27.1% of all injury collisions	15.4% of all injury collisions	-
Inclement Weather Collisions	6.5% of all injury collisions	11.1% of all injury collisions	-
DUI Related Collisions	22.1% of all fatal and severe injury collisions	10.8% of all fatal and severe injury collisions	32%
Construction Related Collisions	2.8% of all fatal and severe injury collisions	0% of all fatal and severe injury collisions	1.7%
Collision Involving an Animal	0.9% of all injury collisions	3.7% of all injury collisions	-
Collisions Involving a Truck	0.1% of all fatal and severe injury collisions	3.1% of all fatal and severe injury collisions	7%
Pedestrian/Bicycle Collisions	2.1% of all fatal and severe injury collisions	7.7% of all fatal and severe injury collisions	25%

* Data retrieved from the California Strategic Highway Safety Plan (SHSP) Challenge Areas

3.2 Analysis of Crash Rates

To compare locations and determine high crash concentration locations on which to focus the analysis, a crash rate was calculated for each location using available traffic volumes provided by Caltrans, dated 2016, and Amador County for the period of 2002 through 2006.

As defined in the LRSM, the equation used to calculate the crash rates is:

$$\textbf{Crash Rate} = \frac{\mathbf{C * 1,000,000}}{\mathbf{V * 365 * N * L}}$$

Where:

C = Total number of crashes per million vehicle miles (MVM)
V = Traffic Volumes using Average Annual Daily Traffic (AADT) volumes
N = Number of years of data
L = Length of roadway segment in miles

In order to determine what constitutes a high crash rate, roadway segment and intersection crash rates were compared to the statewide average crash rates provided in the 2014 Caltrans report for 'Collision Data on California State Highways'. Tables 3.3 and 3.4 below provide the statewide averages that were used.

Table 3.3- Average Statewide Segment Accident Rates

Area	Lanes	2014 Total Per MVM	2012,2013, 2014 Total Per MVM	2014 Fatalities/Severe Injuries Per MVM	2012,2013,2014 Fatalities/Severe Injuries Per MVM
Rural (Outside City)	2 and 3 Lane2	0.94	0.87	0.44	0.42
Urban (Inside City)	2 and 3 Lane2	1.37	1.19	0.60	0.53

Table 3.4- Average Statewide Intersection Accident Rates

Area	Intersection Type	Control Type	2014Total Per MVM	% Fatal
Rural	Tee	Stop or Yield Sign	0.16	1.7
Rural	Four Way	Stop or Yield Sign	0.6	0.8
Suburban	Tee	Stop or Yield Sign	0.14	0.7
Urban	Four Way	Signal	0.27	0.4
Rural	Tee	Uncontrolled	0.12	1.6

Refer to Appendix B for a summary of the calculated crash rates for all roadway segments and intersections included in the study. The top segments for each county, based solely on crash rates, are provided in Table 3.5.

Table 3.5- Top Segments Based on Crash Rates

Segment Name	Description	Crash Rate
Amador County		
Stony Creek Rd	From Ellis Ranch Rd to Argonaut Ln	3.70
Rams Horn Grade	From National St to Shake Ridge Rd	3.52
Route 104/Main St (Ione)	From Foothill Blvd to SR 124	2.95
SR 88	From the Amador/Alpine County Line to 2.5 miles west of the county line	2.49
SR 49	Through Martell and Sutter Hill	2.37
SR 104 (Ridge Rd)	From SR 88 to SR 49 in Sutter Hill	2.24
Stony Creek Rd	From Buena Vista Rd to Ellis Ranch Rd	2.24
SR 26	From SR 88 to the Amador Calaveras County Line	2.19
SR 88	From Mormon Emigrant Trail to Tragedy Springs	2.07
SR 88	From SR 104 (Ridge Rd) to SR 49	2.06
Alpine County		
SR 88	From Alpine/Amador County Line to east side of Caples Lake	2.49
SR 88	From East side of Caples Lake to east side of Red Lake	1.72
SR 89	From Luther Pass Rd to SR 89 towards Markleeville	1.32
SR 89 (Luther Pass Rd)	From Alpine/El Dorado County Line to SR 88	0.86
SR 89	From Laramie St to SR 4	0.72

3.3 Analysis of Crash Costs

The second factor used to determine high crash concentration locations included the determination of crash cost, which is based on the severity of injury resulting from the collision. Injury collisions are recorded under the category of fatal (i.e., at least one party involved was

killed from injuries resulting from the collision), severe injury, other visible injury, or complaint of pain. If there is no apparent injury reported, collisions are recorded as property damage only. Each collision was assigned a crash cost based on values provided in the LRSM and are shown in Table 3.6.

Table 3.6- HSIP Crash Costs for Intersections and Roadway Segments

	Crash Cost		
Collision Severity	Intersection		Segment
Fatal	$ 1,460,000	*signalized*	$ 2,000,000
	$ 2,310,000	*non-signalized*	
Injury (Severe)	$ 1,460,000	*signalized*	$ 2,000,000
	$ 2,310,000	*non-signalized*	
Injury (Other Visible)	$ 126,500		$ 126,500
Injury (Complaint of Pain)	$ 71,900		$ 71,900
Property Damage Only	$ 11,800		$ 11,800

A summary of the collision severity data for each county is presented below in Figures 3.3 and 3.4. It is evident that most of the collisions in both counties resulted in property damage only. Approximately 2% and 3% of the collisions resulted in fatalities for Amador and Alpine Counties, respectively. This solidified the importance of attaining the additional records from SWITRS and the local agencies as there were insufficient numbers of only fatal and severe injury crashes to fully assess the roadway network and identify potential safety issues.

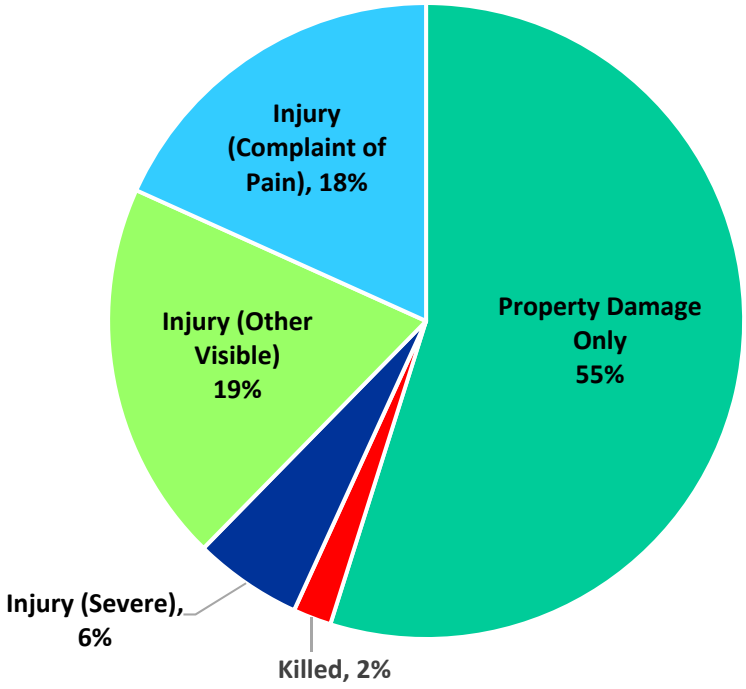

Figure 3.3- Amador County Collision Severities

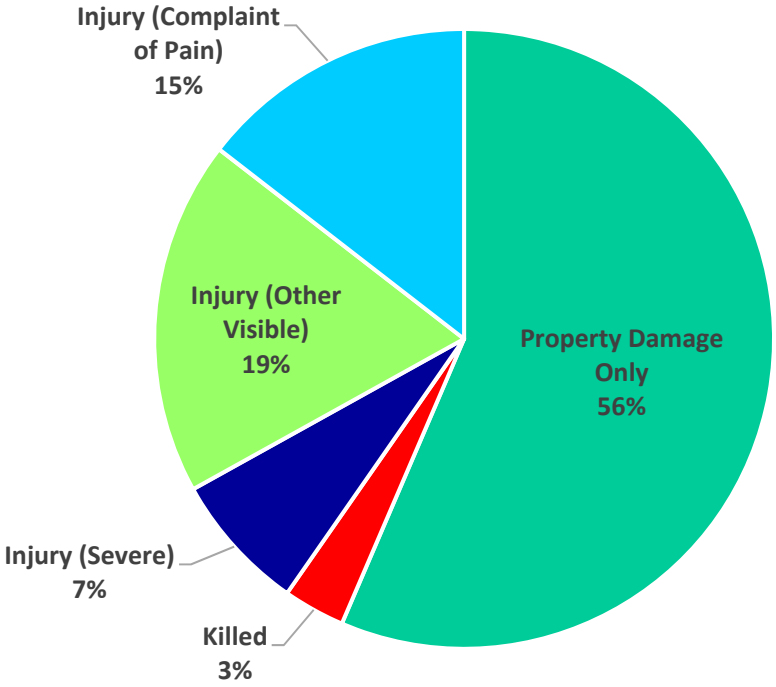

Figure 3.4- Alpine County Collision Severities

An initial list of priority roadway segments and intersections on which to focus the analysis was identified based on the calculated crash rates and costs. These lists can be seen in Tables 3.7 and 3.8. A high crash rate does not always correlate to a high crash cost due to the cost differences between fatal and property damage only crashes. Also, a high crash rate does not always correlate to a large number of crashes on a segment if the traffic volume is low. Preference was given to the segments and intersections with high crash rates and costs while balancing the focus locations between State Routes and local roadways.

