District 3 Recreation Travel Hot Spot Transportation Management Study

Recreation Hot Spot Transportation Management Study and Implementation Plan

Prepared for:

Caltrans

Prepared by:

Kimley»Horn

Expect More. Experience Better.

Document Control Panel			
Version No	Author	Submittal Date	Description/Disposition
1.0	J. Arroyo/M. Bouchet/A. Phaneuf	1/13/2020	First Draft – Implementation Plan
2.0	J. Arroyo / M. Bouchet / A. Phaneuf	1/19/2021	Second Draft – Final Draft Plan
3.0	J. Arroyo / M. Bouchet / A. Phaneuf	2/3/2021	Third Draft – Final Draft Plan
4.0	J. Arroyo / M. Bouchet / A. Phaneuf	2/15/2021	Fourth Draft – Final Draft Plan
5.0	J. Arroyo / M. Bouchet / A. Phaneuf	2/28/2021	Fifth Draft – Final Draft Plan
6.0	Caltrans D3	10/19/2021	Final Plan

Table of Contents

Table of Figures

Tables

I. Introduction

The US-50 Hot Spots Recreational Travel Transportation Management Study was developed by the stakeholders to identify adaptive roadway management strategies to address congestion caused by recreational travel. The purpose of this Implementation Plan is to summarize the selected adaptive roadway management strategies and develop implementation steps and timeline.

A. Background/ Project Area

US-50 begins in West Sacramento and crosses the United States serving different populations and their varying needs. In California, US-50 connects travelers from metropolitan regions to recreational getaways in the Tahoe Basin. Along this corridor, there are local populations that not only depend on recreational travel to support the local economy but are also greatly impacted by the congestion that this travel creates.

For the purposes of this project, the study area is roughly 63 miles, starting to the west in the City of Placerville and concluding in the east at the Stateline in the City of South Lake Tahoe. This area was carefully selected for its mobility challenges. US-50 regularly experiences local and recreational congestion, causing motorists to become frustrated and contribute to greenhouse gas emissions. Congestion, paired with unpredictable weather conditions, can lead to safety hazards and incidents that negatively impact travelers. The mostly rural and mountainous terrain makes it difficult to add roadway capacity or provide alternate routes. These factors create a challenging, but necessary, project that aims to improve the current operations along US-50.

Caltrans District 3 has teamed up with Kimley-Horn and Associates to determine adaptive roadway management strategies for the Corridor. The US-50 Recreation Hot Spots Transportation Management and Implementation Plan identifies key steps towards project implementation.

B. Defining Adaptive Roadway Management Strategies

Adaptive roadway management strategies can be used to dynamically manage congestion based on existing and future traffic conditions. These strategies focus on increasing throughput while maintaining or increasing safety along a corridor. Adaptive roadway management strategies rely on the use of integrated systems and technology to achieve specific goals. Examples of adaptive roadway management strategies that work specifically along the US-50 corridor include transit signal priority, adaptive traffic signal control, and changeable message signs (CMS). These three strategies use the existing roadway, without adding capacity, all while enhancing functionality and adaptability.

C. Project Area

The project area runs along a 63 mile stretch of US-50, wherein the characteristics of the roadway and surrounding landscape changes. The Project Area begins in Placerville (to the west) and ends in South Lake Tahoe at Stateline (to the east). Some strategies identified in this report may apply to specific points along the Corridor, whereas others may be Corridor wide, such as traveler information.

The project is divided into segments (Figure 1) to categorize parts of the Corridor with similar characteristics such as urban contexts with signals and rural areas with limited lanes and intersections. Project locations were determined based on the five segments identified at the beginning of this report and summarized below:

- Segment 1 is the urbanized context from Stateline to South Lake Tahoe. This includes many traffic signals that fall along US-50. (PM 75.446- PM 80.449)

- Segment 2 covers the Echo Summit and Meyers Chain Control Areas, where travelers maneuver through steep terrain. This portion is two lane semi-rural context and eventually meets with the border of South Lake Tahoe. (PM 57.935 – PM 75.449)

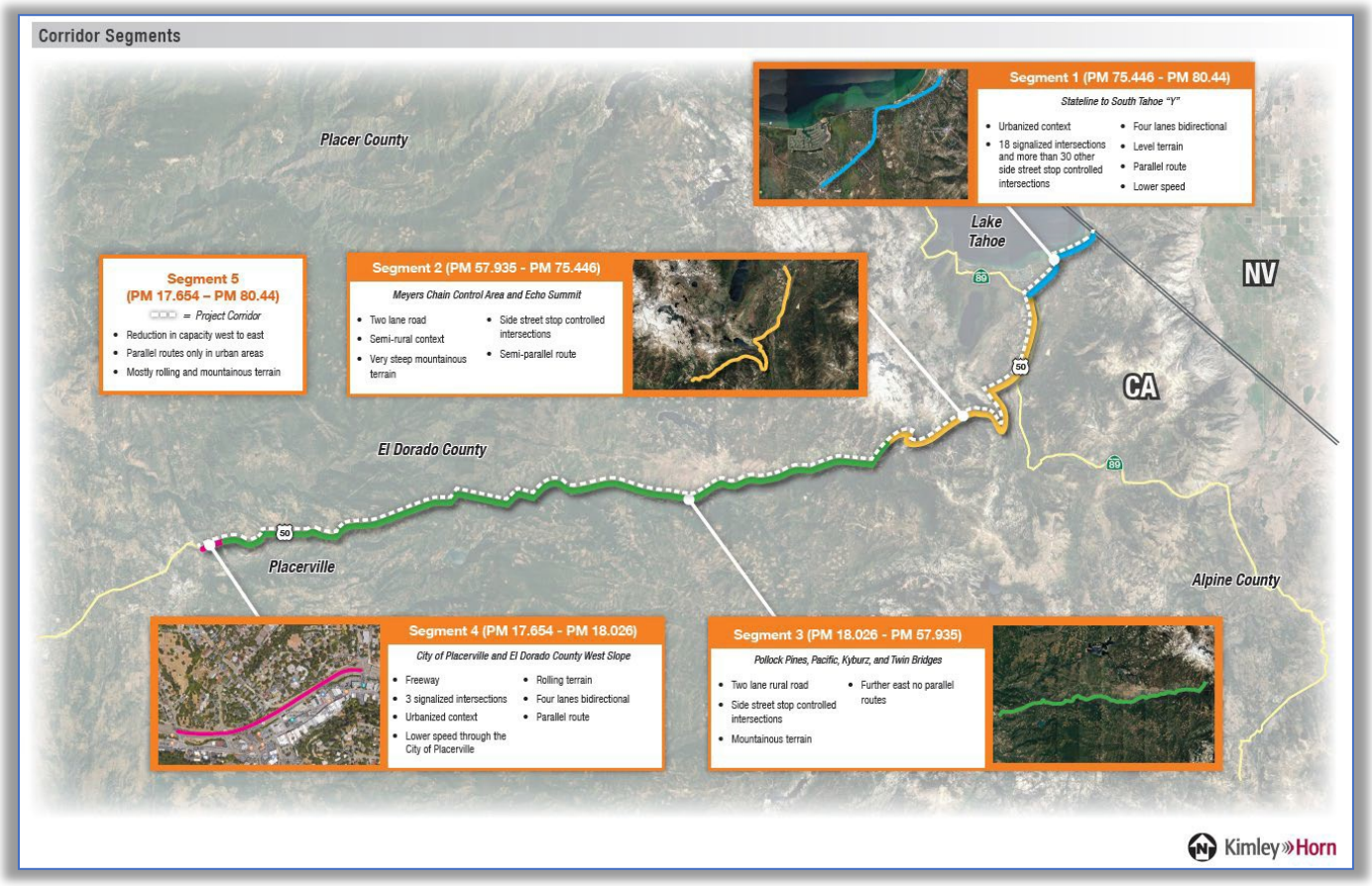
- Segment 3 covers the communities of Pollock Pines, Pacific, Kyburz, and Twin Bridges which is both a four-lane and a two-lane rural road and has mountainous terrain. There are some parallel routes along the west portion of this segment, but further east it becomes more difficult to navigate especially when congestion occurs. (PM 18.026- PM 57.935)

- Segment 4 is the freeway area from El Dorado County West Slope to the City of Placerville. This is a rolling terrain area with three signalized intersections in the west-most portion in Placerville. While the corridor urban in the west portion, this segment passes through smaller rural communities too. (PM 17.521 – PM 18.026)

- Segment 5 includes the entire length of the project corridor. (PM 17.521 – PM 80.449)

The following figures provide high-level project locations divided between each of the project segments.

Figure 1 - US-50 Corridor Map



D. Purpose of the Report

The purpose of the Recreation Hot Spots Report is to provide an implementation plan to develop and phase projects. The following document provides an overview of the region, prioritized projects, funding opportunities, and project delivery and schedule. While the Hot Spots Report is a planning level document, it is intended to provide stakeholders with next steps towards project implementation.

E. Previous Steps

This report identifies adaptive roadway strategies using the existing conditions and stakeholder needs as the foundation. There were multiple reports produced before this one to identify key information that would be carried throughout the project planning process:

- Best Practices Memorandum – provided a cross section of best practices for addressing recreational congestion across the country

- Existing Conditions Report developed an understanding of baseline conditions, as it relates to existing infrastructure, road geometry, alternate routes, crash history, and other improvement projects along the corridor

- Methodology – establishes a methodology for how to evaluate strategies and determines this evaluation criteria based of the needs and priorities of the stakeholders and the Lake Tahoe region

- Identify and Analyze Adaptive Roadway Management Strategies Report – The Report identifies potential strategies for the Corridor, their prospective locations, and their benefits and considerations. While many strategies are identified, this does not mean that all of them are viable candidates for US-50.

- Prioritization Report – The Prioritization document applies the methodology developed in the Methodology Report to prioritize a list of strategies for short-term, medium-term, and long-term implementation.

F. Goals and Objectives

Stakeholder outreach has been an integral part of the project development process and has been integrated with each of these deliverables. Stakeholders expressed concerns for US-50's local and recreational travelers. These concerns are related to safety and travel time reliability along corridor. These challenges are typically amplified during peak seasons when the roads receive a higher volume of vehicles. Additionally, the road geometry creates constraints for both safety and efficiency improvements. With these factors in mind, the stakeholders determined a set of corridor needs:

1. Reliable traveler information that informs travelers before they leave their destination, and provides quality weather information

2. Designated pull over areas for trucks

3. Reliable cell phone communication

4. A unified institutional framework that allows agencies to communicate and coordinate

5. Interregional funding sources for improvements

6. Improved maintenance through increased staffing, financial resources, and documentation

7. Multi-modal transportation to support local and recreational demand

8. Designated rest areas and scenic stopping areas

9. Improved communications that provides remote access to traffic and ITS infrastructure

10. Safety improvements in areas with high collision volumes

11. Viable parallel routes when rerouting is necessary

12. Greater accessibility during unplanned events for incident management and emergency responders

The stakeholder group developed a guiding vision for the project. This vision helps establish a set of goals to advance the project.

The project vision is as follows:

The vision for the project study is to identify the state of the practice for adaptive roadway strategies that will improve safety and efficiency along US-50. The project will consider multimodal strategies for local and regional recreational travel while remaining sensitive to the local context and environment.

The goals for the D3 Recreational Hotspot Transportation Management Study are to:

1. Improve safety

2. Enhance efficiency

3. Increase access to multimodal travel options

4. Promote sustainability and remain sensitive to the local context

5. Consider local economic opportunities

The goals lead to objectives, which are outcomes the goals hope to achieve. Objectives can hold this project accountable for meeting its goals. The relationships between goals and objectives for US-50 are described in Table 1.

Table 1 - US-50 Goals and Objectives

Goals	Objectives
Improve Safety	• Reduce collisions • Reduce fatalities • Adopt operating strategies that reduce safety risks • Improve accessibility and response times for emergency and first responders

Enhance Efficiency	• Increase person throughput • Reduce travel times • Increase vehicle throughput • Provide useful multimodal options • Increase travel time reliability
Access to multimodal options	• Increase ridership • Reduce congestion on roadways
Promote sustainability to remain sensitive to local context	• Reduce emissions • Mode choice change • Reduce congestion
Consider local economic opportunities	• Reduce congestion • Increase person throughput

G. Existing Conditions

The Existing Conditions Report describes the current environment along US-50 from Placerville to South Lake Tahoe as it relates to the transportation network. This document aims to provide an understanding of the existing infrastructure, operations, and stakeholders that are linked to the project corridor. The document summarizes previous planning efforts, takes inventory of field devices, and reviews traffic counts and collision data. The following information will inform stakeholders of the existing conditions along the corridor and prepare them to select roadway strategies to improve the corridor.

a) Description of the Corridor

The project area from Placerville to South Lake Tahoe is approximately 62 miles and connects various communities. Some of these communities include:

- Camino
- Pollock Pines
- Kyburz
- Twin Bridges
- Strawberry
- Meyers

While heading eastbound, the corridor passes through the El Dorado National Forest and eventually crosses with CA-89 in South Lake Tahoe at a point called the "Y." The project area ends at Stateline, where the California and Nevada border meet.

Beginning in the City of Placerville, the road has three lanes heading eastbound and a designated left-turn lane. There are two through-lanes heading and one left-turn lane in the westbound direction. There is no shoulder westbound, but there is a shoulder in the eastbound direction. These lanes travel through three signals in Placerville, and then turn into two lanes in both directions, each with a small shoulder for emergency use.

The corridor continues as two lanes in each direction until the Pollock Pines area, where the eastbound direction is reduced to one lane. From there, passing lanes are presented every four miles or so up until US-50 meets North Upper Truckee Road, where there is a designated left-turn lane. The highway continues as one through road with some intermittent right and left-turn lanes and turn-out areas. The road becomes two through lanes at around E Street in South Lake Tahoe and continues like this until Stateline with some designated turn lanes.

In the westbound direction, starting in South Lake Tahoe, the roadway reduces to one lane around E Street, after passing through the urban part of the City. Turn outs are provided for slow traffic and trucks to pull over after the lane reduction. The westbound direction has passing lanes every four miles or so as they do in the eastbound direction. The road turns into two lanes at Ice House Road in Riverton and continues this way until Placerville.

Changeable message signs (CMS) are placed along the corridor. CMS inventory is discussed later in the document in greater detail. Highway advisory radio signs also fall along the corridor with lights that will flash when drivers are advised to check for current traffic conditions. The designated station for the Lake Tahoe area is 1610 AM.

b) Challenges / Limitations

Along US-50 there are limitations for where capacity can be added. This is due to the geographical landscape, which often presents steep drops on one side of the road and mountains on the other side. Additionally, there are limited parallel routes. Alternate routes can be found in South Lake Tahoe and near the Apple Hill area, but there are large stretches between these two destinations that go without viable parallel routes. If an emergency occurs or the weather conditions are too extreme, travelers may be rerouted. This will typically take them out of the way to I-80, where they will be taken to the northside of Lake Tahoe and routed down SR-89 to South Lake Tahoe.

Additionally, SR-89 may also be presented as an alternate route, leading travelers to CA-88. The challenges with these options are that these routes face similar constraints. While I-80 is a larger freeway, SR-89 is still a highway that travels in one direction each way. SR-89 also leads to a scenic overlook area on Emerald Bay where visitors will often double park and block part of the road. When weather maintenance is performed on these smaller highways, drivers can often get stuck behind vehicles, leading to a long queue of vehicles waiting to pass the snow plow.

c) Stakeholders

The project area integrates different stakeholders from a local and regional level. These agencies come from different backgrounds such as public works, transit, maintenance, and operations. Stakeholder feedback serves as key guidance for the project and helps provide a better understanding of the area from people with experience in these communities. Table 2 describes the involved stakeholders and their current roles as it pertains to the region.