Table 3.7- Amador County Initial Focus Segments and Intersections

Amador County			
Location	**Description**	**Crash Rate**	**Cost**
Stony Creek Rd	5.43-mile segment south of Martell/Jackson	3.70	$2,395,700
Rams Horn Grade	2.82-mile segment north of Volcano	3.52	$6,323,800
Route 104/Main St	0.75-mile segment through Ione	2.95	$1,166,500
SR 88	5.8-mile segment	0.66	$19,584,400
SR 49	3.35-mile segment through Jackson	0.86	$16,073,200
SR 88	4.63-mile segment from Pine Grove to Pioneer	0.98	$13,990,300
SR 88 and Buena Vista Rd	Unsignalized intersection south of Ione	1.39	$6,150,400
SR 26 and Deer Ln	Unsignalized intersection between Pioneer and Pine Grove	2.08	$2,567,400
Ridge Rd and Running Gold Rd	Unsignalized intersection east of Sutter Hill	0.32	$2,615,700
SR 124 and SR 16	Unsignalized intersection north of Drytown	0.08	$2,381,900

Table 3.8- Alpine County Initial Focus Segments and Intersections

Alpine County			
Location	**Description**	**Crash Rate**	**Cost**
SR 88	2.9-mile segment from the county line to east of Caples Lake	2.49	$4,312,000
SR 88	4.96-mile segment from east of Caples Lake to East of Red Lake	1.72	$4,950,300
SR 89	5.54-mile segment from Luther Pass Rd to Woodford	1.32	$6,581,200
SR 88	6.52-mile segment from east of Red Lake to Luther Pass Rd	0.57	$5,075,700
SR 89	2.59-mile segment also called Luther Pass Rd	0.86	$4,707,700

SR 88 and SR 89	Unsignalized intersection in Woodfords	0.48	$2,603,900
SR 89 and Luther Pass Rd	Unsignalized intersection west of Sorensens	0.18	$2,321,800
SR 88 and Diamond Valley Rd	Unsignalized intersection in Paynesville	0.15	$126,500

4. HIGHEST OCCURRING CRASH TYPES AND PRIMARY COLLISION FACTORS

4.1 Crash Types

About 44% of the crashes in Amador County resulted in hitting an object. In these cases, hitting an object indicates that the vehicle departed from the roadway. Other types of common collision types were rear ends (15%) and broadsides (12%), which are generally intersection related, and overturns (11%). The highest occurring crash types for Amador County can be seen in Figure 4.1.

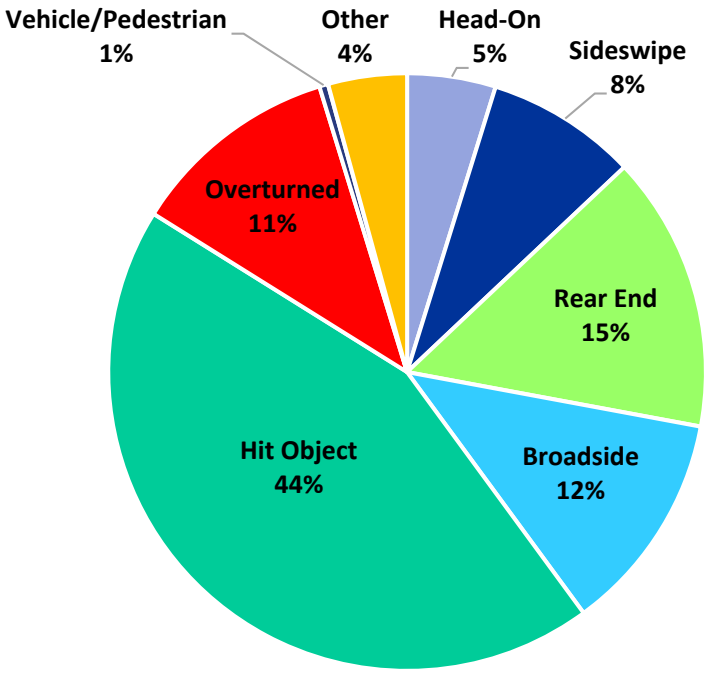

Figure 4.1- Amador County Collision Types

For Alpine County, 47% of the crashes resulted in hitting an object. The majority of the other crashes resulted in overturning (21%). The highest occurring crash types for Alpine County can be seen in Figure 4.2. There are fewer intersection related crashes (rear end, sideswipe, broadside) compared to Amador County, which shows a difference in the type of roadways analyzed for Alpine County.

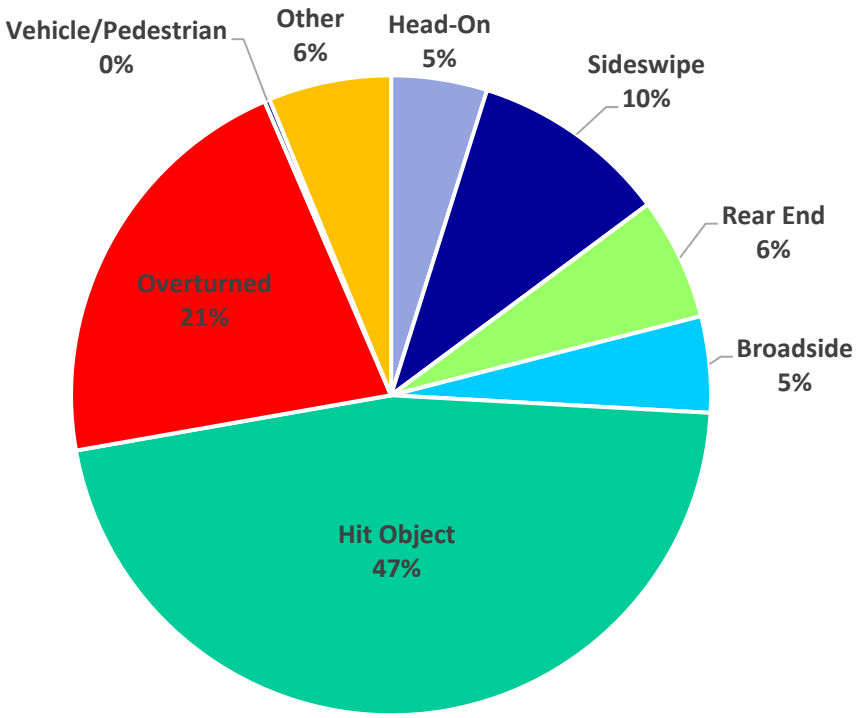

Figure 4.2- Alpine County Collision Types

4.2 Primary Collision Factors

Another key component to understanding the collisions on each roadway network is the primary collision factor (PCF). The PCF is typically the vehicle code violation that is attributed to a specific crash. Figures 4.3 and 4.4 present the primary collision factors for Amador and Alpine Counties, respectively. The most common PCF for Amador County is 'wrong side of the road' while it is 'unsafe speed' for Alpine County. Theses PCF's were taken into consideration while selecting appropriate countermeasures. For example, 'wrong side of the road' collisions lend themselves to countermeasures like centerline rumble strips and raised pavement markers. 'Unsafe speed' can be addressed through engineering countermeasures, such as improved warning signs or by increased enforcement and education measures.

Driving under the influence of drugs or alcohol (DUI), is another common PCF in Amador and Alpine counties. For DUI's, education and enforcement are going to be more effective than engineering countermeasures.

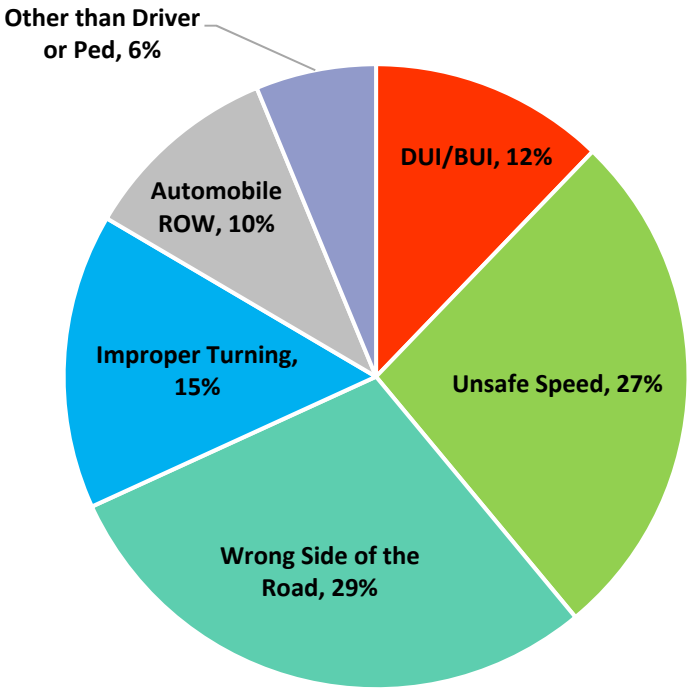

Figure 4.3- Amador County Primary Collision Factors

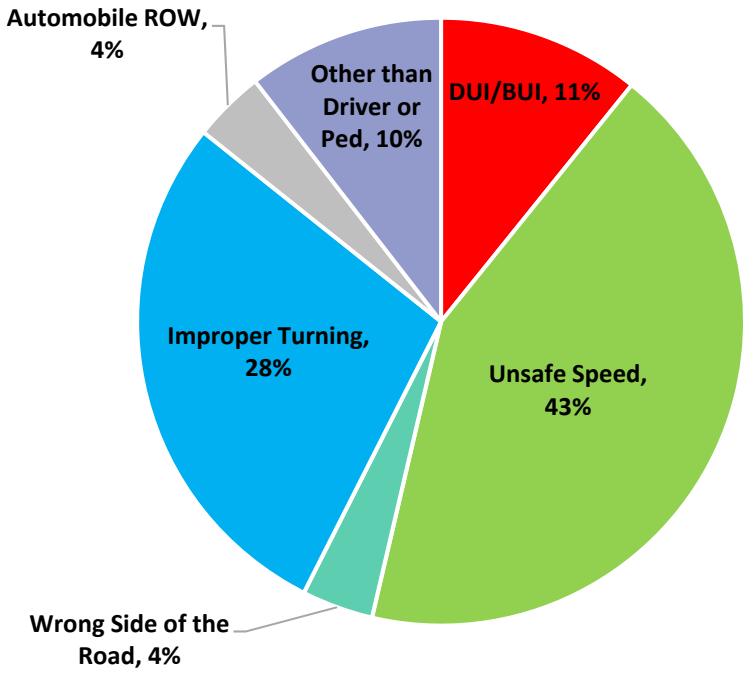

Figure 4.4- Alpine County Primary Collision Factors

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

Based on the rates and types of crashes that occur throughout the counties, a spot location approach was used to locate high crash concentration (i.e., focus) corridors and intersections at which to conduct a detailed review of collisions to identify potential safety issues to guide the selection of countermeasures and develop potential projects. The list of focus locations was determined using the top ten crash rate and crash cost locations identified in Section 3. The final list was amended following discussion with the partner agencies to confirm the locations identified were adequate and to incorporate other locations with potential safety concerns and based on input provided by the public on the project website at safetricountyroads.com.

Table 5.1 lists the focus segments and intersections identified for the detailed analysis.

Table 5.1- Focus Locations with Crash Rates and Crash Costs

	Crash Rate	**Crash Cost**
Amador County Rural Road Segments		
Stony Creek Rd (North)	*3.70*	*$2,395,700*
Rams Horn Grade	*3.52*	*$6,323,800*
Stony Creek Rd (South)	*2.24*	*$504,100*
Coal Mine Rd	*2.04*	*$451,400*
Latrobe Rd	*1.74*	*$8,075,100*
Jackson Valley Rd	*1.64*	*$3,069,100*
Shenandoah Rd	*1.61*	*$167,400*
Amador County Urban Street Segments		
Route 49/Route 88 (Jackson) A	*0.86*	*$865,500*
Route 49/Route 88 (Jackson) B	*0.20*	*$9,906,700*
Route 49/Route 88 (Jackson) C	*1.52*	*$7,351,500*
Route 104/Route 124 (Ione)	*0.77*	*$1,166,500*
Ridge Road (Sutter Creek)	*1.21*	*$5,040,600*
Amador County Intersections		
Route 26 and Deer Ln	*2.08*	*$2,567,400*
Ridge Rd and Running Gold Rd	*0.32*	*$2,615,700*
Alpine County Rural Road Segments		
Route 88 (West)	*2.49*	*$4,312,000*
Route 88 (East)	*1.72*	*$4,950,300*
Route 89	*1.32*	*$6,581,200*
Alpine County Intersections		
Route 89 (Towards Markleeville) and Route 88	*0.48*	*$2,603,900*

Due to the rural nature of both counties, more roadway segments were identified than intersections. GIS tools were used to map the specific collisions at each segment and intersection. Additional qualitative analysis was then conducted at each location with a site visit and review of Google Earth to confirm existing conditions and identify potential safety issues that could be remedied with systemic safety countermeasures.

Below are summaries of the roadway characteristics and crash histories for the top crash focus locations identified for each county. Appendix C and Appendix D include a more detailed explanation of each location and GIS collision maps.

5.1 Amador County Focus Locations

Stony Creek Road (North) from Argonaut Lane to 0.7 Miles South of Ellis Ranch Rd

CRASH HISTORY
0 Fatalities
1 Severe Injury
2 Injury - Visible
1 Injury – Pain
6 Property Damage

TOTAL # COLLISIONS
10
TOP COLLISION TYPE
(8) Hit Object
TOP VIOLATION
(4) Unsafe Speed

Stony Creek Road is a narrow, winding, two lane road with primarily gravel shoulders. Travel lanes widths are nine feet to ten feet wide and paved shoulders range from zero to two feet wide. There is no posted speed limit on either end of the roadway segment. Two curves have posted curve warning signs with advisory speeds of 30 and 35 MPH and chevron markers. Adjacent land use is primarily agricultural. The northern end of the roadway segment approaches playing fields for Argonaut High School and has a 25 MPH school zone speed limit posted on both sides of the roadway.

Center and edge line striping is worn and faded through much of the segment. The bridge for Jackson Creek at the south end of the segment has a metal railing but lacks guardrails on both approaches. Two drainage culverts along the roadway have object markers posted but lack railings and guardrails. Roadside ditches, steep embankments, and fences next to the roadway were observed along portions of the segment.

Rams Horn Grade from Shake Ridge Road to National Street

CRASH HISTORY
0 Fatalities
3 Severe Injury
2 Injury - Visible
0 Injury – Pain
6 Property Damage

TOTAL # COLLISIONS
11
TOP COLLISION TYPE
(6) Hit Object
TOP VIOLATION
(6) Wrong Side of the Road

Rams Horn Grade is a winding, two lane road with 11-foot lanes. Paved and gravel shoulders range between 0 and 2-feet wide. An "End 40 MPH Zone" sign is posted at the north end of the segment and a 25 MPH speed limit is posted on the south end, entering the Town of Volcano. The north end of the roadway connects with Shake Ridge Road at the Daffodil Hill area.

Steep mountainside embankments were observed close to the travel lanes along with limited curve warnings. The pavement is in fair condition, but the striping is worn and faded at locations where vehicles may be crossing over the center line of the roadway. Bicyclists are known to frequent this segment of roadway but there are no reported bicycle-involved collisions in the past five years.

Stony Creek Road (South) from 0.7 Miles South of Ellis Ranch Rd to Buena Vista Rd

CRASH HISTORY
0 Fatalities
0 Severe Injury
2 Injury - Visible
3 Injury – Pain
3 Property Damage

TOTAL # COLLISIONS
8
TOP COLLISION TYPE
(4) Hit Object
TOP VIOLATION
(5) Wrong Side of the Road

Stony Creek Road is a narrow, winding, two lane road with limited shoulders. Travel lanes range between 9 and 10-feet wide with 0 to 2-foot wide paved and gravel shoulders throughout. This segment joins the north segment of Stony Creek Road at Jackson Creek and provides access to the Pardee Lake Recreation Area.

No posted speed limit was observed on either end of the segment. Several of the curves do not have curve warning signs or curve advisory speeds. The guardrails protecting approaches to the north side of the Pardee Reservoir Dam crossing show signs of being hit. The approaches to the dam on the south side lack guardrail. Portions of the roadway pavement is in poor condition. Striping is worn and faded in several locations along the segment.

Coal Mine Rd from Buena Vista Rd to Camanche Pkwy North

CRASH HISTORY
0 Fatalities
0 Severe Injury
3 Injury - Visible
1 Injury – Pain
0 Property Damage

TOTAL # COLLISIONS
4
TOP COLLISION TYPE
(3) Overturn
TOP VIOLATION
(1) Unsafe Speed
(1) Wrong Side of the Road

Coal Mine Road is a narrow two-lane road with a half-mile long reversing curve section midway through the segment. The roadway has 9-foot wide travel lanes with gravel or no shoulders through most of the segment.

No speed limit is posted on either end of the segment. Chevrons and a curve warning sign have been provided on the southbound approach to the reverse curve section but not on the northbound approach. Portions of the roadway pavement are in poor condition and striping is worn and faded along most of the segment.

Latrobe Rd from SR 16 to the El Dorado County Line

CRASH HISTORY
0 Fatalities
3 Severe Injury
10 Injury - Visible
7 Injury – Pain
26 Property Damage

TOTAL # COLLISIONS
47
TOP COLLISION TYPE
(30) Hit Object
TOP VIOLATION
(23) Wrong Side of the Road

Latrobe Road is a winding, two-lane road that connects the El Dorado County Line at the Cosumnes River Bridge to Highway 16. Within El Dorado County, Latrobe Road has 12-foot wide lanes with 8-foot paved shoulders and a 55 MPH posted speed limit. Within Amador County, Latrobe Road narrows to 10 to 11-foot wide travel lanes with 1 to 2-foot wide paved shoulders. There is no posted speed limit on the Amador County segment of Latrobe Road.

Curve warning signs and chevrons are posted at multiple locations along the segment. However, several curves lack warning signs or markers. There is a four-way stop-controlled intersection at Old Sacramento Road as well as stop control for Latrobe Road approaching Highway 16.

Jackson Valley Rd from SR 88 to Ione Buena Vista Rd

CRASH HISTORY
0 Fatalities
1 Severe Injury
6 Injury - Visible
3 Injury – Pain
7 Property Damage

TOTAL # COLLISIONS
18
TOP COLLISION TYPE
(8) Hit Object
(8) Overturn
TOP VIOLATION
(8) Wrong Side of the Road

Jackson Valley Road is a two-lane road with 11-foot lanes and shoulder widths ranging from 0 to 2-feet wide. The intersection of Jackson Valley Road and Buena Vista Road is four-way stop controlled. There is no posted speed limit on this segment of Jackson Valley Road. The striping is worn and faded in some areas.

There is a reversing curve approximately 0.5 miles south of State Route 88 that is experiencing high numbers of hit object and overturn collisions despite having posted curve warning signs.

Shenandoah Rd from the County Line to 0.15 Miles South of Spring Lane

CRASH HISTORY
0 Fatalities
0 Severe Injury
1 Injury - Visible
2 Injury – Pain
2 Property Damage

TOTAL # COLLISIONS
5
TOP COLLISION TYPE
(3) Hit Object
TOP VIOLATION
(2) Unsafe Speed
(2) Wrong Side of the Road

Shenandoah Road is a winding, two-lane road that runs through the community of River Pines. There are several cross streets and driveways along this segment. The segment ends at the El Dorado County line on the Cosumnes River Bridge. Roadway travel lanes are 12-feet wide with 4-foot shoulders. There is a 25-MPH speed limit posted on both ends of the segment.

The curve on the north end of the segment has curve warnings and a 20-MPH advisory speed. A pedestrian warning sign indicates pedestrians crossing the roadway or walking on the shoulders in this area. Approaches to the Cosumnes River bridge have guardrail that shows signs of being hit.

State Route 49/88 through Jackson from Argonaut Ln. to Sutter St.

CRASH HISTORY
0 Fatalities
0 Severe Injury
4 Injury - Visible
5 Injury – Pain
0 Property Damage

TOTAL # COLLISIONS
9
TOP COLLISION TYPE
(3) Rear End
TOP VIOLATION
(3) Unsafe Speed

Most of this northern portion of SR 49/88 through Jackson consists of 3 lanes (one lane traveling south and two lanes traveling north) and a two way left turn lane. An additional southbound lane begins half way between Vogan Toll Road and Sutter Street. There are discontinuous pedestrian facilities along this portion of SR 49/88. There is a posted speed limit of 50 MPH near Argonaut Lane, which is reduced to 40 MPH near Vogan Toll Road.

State Route 49/88 through Jackson from Sutter St. to SR 88 E

CRASH HISTORY
1 Fatality
3 Severe Injury
2 Injury - Visible
23 Injury – Pain
0 Property Damage

TOTAL # COLLISIONS
29
TOP COLLISION TYPE
(14) Rear End
TOP VIOLATION
(14) Unsafe Speed

This middle portion of SR 49/88 runs through the downtown "core" of Jackson and consists of four lanes with a continuous two way left turn lane and intermittent sidewalk on either side. There are six pedestrian crossings on this 0.58-mile-long segment. Four of the six crossings are uncontrolled. The posted speed limit is 30 MPH through with numerous side street intersections and commercial driveways. Despite there being ample opportunities for pedestrians to cross the street, the lack of continuous sidewalk forces pedestrians to walk in the shoulders.

State Route 49 through Jackson from SR 88 E to Middle Bar Rd.

CRASH HISTORY
2 Fatalities
1 Severe Injury
5 Injury - Visible
10 Injury – Pain
0 Property Damage

TOTAL # COLLISIONS
18
TOP COLLISION TYPE
(7) Broadside
TOP VIOLATION
(10) Automobile Right of Way

This southern portion of SR 49 through Jackson consists of 4 lanes and a two way left turn lane from SR 88 East to French Bar Road and then is reduced to a two-lane road with a two way left turn lane heading south. The speed limit begins at 40 MPH but increases to 45 MPH and 50 MPH in the southbound direction heading out of town.