Table 2 - Corridor Stakeholders Existing Roles and Responsibilities

Agency	Roles
Caltrans D3	• Operates and maintains field devices along US-50; including CMS, Caltrans traffic signals, detection, and other highway equipment • Monitors traffic along US-50 • Coordinates with CHP to provide enforcement and safety services • Updates QuickMap with traveler information across the State of California • Facilitates capital improvements projects
California Highway Patrol (CHP)	• Enforces California highway rules to maintain safety • Dispatches FSP and emergency services when it is necessary • Logs incidents and provides updates and reports to Caltrans
Freeway Service Patrol (FSP)	• Serves as an incident management responder • Provides towing, gas, and other vehicle services to cars when stopped on the road

Agency	Roles
	• Main role is to remove any debris (including vehicles) from lanes and get them to the shoulder, or other designated areas, to reduce traffic delays
City of South Lake Tahoe	• Owns, operates, and maintains traffic signals in its jurisdiction • Provides emergency and fire services • Manages Lake Tahoe Airport • Facilitates Capital Improvements Projects
City of Placerville	• Owns, operates, and maintains traffic signals in its jurisdiction • Facilitates capital improvements projects • Provides emergency and fire services
Tahoe Transportation District (TTD)	• Provides transportation services throughout North and South Lake Tahoe in both CA & NV • Transit services include South Shore Service, Lake & Valley Express, Summer Services, and paratransit • Facilitates transit and capital improvement projects
El Dorado County DOT	• Responsible for owning, maintaining, and operating traffic signals in the County Road System • Funds, plans, and designs new projects • Provides County Emergency Services
Tahoe Regional Planning Agency (TRPA)	• Responsible for regional planning efforts • Promotes sustainability initiatives through the region including preservation, transportation, and consumption • Facilitates complete street projects • Partners with local agencies to facilitate project implementation

Agency	Roles
El Dorado County Transportation (EDCTC)	• Coordinates transportation planning for western slope of El Dorado County • Facilitates projects for the area including active transportation, highways, roadways, transit, ITS, and goods movement
Sacramento County Association of Governments (SACOG)	• Oversees the planning and implementation of transportation projects throughout the Sacramento region • Owns and operate SacRegion 511 • Coordinates regional transportation operations • Facilitates data sharing through STARNET and coordinates operations across agency boundaries

Together, these stakeholders can take a coordinated approach for managing the corridor to improve its current operations. Meetings will continue to be held periodically throughout the project development and implementation process to promote a collaborative process.

I. Existing / Previous Studies

The following section discusses previous efforts in the region. These can best be categorized into the following categories:

- Previously Proposed Projects
- Previous Studies
- Planned Infrastructure Improvement Projects
- Planned RTIP Projects

While these documents vary in characteristic, they share a similar purpose of improving the Lake Tahoe region through projects, strategies, and documentation. These documents are tied to one another through a shared vision to improve safety and congestion in the area. Some of these reports may extend beyond this specific project area, but still provide overall regional context which is important to include. Table 3 lists all of the documents reviewed by category.

Table 3 - Reviewed Documents	
Category	Document Title
Previously Proposed Projects	Highway 50 Improvements through Placerville Engineering and Environmental Studies
	City of Placerville - Project Study Report
	Project Report - On Route 50 in El Dorado County in Placerville
	Caltrans Project Study for Camino Corridor
Previous Studies	El Dorado County Sustainable Agritourism Mobility Study (2016)
	Bay Area to Tahoe Basin Recreation and Tourism Travel Impact Study (2014)
	El Dorado County Regional Transportation Plan 2015-2035
	Circulation and Safety Review for the Apple Hill Areas (2013)
	Linking Tahoe: Corridor Connection Plan (2017)
Planned Infrastructure Improvement Projects	State Highway Operations and Protection Program (SHOPP)
	The Camino Safety Project (2013-ongoing)
	The Lake Tahoe Basin Smart Cities Strategy (2019)
	El Dorado Signal Timing Adjustments (ongoing)

a) Previously Proposed Projects

For decades, recommendations have been developed for improving US-50. The following section describes historical documents for proposed projects and traffic studies. These documents throughout the years demonstrate the highway's ongoing challenges and agency efforts to improve US-50. While reading these project descriptions, it is important to remember that these projects have not been implemented.

Highway 50 Improvements through Placerville Engineering and Environmental Studies[1]

In 1989, a Preliminary Concepts Report was released for project alternatives along US-50. The report includes advantages and disadvantages of various alternatives for constructing depressed and elevated roadways alignments and overcrossings. No specific recommendations were made.

Placerville Operational Improvements Project Study Report (1996)[2]

In 1996, a Project Status Report was released to explore projects for the City of Placerville. These projects targeted US-50 between Placerville Drive to Bedford Avenue, and incorporate portions of SR- 49 from South of Sacramento Street to the US-50. The alternatives examined included construction of flyover ramps, bridge structures, and roadway widening to reduce congestion in the City of Placerville. The alternatives also considered traffic signal retiming within the study area.

Project Report - On Route 50 in El Dorado County in Placerville [3]

In 2002, Caltrans released a Project Report that focused on the area from the West Placerville Undercrossing to the Clay Street Undercrossing. The project report explores various alternatives for three projects: Placerville Drive to Main Street Connection Alternatives, Route 50 Mainline Alternatives, and Route 49 Realignment. These projects focused on roadway improvements including ramp realignments, roadway widening, and construction of a flyover.

Caltrans Project Study for Camino Corridor [4]

The primary purpose of the report is to review alternatives improve safety and operations along the Camino Corridor. Three alternatives are considered in the project report including a mainline median barrier and Pondorado undercrossing, and mainline median barrier to extend past Upper Carson and Pondorado undercrossing.

b) Previous Studies

This section examines previous efforts in the area. These studies lay an important foundation of information that the Recreation Travel Hot Spot can build from and compliment. The literature details stakeholder needs and goals at the county and city level. Many of these documents

[1] Caltrans, "Project Study Report Volume III: Improvements on Route 50 through Placerville," May 1989.
[2] Caltrans, "Project Study Report – In the City of Placerville on State Route 50 between west of Placerville Drive and east of Bedford Avenue; and, State Route 49 from south of Sacramento Street to north of State Route 50," March 1996.
[3] Caltrans, "Project Report – On Route 50 in El Dorado County in Placerville," December 2002.
[4] Caltrans, "Project Study Report To Request Programming on US Route 50 Between Smith Flat Interchange and Cedar Grove Interchange in Camino, California," November 2009.

illustrate a goal to enhance safety and mitigate congestion in the region while integrating new modes and technologies.

El Dorado County Sustainable Agritourism Mobility Study (2016)[5]

Conducted in 2016, El Dorado Sustainable Agritourism Mobility Study identified mobility challenges related to agritourism. The study targeted the Apple Hill region, which not only is an agricultural area, but also a destination for tourists, especially during apple picking season. The project aimed to identify low-cost, high-impact solutions to support the local economy and ensure that future mobility conditions continued to propel the agriculture industry forward. The study examined the most used routes, most congested areas, and current conditions of equipment and transportation services. They proposed various strategies to improve traveling for both locals and tourists. These strategies included, real-time traveler information, wayfinding, marketing, multimodal access through shuttle and park-and-ride facilities, improved pedestrian and bicycle facilities. The report also provided an implementation strategy with available funding sources.

Bay Area to Tahoe Basin Recreation and Tourism Travel Impact Study (2014)[6]

The Bay to Tahoe Basin Recreation and Tourism Travel Impact Study examines travel patterns between the major Northern California urban areas and the rural recreation areas surrounding Lake Tahoe Basin. The study was produced for the El Dorado County Transportation Commission and funded by Caltrans. The project study area incorporated multiple counties including Amador, Placer, El Dorado, Nevada, and Sierra Counties. The study used origin and destination data collected from Bluetooth sensor technology to evaluate the impacts of regional and interregional tourism traffic on the existing rural highway network. The resulting analysis identified several strategies that will bolster tourism, while also managing the needs of the local community. Some of the recommendations listed in the study include the implementation of ITS equipment, real time traveler information, a comprehensive transit network, and regional integration with statewide policies and procedures. The plan promotes consistency in planning efforts to create a cohesive area. The plan also recommends that tourists be recognized as a population as they have a significant impact on the area. Specific funding sources are identified to promote next steps for implementation of improvement strategies.

[5] El Dorado County Transportation Commission, "El Dorado County Sustainable Agritourism Mobility Study," December 2016.
[6] El Dorado County Transportation Commission, "Bay to Tahoe Basin Recreation and Tourism Traffic Impact Study," October 2014.

El Dorado County Regional Transportation Plan 2015-2035[7]

This comprehensive plan addresses the current and future transportation needs in El Dorado County. The plan provides proposed roadway, transit, freight, ITS, and TDM strategies to improve mobility in the County. The ITS improvements include signal synchronization, intersection coordination, and the Rural Safety Innovation Project. TDM measures including biking /walking to work days, commuter service, vanpool programs, and park and ride lots. Freight programs include a US-50 HOV lane between El Dorado Hills to Bass Lake, an auxiliary lane on US-50 through the City of Placerville, and interchange improvements. The transit section discussed expanding transit service to Pollock Pines, expanding commuter service, and increasing bicycle racks on transit buses.

Circulation and Safety Review for the Apple Hill Areas (2013)[8]

The Circulation and Safety Review examines the Apple Hill area during peak season from October-November. The study took traffic counts and determined that the most congested areas were Carson Road at Union Ridge Road, Carson Road at Gaitlin Road / High Hill Ranch Road and Carson Road east of the North Canyon Road. The study also noted that ingress and egress for businesses was contributing to congestion in the area. The recommended options included one-way exits out of businesses that would direct traffic from congested areas. The plan suggests more effective traveler information through websites, message boats, and wayfinding platforms.

Linking Tahoe: Corridor Connection Plan (2017)[9]

The Linking Tahoe Plan was established in 2017 to create a cohesive plan for the region. The Plan is a multi-agency and multi-state initiative that aims to tackle congestion with the primary purpose to:

1. Protect the fragile environment
2. Foster a strong economy
3. Balance impact of visitor vehicles with the need to preserve the quality of life for current residents.

US-50 was examined as a primary route into the area. The document dives into statistics illustrating that most vehicles in the area belong to tourists, and that 43% of tourists are day visitors. Linking Tahoe sees these challenges as an opportunity to expand the transit network and

[7] El Dorado County, "El Dorado County Regional Transportation Plan 2015-2035," September 2015.
[8] El Dorado County, "Circulation and Safety Review for the Apple Hill Areas Including Placerville, Camino, Cedar Grove, and Pollock Pines," 2013.
[9] Tahoe Transportation District, "Linking Tahoe: Corridor Connection Plan," September 2017.

implement mobility hubs to increase ridership to the area. The Plan also identifies opportunities for technology implementation to promote a cohesive region. These strategies are divided into short, medium, and long-term phases as well. The technology strategies recommended are:

Immediate and short-term technologies (0-5 years):

- Parking management information systems
- Event management information systems
- Clean fuels
- Traveler data collection – wireless, cellular, Bluetooth, and automated passenger counters
- Traveler information systems using radio, dynamic messaging, e-mail, or texts
- NextBus real time passenger information systems
- Queue jumping
- Ride sharing systems
- Bike sharing (implemented in key areas)
- Personal car sharing
- Integrated transit fare collection

Mid-term technologies (5-10 years)

- Integrated, comprehensive itinerary planning for visitors, including activities, lodging, dining, and transportation
- Congestion charging within Basin
- VMT fee within Basin
- Personal miles traveled (PMT) charge within the Basin that varies by mode

Long-term technologies (10+ years)

- Autonomous vehicles
- Ferries and water taxis/shuttles

c) Planned Infrastructure Improvement Projects

Caltrans D3 has identified this area for improvements and there are multiple projects underway in the area. While most of the Caltrans projects relate to US-50, there are other municipal and

county projects related to bicycle infrastructure, intersection improvements, and a park and ride lot. The current Caltrans projects that relate to US-50 include[10]:

State Highway Operations and Protection Program (SHOPP)

SHOPP is a four-year portfolio of projects that is part of the State Highway System Management Plan.[11] It incorporates the planning, developing, and managing of projects to promote better highway operations across the State of California. Along US-50 there are various SHOPP projects including storm water improvements, pavement upgrades, and more specifically mobility improvements along Pioneer Trail in South Lake Tahoe.[12]

El Dorado West Slope Projects:

- Redhawk Parkway to Sly Park Road - Replace Crash Cushions
- Mosquito Road Undercrossing -Bridge Deck Rehabilitation
- Sacramento County Line to Nevada State Line - Upgrade Metal Beam Guard Rail at Various Locations
- County Line to Ridgeway Drive - Place 6" Striping
- Sierra-At-Tahoe to Pioneer Trail - Pavement Rehabilitation
- Sacramento County Line to State Line - Install Traffic Management Systems at Various Locations
- Bridal Veil Falls Rd to Strawberry Lodge Drive - Construct Sand Vaults
- .02 miles west of Alder Creek Road - Slope Repair
- 28 Bridal Veil Falls Road - Repair Slip out
- Ridgeway Drive to S. Fork American River - Pavement Overlay
- Forest Ranch / Fresh Pond - Pavement Restoration
- Various Locations - Safety – Upgrade Guardrail
- Sawmill Road Undercrossing - Replace Bridge
- Schnell School Road to Sly Park Road - Pavement Rehabilitation
- Still Meadows Road to Upper Carson Road - Safety Improvements

[10]https://static1.squarespace.com/static/5a94975445776eaaf7fe13f6/t/5c588bbbeb393160be1d6ce6/1549306879552/Project+Monitoring+Report_February+-2019_C.pdf
[11] http://www.dot.ca.gov/hq/transprog/shopp.htm
[12]https://static1.squarespace.com/static/5a94975445776eaaf7fe13f6/t/5c588bbbeb393160be1d6ce6/1549306879552/Project+Monitoring+Report_February+-2019_C.pdf

Sacramento County Line to State Line - Install Traffic Management Systems at Various Locations[13]

This project proposed to install new Transportation Management System elements along US-50 from the El Dorado County/Sacramento County line to Stateline Avenue in the City of South Lake Tahoe. The proposed elements include Closed Circuit Television (CCTV) cameras, Changeable Message Signs (CMS), Traffic Monitoring Stations (TMS), Remote Weather Information Stations (RWIS) and Highway Advisory Radio (HAR) equipment. The devices will be installed at major interchanges along the corridor. The purpose of this project is to improve communication for traffic operators to safely and efficiently manage congestion and reduce delay during peak travel periods. These improvements are necessary as existing devices along US-50 are obsolete or no longer compatible with current cellular technology. If the equipment is not replaced, the corridor will remain inefficient and difficult to manage.

The project is estimated to cost $13.4 million and is receiving funding through SHOPP. The construction is expected to begin in Summer 2020 and be completed by the end of 2021.

The Camino Safety Project on US Highway 50 (2013-ongoing)

The Camino Safety Project targets the area of US-50 between Still Meadows Road and Upper Carson Road. This segment of US-50 experiences collisions that have resulted in fatalities. The project is a joint effort between Caltrans and El Dorado County.

Caltrans will install a concrete median to close off five local intersections, widen outside shoulders, and install acceleration / deacceleration lanes. To replace the closing of these intersections, there will be an undercrossing placed at Pondorado Road. Additional improvements include local roadway widening, turning restrictions, upgrading intersections, and implementing pedestrian and bicycle improvements.