There is a continuous right turn lane in the southbound direction for the shopping centers and approaching the intersection of French Bar Road. There are multiple closely spaced warning signs leading up to French Bar. Within 500 feet of the intersection, there is a pedestrian warning, a no parking sign, Thru Traffic Merge Left, signal warning, Right Lane Turns Right Ahead, Right Lane Must Turn Right, and another no parking sign.

Ridge Rd (SR 104) through Sutter Creek from Bowers Rd. to SR 49

CRASH HISTORY
0 Fatalities
2 Severe Injury
0 Injury - Visible
16 Injury – Pain
44 Property Damage

TOTAL # COLLISIONS
61
TOP COLLISION TYPE
Not Specified
TOP VIOLATION
(28) Automobile Right of Way

State Route 49 and Ridge Road (SR 104) meet in the center of Sutter Hill, a small community in Sutter Creek. Approximately 19,000 vehicles pass through this intersection each with adjacent businesses including gas stations and a Walgreens. The intersection is signalized with pedestrian crossings.

Approaching Bowers Road, Ridge Road has one through lane, one left turn lane, and one right turn lane. Traffic on Ridge Road does not stop while Bowers Road (Prospect Drive across the street) has a stop sign. There is a crest on Ridge Road between Bowers Road and SR 49 which limits sight distance for vehicles turning onto Ridge Road from Bowers Road or Prospect Drive.

State Route 104/ State Route 124 in Ione

CRASH HISTORY
0 Fatalities
0 Severe Injury
Injury - Visible
Injury – Pain
17 Property Damage

TOTAL # COLLISIONS
26
TOP COLLISION TYPE
(9) Hit Object
TOP VIOLATION
(7) Unsafe Speed

State Route 104, E Main Street, and Preston Avenue run through the City of Ione. Ione elementary is located at SR 104 and Ione Street and there are several small shops along E Main Street in downtown Ione. SR 104 has one lane in each direction and sidewalk on one side from Ione Street to E Main Street. E Main Street also has one lane in each direction with parking on each side of the road. Preston Ave. from E Main Street to SR 124 has one lane in each direction and sidewalk on both sides.

Most of the pedestrian crossings lack high visibility signage and markings and ADA compliant curb ramps.

State Route 26 and Deer Ln Intersection

CRASH HISTORY
0 Fatalities
1 Severe Injury
1 Injury - Visible
1 Injury – Pain
5 Property Damage

TOTAL # COLLISIONS
8
TOP COLLISION TYPE
(4) Hit Object
TOP VIOLATION
(3) Wrong Side of the Road

The State Route 26 (SR 26) and Deer Lane intersection is located on the outskirts of the community of Pioneer. SR 26 has 12-foot lanes with 1-foot shoulders and the speed limit is assumed to be 55 MPH. Most of the collisions are along SR 26 between Deer Lane and Marilyn Lane. Both Deer Lane and Marilyn Lane are local roads serving residences and have very low traffic volumes. Visibility at the intersection is limited by vertical and horizontal curves on SR 26.

Ridge Rd and Running Gold Rd Intersection

CRASH HISTORY
1 Fatalities
0 Severe Injury
1 Injury - Visible
2 Injury – Pain
3 Property Damage

TOTAL # COLLISIONS
6
TOP COLLISION TYPE
(5) Rear End
TOP VIOLATION
(5) Unsafe Speed

The intersection of Ridge Road and Running Gold Road is located near the outskirts of the City of Sutter Creek. Ridge Road is a two-lane road with 10-foot lanes and 6-foot shoulders that connects Sutter Creek to the community of Pine Grove. The posted speed limit on Ridge Road is 55 MPH. Running Gold Road is a two-lane road that leads into a neighborhood.

Sight distance at the intersection is limited by a crest vertical curve on Ridge Road, east of the intersection. The maximum sight distance to the east is 575'. Advance intersection warning signs are posted at this location and there is a street light at the intersection. There is no turn lane on Ridge Road on to Running Gold Road, therefore, though traffic on Ridge Road must stop behind the turning vehicle.

5.2 Alpine County Focus Locations

State Route 88 from the County Line to the East Side of Caples Lake

CRASH HISTORY
2 Fatalities
2 Severe Injury
3 Injury - Visible
4 Injury – Pain
24 Property Damage

TOTAL # COLLISIONS
33
TOP COLLISION TYPE
(22) Hit Object
TOP VIOLATION
(20) Unsafe Speed

This section of State Route 88 begins at the Alpine/Amador County Line at Kirkwood and continues past Caples Lake. This segment includes the portion of roadway known as the 'Ice Box' which experiences frequent icy conditions during winter months. Caltrans is investigating potential Road Weather Information Systems (RWIS) and a potential ice detection and warning system to deploy at the Ice Box area.

The roadway consists of two 12-foot lanes and a shoulder ranging from 0 to 30-feet for pullouts. Several improvements have been made to this segment to aid drivers during the snowy winters. The pavement, signage, and striping have all been recently updated. Caltrans is developing plans to improve roadway safety along SR 88 in Alpine County with a project to install centerline rumble strips, repair of existing asphalt surfaces, restriping the roadway and improving warning signs and markings.

State Route 88 from the East Side of Caples Lake to the East Side of Red Lake

CRASH HISTORY
1 Fatalities
2 Severe Injury
4 Injury - Visible
4 Injury – Pain
29 Property Damage

TOTAL # COLLISIONS
39
TOP COLLISION TYPE
(17) Hit Object
TOP VIOLATION
(19) Unsafe Speed

This portion of State Route 88 shares the same features as the adjacent segment, described above. The roadway is windy and narrows in several areas, leaving vehicles driving next to steep embankments. These embankments, or the guardrails protecting them, result in the hit object type collisions caused by unsafe speed. Caltrans is

developing plans to improve roadway safety along SR 88 in Alpine County with a project to install centerline rumble strips, repair of existing asphalt surfaces, restriping the roadway and improving warning signs and markings.

State Route 88/89 from Luther Pass to State Route 89 at Woodfords

CRASH HISTORY
3 Fatalities
1 Severe Injury
7 Injury - Visible
10 Injury – Pain
23 Property Damage

TOTAL # COLLISIONS
40
TOP COLLISION TYPE
(24) Hit Object
TOP VIOLATION
(14) Unsafe Speed

This portion of State Route 88/89 connects the small community of Sorensens to Woodfords and Alpine Village. Most of this segment has 12-foot lanes with 2-foot paved shoulders. The pavement, signage, and striping have all been recently upgraded. Large trees parallel the roadway on both sides. Caltrans is developing plans to improve roadway safety along SR 88/89 in Alpine County with a project to install centerline rumble strips, repair of existing asphalt surfaces, restriping the roadway and improving warning signs and markings.

This segment becomes difficult to traverse during winter driving conditions. Vehicles travelling at an unsafe speed during inclement weather do not have a lot of room for error when making turns, which results in a high number of hit object type collisions. Public comments have been provided regarding vehicles stopped in the shoulder and encroaching on the roadway when installing tire chains.

State Route 88 and State Route 89 Intersection

CRASH HISTORY
1 Fatalities
0 Severe Injury
1 Injury - Visible
2 Injury – Pain
2 Property Damage

TOTAL # COLLISIONS
6
TOP COLLISION TYPE
(2) Rear End
TOP VIOLATION
(3) Unsafe Speed

To differentiate between two intersections with the same name, this intersection is with State Route 89 heading south towards Markleeville. SR 89 is stop controlled while SR 88 has the right of way. Flashing beacons overhead help warn motorists of the intersection. SR 88 has a designated right turn lane but not a left turn lane onto SR 89. SR 89 has one lane for left turns and one lane for right turns and through movements.

Sight distance is limited by the large trees, and a horizontal curve on SR 88, making it difficult for motorists on SR 89 to determine when it is safe for them to proceed through the intersection.

6. COUNTERMEASURES IDENTIFIED TO ADDRESS THE SAFETY ISSUES

The primary focus of this SSAR is the identification of engineering countermeasures that could be applied systemically to roadways throughout the counties to improve roadway safety. Section 6.1 provides descriptions of the engineering countermeasures recommended for implementation in Amador and Alpine Counties. Strategies to improve roadway safety through education, enforcement and emergency response measures are discussed in Section 6.2.

6.1 Engineering Countermeasures

Engineering countermeasures are individual elements that can help improve the overall safety of a specific location based on the types of collisions experienced and existing road characteristics. The challenging aspect of selecting engineering countermeasures is identifying those that will have the greatest benefit for the specific area of interest. The selection of improper engineering countermeasures can sometimes result in more harm than benefit, so proposed safety improvements must be reviewed to ensure that they will help reduce the likelihood of future crashes.

The two factors that are indicators of the effectiveness of a countermeasure are Crash Modification Factors (CMFs) and Crash Reduction Factors (CRFs). CMFs help estimate the expected number of crashes after implementing a specific treatment while CRFs measure the percentage of crashes that the treatment is expected to reduce. These two values can be used interchangeably as CRF = 1-CMF. Higher CRF percentages represent a greater reduction is crashes.

The engineering countermeasures considered for implementation in Amador and Alpine Counties are sorted into three categories: rural roads, urban streets, and intersections. Table 6.1 summarizes systemic countermeasures identified for implementation. A list of all HSIP-approved countermeasures is included in the LRSM. Additional countermeasures may be considered using the FHWA CMF Clearinghouse website at http://www.cmfclearinghouse.org/.

Table 6.1- Countermeasures Considered for Amador and Alpine Counties

COUNTERMEASURE		CRASH REDUCTION FACTOR	EXPECTED LIFE (YEARS)	FEDERAL FUNDING ELIGIBILITY	SYSTEMATIC APPROACH OPPORTUNITY
Rural Roads					
R4	Install guardrail	25%	20	100%	High
R24	Improve pavement friction (High Friction Surface Treatments)	40%	10	100%	High
R26	Install/Upgrade signs with new fluorescent sheeting (regulatory or warning)	15%	10	100%	Very High
R27	Install chevron signs on horizontal curves	40%	10	100%	Very High
R28	Install curve advance warning signs	25%	10	100%	Very High
R31	Add delineators, reflectors, and/or object markers	15%	10	100%	Very High
R32	Install edge-lines and centerlines	25%	10	100%	Very High
R34	Install centerline rumble strips/stripes	20%	10	100%	High
R35	Install edgeline rumble strips/stripes	15%	10	100%	High
Urban Streets					

COUNTERMEASURE		CRASH REDUCTION FACTOR	EXPECTED LIFE (YEARS)	FEDERAL FUNDING ELIGIBILITY	SYSTEMATIC APPROACH OPPORTUNITY
R1	Add segment lighting	40%	10	100	Medium
R15	Road Diet (To reduce number of lanes or add bike lanes)	30%	20	90%	Medium
R26	Install/Upgrade signs with new fluorescent sheeting (regulatory or warning)	15%	10	100%	Very High
R38	Install pedestrian crossing (with enhanced safety features)	30%	10	90%	Medium
N/A	Install Radar Speed Feedback Signs (Not an approved HSIP Countermeasure)	-	-	-	High
Intersections					
S1	Signalized-Add intersection lighting	40%	20	100%	Medium
S9	Signalized- Install flashing beacons as advanced warning	30%	10	100%	Medium
S11	Signalized-Improve pavement friction (High friction surface treatments)	40%	10	100%	Medium
NS1	Non-Signalized- Add intersection lighting	40%	20	100%	Medium
NS3	Non-Signalized-Install signals	25%	20	100%	Low
NS5	Install/Upgrade larger or additional stop signs or other intersection warning/regulatory signs	15%	10	100%	Very High
NS7	Non-Signalized- Install flashing beacons at stop-controlled intersections	15%	10	100%	High
NS8	Non-Signalized- Install flashing beacons as advance warning	30%	10	100%	High
NS9	Non-Signalized- Install transverse rumble strips on approaches	20%	10	90%	High
NS10	Improve Sight Distance at Intersection (Clear Sight Triangles)	20%	10	90%	High
NS14	Non-Signalized- Install right turn lane	20%	20	90%	Low

COUNTERMEASURE		CRASH REDUCTION FACTOR	EXPECTED LIFE (YEARS)	FEDERAL FUNDING ELIGIBILITY	SYSTEMATIC APPROACH OPPORTUNITY
NS15	Non-Signalized- Install left turn lane (where no left turn lane exists)	35%	20	90%	Low
NS18	Non-Signalized- Install pedestrian crossing at uncontrolled locations (with enhanced safety features)	35%	20	100%	Medium

Rural Road Countermeasures

Add or Upgrade Guardrail [R4]

Guardrails reduce the severity of hit object crashes by redirecting vehicles away from steep embankments or fixed objects and dissipating the energy of the vehicle prior to the collision. Existing guardrails show signs of damage from vehicle collisions with bent rails and posts. For Cycle 9 HSIP funding, upgrading (i.e., replacing) existing guardrail is considered a set-aside countermeasure and does not need a B/C ratio for the application. Further, guardrail upgrades do not count towards the agency maximum HSIP limit of $10 million. An HSIP application to upgrade existing guardrails need only be limited to locations with existing guardrail that needs replacement. Installation of new guardrails, however, does require B/C ratio calculations.

The costs associated with guardrail vary based on type of guardrail, what is being protected, extent of shoulder improvements or widening needed, and whether the guardrail is being installed or upgraded. Additional costs to install a new guardrail on a bridge approach may require substantial additional cost to upgrade the bridge railing to meet current standards. Installing new guardrail along a creek crossing is approximately $95 per linear foot.

High Friction Surface Treatment at High Incident Curves [R24]

Application of a high friction surface treatment is intended for locations along curves where appropriate warning signs and delineators, or other lower cost countermeasures have been installed and a high number of incidents are still occurring. This treatment improves skid

resistance during wet and dry weather and reduces crashes resulting from crossing the centerline or running off the road. High friction surface treatments are a suggested countermeasure included in the SHSP as a substantially lower cost and lower impact improvement compared to realigning a roadway. As such, this treatment is considered a set-aside countermeasure in HSIP Cycle 9. B/C ratios are required and it does count towards the agency maximum HSIP limit of $10 million.

High friction surface treatments should only be applied to roadways with good pavement conditions. Therefore, pavement rehabilitation and crack sealing may be needed prior to treatment. Accounting for needed pavement repairs or rehabilitation, applying a high friction surface treatment costs approximately $40 per square yard. For snowy and icy areas, the recommended thickness of the high friction surface treatment is increased which increased the cost to $70 per square yard.

Improve Roadway Signage (Curve Warnings, Edge Delineation, and Nighttime Visibility) [R26] [R27] [R28] [R31]

Roadway signs are installed throughout County to increase driver awareness to upcoming potential hazards including intersections, curves in the roadway, narrowing pavement or shoulders, animal crossings, and to mark obstructions near the edge of the roadway. Improving roadway warning and regulatory signage is one of the least expensive methods to improve roadway safety. Typical improvements include replacing damaged, worn-out, and non-standard sign panels, relocating signs to improve visibility, adding advisory speeds in advance of curves, and adding new signs.

New technology allows for a comprehensive review of roadside signage that could be used to improve roadway signage throughout the County. By conducting a Roadway Safety and Signing Audit (RSSA), the County and local jurisdictions can create a plan for carrying out detailed recommendations related to roadway signing. The RSSA consists of the following:

Mobile LiDAR Scanning and 360-Degree Field of View Photos of roadway corridor

- LiDAR= Light Detection and Ranging and provides:
- Sign type and classification
- GPS coordinates for location of every sign
- Location in relation to adjacent roadway
- Post type
- Sign height and condition
- Sign visibility

Curve Advisory Reporting System (CARS)

- GPS enabled to correlate data with mobile LiDAR
- Establishes curve advisory warning speeds
- Chevron spacing

Advanced Mobile Asset Collection (AMAC)

- Collection and evaluation of sign retroreflectivity
- Sign luminance
- Contrast ratio for regulatory signs
- Predicts retroreflectivity and sign replacement needs

The data collected from these three tools is analyzed by engineers and consolidated into a final report with collision data, current conditions, and a plan of action to upgrade signs along the full extents of the roadways analyzed.

A prior HSIP application prepared by Nevada County to conduct an RSSA on 48 miles of county roads utilized an overall CRF of 0.33. Costs to conduct RSSA's vary depending on the amount of data extracted from the Lidar survey, such as for embankment slopes adjacent to the roadway, and for level of effort to complete environmental clearance and prepare construction documents. The estimated cost of conducting an RSSA is $1,400 per mile. The cost for implementing the improvements and sign upgrades is an additional $2,000 per mile.

Restripe and Add Reflective Pavement Markers [R32]

Upgrading traffic striping and adding reflective pavement markers is one of the other cost-effective methods to improve roadway safety to address run-off-the-road, head-on, nighttime and inclement weather-related crashes. Painted traffic stripes are typical throughout the rural areas of the counties and are worn and faded in many locations. Painted stripes need regular maintenance to ensure adequate visibility. However, restriping roadways is not eligible for federal HSIP funds unless the new striping provided is a substantial upgrade to the existing roadway striping or markers. As a systematic improvement, striping improvements would typically be included with a roadway improvement or rehabilitation project.

Caltrans' 'Guideline for Selecting Materials and Standard Special Provisions for Traffic Striping and Pavement Marking', dated December 2011, includes multiple options for improving striping on roadways where roadways are frequently snowplowed or where enhanced wet night and fog visibility is needed. Recommendations include:

- Thermoplastic traffic stripes
- Two-component paint traffic stripe and pavement markings for snowplowed roads
- Recessed thermoplastic traffic stripes for frequently snowplowed roads
- Thermoplastic traffic stripes with glass beads for enhanced wet night visibility when reflective pavement makers cannot be used
- Lane delineation using a combination of traffic stripes and raised, non-reflective, pavement markers is recommended on roadways in fog areas to provide a tactile and audible warning to errant drivers.

A Roadway Striping Safety Audit is a potential project to improve striping on multiple roadways and on long segments. A Roadway Striping Safety Audit can be conducted alongside an RSSA (see above) to correct the limits of 'no passing zones' or add striping in areas where needed.

Separate from any project to improve the roadway, the anticipated cost to improve roadway striping is $8/LF to include grinding the existing striping. This cost does not include any needed pavement rehabilitation or repairs. Local jurisdictions need to consider the added cost associated with replacing enhanced stripes and pavement markers with future roadway rehabilitation projects.

Install Rumble Strips [R34] [R35]

Edgeline and center line rumble strips aim to reduce the number of vehicles running off the road or crossing into oncoming traffic. They provide an auditory and vibratory warning when driven on, which alerts drivers when they are leaving the roadway or crossing the center line.

Adequate roadway width is needed to provide centerline and edgeline rumble strips. A minimum of 14’ from the centerline to edge of pavement is recommended for consideration of centerline rumble strips as a safety countermeasure. In areas with bicycle use, edgeline rumble strips should not be installed unless the paved shoulder width exceeds 4’and where guardrail/dike is more than 4’ from the edge of travel way. Edgeline rumble strips should also not be considered as a countermeasure where travel lane width is less than 11.5’ and on winding roads or through transition areas at intersections. This precludes installation of edgeline rumble strips on most of the county roadways within Amador County and on most of the State Routes within Alpine County.

When pavement is in good condition, milling rumble strips is quick and is relatively inexpensive. If pavement is in poor condition, pavement rehabilitation, such as a grind and overlay, would be needed prior to installing the rumble strips. Installing 6” rumble strips costs approximately $64 per 100’.

Frequent roadway sweeping is also needed to keep the rumble strips free of debris, especially in areas were roadways are sanded for increased traction during the winter.

Provide Tapered Pavement Edge Treatment [Non-HSIP Countermeasure]

Many of the rural county roadways have vertical roadway edges within two feet of the edge of travel way. Providing a tapered edge treatment would help prevent run-off-the-road crashes by helping drivers stay on the roadway when a tire leaves the paved surface. As a systematic improvement, tapered edge treatments would typically be included as a low-cost improvement with a roadway improvement or rehabilitation project. Pavement rehabilitation is not eligible for federal HSIP funds.

Urban Streets

Add Street Lighting Between Intersections [R1]

Installing new street lighting aims to reduce crashes occurring at nighttime, as drivers may be unaware of the roadway characteristics in a low light situation. Lighting also helps improve sight distance for motorists and increases awareness to pedestrians walking on the shoulder.

Adding segment lighting can be considered a high cost countermeasure due to costs associated with lighting, power, poles, and routine maintenance. Installing new street lights with 220-foot spacing would cost approximately $240,000 per mile.