The funding sources come from both SHOPP and Federal Highway Safety Improvement Program (HSIP). The estimated project cost is approximately 50.3 million dollars. Construction will begin in Summer 2019 for the Camino Safety Project.

The Lake Tahoe Basin Smart Cities Strategy (2019)[14]

[13] https://dot.ca.gov/caltrans-near-me/district-3/d3-projects/d3-us-50-highway-transportation-management-upgrade

[14] Tahoe Regional Planning Agency, "Linking Tahoe: Smart Cities Strategy – Public Safety and Transportation Rural Systems Integration," 2019.

The Lake Tahoe Basin Smart Cities Strategy develops communications and public warning systems to warn locals and tourists of potential hazards in this area. This is achieved through a coordinated system that crosses county and state boundaries. To better prepare for emergencies, the Lake Tahoe Basin has determined that investing in broadband communications is critical to the success and safety of the region. Underground communication should be considered as a long-term planning effort as aerial utilities are susceptible to fires and other types of disasters.

Northern Tahoe Fire Protection District, in partnership with TTD, applied for a grant through FEMA to deploy a warning system to enhance public safety. This followed the success of a pilot program launched by NDOT that uses WayCare. This existing effort uses Software as a Service platform to create an environment that promotes effective emergency and incident management. The program integrates partners such as NDOT, CHP, and the Regional Transportation Commission (RTC) of Southern Nevada. The Software as a Service program uses real-time data and artificial intelligence to improve response times. This is achieved through different sources such as loop detection, microwave vehicle detectors, on-board devices, navigation apps, weather data, special events, dynamic warning signs, construction / road closure information, public transit information, road camera feeds, traffic crashes through Waze, CHP, and 911 systems.

The project will also integrate smart street lights and various public facing warning systems including sirens, dynamic message boards, camera systems, and lights to guide traffic in the event of evacuation.

TTD is spearheading additional potential projects that include a Traffic Management Center and Ferry System in Lake Tahoe. A ferry system can serve as an additional method for evacuation, when the limited number of roads in the area are closed due to weather conditions.

El Dorado Signal Timing Adjustments (ongoing)

Over the years, El Dorado County has taken different approaches to signal timing. Traffic signals are adjusted during the time of year. Specifically, in Placerville, the County has received complaints regarding peak season and pm school peak. For the pm school peak, the Spring Street signal was reported to have long queues. General mainline congestion was reported during peak season in the Apple Hill area. The County took various avenues to help ease the problem. This included annual hourly volumes, midweek intersection traffic volumes, and Synchro simulation. This continued each year and led to a year-to-year volume comparison. In 2014, the Apple Hill Event Signal Timing Eastbound Queue Study was produced to determine the impacts during this peak season. On weekends, from Apple Season to the close of Christmas, the signals on Canal Street, Spring Street, and Bedford Avenue are timed to prioritize US-50 to optimize traffic flow.

The goal of this is to accommodate tourists, while relieving local traffic, by moving vehicles through the Placerville area efficiently.

d) Regional Transportation Plan (RTP) Conceptual Projects

There are multiple agencies in the Tahoe Region that are dedicated to implementing improvements. Improvements in the area could influence and be incorporated into the strategies that are selected for this project. Below are a handful of highlighted projects that are planned for the future. These projects will be considered as the baseline for the strategies that are proposed.

Lake Tahoe Basin

California Multi-Modal Signal Control Optimization

Caltrans D3, in collaboration with El Dorado County and Tahoe Regional Planning Agency (TRPA), is implementing communications improvements, CCTV cameras, DMS, Traffic Monitor Systems, Remote Weather Information Stations (RWIS) and Highway Advisory Radio (HAR) equipment. There is one identified location in the Tahoe Basin, but the project runs along US-50 from Sacramento County to El Dorado County. The project in Tahoe Basin is located near Meyers. This improvement is part of a comprehensive transportation plan called Linking Tahoe, which was developed by TRPA. It is expected to be constructed by 2024.

Transit Signal Priority Along South Shore

The transit signal priority project along the South Shore is in development by Caltrans and partner agencies such as El Dorado County and TRPA. The project includes transit signal priority through queue jumps, preemption, and other signal priority technologies. This project aims to make transit ridership more efficient, reliable, and sustainable, by minimizing the number of times transit services have to stop for signals. The goal of this project is to influence mode choice, reduce vehicle miles traveled (VMT), and therefore improve air and water quality in this area. The locations have not been specified yet but will likely include existing signals through South Lake Tahoe.

Pioneer Trail Safety Improvement Project

The Pioneer Trail Safety Improvement Project plans for (DMS) Dynamic Messaging Signs, striping and lighting improvements on approaches and at intersections in the City of South Lake Tahoe. Pioneer Trail connects to US-50 just north of Meyers and again further north in South Lake Tahoe near Stateline. The road is two lanes, with almost no lighting or signage. It is surrounded by residential land uses but provides access to the main road through South Lake Tahoe. The project also integrates design for a roundabout to promote efficient and safe traffic flow. The project plans to integrate active transportation improvements that accommodate cyclists and pedestrians.

Supplemental Transit Services – Shuttle Services

Supplemental Transit Services are proposed throughout various counties in the area and would be owned by a private entity but could be operated by a private or public entity. These services would include microshuttles, on demand shuttles, and regional services.

Mobility Hub and Transit Center Capital and Operations

Mobility Hubs are proposed by the TRPA at various locations including Incline, Truckee, South Y, Emerald Bay, Meyers, Squaw, Homewood, Mt Rose, Spooner, Sierra, Zephyr, Stateline, and Cal Base. These are long term projects expected between the years of 2021 to 2045. The area has already adopted mobility hubs and has one near completion at Tahoe Community College. This effort was paired with a grant to bring electric buses to South Lake Tahoe. The mobility hub provides the charging infrastructure for these buses.

Meyers Corridor Operational Improvement Project

The Meyers Corridor Operational Improvement Project includes planning, design, and construction of multimodal complete streets. The project occupies a 1.3 mile stretch on US-50 and SR-89. The design concepts feature frontage roads, diagonal parking, bike lanes, roundabout. The goal of these efforts is to promote active transportation, while enhancing safety for these travelers. As shown in, Figure 2 the project aims to beautify the community of Meyers by providing landscaping and roadway and sidewalk improvements. These improvements are meant to improve conditions for all modes during all hours of the day; the project is not planning to address peak period or recreational congestion. Meyers Operational Improvement Project is managed by El Dorado County; they have worked in conjunction with Caltrans throughout many phases of the project. The project completion is anticipated to be Summer 2022.

Caltrans US-50 Traffic Management Center in South Lake Tahoe

Caltrans D3 plans to develop a Traffic Management Center in South Lake Tahoe to conduct surveillance, manage traveler information platforms, and adjust to road conditions during the winter. The proposed cost of this effort is 2.8 million dollars and the expected timeline is between 2036-2040. The lead agencies on this effort are Caltrans D3 and El Dorado County.

Figure 2 – Meyers Corridor Design Concept for US-50 from El Dorado County and Alta Planning and Design

El Dorado Region

SR 50 Transportation Management System Upgrades Project (ED 50 Advance Warning System & ITS)

The US-50 Advance Warning and ITS Project, located in El Dorado County, spans from the Sacramento County Line to east of Stateline Avenue. The project upgrades new transportation management system elements and implements new ITS field elements. There is one location in the Tahoe Basin at the intersection of US-50 and Pioneer Trail in Meyers. This project is anticipated to go to construction in 2021.

Intelligent Transportation Systems (ITS) Improvements – Phase 1

ITS Improvements Phase 1 identifies various Intelligent Transportation System (ITS) improvements along US-50 and regionally significant corridors in the County. Projects may include, but are not limited to, upgrading all controllers, developing the communications infrastructure, adding CCTVs, implementing DMS, and connecting all signals. The project is anticipated to cost 5.8 million dollars and is planned sometime between 2036-2040. The lead agency for the project is El Dorado County.

Intelligent Transportation System (ITS) Improvements - Phase 2

ITS Improvements Phase 2 consists of minor improvements is also planned for US-50 and regionally significant corridors in the County. The estimated cost for this project is 5 million dollars and is expected between the years of 2036-2040. The lead agency is El Dorado County.

US-50 Westbound Auxiliary Lane

A westbound auxiliary lane is planned for the future along US-50 in the City of Placerville. The lane would start west of the Colima Road Off-Ramp to the Placerville Drive Off-Ramp. The project is anticipated to begin around 2040 and led by Caltrans D3.

El Dorado CTC's – US-50 Hot Spot Outreach Report

4 Conceptual Alternatives – US-50 Improvements Project - Placerville

El Dorado County has partnered with a consultant to develop a planning level assessment of design concepts to help ease congestion through the City of Placerville. The City of Placerville experiences not only recurring peak hour congestion, but also experiences recreational congestion reaching its peak during midday Sunday, heading in the westbound direction. These patterns put a strain on the City of Placerville and impact not only other recreational travelers, but also the local community. The goal of this study is to develop solutions for both recreational and local travel in the Placerville area. These four alternatives include Adaptive Management Strategies, large capital improvement projects, and a hybrid between the adaptive management strategies & large capital improvement projects. The study area includes the following intersections:

- Placerville Drive / US-50 Westbound Off-Ramp
- Placerville Drive / US-50 Eastbound On-Ramp
- Canal Street / US-50
- SR-49 (Spring Street) / US-50
- Coloma Street / Center Street / US-50
- Bedford Avenue / US-50
- Mosquito Road / US-50 Westbound Ramps
- Mosquito Road / Broadway
- US-50 Eastbound Off-Ramp / Broadway

Below are the four different alternatives identified in the assessment:

Alternative 1 - Third Westbound Lane

The first alternative would add a third westbound lane to US-50. The lane would begin at Bedford Avenue and continue at an exit only lane to Placerville Drive. The westbound lane would match the existing

eastbound lane configuration through Placerville. While this concept improves capacity in the westbound direction, it would exceed the capacity in the eastbound direction when these vehicles make a return trip.

Alternative 2 – Elevated Toll Lanes

Alternative 2 would add a third westbound lane (similar to Alternative 1)., while also restricting through movements from side streets. The goal of this configuration is to enhance through movements on US-50 and minimize impacts from side streets, which have relatively low volumes. The side streets would be required to either turn left or make a U-Turn at the next opportunity. This travel pattern would increase VMT for the side street vehicles but would reduce delays for vehicles on US-50.

Alternative 3 – Elevated Freeway

Alternative 3 proposes a two-lane viaduct that is elevated through Placerville. The viaduct would connect to the freeway portion of US-50 west of Placerville Drive near Mosquito Road. The viaduct is shown to the south of the US-50 mainline. Design options include the viaduct constructed directly over US-50 or just to the north of the Corridor. The viaduct would be limited to HOV or tolled vehicles. This would help manage demand on the mainline US-50.

Alternative 4 – "Super Streets" - Prohibit North / South Through Movements

The fourth alternative is the "superstreet" concept, where left turns and through movement from minor streets are restricted. In the first alternative, three U-turn intersections would be added. The second alternative is similar, the end U-turn intersections are eliminated, making there only one U-turn intersection. These two concepts were analyzed for US-50 delay and local delay. While the side streets have relatively low volumes and this could reduce unnecessary delays, it has the potential to increase VMT by requiring vehicles to travel in the opposite direction and then make a U-Turn to get to their destination.

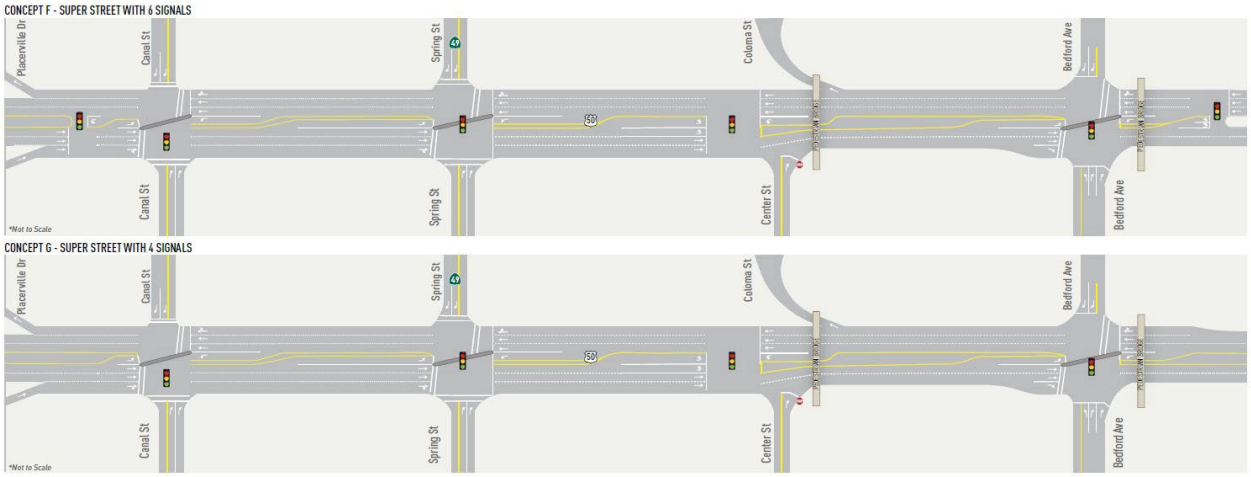
The study by EDCTC ranked the alternatives based on performance, which included various metrics: US-50 Delay, Local Delay, Construction Costs, and Right of Way Impact. Managed lanes were ranked as the following: "Medium" Delay on US-50, "Medium" Delay for Local Streets, "High" Construction Costs, and "Medium" Right-of-Way Impacts.[15] The Study also did a comparison of delays in seconds during the Cumulative Sunday Peak Hour. It found that elevated toll lanes cause a delay of 91.2 seconds in the westbound direction and 47.8 seconds in the eastbound direction. This conclusion is consistent with the direction of recreational travel. It is important to note that these numbers are still significantly lower than the other alternatives in the EDCTC study, which includes Current Configuration (713.1 seconds in westbound direction, and 33.6 seconds in eastbound direction), adding third westbound lane (173 seconds in westbound direction, and 47.8 seconds in the eastbound direction), and adding a third westbound lane and prohibiting north / south through movements (260.8 seconds in westbound direction and 72.8 in the eastbound direction). The only alternative that scored higher than managed

[15] US-50 Hot Spot Study – Planning Level Assessment. *Fehr and Peers.* 21 February 2020.

lanes was the Super Street with Six Signals, which requires drivers from minor streets at signalized intersections to turn right and make U-turns in a designated area downstream.

Figure 3 shows the two Super Street Concepts described in the El Dorado County report for US-50.

Figure 3 - Fehr and Peers Superstreet Concepts for El Dorado County



II. Existing Infrastructure

The primary traffic operation system (TOS) devices along the US-50 corridor that help mitigate congestion are traffic signals and changeable message signs (CMS). Traffic signals are centered in Placerville, California in the West end of the project area and South Lake Tahoe, California in the East end. CMS are sporadically spaced along the corridor facing both directions.

a) Traffic Signal Inventory

Traffic control signals direct vehicles to stop and proceed at highway intersections with the goal of managing traffic movement through orderly assignment of right of way. The existing signals are using Trafficware Type 2070 signal controllers. Time of day coordination plans are put in place to increase efficiency of a corridor. Emergency Vehicle Preemption (EVP) is a technology that allows emergency vehicles to have priority at signalized intersections.

Table 4 summarizes the signalized intersections along US-50 within the project area limits.