Road Diet (Narrow Travel Lanes) [R15]

Road Diet (Narrow Travel Lanes) [R15]

The reduction of travel lane widths is a frequently proposed countermeasure on roadway segments within urban areas. Typically, these measures are undertaken to install new turn lanes or bike lanes on an existing roadway. Without changes to the existing number of travel lanes, there would be limited benefit for reduced vehicle speeds and safety may worsen with increased sideswipe or turning collisions. Reducing the number of travel lanes requires a traffic

analysis to verify there is sufficient roadway capacity to handle the reduced travel lanes and potential vehicle diversions to other streets. Locations considered for implementation in Amador County include a portion of SR 49/88 through Jackson.

Install Radar Speed Feedback Signs [Non-HSIP Countermeasure]

Radar speed feedback signs help to alert drivers of their speed compared to the posted speed limit. They are most effective when installed at locations where a set of warrants are met including[2]:

- 85th Percentile Speeds exceed the posted speed limit by more than 5 MPH
- ADT exceeds 500 vehicles per day
- Site exhibits a correctable speed-related accident history
- Sites exhibits a pedestrian-related accident history
- Sites where posted speed limit is 25 MPH or greater

Locations particularly suited for installation of Radar Speed Feedback Signs include school zones and parks, transition zones entering a developed area (with a lower speed limit) from a less developed area (with a higher speed limit), as a supplemental curve warning device or where vehicle speeds approaching a signalized intersection exceed 45 MPH.

There is currently no approved CRF for radar speed feedback signs, so funding would need to be obtained from a source other than HSIP. The cost to install a Radar Speed Feedback sign varies between $6,000 to $10,000 depending on the availability of electrical power or if solar powered systems are implemented.

Intersections

Install Advance Warning Signs or Upgrade Signs to Include Flashing Beacons [S9] [NS5] [NS7] [NS8]

Installing new advance warning signs for upcoming intersections would improve driver awareness and reduce the amount of intersection related crashes. This countermeasure includes replacing existing signs and installing new signs.

Adding advance intersection warning signs can be done quickly, with minimal impacts, and at low cost. Installing one new sign costs approximately $250. Due to the low cost per installation, installation or replacement of advance warning signs as a systemic countermeasure would be difficult using HSIP funds with the required minimum project cost of $100,000, which would necessitate identifying many locations. However, advance warning signs could be included as a category with the RSSA and Sign Upgrade project.

Installing flashing beacons above stops signs or on advance warning signs would increase driver awareness to the intersection where signs have already been installed but there are still frequent rear end and broadside crashes. Flashing beacons can improve driver awareness of the stop-controlled and signalized intersections and reduce auto right of way related violations. Additionally, they would improve nighttime visibility for drivers approaching the intersection.

Flashing beacons can be installed with minimal environmental and right of way impacts and with relatively low costs. The availability of LED beacons allows for increased use of solar power systems that reduce installation cost and ongoing costs for electrical power. The estimated cost to install a flashing beacon on one approach per intersection is $1,000 to $3,000.

Install Transverse Rumble Strips [NS9]

Installing transverse rumble strips on approaches for stop-controlled intersections would help reduce intersection related crashes such as broadsides and sideswipes. They provide an auditory and tactile sensation for motorists approaching the intersection, alerting them of the stop sign. This countermeasure would be particularly effective on rural roads, where stop signs are few and far between, and advance warning signs and flashing beacons have proven ineffective.

Transverse rumble strips can be installed quickly and with minimal impacts. Due to the noise generated as the vehicles pass over the rumble strips, care should be taken when deciding on the placement and location of this countermeasure so avoid disruption to residents and businesses. The estimated cost to install transverse rumble strips is $148 per 100 feet.

Trim Vegetation [NS10]

Trimming vegetation is intended to improve sight distance at the intersection by removing obstructions from the field of vision. Common obstructions include tree branches below 7’ high, and fences, shrubs and grasses over 3’ high. This countermeasure applies to both stop and yield controlled intersections and aims to alleviate sideswipes and broadsides. Removing obstructions

would allow drivers to see other approaching vehicles and make better decisions about entering the intersection safely. Clearing roadside vegetation is a low-cost countermeasure but the costs would vary depending on the type of obstruction.

As a systematic countermeasure, trimming vegetation is typically conducted as part of regular road maintenance activities if located within the public right-of-way. If the obstruction is located on private property, the removal is typically undertaken by the property owner upon notification by the local jurisdiction. Trimming vegetation may be eligible for HSIP funds if included as part of a larger project meant to clear roadside obstructions including trees, fences, signs, etc., (without major reconstruction of the roadway) to improve sight distance.

Restripe/Widen Street to Add Turn Pockets (Potential High Cost Countermeasure) [NS14] [NS15]

For roadways with higher vehicle speeds, ADT's, and limited sight distance, installing left or right turn lanes would reduce the amount of rear end, broadside and sideswipe crashes at uncontrolled intersections. Adding a left or right turn lane will remove the vehicles stopped or decelerating in the travel lane from the traffic stream. Providing a separate location for the drivers waiting for a gap in the opposing through traffic will allow them to make safer decisions when turning left as they are not holding up the through traffic behind them.

For roadways with adequate shoulder width, left right turn lanes can be added by restriping, which can be done quickly and with minimal impacts. For other locations, the shoulder may need to be paved or widened, which can be a high cost countermeasure involving greater environmental impacts, acquisition of right of way, and relocation of utilities. Care must be taken to study the potential impacts to pedestrians when adding a left or right turn lane.

Restripe Pedestrian Crosswalks and Add High-Visibility Treatments [NS18]

Enhancements for existing pedestrian crosswalks aim to prevent pedestrian related collisions. For HSIP, these enhancements include high visibility 'continental, ladder or zebra-style' crosswalk markings, advance yield lines, advance warning signs and potentially pedestrian-activated lighted warning systems.

Upgrades to existing crossings are considered set-asides for Cycle 9 HSIP funding and do not require a B/C ratio. Upgrade projects are limited to a maximum of $250,000 per jurisdiction. The cost to install an improved high-visibility crosswalk with flashing beacons can be considered a high cost countermeasure as the costs vary depending on site specific issues such as where new curb ramps, bulb-outs, and sidewalk improvements are required.

Additional Items Considered but Not Recommended as Systemic Countermeasures

In addition to the systemic countermeasures discussed above, other countermeasures, both short term and long term, were reviewed to improve safety throughout each county's roadway network. Below are brief descriptions of what each countermeasure would entail. These descriptions include countermeasures that could be utilized in future HSIP applications once other, lower cost, measures are implemented. Additional information for each countermeasure and additional countermeasures can be found in the LRSM.

Install Traffic Signal or Roundabout [NS3] [NS4]

Installation of traffic signals and roundabouts at unsignalized intersections may be considered a potential safety countermeasure to prevent broadside collisions that can lead to severe and fatal injuries. Other lower cost countermeasures, such as improving intersection advance warning signs or adding turn lanes, must be implemented in an attempt to reduce collisions prior to installing a traffic signal or roundabout as installation of traffic control device will frequently lead

to an increase in other collision types, such as rear end collisions, and increased roadway congestion. Installation of a traffic signal must comply with the Manual on Uniform Traffic Control Devices (MUTCD) Warrants for Traffic Signals. In addition, any new signal or roundabout installed on a State Route would require an Intersection Control Evaluation, approved by Caltrans, that analyzes potential traffic impacts and makes consideration for other potential intersection control measures. Intersection control devices typically cost from $350,000 to much higher depending on the work necessary for roadway and ADA improvements and right of way needed to accommodate the new features.

Roadway Realignment [R19] [R20] [R21]

Realigning roadways to improve horizontal and vertical alignments typically has a very high cost and results in impacts to the natural environment and/or acquisition of property to create new right of way for the roadway. As such, roadway realignment can only be considered as a HSIP-eligible countermeasure if an agency has pursued other lower cost countermeasures and is still documenting a higher than average collision rate. Lower cost countermeasures discussed in this SSAR as alternative to roadway realignment include clearing vegetation and other obstructions, signage upgrades, striping upgrades, high friction surface treatments, rumble strips and guardrails. Roadway realignment may be considered on roadway segments or at unsignalized intersections where sight distance is limited. Cost vary widely depending on the scope of the improvements desired.

6.2 Non-Engineering Countermeasures

comprehensive approach to improving roadway safety must address all “4 E’s of Safety”. These include Engineering, Enforcement, Education and Emergency Medical Services. The engineering countermeasures discussed in this SSAR will not resolve all safety issues identified on roadways throughout the County. Many of these issues are discussed as challenge areas in the California Strategic Highway Safety Plan (SHSP), which provides an implementation plan to improve roadway safety throughout the state.

Issues that have been identified as areas of concern for the County during the preparation of this SSAR include:

- Speeding and aggressive driving,
- Driving under the influence of drugs and alcohol (DUI),

- Distracted driving,
- Chain installation and removal areas,
- Commercial vehicle enforcement,
- Emergency Medical Service Response, and
- Sharing the road with bicyclists and pedestrians.

Speeding and Aggressive Driving:

The SHSP reports that 18 percent of traffic-related fatalities and injuries in California between 2012 and 2015 involved speeding or aggressive driving. Within Amador and Alpine Counties between 2013 and 2017, 24.6 and 31.9 percent of traffic-related fatalities and injuries involved unsafe speed as the primary collision factor reported, respectively. Unsafe speed can either mean driving too fast for conditions or exceeding the posted speed limit.

Vehicle speed is one of the critical factors when it comes to reducing fatal and sever injury crashes. As speed increases, the likelihood of crashes and severe or fatal injury also increases.[1] This is of particular concern in rural areas where vehicle speeds and speed limits are higher than in urban areas.

One of the key issues identified on the rural county roads is the lack posted speed limits. A posted speed limit is not required for enforcement of a 55 MPH maximum speed on rural roads. In order to post a speed limit lower than 55 MPH and enforce reduced speeds, an Engineering and Traffic Study must be prepared by a registered traffic engineer to determine the maximum safe speed for the roadway. Refer to the Caltrans Manual for Setting Speed Limits for additional information. Once a speed limit has been determined, and approved by the jurisdiction with authority, speed limit signs should be posted frequently along each roadway segment for any speed less than 55 MPH. This will alert drivers as to the maximum safe speed to approach the upcoming segment. There is no CRF associated with conducting an Engineering and Traffic Study or posting speed limits, so these projects would need to be paid for with local funds.