Table 4 - Signalized Intersections

City	Intersection Name	Coordination	Coordination Direction	Time of Coordination on Fridays and Sundays	EVP
Placerville	US-50 / Canal Street	Yes, Everyday	US-50, Eastbound and Westbound	Fri 6:30 AM – 8:30 PM Sun 7:30 AM – 8:30 PM	Yes, on all but cannot detect on Westbound approach
Placerville	US-50 / Spring Street	Yes, Everyday	US-50, Eastbound and Westbound	Fri 6:30 AM – 8:30 PM Sun 7:30 AM – 8:30 PM	Yes, but cannot detect on Westbound leg of US-50
Placerville	US-50 / Bedford Avenue	Yes, Everyday	US-50, Eastbound and Westbound	Fri 6:30 AM – 8:30 PM Sun 7:30 AM – 8:30 PM	Yes, but cannot detect on Eastbound leg of US-50
South Lake Tahoe	US-50 / Pioneer Trail (south terminus)	No	N/A	N/A	Cannot detect
South Lake Tahoe	US-50 / Lake Tahoe Boulevard*	N/A	N/A	N/A	Yes, on all 4 legs
South Lake Tahoe	US-50/ 3rd Street	No	N/A	N/A	Cannot detect
South Lake Tahoe	US-50 / Tahoe Keys Boulevard	Yes, Everyday	US-50, Eastbound and Westbound	Fri 7:00 AM – 10:00 PM Sun 7:00 AM – 10:0 PM	Cannot detect
South Lake Tahoe	US-50 / Sierra Boulevard	No	N/A	N/A	No
South Lake Tahoe	US-50 / Carson Avenue	Yes, Everyday	US-50, Eastbound and Westbound	Fri 7:00 AM – 10:00 PM Sun 7:00 AM – 10:0 PM	No

City	Intersection Name	Coordination	Coordination Direction	Time of Coordination on Fridays and Sundays	EVP
South Lake Tahoe	US-50 / Al Tahoe Boulevard / Tulare Avenue	No	N/A	N/A	No
South Lake Tahoe	US-50 / Lyons Avenue	No	N/A	N/A	No
South Lake Tahoe	US-50 / Tallac Avenue	No	N/A	N/A	No
South Lake Tahoe	US-50 / Lakeview Avenue	No	N/A	N/A	No
South Lake Tahoe	US-50 / Rufus Allen Boulevard	No	N/A	N/A	No
South Lake Tahoe	US-50 / Takela Drive	No	N/A	N/A	No
South Lake Tahoe	US-50 / Fairway Avenue	Yes, Weekends	US-50, Eastbound and Westbound	Fri N/A Sun 7:30 AM – 7:00 PM	No
South Lake Tahoe	US-50 / Ski Run Boulevard	No	N/A	N/A	No
South Lake Tahoe	US-50 / Wildwood Avenue*	N/A	N/A	N/A	No
South Lake Tahoe	US-50 / Pioneer Trail (north terminus)	No	N/A	N/A	No
South Lake Tahoe	US-50 / Park Avenue / Heavenly Village Way	No	N/A	N/A	No

City	Intersection Name	Coordination	Coordination Direction	Time of Coordination on Fridays and Sundays	EVP
South Lake Tahoe	US-50 / Friday Avenue	No	N/A	N/A	No
South Lake Tahoe	US-50 / Stateline Avenue	No	N/A	N/A	No

*Intersection signal timing sheet not provided

The County currently does not have a signal interconnect network or time-synching method to enforce coordination between intersections. As a result, coordination plans may be unreliable. Intersections that are not coordinated are operating as fully-actuated.

b) ITS Inventory

Changeable messages signs (CMS) are electronic signs that provide pertinent information to drivers including but not limited to: roadway conditions, alternate routes, and travel time information. While these signs inform drivers, they do not directly control traffic. The signs found in the project area are controlled from the District 3 Traffic Management Center. Table 5 summarizes the CMS locations along US-50 within the project area limits.

Table 5 - CMS Locations

City / Unincorporated Community	Location	Direction
Smithflat	US-50 East of Hangtown Creek (PM ED 19.81)	Eastbound
Pollock Pines	US-50 West of Sly Park Road (PM ED R30.44)	Eastbound
Kyburz	US-50 West of Weber Mill Road (PM ED 47.31)	Eastbound
Strawberry	US-50 South of Pyramid Peak via Rocky Canyon Trail (PM ED 87.10)	Eastbound
South Lake Tahoe	US-50 between Cirugu Street / US-89 (PM ED 70.59)	Westbound

Table 5 - CMS Locations		
City / Unincorporated Community	Location	Direction
South Lake Tahoe	US-50 between Dunlap Drive / 4th Street (PM ED 75.59)	Westbound
South Lake Tahoe	US-50 between Lake Road / Pioneer Trail (PM ED 7.9.9)	Westbound

Closed circuit television cameras (CCTV) are electronic video devices that allow operators at the District 3 Traffic Management Center to identify and verify route conditions. Drivers can also access video feeds via the Caltrans website. Table 6 summarizes the video surveillance locations along US-50 within the project area limits.

Table 6 – Video Surveillance Locations	
City	Intersection Name
Placerville	US-50 / Spring Street
Twin Bridges	US-50 / Pyramid Creek Road
Phillips	US-50 / Sierra-At-Tahoe Road
Echo Summit	US-50 / Echo Drive
South Lake Tahoe	US-50 / Luther Pass Road
South Lake Tahoe	US-50 / Lake Tahoe Boulevard
South Lake Tahoe	US-50 / Ski Run Boulevard

Vehicle detection is used to actively monitor traffic flow and provide efficient signal control based on vehicle demand. Loop detectors are installed in the roadway while video detection cameras are usually mounted on traffic signals. Table 7 summarizes the type of vehicle detection along US-50 within the project area limits.

Table 7 – Type of Vehicle Detection per Project Intersection		
City	Intersection Name	Type of Detection
Placerville	US-50 / Canal Street	Video on all 4 legs
Placerville	US-50 / Spring Street	Video on 3 legs (cannot detect Westbound approach).
Placerville	US-50 / Bedford Avenue	Video on all 4 legs
South Lake Tahoe	US-50 / Pioneer Trail (south terminus)	Video on all 3 legs
South Lake Tahoe	Us-50 / Lake Tahoe Boulevard	Video on all 4 legs
South Lake Tahoe	US-50/ 3rd Street	Video on all 4 legs
South Lake Tahoe	US-50 / Tahoe Keys Boulevard	Video on all 4 legs
South Lake Tahoe	US-50 / Sierra Boulevard	Loop detection on minor road.
South Lake Tahoe	US-50 / Carson Avenue / Rubicon Trail	Loop detection on minor road and left-turns on major road.
South Lake Tahoe	US-50 / Al Tahoe Boulevard / Tulare Avenue	Video on all 4 legs
South Lake Tahoe	US-50 / Lyons Avenue	Video on all 3 legs
South Lake Tahoe	US-50 / Tallac Avenue	Video on all 3 legs
South Lake Tahoe	US-50 / Lakeview Avenue	Video on all 3 legs
South Lake Tahoe	US-50 / Rufus Allen Boulevard	Video on all 3 legs

Table 7 – Type of Vehicle Detection per Project Intersection		
City	Intersection Name	Type of Detection
South Lake Tahoe	US-50 / Takela Drive	Video on all 4 legs
South Lake Tahoe	US-50 / Fairway Avenue	Video on all 4 legs
South Lake Tahoe	US-50 / Ski Run Boulevard	Video on all 4 legs
South Lake Tahoe	US-50 / Wildwood Avenue	No detection
South Lake Tahoe	US-50 / Pioneer Trail (north terminus)	Loop detection on minor road and left-turns on major road.
South Lake Tahoe	US-50 / Park Avenue / Heavenly Village Way	Loop detection on minor road
South Lake Tahoe	US-50 / Friday Avenue	Video on all 3 legs
South Lake Tahoe	US-50 / Stateline Avenue	Video pointed at Eastbound approach

c) Traveler Information

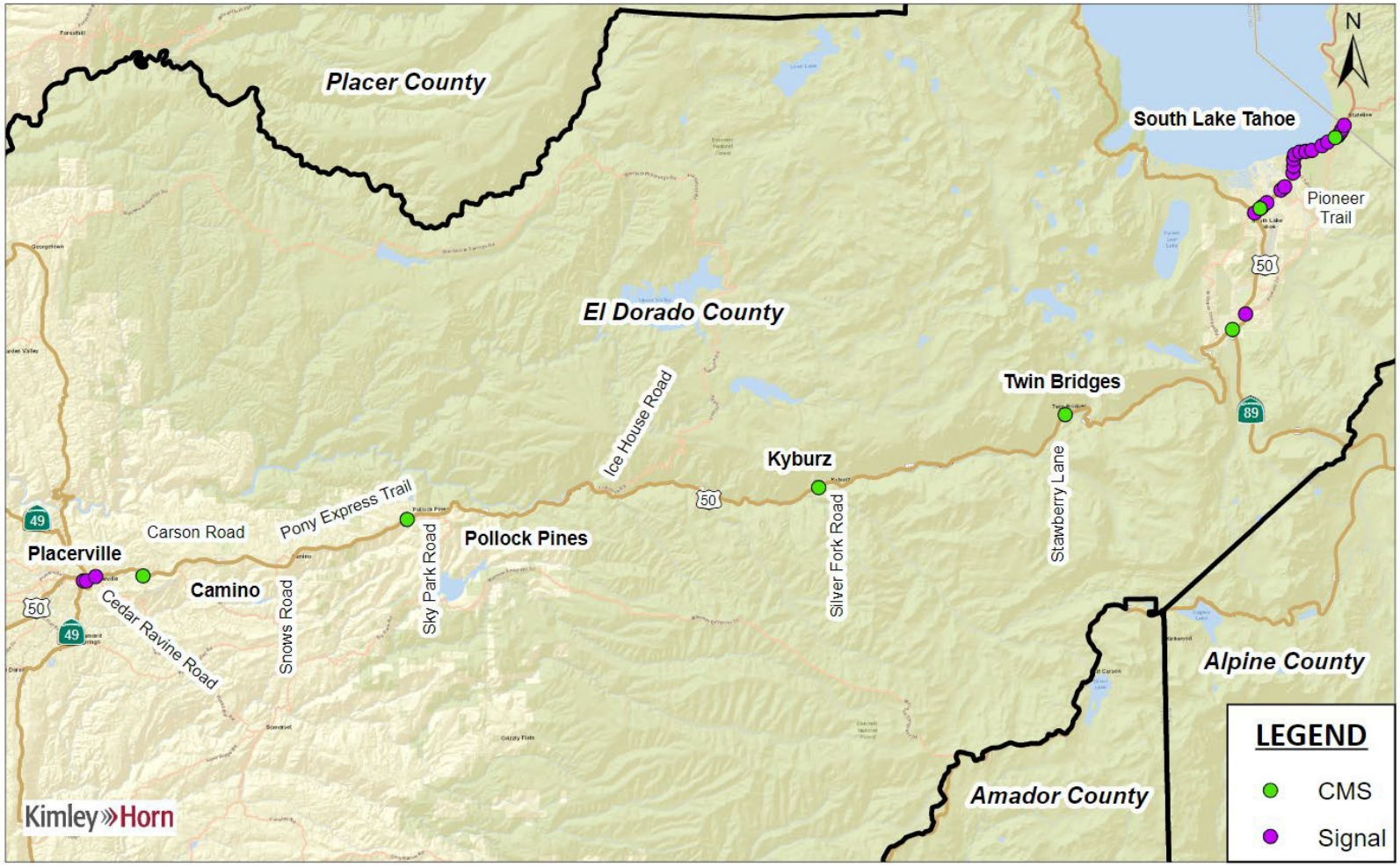
There are two traveler information systems that cover the project area: Caltrans QuickMap and SacRegion 511. Table 8 discusses the features of both platforms:

Table 8 - Traveler Information Platforms	
SacRegion 511	Caltrans QuickMap
Provides phone, web, and mobile app service	Provides web and mobile app service Caltrans Highway Information Service (CHIN) is an automated phone line that provides updates based on individual highways. CHIN does not provide information for US-50.

Table 8 - Traveler Information Platforms	
SacRegion 511	Caltrans QuickMap
Traffic map includes: ▪ Trip planning ▪ Mode choice options ▪ Traffic conditions overlay ▪ Cameras ▪ CMS ▪ Personalization settings for stored routes ▪ Transit routes ▪ Reports in the specified location	Traffic map includes: ▪ CMS ▪ Cameras ▪ Rest Areas ▪ Road conditions ▪ Snow Plows ▪ Chain Controls ▪ CHP Reports with closures and incidents ▪ Waze data with user reported traffic jams, hazards, construction, and closures
Language options provided by Google Translate	Language options provided by Google Translate

Figure 4 - Existing Field Devices summarizes the existing field devices along the project corridor.

Figure 4 - Existing Field Devices



d) Weather and Incident Management Operations

Snow removal along US-50 within El Dorado County is the responsibility of following three Caltrans Maintenance Stations:

- Placerville Maintenance Station
- Kyburz Maintenance Station
- South Lake Tahoe Maintenance Station

When heavy snow accumulates on steep mountain slopes along US-50, the South Lake Tahoe Maintenance Station is responsible for performing avalanche control at Echo Summit Mountain Pass at US-50 ED 66.77.

There are chain up areas along US-50 in certain four-lane sections. To encourage safety, the chain up areas are on low grades prior to chain control check points. Tunable signs are installed in advance of chain control areas, at the chain checkpoint, and on-ramps to inform drivers of the chain control. During chain control the recommended speed limit is 25 mph.

If there is heavy traffic during chain control, Caltrans meters vehicles traveling along US-50 at the following locations:

- Sly Park Road, Pollock Pines (PM ED 31.31)
- Sand Flat Campground, Kyburz (PM ED 47.22)
- Twin Bridges, Unincorporated Community (PM ED 59.83)

Metering allows motorists to turn around to avoid the delay rather than waiting in the queue.

The Regional Transportation Management Center (RTMC) is in Rancho Cordova. The RTMC controls the CMSs, Highway Advisory Radio (HAR), and coordinate snow operations. It is co-located with the CHP Call Center. Freeway Service Patrol (FSP) Valley Division provides incident management services to El Dorado County. Their role is to clear the road of debris and vehicles and reduce the impacts of incidents on traffic. FSP works with conjunction with CHP to ensure that adequate resources are deployed to the incident scene. When necessary, emergency and first responders will be called to support incident management efforts. CHP is responsible for logging incident reports and will provide them to Caltrans.

When traffic increases, Caltrans closes three left turns on eastbound US-50 during the weekend to mitigate dangers of increased traffic from Apple Hill Season.

III. Existing Traffic Data

US-50 between Placerville and South Lake Tahoe has seasonal congestion primarily due to agritourism and recreational weekend travel. Currently CMS, CCTV, and coordinated traffic signals are implemented between Placerville and South Lake Tahoe to manage tourist congestion. These congestion issues are made worse by large freight trucks which must travel slowly on steep grades and avalanche control.

These technologies are mostly centered in Placerville or South Lake Tahoe. Routing services lead tourists down alternate routes, which negatively impacts residents. El Dorado County Transportation Commission has undertaken an effort to provide microsimulation modeling to assess existing performance metrics. Those findings are included under separate cover in a separate project that will inform this one.

a) Collision Data and Hot Spots

Collision data was acquired through Caltrans using the Traffic Accident Surveillance and Analysis System (TASAS). The data examines a three-year period from January 1, 2015 to December 31, 2017. Over this period, there were a total of 728 collisions:

- There were 20 total fatalities and 262 injuries
- Weather conditions were a factor in 104 incidents, where the road was described as wet
- 246 instances were linked to low visibility due to darkness

Figure 6 on the next page summarizes the crash data from January 1st, 2015 to December 31st, 2017along US-50 from Placerville to South Lake Tahoe, CA.

Figure 5 – Collision Information Along the Project Corridor

The map illustrates collision information and categorizes corridor segments in colors corresponding to collision volumes. Areas in white experience no collisions, yellow and orange show low to moderate collision concentrations, and red and dark red demonstrate higher concentrations of collisions, otherwise known as hot spots. Collision data demonstrates that the three signalized intersections in Downtown Placerville are hot spots for the corridor. Echo Summit also experienced a higher concentration of collisions, where the road is steeper and makes sharp turns.

The black diamonds on the map illustrate fatalities. Fatalities were located throughout the corridor. South Lake Tahoe had four reported fatalities. Three fatalities occurred just west of Pollock Pines in the Camino community. Three additional fatalities occurred near Ice House Road in Kyburz.

b) Traffic Data

Traditional traffic counts are typically taken Tuesday-Thursday to examine weekly commuter traffic. These days are selected as they are the most "typical" days of the week for recurring congestion. Peak hours can vary by location and depend on different factors such as proximity to employment centers. Peak hours will typically be from 7AM-9AM and 4-6PM. For the purposes of the Recreation Travel Hot Spot Study, traffic counts were taken Friday-Sunday. This is based on the recreation peak, which coincides with weekend travel times. Most Lake Tahoe vacationers will head eastbound on Friday afternoons and will return west on Sunday afternoons.

As part of the Sustainable Agritourism Mobility Study, traffic counts were conducted over weekends to determine peak period trends. *Figure 6* depicts the peaks for the 2014-2015 winter seasons. The highest traffic volumes coincide with holiday weekends and appear to generally be higher on Fridays than on Sundays. President's Day weekend in February demonstrates the highest volume of vehicles compared to the other weekends. As these traffic counts were taken in winter, it can be inferred that summer holidays would experience similar, if not greater increases in vehicles.

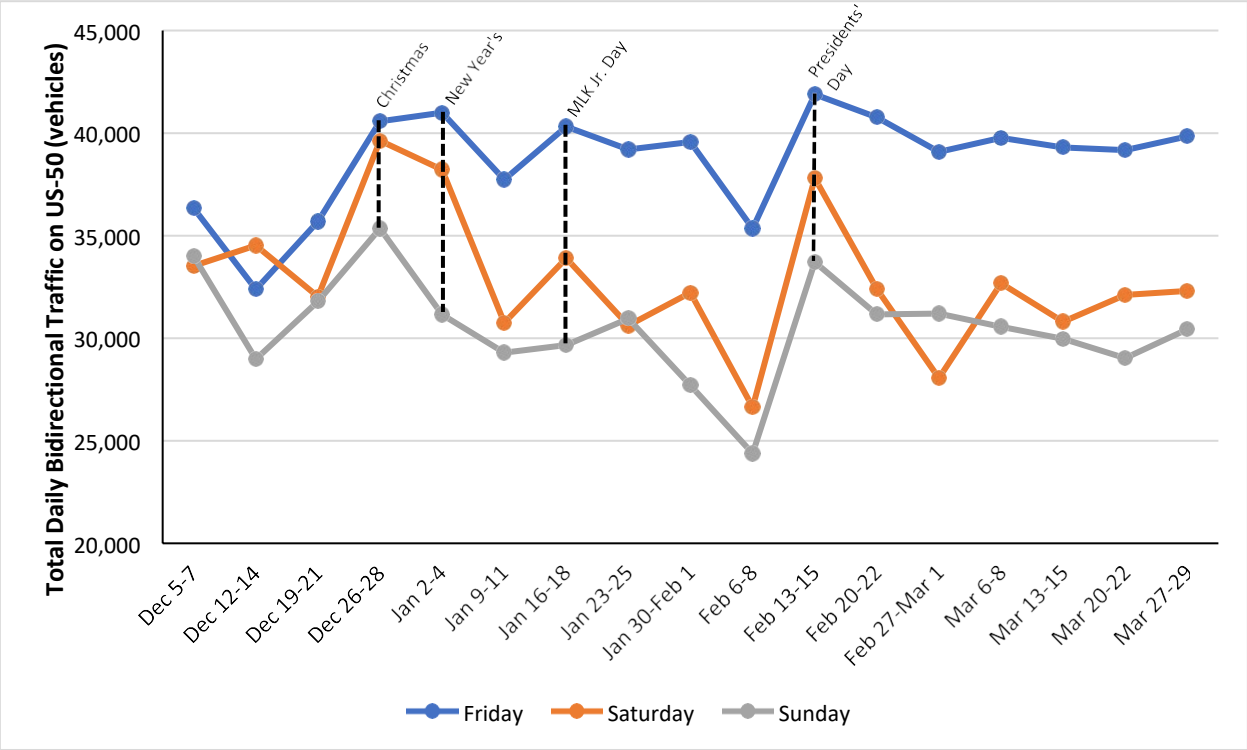


Figure 6 - Winter Weekends Bidirectional Daily Counts 2014-2015

Turning movement counts provide an understanding of travel patterns and behaviors. They can often be helpful in gathering information about specific intersections and the volumes that travel through an area. To better understand US-50 and its relationship to local roads, turning movement counts were collected

at the following locations on March 15-17th, 2019 during typical winter weather conditions (clear skies, snowy banks):

- US-50 Off-Ramp / Coloma Street / High Street / Conrad Street
- US-50 Westbound Ramp / Sly Park Road
- US-50 Eastbound Ramp / Sly Park Road
- US-50 Westbound Ramp / Ridgeway Drive
- US-50 / Kyburz Drive
- US-50 / Sierra at Tahoe Road
- US-50 / Upper Truckee Road
- US-50 / US-89 / Luther Pass Road
- US-50 / Sawmill Road
- US-50 / Lodi Avenue
- US-50 / Truckee Drive
- US-50 / Pioneer Trail
- US-50 / Tahoe Keys Boulevard
- US-50 / Stateline Avenue
- US-50 / Park Avenue
- US-50 / Ski Run Boulevard
- US-50 / Al Tahoe Boulevard
- US-50 / Lincoln Highway

For this project, US-50 is considered as the major street, whereas all cross streets are referred to as the minor street. Counts were collected on Friday and Sunday. Generally, counts on Friday show higher volumes than on Sunday. The following descriptions describe counts during the peak hour, which is listed next to the intersection.

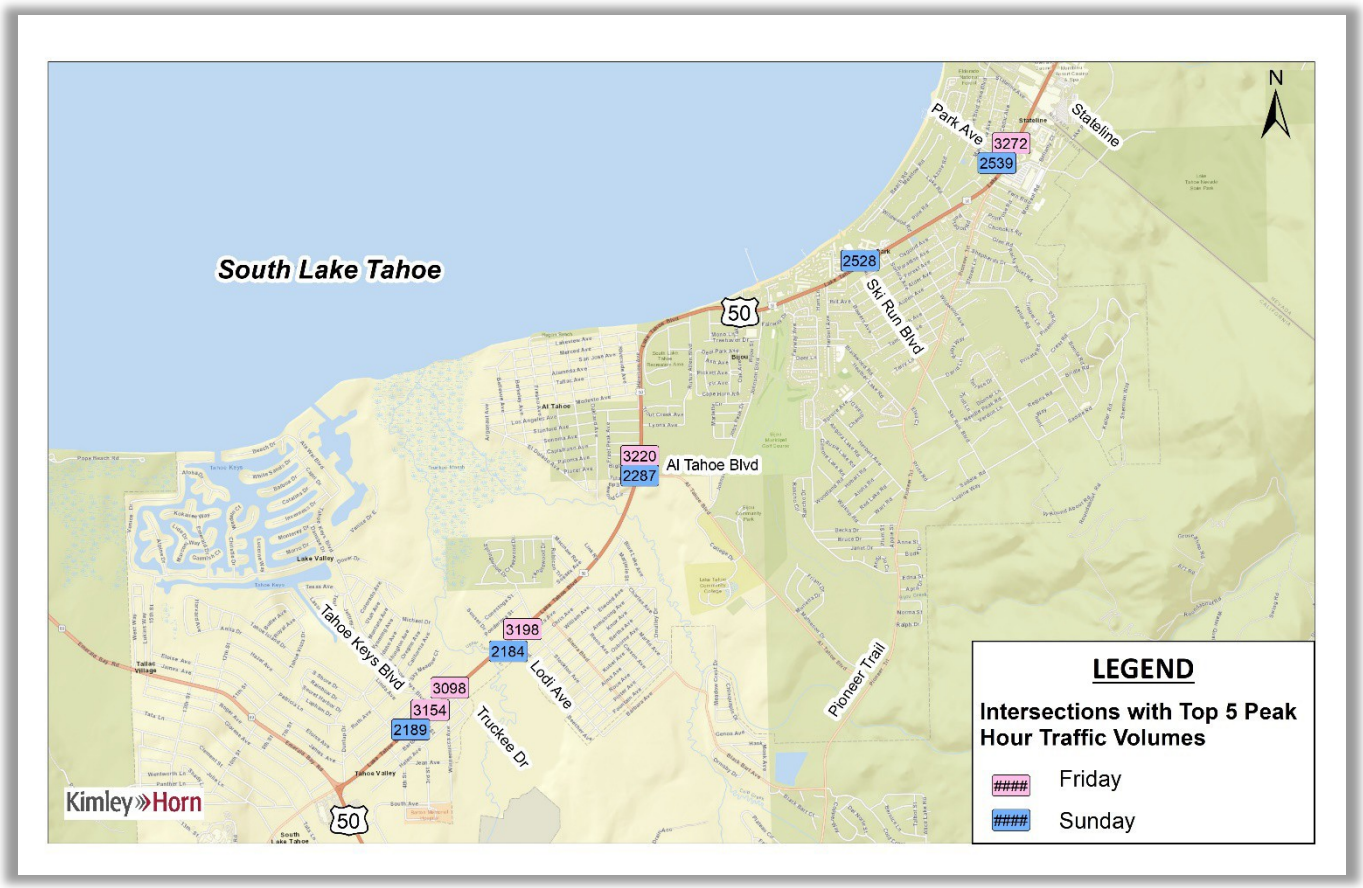


Figure 7 - Intersections with the Top 5 Traffic Volumes

The following intersections demonstrated the highest overall volumes on Friday:

1. US-50 / Park Avenue (Friday 4:15-5:15PM)
2. US-50 / Al Tahoe Boulevard (Friday 4:15-5:15PM)
3. US-50 / Lodi Avenue (Friday 4:15-5:15PM)
4. US-50 / Tahoe Keys Boulevard (Friday-5:15PM)
5. US-50 / Truckee Drive (Friday-4:15-5:15PM)

The following intersections demonstrated the highest overall volumes on Sunday:

1. US-50 / Park Avenue (Sunday 4:00PM-5:00PM)
2. US-50 / Ski Run Boulevard (Sunday 4:15-5:15PM)
3. US-50 / Al Tahoe Boulevard (Sunday 4:15-5:15PM)
4. US-50/ Tahoe Keys Boulevard (Sunday 2:30-3:30PM)
5. US-50 / Lodi Avenue (Sunday 4:15-5:15PM)

The following intersections showed the highest minor street volumes on Friday:

1. US-50 / Al Tahoe Boulevard (Friday 4:15-5:15PM)
2. US-50 / Ski Run Boulevard (Friday 4:15-5:15PM)
3. US-50 Westbound Ramp / Sly Park Road (Friday 4:15-5:15PM)
4. US-50 / Park Avenue (Friday 4:15-5:15PM)
5. US-50 / Sierra at Tahoe (Friday 3:45-4:45PM)
6. US-50 Eastbound Ramp / Sly Park (Friday 4:30-5:30PM)

The following intersections showed the highest minor street volumes on Sundays:

1. US-50 Westbound Ramp / Sly Park (Sunday 3:15-4:15PM)
2. US-50 / Sierra at Tahoe (Sunday 3:15-4:15PM)
3. Park Avenue (Sunday 4:00PM-5:00PM)
4. Ski Run Boulevard (Sunday 4:15-5:15PM)
5. Pioneer Trail (Sunday 3:30-4:30PM)

Many tourists head in the eastbound direction on Fridays and the westbound direction on Sundays. Some motorists will use side streets to get back to US-50 and sometimes bypass traffic through South Lake Tahoe. The following sections describe the turning movements for motorists who are heading in these typical recreational directions on Fridays and Sundays.

These intersections demonstrate the highest right-turn movements from northbound minor streets on Fridays:

1. US-50 / Sierra at Tahoe (Friday 3:45-4:45PM)
2. US-50 / US-89 (Friday 3:45-4:45PM)
3. US-50 / Al Tahoe Boulevard (Friday 4:15-5:15PM)

These intersections demonstrate the highest left-turn movements from southbound minor streets on Fridays:

1. US-50 / Tahoe Keys Boulevard (Friday 4:15-5:15PM)
2. US-50 / Ski Run Boulevard (Friday 4:15-5:15PM)
3. US-50 / Al Tahoe Boulevard (Friday 4:15-5:15PM)

These intersections demonstrate the highest left-turn movements from northbound minor streets on Sundays:

1. US-50 / Pioneer Trail (Sunday 3:30-4:30PM)
2. US-50 / Sierra at Tahoe (Sunday 3:15-4:15PM)

3. US-50 Ski Run Boulevard (Sunday 4:15PM-5:15PM)
4. US-50 / Park Avenue (Sunday 4:00-5:00PM)

These intersections demonstrate the highest right-turn movements from southbound minor streets on Sundays:

1. US-50 / Park Avenue (Sunday 4:00-5:00PM)
2. US-50 / Stateline Avenue (Sunday 2:45-3:45PM)
3. US-50 Westbound / Sly Park Road (Sunday 3:15-4:15PM)

c) Transit

Transit services along the project corridor are operated by Tahoe Transportation District, El Dorado Transit, and Amtrak. Together these agencies provide services that cover local and regional routes to connect travelers to various locals. Services are described by agency below:

1. Amtrak

Amtrak provides bus service along US-50 between Placerville to Stateline. There is one stop in Placerville just east of Downtown Placerville, one in South Lake Tahoe that stops at the Y where US-50 meets US-89, and one at Stateline. The bus services run seven days a week, once a day. On weekdays, the bus leaves Placerville at 11:00AM and gets to Stateline at about 12:35PM. On weekends, this bus leaves at 11:20AM and gets to Stateline at around 12:55PM. All trains department Stateline at 2:00PM, seven days a week.

2. El Dorado Transit

El Dorado Transit provides service in Placerville with Bus Route 20. This transit line provides service times from 6:30AM-7:30PM Monday through Friday. Bus service occurs each hour. The stops run from Canal St. at Moulton Drive to the west and Smith Flat Road at School Road to the east. The route connects with Routes 50 and 60 each hour at the Placerville Station Transfer Center.

Bus Route 60 provides service from the Placerville Station Transfer Center (to the west) to Safeway Plaza Pony Express Trail (to the east) from 7:00AM-7:00PM Monday through Friday. Bus service occurs each hour.

Bus Route 50 Express provides service from the Placerville Station Transfer Center (to the east) to the Iron Point Light Rail Station in Folsom (to the west) from 6:00AM-8:00PM Monday through Friday. Bus service occurs each hour.

Bus Route 35 provides service from the Missouri Flat Transfer Center (to the west) to Safeway Plaza Pony Express Trail (to the east) from 9:00AM-5:00PM Saturdays. Bus service occurs each hour.