Once speed limits are set, reductions in vehicle speeds rely on a combination of engineering, enforcement and driver education. Strategies discussed in the SHSP include providing high-profile speed enforcement at high-visibility locations, increasing the use of radar speed units to aid speed measurement, and conducting an outreach campaign to educate drivers on the risks associated with speeding. The California Office of Traffic Safety (OTS) provides grants to assist with increased speed enforcement measures.

[1] SWOV Fact Sheet 'The relation between speed and crashes', April 2012

Driving Under the Influence of Drugs or Alcohol:

The SHSP reports that 32 percent of traffic-related fatalities and severe injuries in California between 2012 and 2015 involved an impaired person. Within Amador and Alpine Counties between 2013 and 2017, 22.1 and 10.8 percent of traffic-related fatalities and severe injuries involved DUI as the primary collision factor reported, respectively.

Collisions involving DUI are not readily addressed using engineering countermeasures. Under HSIP, collisions involving DUI are not allowed to be considered in the calculation of the B/C ratio. The SHSP includes strategies to reduce DUI-related collisions through a combination of enforcement and education measures with increased treatment programs for repeat or high-blood alcohol content offenders. As discussed in Table 6.2 below, the OTS provides grants to local law enforcement agencies for increased enforcement activities like high-profile DUI checkpoints and officer training for roadside detection of impaired drivers. The California Department of Alcoholic Beverage Control offers grants to expand efforts for treatment of alcohol-related problems.

Commercial Vehicle Enforcement:

The SHSP reports that 7 percent of traffic-related fatalities and severe injuries in California between 2012 and 2015 involved commercial vehicles, which can include trucks and buses. Within Amador and Alpine Counties between 2013 and 2017, 0.1 and 3.1 percent of traffic-related fatalities and severe injuries involved commercial vehicles, respectively.

Collisions involving commercial vehicles are exacerbated by the narrow and winding roadways typical throughout the counties. Achieving reduction in commercial vehicle collisions involves outreach to commercial vehicle industry stakeholders especially regarding any changes to commercial vehicle routes and regulations. Engineering measures like rumble strips and improved signage can further help reduce collisions.

Emergency Medical Services Response:

Emergency medical response in rural areas is a primary concern. Transporting a patient to an emergency/trauma center within the “golden hour” is a key measure of the ability of emergency responders to reduce fatalities. The SHSP reports that 37 percent of fatal collisions in rural areas are 30 or more miles from an emergency/trauma center; whereas, 8 percent of fatal collisions in urban areas are 30 or more miles from an emergency/trauma center.

Additional outreach is needed with emergency responders in Amador and Alpine counties to study response times and document specific measures to improve response to crashes within the “golden hour”. One area that could be benefitted with measures included in this report is the

identification of 'choke points' or narrow roadway segments or bridges that can prevent large fire trucks and ambulances from responding to a fire or crash. The RSSA may be used to identify potential choke points throughout the counties.

Table 6.2- Potential Funding Sources for Non-Engineering Safety Measures

Name	Description	Website
California Department of Alcoholic Beverage Control Grants	Funds the expansion of efforts in addressing alcohol-related problems.	Abc.ca.gov
Community Policing Development Program	Funds the development of capacity of law enforcement to implement community policing strategies.	Cops.usdoj.gov
California Office of Traffic Safety Grants	Funds efforts to reduce alcohol/drug impaired driving, motorcycle safety, police traffic services and more.	Ots.ca.gov
Grant Assistance Program	A resource for grant research, alerts, and application help.	Policegrantshelp.com

Bicycle and Pedestrian Safety:

The percentage of collisions involving bicycles and pedestrians is relatively low throughout the counties. However, as the number of facilities available for walking and biking are increased, it is expected the number of collisions is expected to increase.

Engineering countermeasures discussed in this SSAR, including road diets to add bike lanes and crosswalk upgrades, are good systematic improvements to reduce bike and pedestrian involved collisions. However, other measures that have been identified to add new facilities for walking and biking through Jackson, including sidewalk gap closures and other new facilities for walking and biking, will require funding sources other than HSIP.

Table 6.3 provides potential funding sources for increased walking and biking facilities and well as education and encouragement measures that can help improve safety for all roadway users.

Table 6.3- Funding Sources for Bicycle/Pedestrian Safety Improvements

Name	Description	Website
Federal Funding		
Transportation Alternatives (Under MAP-21)	Funds education and encouragement programming for pedestrians and bicyclists. Also includes streetscape projects such as sidewalks, paths, and trails.	Fhwa.dot.gov
Surface Transportation Program (Under MAP-21)	Funds road, bridge, transit, bicycle facilities, sidewalks, trails, crosswalks, and other facilities.	Fhwa.dot.gov
Pilot Transit-Oriented Development Planning (Under MAP-21)	Funds projects that seek to facilitate multimodal connectivity and access to transit hubs for pedestrian and bicycle traffic.	Transit.dot.gov
Congestion Mitigation and Air Quality Improvement Program (CMAQ)	Funds the building of bicycle and pedestrian facilities that reduce automobile travel. Not to be used for purely recreational facilities.	Fhwa.dot.gov
Partnership for Sustainable Communities	Funds bicycle and pedestrian infrastructure to decrease household transportation costs, reduce our nation's dependence on foreign oil. Improve air quality and promote public health.	Epa.gov
Federal Transit Act	Funds shelters and parking facilities for bicycles around mass transit facilities and installation of bike racks or other equipment for transporting bicycles on mass transportation vehicles.	Transit.dot.gov
Community Transformation Grants	Funds active transportation infrastructure and programs that promotes a healthy lifestyle.	Cdc.gov
State Funding		
Active Transportation Program	Funds infrastructure, education, encouragement, enforcement, and planning activities for increasing the safety and mobility of nonmotorized users.	Dot.ca.gov
State Highway Account	Caltrans is required to set aside money for the construction of nonmotorized facilities that will be used in conjunction with the state highway system. Project approvals and funding depend on how much money is needed/requested.	Dot.ca.gov
Office of Traffic Safety Grants	Grants can be used to establish new traffic safety programs or expand ongoing programs. Grants are not to be used for construction.	Ots.ca.gov

7. VIABLE PROJECT SCOPES AND PRIORITIZED LIST OF SAFETY PROJECTS

7.1 Prioritized List of Safety Projects

Based on the systemic and site-specific safety analysis conducted and selection of safety countermeasures included in this SSAR, potential safety projects were evaluated for potential HSIP applications. Locations were identified for the implementation of each systemic countermeasure suggested which were then analyzed for cost effectiveness using the HSIP application process. This evaluation narrowed each countermeasure list down to only those that would produce the highest benefit.

Project cost estimates were prepared and include both the construction costs and the project development and administration costs. Allowances were added to each potential project's cost estimate including mobilization, contingency, construction management, engineering/design, environmental studies and documentation, and right of way acquisition, if needed. B/C ratios were calculated for each countermeasure using the HSIP Analyzer tool. Providing individual ratios and a group ratio for each countermeasure helps determine how projects should be combined for the greatest B/C ratio and HSIP potential. A summary of the top projects and their B/C ratios is provided in Table 7.1. The detailed cost estimate and B/C ratio calculations for each project that were not selected can be seen in Appendix E.

Table 7.1- Viable HSIP Safety Projects

Priority No.	Project Name	Location(s)	B/C Ratio	Estimated Project Cost	Federal Funding Eligibility
1	Ridge Rd and Running Gold Rd Widening	Ridge Rd and Running Gold Rd Intersection	3.61	$976,200	90%
2	Jackson Segment Lighting	SR 49 through Jackson (Subject to Caltrans approval)	14.05	$199,300	100%
3A	Amador County RSSA and Sign Upgrades	Various locations throughout Amador County	76.56	$1,170200	100%
3B	Amador Alpine State Route RSSA and Sign Upgrades	State Routes throughout Amador and Alpine Counties (Subject to Caltrans approval)	218.4	$1,362,100	100%

4	Amador County Advance Intersection Flashing Beacons	Unsignalized intersections in Amador County	25.9	$114,900	100%
5	Amador County Segment Lighting	Martel and Drytown	5.9	$1,162,500	100%
6	High Friction Surface Treatment	Latrobe Rd and Jackson Valley Rd	5.8	$481,100	100%
7	Pedestrian Crossing Enhancements	Jackson, Ione, Plymouth and County Crossings	N/A (Set Aside)	$250K Max	100%
8	Guardrail Upgrades	Stony Creek Rd and Shenandoah Rd	N/A (Set Aside)	$260,000 ($1M Max)	100%

7.2 Viable Project Scopes

1. **Ridge Road and Running Gold Road Widening**

Ridge Road will be widened on both sides of Running Gold Road to add a left turn lane and an acceleration/merge lane. The construction estimate includes all the necessary items for roadway widening along with relocating utilities, signing, mailboxes, and tree removal. This project was high on the County's priority list due to several comments and complaints from the community about the deficiencies at the intersection. Additional project information can be found in Appendix F.

2. **RSSA and Sign Upgrades**

The RSSA projects have been separated out for Amador County roads and State Routes through Amador and Alpine Counties. A complete list of the roadways included in the RSSA can be seen in Figures 7.1 and 7.2 and in Appendix H. Any work on State Routes must be completed under a Caltrans Encroachment Permit.

These projects have a particularly high B/C ratio because all the collisions on each segment are considered and the audit and sign upgrades are relatively inexpensive to complete. This project is the first step in upgrading roadway safety. If high collision rates persist after the upgrades, these roadways would then be eligible for more extensive upgrades through HSIP.

The construction estimate, which can also be seen in Appendix F, assumes $1400 per miles for the RSSA and $2000 per mile for the construction (relocating, upgrading, removing signs). Mobilization and traffic control are also included. Engineering, construction management, and environmental fees are added in the HSIP application for the B/C calculation.

Depending on approval from Caltrans, there is potential option to conduct an RSSA on all State Routes throughout Amador and Alpine counties. Caltrans would then either use the recommendation provided through the RSSA to further analyze and program sign upgrades or allow the local agencies to complete the sign upgrades under a Caltrans Encroachment Permit.