The Sacramento Commuter is a commuter service that provides transportation between Placerville (to the east) and Sacramento near the State Capitol (to the west) with stops in El Dorado County, and in

Midtown and Downtown Sacramento. Service begins at 5:10AM at the Central Park and Ride on Commerce way (Monday-Friday) with the last morning bus leaving Placerville at 7:58 from the Ray Lawyer Drive Park and Ride. Afternoon service begins at 2:46PM at 5th Street/P Street in Sacramento. The final bus leaves the 5th Street/P Street stop at 6:00PM. The Sacramento Commuter also provides reverse commute services, connecting travelers from Sacramento to Placerville in the morning and the reverse in the afternoon.

3. Tahoe Transportation District

There are two routes that run through South Lake Tahoe. Route 55 travels from South Y Transit Center to the Stateline Transit Center along Pioneer Trail, and Route 50 runs along US-50 from South Y Transit Center to Stateline Transit Center.

Route 50 provides eastbound service everyday beginning at 6:30AM at South Y Transit Center. Service falls in one-hour, fifty-minute, forty-minute, and twenty-minute intervals. Twenty-minute intervals occur during more typical traveling times such as 9AM and 5PM. The last bus leaves South Y Transit Center at 7:40PM. The westbound direction also provides daily service that begins at Stateline Transit Center at 7:00AM. Time intervals for this service are one hour, fifty minutes, forty minutes, and twenty-minutes.

Route 55 provides service in the eastbound direction at South Y Transit Center beginning at 6:00AM with service every hour daily. The last bus leaves South Y Transit Center at 5PM. Westbound daily service begins at 7:00AM at Kingsbury Transit Center and occurs every hour from this stop until 6:00PM. The last bus leaves Stateline Transit Center at 8:10PM.

IV. Freight

Freight is permitted along US-50 to South Lake Tahoe. Trucks will frequently have to slow down in areas of steep inclines or declines. This is especially prevalent along the Echo Summit area, where there is no shoulder and the road is steep and curvy. Freight often faces challenges with uphill speed, as they often drive slowly and vehicles behind them become frustrated. Truck drivers will often pull over when given a chance, but these designated areas fall every 4 miles or so. This results in a long line of queuing cars and causes congestion. Once the commercial vehicle pulls over, cars will start to increase their speed and eventually traffic will return to more typical conditions.

Truck routes are defined into different categories that permit different types of commercial vehicles. While there are many for the purposes of the project area, there are three applicable categories. They are defined as:[16]

- National Network – National network of approved state highways and interstates by the Surface Transportation Assistance Act of 1982. The National Network uses high-volume roads that can be extensively used by commercial vehicles safely for goods movement.

[16] http://www.dot.ca.gov/trafficops/trucks/docs/truck-legend.pdf

- 65’ California Legal Route- Permits a California Legal Truck Tractor – Semitrailer with a maximum overall length of 65 feet
- Terminal Access- Interstate “STAA” trucks may travel to State Highways if signage explains terminal access

The project area is divided into three categories for trucks:

- From Placerville to Sly Park Road at Pollock Pines is defined as part of the National Network (STAA)
- From Pollock Pines to the “Y” where US-50 meets US-89 is a 65’ California Legal Route
- From the “Y” to Stateline the road is considered as a Terminal Access (STAA) road

V. Field Observations

General observations were made in the field driving along the corridor during the typical peak recreational times. The consensus was that during the winter season, snow conditions impact the number of visitors the area receives. As skiing and snowboarding are two of the biggest attractions for the South Lake Tahoe area in the winter, visitors will decide whether they visit depending on these conditions. When there is a low to moderate amount of visitors, roads are manageable and traffic delays are limited. On the other hand, when there is an influx of visitors, traffic queues will build, especially when caught at traffic signals in South Lake Tahoe and Downtown Placerville. Slow vehicles, trucks, and weather maintenance vehicles will also gather a line of vehicles behind them, which only seems to escalate when the roads are crowded.

Slowing occurs in the South Lake Tahoe area where tourists will decelerate to look at restaurants and shops. Drivers tend to do this also around Lake Tahoe recreational area, where there is limited parking, but many want to take photos of the scenic area.

Passing lanes also seem to be hazardous with aggressive drivers. There are two major challenges with the passing lane. For one, slow drivers will get over, but other faster drivers will start to speed up in the left-hand lane. The amount of drivers in the left-hand lane will start to accumulate only causing a line of cars that immediately have to slam on their brakes to merge back into the right-hand lane. This can be dangerous especially when some vehicles will try to bypass traffic at extreme speeds using the left-lanes and get over into the right-lane. The second challenge is that fast vehicles are sometimes forced to weave in and out of the two lanes as slower drivers do not move to the right.

Destinations determine what routes are used to travel from Point A to Point B. When drivers are stuck in traffic, they may resort to using an alternate route to bypass traffic on a main road. This happens in the urban area of South Lake Tahoe. The major alternate route is Pioneer Trail, which does not have many stop signs and can get vehicles around traffic on US-50.

Additionally, some routes during the winter time will seem like viable options, but will turn out to be narrow and icy. The snow is pushed to the side, which causes large mounds that can often make it

difficult to see around beds, or when trying to turn back on the US-50. Signage can also be covered during the winter months causing additional hazards as drivers may not be aware of a stop sign or other warning.

The following list is not a comprehensive list of destinations, but identifies destinations for motorists in this area:

- Downtown Placerville (Main Street)
- Gold Bug Park and Mine (Placerville using Bedford Avenue)
- Apple Hill
- Heavenly Ski Resort
- Lake Tahoe Hikes; some examples include:
  - South Lake Tahoe – El Dorado Recreational Area
  - Bridal Veil Falls
  - Echo Lakes Trail
  - Lake Valley State Recreation Area
  - High Meadow Trailhead
  - Twin Peaks

Cell phone reception seems to be a challenge in specific areas of the corridor. There are points where the reception quality decreases or is completely gone. In South Lake Tahoe, the reception can seem deceiving. An issue that may also be a result of peak demand for some carriers, is that cell phones will appear to have full bars, and individuals can send text messages, but cannot use data. Due to this challenge, the use of mobile apps for transit, parking, and traveler information is severely limited.

While reception varies between cell phone carriers, there are specific points, where it generally drops. These areas include:

- From Pollock Pines to Fresh Pond
- Echo Summit (full phone reception, but no data)
- Along US-50 in South Lake Tahoe (full phone reception, but no data)

VI. Alternate Routes

Three main alternate routes were noted during the field observations. In the east end of the project area, Pioneer Trail in South Lake Tahoe was recommended by navigation services to avoid congestion. The Pony Express Trail and Carson Road provided an alternate route in the West end of the project area from Pollock Pines to Placerville.

There were no observed alternate routes between the South Lake Tahoe and Pollock Pines. While there are possible alternate routes along the rest of the project area, their length and hard-to-drive road geometry make them less preferable alternates.

Table 9 summarizes the alternate routes noted during field observations.

Table 9 – Alternate Routes			
Route	Approximate Route Length (miles)	US-50 Intersection (Begin PM)	US-50 Intersection (End PM)
Pioneer Trail	8	Pioneer Trail, South Lake Tahoe, CA (ED R80.01)	Pioneer Trail, South Lake Tahoe, CA (ED R71.48)
Pony Express Trail	7	Frontier Road, Pollock Pines, CA (ED R32.30)	Carson Road, Camino, CA (ED R25.26)
Carson Road	7.5	Carson Road, Camino, CA (ED R25.26)	Carson Road, Placerville, CA (ED R18.76)

Pioneer Trail is a two-lane route cutting through primarily residential neighborhoods in South Lake Tahoe. The corridor has transit stops and bike routes. Pioneer Trail provides the following connections to US-50:

- Ski Run Boulevard, South Lake Tahoe
- Al Tahoe Boulevard, South Lake Tahoe
- Pioneer Trail, South Lake Tahoe (ends just south of Arapahoe St)

The Pony Express Trail is a two-lane route cutting through primarily residential neighborhoods from Pollock Pines to Camino. Pony Express Trail provides the following connections to US-50"

- Frontier (Eastbound / Westbound)
- Sunset Dr (Eastbound / Westbound)
- Sly Park Rd (Eastbound / Westbound)
- Ridgeway Dr (Eastbound / Westbound)
- Carson Road / 8 Mile Rd (Eastbound / Westbound)

Carson Road is a two-lane route cutting through primarily residential neighborhoods from Camino to Placerville. Carson Road provides the following access points to US-50:

- Carson Road / 8 Mile Rd (Eastbound / Westbound) – connects with Pony Express Trail

- Carson Road (Westbound)
- Sierra Blanca Road, Camino (Eastbound)
- Carson Road (Westbound)
- 5 Mile Road, Placerville (Westbound)
- Jacquier Road, Placerville (Eastbound / Westbound))
- Schnell School Road, Placerville (Eastbound / Westbound)

VII. Existing Conditions Summary

US-50 is characterized by "hot spots" locations of incidents, recreational travel-related congestion that is concentrated at either end of the corridor, and gaps in real-time information to truly understand the operations of the corridor. Both residents and recreational travelers express frustration at the lack of traveler information along the corridor and the incorrect information provided by private-sector traveler information websites. These conditions are exacerbated by the lack of alternate routes and intermittent network connectivity once recreational travelers make the choice to use US-50.

II. Adaptive Roadway Management Strategies

Adaptive roadway strategies make use of the existing roadway and use technology or operational improvements for corridor management to meet the needs of the corridor. Adaptive roadway strategies are not intended to add capacity to a facility, but instead to manage the demand on a facility with the existing roadway. These types of strategies integrate technology and infrastructure that adjusts with the changing needs of the roadway and related facilities. These practices can be especially helpful in recreational areas where demand can escalate during concentrated time periods not associated with typical work-based commute periods and where the geography presents restrictions for adding capacity. They are, in general, quicker and less expensive to implement when compared to roadway construction projects. They also complement larger roadway improvements.

The following section provides an overview of potential strategies and identifies some benefits and considerations as they relate to US-50 and the Tahoe Region. Table 5 provides a summary of the strategies described in this section. They have been divided into sub-categories such as Safety Strategies or Congestion Reduction Strategies.

Table 10 - Strategy Summary Table

Strategy	Sub-Category
Traveler Information	Data Collection / Dissemination
Data Collection	Data Collection / Dissemination
Smart Streetlights with WiFi	Data Collection / Dissemination

Strategy	Sub-Category
LED Striping	Safety
VSL	Safety
Truck Pull-Outs	Safety
Truck / Bus Climbing Lane	Safety
Designated Chain Control Area	Safety
Interregional Transit	Congestion Reduction
HOV Lanes	Managed Lanes
Bus Only Lanes	Managed Lanes
Pricing	Managed Lanes
Reversible Lanes	Managed Lanes
Managed Lane Study	Managed Lanes
Transit Signal Priority (TSP) / Queue Jump Lanes	Multimodal
Traffic and Feasibility Study for TSP, EVP, and Queue Jump Lanes	Multimodal
Micromobility	Multimodal
Multimodal Signal Coordination	Multimodal
Mobility Hubs	Multimodal
TSMO	TSMO
Traveler Information	Emergency Management
Pre-Season Meetings / After-Action Reviews	Emergency Management
Incident Management Training / Planning	Emergency Management
Emergency Rerouting	Emergency Management

A. Data Collection/Dissemination Strategies

Data collection and dissemination strategies focus on collecting, synthesizing, and releasing information to agencies and to the general public. The strategies discussed in the following section identify ways in which data can be captured, shared among agencies, and filtered for the public. Ultimately, the information collected and shared should promote safety and efficiency. Data collection and dissemination strategies may overlap with emergency management strategies, but the key difference is that these strategies focus on more day-to-day occurrences such as peak hour congestion, recurring recreational congestion, and collisions.

i. Traveler Information

Traveler information is an effective tool for agencies to release information to the general public. With advanced traveler information systems, information can be released in real-time. Traveler information can integrate various data streams from agencies into one platform that is easy for the public to understand. SacRegion 511 is managed by SACOG and provides many existing features such as trip planning for drivers, bikes, transit, and walking. Additionally, the platform presents layers that are specific to this region such as Apple Farms, Breweries, Christmas Tree Farms, Resorts and Spas, ZipCar, Jump Bikeshare, and Food / Drink Wholesale. The strategies mentioned in this section are to further enhance 511's capabilities for US-50.

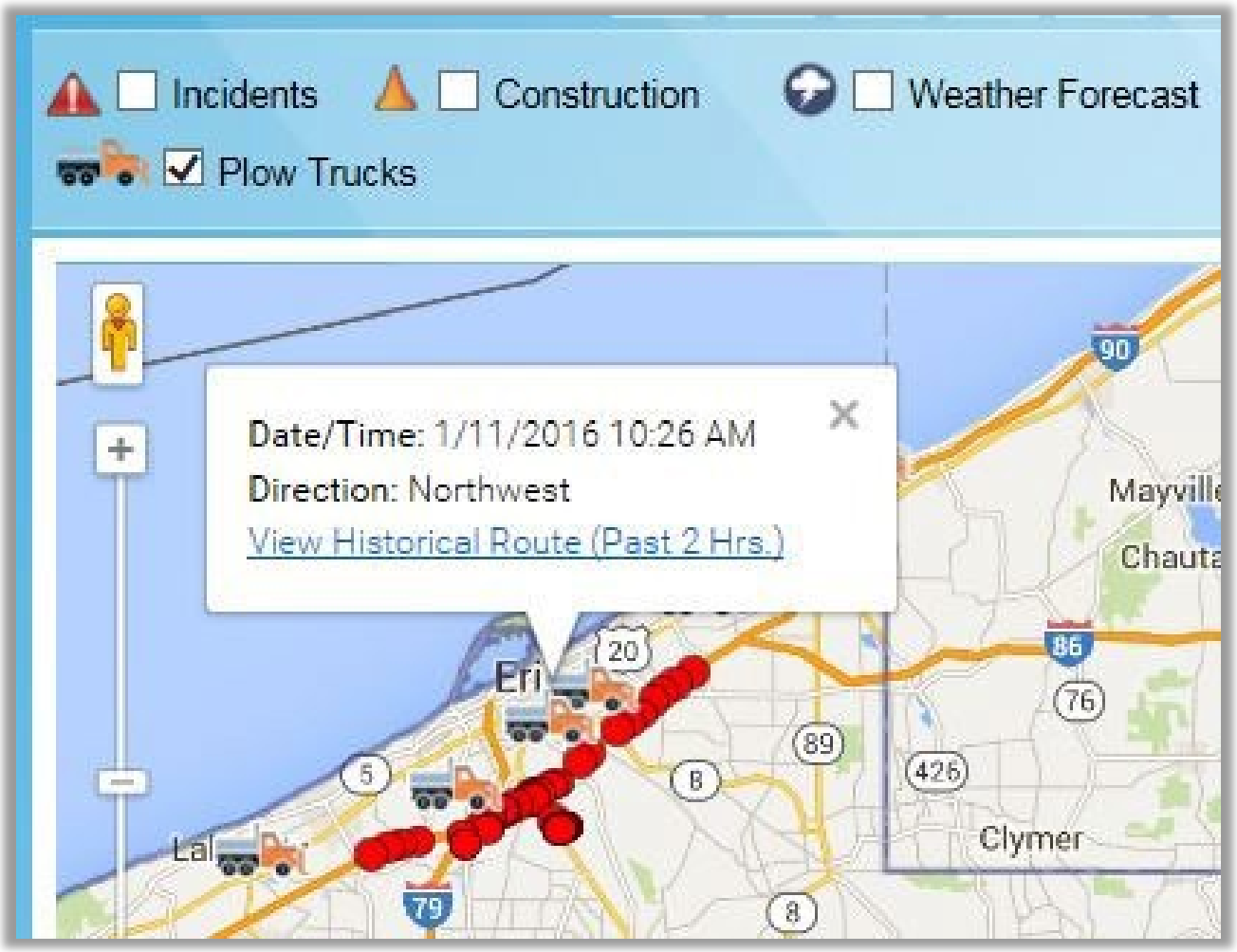
The traveler information strategy consists of two types of implementation. The first one includes the changeable message signs and communication infrastructure that provides information to travelers on the route. The second type of traveler information is additional integration of recreational traveler information into 511 in the Bay Area and the larger Sacramento region. Communication is vital to the success of acquiring quality data for traveler information and should be seen as step one in the implementation process for both CMS and 511 platforms.

Weather conditions are especially important in a region like Lake Tahoe, where storms are common causing unexpected road closures. Figure 8 shows an example of road conditions, which can often be extreme, so it important to have real-time information about snowplow locations and road closures.

Figure 8 - Existing Road Conditions on Parallel Road near US-50

Traveler information during emergencies should be a Corridor wide strategy; it may be useful expanding outside of the Corridor and gathering data from other parts of the region with a focus on road conditions, such as which roads are plowed, chain controlled, and the corresponding travel times. New transit service information may be added once it is implemented. Caltrans' QuickMap service covers the entire state of California and SacRegion511 covers the Sacramento Region, which ends at the edge of Placerville. Traffic information from neighboring cities may impact recreational traveler, especially for those coming from Sacramento or further away.

Figure 9- PennDOT 511PA Traffic Map



Stakeholders identified reliable traveler information as an important need for the Corridor. Traveler information should be able to inform travelers before they leave their destination and provide quality weather information. This can be achieved by using historical data to predict traffic patterns and using weather predictions and updates to inform travelers before they get to US-50 about viable routes to their destination.

Figure 10 - Example of Existing CMS on US-50

Benefits

Traveler Information brings valuable real-time information to a region. It provides a platform for agencies to disseminate information to the public efficiently and clearly. By focusing on road conditions, SacRegion 511 can provide valuable information that may not be provided or reliable on private third-party applications. Additionally, the road condition information will help travelers pre-plan their trips, while reducing delays and unsafe situations. When incidents occur 511 will be prepared to find viable alternative routes, especially during the winter season.

Considerations

The foundation of much of traveler information infrastructure comes from communication. Without it, it can be difficult to acquire accurate data in real-time. Communication is costly, typically requiring extensive design, utility coordination, and construction.

Investment in 511 systems can often require time, money, and maintenance. Over the years, third party applications have emerged as the most widely used platforms for traveler information. While apps like Google and Waze are user-friendly, they cover entire continents, making their focus on receiving high-

quality data limited. They rely on crowdsourced data which serves a purpose, but cannot predict road closures, snowplow locations, and unsafe road conditions. This data typically comes from an agency source. Additionally, these third-party applications often re-route onto residential streets, which are not designed to accommodate high volumes of cars and typically are not maintained during the winter at the same rate as major roads. Rerouting without accurate information can be especially risky during weather events or major incidents. A few steps that can help combat these challenges include:

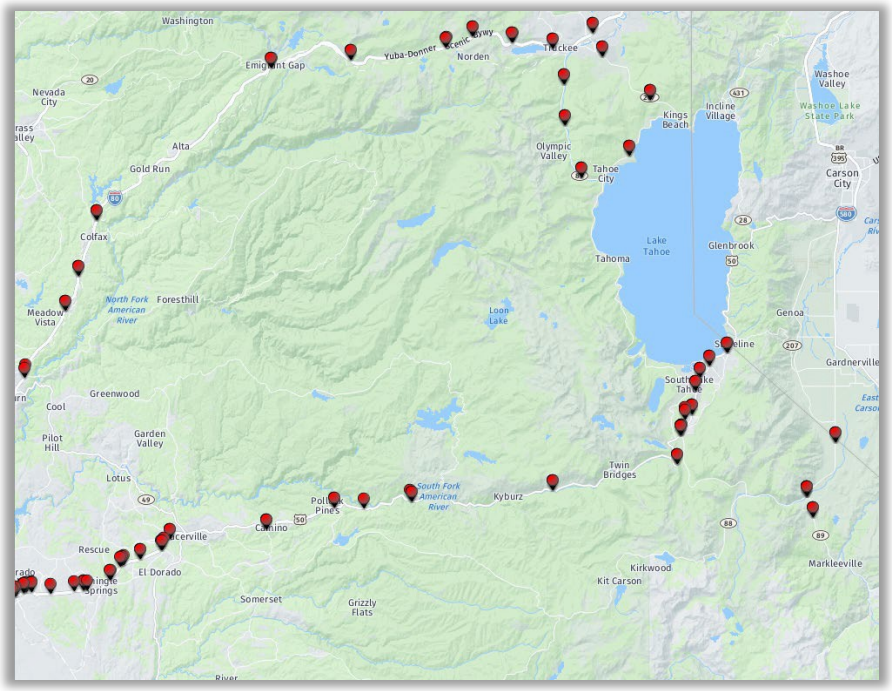
- Develop policy to regulate where vehicles can be redirected
- Establish relationships between agencies and these private sector technology companies
- Public outreach to help establish SacRegion 511 as the premiere traveler information platform

ii. Data Collection

The most important step in addressing congestion is understanding where and when it is recurring. The corridor currently lacks detection to determine the extent and location of congestion in real time. Because of the lack of communication infrastructure and cell phone coverage, there is no reliable source for real time data and also limited historic information for performance measurement analysis. The technology would depend on the reliability of communication, but there are a variety of wireless options that would improve data coverage in the area.

Figure 11 shows existing detection along the corridor; this information is taken from the Caltrans Freeway Performance Measurement System (PeMS). This strategy recommends the additional of detection throughout the corridor where existing coverage is missing.

Figure 11 - Caltrans PeMS Existing Vehicle Detection Stations (VDS)



Benefits

Detection would provide more definitive data on what exactly is happening in the corridor. It would also be a basis to measure the performance of other adaptive roadway strategies as well as capturing valuable performance data DVHD (Daily Vehicle Hour of Delay) necessary for the District Mobility Performance Report (MPR) and to better estimate the total district performance need for initiation/funding of operational improvement projects (310 Program). Currently this data is mainly captured only in the urban areas of District 3 as a large slice that would be the Tahoe Basin goes largely unnoticed. The detection can be used to trigger alerts that can be shared by Caltrans with local partners to prepare for congested conditions and with traveler information platforms to broadcast conditions to other Caltrans districts.

Considerations

The major consideration for detection is identifying a technology that will provide the coverage necessary without requiring major infrastructure improvements. There are several technologies that rely on battery-driven, WiFi-enabled detection. These technologies include wireless magnetometers and video solutions that are activated based on presence of congestion. These technologies have limitations during weather events. This strategy would be implemented by Caltrans District 3.

iii. Smart Street Lights with Wi-Fi

Smart Streetlights are typically energy efficient LED lighting that integrate with other technology solutions. Smart streetlights use machine learning to automate processes such as dynamically adjust

lighting and detect power outages. Additionally, streetlights can be used as WiFi hotspots to provide better connectivity along corridors with limited cell phone reception. Some new streetlight models have the ability to connect to small wireless devices, which can provide a public WiFi hotspot.

Stakeholders identified the need to provide reliable cell phone reception and enhanced communications infrastructure along the corridor. Smart streetlights with WiFi capabilities would benefit the entire Corridor with stronger cell phone reception, but it would be most feasible in Segments 1 and 4, where there is existing infrastructure. Ideally, there would be opportunities to implement Smart Streetlights along Segments 2 and 3 as these are some of the more rural areas along the Corridor, however, there is limited existing infrastructure (such as streetlights or power) to support this effort. Implementing WiFi connectivity is not out of the question for these areas but may require greater investment.

Figure 12 - Image from Landezine of Smart Street Light Deployment throughout Sydney, Australia

Benefits

The benefits of the connecting to streetlights for WiFi hotspots is that it uses existing infrastructure in a seamless way. It also provides more opportunities to provide connectivity than if it were to depend only traffic signal locations. Smart Streetlights also have the ability to provide additional safety features such as enhanced lighting.

Considerations

A major consideration for Smart Streetlights is existing infrastructure. WiFi Hotspots can be relatively inexpensive if the existing infrastructure is in place. On US-50 there are many areas where infrastructure and cell phone reception are lacking concurrently, making the investment to bring WiFi to these areas costly. This strategy may need to be implemented by local agencies partners because of the limitations of using state and federal DOT funding for non-transportation uses, although local agencies and other state DOTs have implemented them in other areas. While the immediate impact to streetlighting would not provide as much benefit to US-50, the need for connectivity across the region for traveler information and emergencies would provide benefits corridor-wide.

B. Safety Strategies

While safety is often discussed in transportation, many strategies are focused on the issue of congestion. While congestion is important to address, efficiency should not be prioritized over safety. On the other hand, congestion and safety are often connected. For example, if an incident were to occur, this could create long delays and impact other vehicles on the road. Safety strategies can often reduce unnecessary congestion. The following section identifies strategies that specifically focus on driver safety, such as enhancing visibility on the roads, reducing speeds along treacherous parts of the roadway, and providing designated areas for trucks to pull over safely.

i. LED Striping

Visibility can often be limited in rural areas, such as along US-50. In 2017, CDOT implemented in-pavement light-emitting diodes (LEDs) lights to improve visibility for drivers along a portion of CO-93 that eventually meets with CO-72. These corridors lead to Golden, CO, which is a city frequented by tourists for its entertainment venues and recreational facilities, such as Clear Creek. The LED lights were implemented in response to numerous collisions due to dark roadways and adverse weather conditions.17 The project uses plastic "puck" LEDs, which illuminate at dusk.

[17] https://www.codot.gov/news/2017-news/december/drivers-to-benefit-from-in-pavement-led-lights-on-co-93-from-64th-avenue-to-co-72-in-golden

Figure 13 - Image from CDOT of LED Striping Deployment

LED Striping could be beneficial along rural parts of the Corridor where visibility is low such as Segments 2 and 3. Areas with high collision rates should be examined for implementation. Providing safety improvements, such as lighting, could help address the need for safety improvements. An ITE Western District study has found that the maintenance of LED striping increases costs on the order of $1000 over three years.[18]

Benefits

The primary benefit to LED striping is the enhanced safety and visibility. It can prevent collisions and motorists from going off the road. It is also especially helpful in areas with extreme weather conditions and sharp turns, when it may be difficult to see. The solar powered LED pucks are also resilient which minimizes maintenance costs. They are protected by a steel ring, which makes them resilient to snowplows during the winter.[19] The case study estimated that from Hidden Valley to Beaver Brook LED pucks would reduce collisions by approximately 35 percent for property damage crashes and 50 percent for crashes with injuries.[20]

[18] https://www.westernite.org/annualmeetings/16_Albuquerque/Papers/5A_Hamood.pdf

[19] https://www.codot.gov/news/2017-news/december/drivers-to-benefit-from-in-pavement-led-lights-on-co-93-from-64th-avenue-to-co-72-in-golden

[20] https://www.codot.gov/news/2017-news/december/drivers-to-benefit-from-in-pavement-led-lights-on-co-93-from-64th-avenue-to-co-72-in-golden

Considerations

LED Striping in the right conditions can improve visibility and safety. It can help prevent incidents, which often lead to congestion and delays. On the other hand, LED striping is not an efficiency enhancement. It should be considered complimentary to more efficiency-based improvements. The cost for LED striping is about $15,000-$20,000 per linear mile, thus strategic implementation is a factor.[21] Along US-50 this would be based on areas with limited lighting and windy parts of the road.The summit next to Echo Summit would certainly be an important area to target between Strawberry to Meyers. Twin Bridges may also benefit from improved lighting as it is a rural part of the Corridor that is also curvy. LED striping is a rapidly improving area of technology. While traditionally maintenance has been a concern, newer technologies have decreased the active maintenance required.

ii. Variable Speed Limits (VSL)

Variable speed limits (VSL) have a variety of applications including speed harmonization as well as assisting drivers in poor visibility or low vehicle traction conditions. This strategy was implemented on I-80 in Wyoming, along Elk Mountain. It begins east of Rawlins and ends west of Laramie. Similar to Lake Tahoe, this area faces varying weather conditions, which often require drivers to travel below the posted speed limit. For this reason, the Wyoming Department of Transportation (WYDOT) decided to implement VSL that incorporate information from the road weather information system (RWIS). DMS provide weather and safety advisory information too.

[21] https://www.codot.gov/news/2017-news/december/drivers-to-benefit-from-in-pavement-led-lights-on-co-93-from-64th-avenue-to-co-72-in-golden

Figure 14 - FHWA Example of Variable Speed Limits

Following system implementation in 2009, researchers examined the system's effectiveness. The report studied compliance from cars, trucks, and both types of vehicles together. The general trend showed that people were most compliant with the posted speed limits during initial implementation. Trucks seemed generally more willing to comply than cars. The system determined that overall compliance was high, which could promote VSL implementation in other locations.

VSL are treated as discretionary over mandatory speed limits. Compared to other strategies, VSL may be helpful in areas of the corridor where drivers must come to an immediate stop due to congestion. This is typical around areas with limited visibility, such as turns in the road or where weather conditions are often extreme. VSL can serve as a cautionary sign for drivers to reduce their speeds to avoid rear-end collisions and ultimately improve safety. This would be especially helpful right before Downtown Placerville where collisions rates are high and N. Upper Truckee Road, in Segment 2, where the road starts to turn and head up to Echo Summit.

Benefits

VSL provide an additional warning to the public about weather conditions. Some drivers may not be able to see with the road conditions, in those circumstances, VSL coupled with warning messages on DMS can

prevent secondary collisions from occurring. VSL can provide speed harmonization, which minimizes the need to stop abruptly this can promote safety on the road and reduce emissions.

Considerations

As mentioned in the case study above, it is difficult to enforce variable speed limits as they are discretionary and not mandatory. Some critics say the technology is costly and can sometimes confuse motorists instead of informing them. Along with the Wyoming Case Study, a pilot program in Missouri did an after study of the implemented VSL and found that it was not effective. They could not justify expanding implementation and spending more money on the infrastructure.

iii. Truck Pull-Outs and Truck / Bus Climbing Lanes

While cars and trucks often share the same facility, they have different needs and travel behaviors. Trucks often travel at slower speeds than vehicles, which can pose challenges when the roadway is reduced to one lane in each direction like on US-50. For this reason, truck pull-out areas can be helpful in promoting better traffic flow. Additionally, truck pull-outs can provide a place for drivers to safely pull over when they experience breakdowns or are tired from a long day.

US-50 has portions of the roadway where there are only two lanes, making passing trucks not a viable option. While some may attempt it anyway, it is hazardous, especially as the road curves and faces both uphill and downhill slopes. As shown in Figure 15, it is not uncommon for cars to start to back up behind a truck as it navigates this curvy road. Truck pull-outs (Figure 16) can provide a solution to this problem by providing designated areas for trucks to safely pull over and let traffic pass.

Figure 15 - Example of Truck Congestion on US-50

Figure 16- Example from Freight Waves of Truck Pull-Outs in a Rural Setting

Stakeholders specifically identified truck rest areas as a priority for the corridor. Truck pull-outs should be prioritized especially on parts of the Corridor where the road narrows to one lane in each direction, seen in Segments 2 and 3. It is also an option to include some rest areas in Segments 1 and 4 to provide the option to pull over throughout the Corridor. Along Segment 2, a rest area should be recommended right before Echo Summit, before the road severely inclines and there is a retaining wall. A second rest stop should be recommended at the bottom of the summit, just before US-50 merges with US-89. Another rest area should be considered in Pollock Pines as the road is narrow in that area, but there are some points in the roadway with a sizeable shoulder.