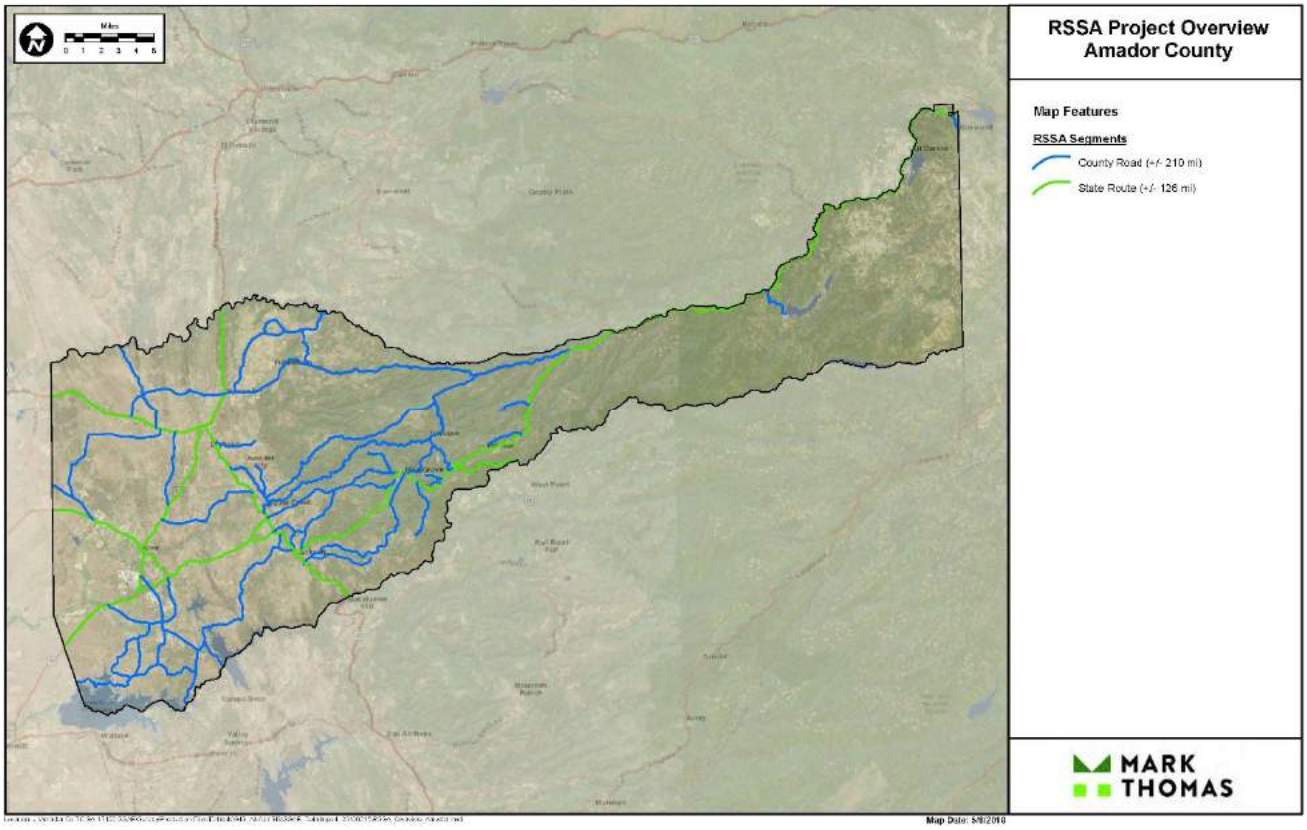

Figure 7.1- Amador County Roads and State Routes Included in the RSSA

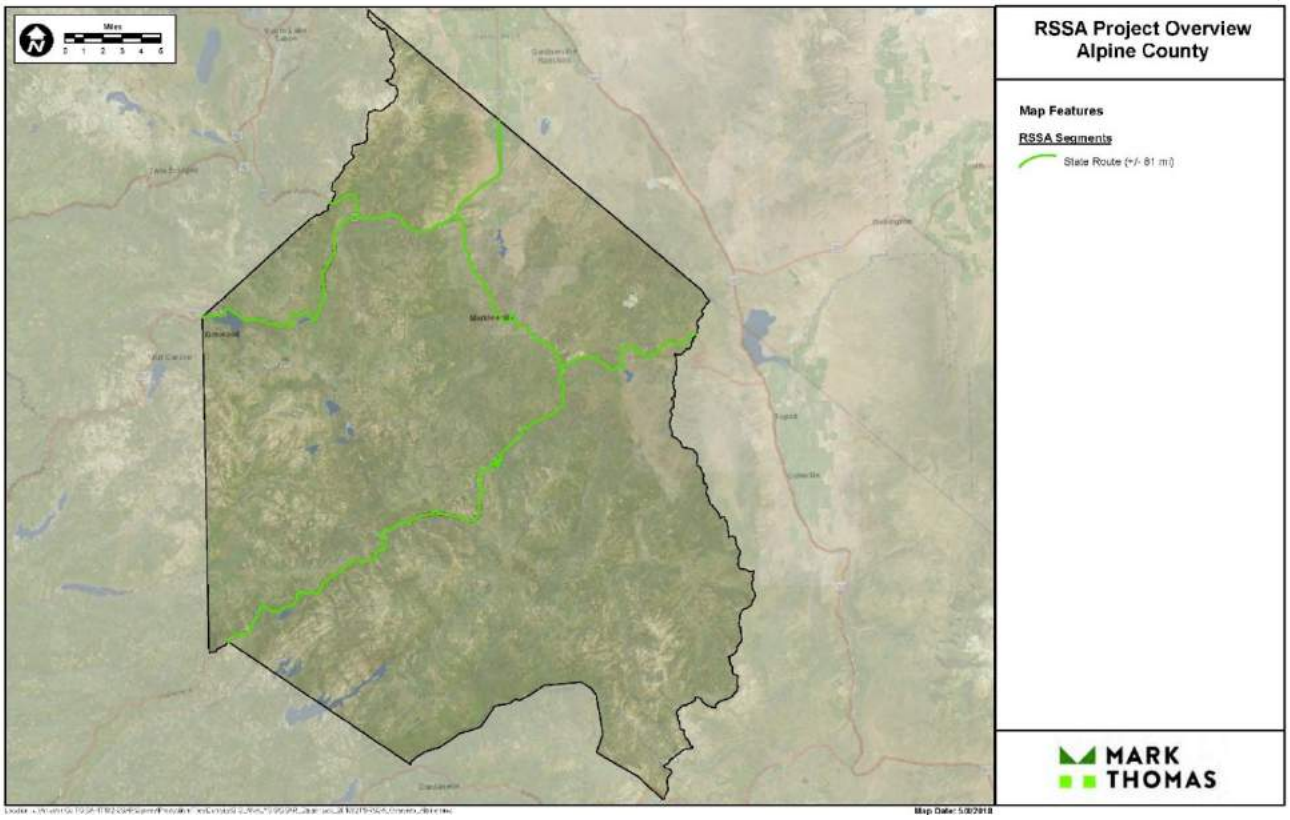

Figure 7.2- Alpine County State Routes Included in the RSSA

3. Advance Intersection Flashing Beacons

Solar Powered flashing beacons and intersection warning signs will be installed as advanced warning for the following non-signalized intersections:

- Latrobe Road and Old Sacramento Road
- Jackson Valley Road and Buena Vista Road
- Ridge Road and Running Gold Road

The construction estimates include mobilization, traffic control, water control, and the installation of beacons and signs. Additional environmental, engineering, and construction management fees are included in the HSIP forms. Additional project information can be found in Appendix I.

4. Amador State Route Segment Lighting

The benefit calculation for this countermeasure only considers collisions that occur at night, therefore, only specific sections of the focus segments could be considered for segment lighting. There were several nighttime collisions along SR 49 through Drytown. The length of the lighting

segment is approximately 1,075 feet from north of Spanish Street to south of China/Church Street. Lighting will also be installed along SR 88 through Martell. The lighting segment will be approximately 5,800 feet long from Wicklow Way to Kennedy Mine Road. Segment lighting maps can be seen in Appendix G.

The construction estimate, which can be seen in Appendix J, assumes a 220' spacing between lights. Mobilization and traffic control are also included. Engineering, construction management, and environmental fees are added in the HSIP application for the B/C calculation.

5. High Friction Surface Treatment

High friction surface treatment will be applied to two high incident curves in Amador County. The first location is south of the city of Ione, along Jackson Valley Road approximately 0.4 miles south of SR 88. The high friction segment is approximately 1,325 feet long. The second location is approximately 2 miles south of the Amador County line, on Latrobe Road. The high friction segment is approximately 980' long and extends along the Lorentz Road curve. Maps for the high friction surface treatment locations can be seen in Appendix K.

While this countermeasure was also suggested for Alpine County, the B/C ratio was much lower due to the need to apply a double layer to be effective in snowy regions. This increased the construction cost estimate, which decreased the B/C ratio.

The construction estimate assumes that the roadway will need to first be resurfaced before applying the high friction surface treatment. A grind and overlay is included along with new striping, mobilization, and traffic control. Engineering, construction management, and environmental fees are added in the HSIP application for the B/C calculation.

6. Pedestrian Crossing Enhancements

The enhancement of existing pedestrian crossings includes the addition of high visibility striping, signage, flashing beacons, and modifying curb ramps to ADA standards, where applicable. Appendix L includes information on locations and estimates for this project.

This countermeasure is considered a set-aside and does not require a B/C ratio, however, there is a funding limit. HSIP will award a maximum $250K per agency. HSIP applications will need to be submitted separately for Plymouth, Jackson, Ione and Amador County to maximize the benefits of this countermeasure.

To help determine the priority locations, it is suggested that the pedestrian crossings nearest schools be considered for upgrades first. Table 7.2 provides the crossings near schools for the Amador County, Jackson, Ione, and Plymouth projects. Appendix L provides a summary of all pedestrian crossings considered for these projects.

Table 7.2- Suggested Pedestrian Crossing Priorities

	School Crossing Locations	Project Cost
City of Ione	SR 104 and E Market St	$97,500
City of Plymouth	Main St and Locust St	$73,000
City of Plymouth	Sherwood St 200' S of Main St	$32,200
Amador County (Pioneer)	SR 88 E of Pioneer Creek Rd	$72,200

7. Guardrail Upgrades

Field reviews provided three locations where existing guardrails were damaged, most likely from vehicle collisions. The first location is on Stoney Creek Road, crossing Jackson Creek. The project will consist of installing Midwest guardrail, flared ends, and relocating signs. The second location is on Stony Creek Road at the Pardee Reservoir Dam. Midwest guardrail, transition railing, and flared ends (or end caps) will be installed along with relocating signs. The third location is on Shenandoah Road, crossing the Cosumnes River in River Pines. Midwest guardrail, transition railing, flared ends (or end caps), and signs will be installed at this location. Additional project details can be found in Appendix M.

Upgrading guardrails is considered a set aside project and does not require a B/C ratio.

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