Benefits for Truck Pull-Outs

Truck pull-outs provide safety and efficiency improvements for motorists and trucks on the road. They protect truck drivers and provide an opportunity to pull over either check on mechanical issues (if there are with the truck) and get some rest when drivers have been overworked. They also promote safety for drivers to prevent the overtaking or unsafe passing of trucks. This can pose safety risks for the car, truck, and vehicles in the opposite direction. Truck improvements can also open opportunities to qualify for different funding sources compared to traditional capital improvements projects.

Considerations for Truck Pull-Outs

Right-of-way will be the one of the biggest challenges in implementing truck pull-outs along US-50. It is very limited along most of the Corridor, especially in areas where there is only one lane in each direction.

Additionally, this type of improvement requires high construction costs compared to some of the other technology improvements.

It can be challenging to convince larger vehicles to pull over. Larger commercial and recreational vehicles sometimes do not want to pull over for fear of losing their momentum. This decision can cause severe slowdowns for the vehicles following. One of the ways to combat this issue is through regulatory signage and enforcement.

Climbing Lanes

Climbing Lanes, also sometimes referred to as crawler lanes, allow slower vehicles, such as trucks and buses, to ascend steep hills. With climbing lanes, trucks / buses can travel at their slower rate without impeding other vehicles on the road from moving efficiently. Climbing lanes are used primarily for steeper grade highways (around 5-6%) and should be marked with signage to advise against others (besides trucks / buses) using the lane.[22] [23]

Climbing lanes should be placed in the steepest areas along the Corridor. Echo Summit is the steepest part of the Corridor, but only has two lanes, with no reasonable area to widen the roadway. Other steeps areas include the communities of Twin Bridges and Phillips, which also have very limited right-of-way with mostly enough space for two travel lanes.

Benefits for Climbing Lanes

Climbing lanes can bring many benefits to a highway like US-50. For one they promote greater efficiency by dedicating a lane to slower large vehicles such as trucks and buses. They also promote safer driving practices, as adding a lane can sway drivers from trying to pass a slow vehicle. This can help reduce collisions on the road, and in turn reduce unnecessary delays. Caltrans D3 has recommended this strategy as an alternative to Bus Only Lane. This strategy accommodates the needs of both buses and trucks, whereas a Bus Only Lane can only accommodate buses. Trucks are important to address as they often cause congestion for the vehicles following behind them and they frequent this area.

Considerations for Climbing Lanes

Climbing lanes can often be costly and require right-of-way. While right-of-way acquisition may not be difficult to acquire some parts of the Corridor don't have right-of-way available such as around Echo Summit, which is one of the steepest areas of US-50. This segment (Segment 2) could benefit greatly from truck / bus climbing lanes paired with truck pull-outs.

iv. Chain Control

US-50 experiences harsh road conditions, especially during the winter season, often requiring drivers to put chains on their tires. This process can take time, especially for those who do not have a lot of

[22] https://dot.ca.gov/caltrans-near-me/district-3/d3-news/d3-news-release-19-280
[23] https://azdot.gov/node/8539

experience. Designated areas for chain control provide a safe place for drivers to pull over and put chains on their tires before getting back on the road.

Benefits

Designated areas for chain control are typically a lot safer than having people put chains on along a shoulder, where there is minimal space between through traffic and stopped vehicles. Additionally, providing a designated area can also reduce congestion impacts by providing a place to pull over. If vehicles are experiencing issues, the designated area can allow drivers inspect their vehicle before getting stuck on the road.

Considerations:

Designated chain control areas require real estate, which can be costly if the agency does not already have the right-of-way. Additionally, road conditions may not always align with the location of the designated area. In some cases, road conditions may require chains before drivers get to the designated area.

C. Congestion Reduction Strategies

Congestion reduction strategies aim to reduce congestion and delays. Congestion can occur in both predictable and unpredictable scenarios. A predictable congestion scenario for US-50 would be during type recreational times, such as the winter and summer seasons with increased visitation between Friday -Sunday. An unpredictable scenario may be a major incident such as a collision or during a wildfire. The following section identifies strategies that are focused on reducing congestion and enhancing efficiency along the Corridor.

i. Managed Lane Strategies

There are different types of managed lanes such as express lanes, toll roads, high-occupancy vehicle (HOV) lanes, and reversible lanes. The goal of these strategies is to better manage the roadway and its demand. The following section describes different types of managed lanes and their benefits and considerations.

Managed lanes can vary depending on how an agency wants to address operations. High Occupancy Vehicle (HOV) lanes, Express Lanes, Pricing, and Bus Only Lanes, are just some examples of the ways in which lanes can be managed. The managed lanes strategies that are applicable to US-50 are described in more detail below.

i. Managed Lanes Study

A Managed Lanes Study develops a preliminary assessment of managed lanes alternatives. The study assesses the alternatives based on criteria such as existing roadway, surrounding environment, travel behaviors, and community needs. The document determines the best solution before design begins and allows the design team to make high-level decisions before focusing on smaller details. For this region, a

managed lane study is important due to the complexity of the types of users and the number of possible managed lane scenarios. The Study would provide the stakeholder coordination required for managed lane implementation. It would identify agency roles and responsibilities and provide preliminary revenue assessments and traffic analysis. This strategy supports all of the Managed Lanes strategies described in this section.

Benefits

The benefits of a Managed Lanes Study are that the document determines the best design option before beginning complete PS&E. It can be an initial step through the environmental process and can help secure funding if there is no construction budget.

Considerations

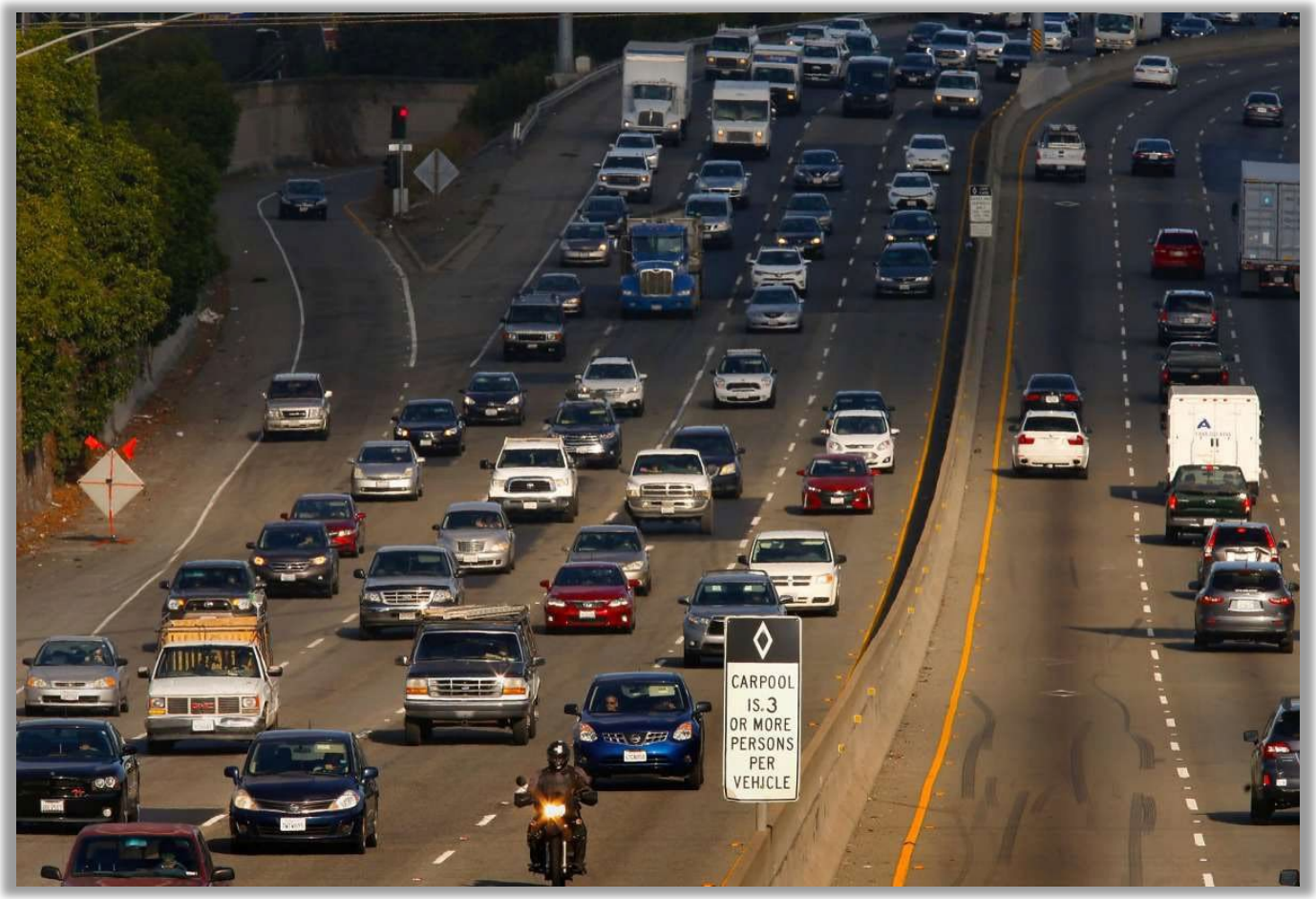
A Managed Lanes Study for this area is not consistent with the District's Managed Lanes Plan. They can be conducted in-house or through hiring outside consultants, but either way require staff resources. Initial studies only scratch the surface of design challenges and there are some cases where a Managed Lanes Study may point to one option but eventually the project changes to a different alternative in design. This can be for a variety of reasons such as changes in leadership, community needs, public policy, budget, and unpredictable field conflicts such as utilities.

ii. HOV Lanes

High-occupancy vehicle lanes are lanes dedicated to vehicles with a certain number of passengers. Typically, it is two or more, but in some cases the restrictions may require more passengers. HOV lanes may be reserved for personal automobiles, carpools, vanpools, and buses. Typically, HOV lanes hold restrictions during peak hours and then are open for use by all vehicles during non-peak hours. In the state of California, HOV lanes have posted signage to indicate the number of passengers required for lane use. Motorcycles are also allowed to use the HOV lane. Additionally, some electric and hybrid vehicles are given an HOV decal, while allows them to use the lane regardless of number of passengers. This is incentive for people to purchase or lease hybrid and electric vehicles.

HOV lanes should be placed in the areas that experience the most recurring congestion. The cities of Placerville and South Lake Tahoe experience both regular commuter peak hour congestion and recreational congestion. These two areas would be the best candidates for HOV lanes.

Figure 17 - Image from SF Gate of Carpool Lane in the Bay Area



Benefits

HOV Lanes promote carpool and electric / hybrid vehicles. They provide a different alternative to adding new lanes without any regulation and can better manage demand of existing lanes. Their purpose is to move more people, by prioritizing other modes besides the single occupancy vehicle. They promote sustainability through incentivizing hybrid / electric vehicles and by reducing vehicle idling during rush hour.

Considerations

HOV Lanes require right-of-way. If there are multiple lanes in each direction, one can be repurposed as an HOV lane, and not as expensive to implement. In most cases, lanes must be added to accommodate HOV, which is costly and may require right-of-way acquisition. Additionally, unlike other managed lanes, HOV lanes do not collect revenue. The only exception is through enforcement, wherein tickets are given to HOV violations. This is not as stable of a source of revenue as pricing and additionally requires staff resources that many agencies cannot accommodate.

ii. Bus Only Lanes

Over the years bus only lanes have been added to many roads to enhance service and provide the benefits that light rail has to offer using a lower cost option. Bus only lanes are dedicated lanes that are only used by buses and other authorized vehicles. Private vehicles are not allowed to use this lane, which reduces the impact that congestion often has on buses. This strategy can make taking transit seem more attractive to drivers.

Bus Only Lanes can become reversible lanes as well, which might be beneficial to US-50, where transit service is infrequent. There are many approaches to reversible lanes. In some cases, agencies may want to consistently initiate the reversible lane to accommodate peak hour congestion. For US-50 this could be heading eastbound on Friday and westbound on Sunday. In other cases, such as emergency evacuation, a reversible lane may be used infrequently and only to accommodate unplanned events.

Bus Only Lanes should be implemented in Placerville and from Echo Summit through South Lake Tahoe. Realistically, Bus Only Lanes cannot be implemented through Echo Summit due to the two constrained lanes. In South Lake Tahoe, Bus Only Lanes could be beneficial as it would promote more transit ridership and prompt visitors to leave their cars at their residence and use transit to make shorter trips.

Benefits

Bus only lanes can promote efficiency and safety on the road. Designating a lane specifically for buses, can remove potential conflicts between buses and cars. Bus only lanes promote efficiency, which can often be a challenge for buses as they make frequent stops and are subjected to recurring congestion. When given their own lane, buses can be more efficient than cars making them seem attractive to people who typically wouldn't use this service. This mode shift can promote getting people out of their cars and into alternative modes to reduce congestion and promote sustainability.

Considerations

One of the biggest considerations for buses is right-of-way. Along most corridors, but especially US-50, lanes are scarce, and there is little opportunity to expand the roadway. With anywhere from two to four lanes, US-50 is severely constrained by space, slope stability, and capacity. For this reason, it might be difficult to justify taking away a lane to accommodate transit. Additionally, while transit exists, it is not abundant along this Corridor, making it difficult to justify repurposing a lane solely for bus use.

iii. Pricing

Pricing is a subset of the managed lane strategies that would require specific users of the corridor to pay a fee to use parts of US-50. There are multiple ways to approach collecting this fee. Traditionally tolling typically applies a flat fee toll to users. The toll may only apply to specific points in the day but historically tolls are based on flat rates. Congestion pricing is a more dynamic approach, wherein the fee matches the demand. When congestion increases, so does the price to use the roadway. This is seen as a more proactive way of managing demand. Pricing can also be based on distance or destination. Destination

based tolls can be helpful in recreational areas, where people are drawn in masses to one specific landmark.

Due to the constraints of the right of way and the congestion due to recreational travel, this strategy would require a user fee to help reduce congestion and to fund additional construction improvements for the corridor. An option is to have fees apply only to recreational users, whereas for residents and local trips, no fee would be required. This strategy will manage congestion by using FasTrak registration addresses to charge a toll for all users that are not registered within the zip codes of the study area. It may also encourage transit use if buses and shuttles are excluded from the toll. Gantries may be required to mount the toll readers periodically throughout the corridor, which would require reliable power and communication. The recommendation for this implementation is to only charge users who have registered FasTrak devices to zip codes outside of the study area. This would target recreational users specifically and would not adversely impact users who live and work in the area. The toll amount could be adjusted dynamically based on congestion and could be limited only to specific days of the week or weeks of the year. The fee would pertain to select users of the roadway and may be a distance based-toll or a travel time-based toll. Transit and shuttles would not be charged or would receive a significant discount to encourage mode shift. The revenue generated from the pricing would fund other improvements that would increase person throughput and fund construction for other alternatives to improve the corridor.

Pricing could be implemented along the entire Corridor. To be more cost effective, the most frequented areas along the Corridor may be prioritized for managed lane implementation: South Lake Tahoe and Placerville (Segments 1 and 4).

Benefits

Pricing provides many benefits to agencies. Motorists who value efficiency are more willing to pay, which manages the demand of the toll lane. Therefore, if the demand is too high, the price will increase and in turn lower the demand. This allows the lane to actively manage itself. Additionally, the dollars collected for the toll goes back to the agency to invest in other capital improvements projects. Managed lanes are more cost effective compared to adding lanes to a roadway.

Pricing can provide many benefits to a recreational area. It can help prioritize local needs, while still serving the recreational travelers. Revenues collected from pricing can lead to improvements that benefit both residents and recreational users, and assures that everyone pays their fair share. Examples may include designating collected tolls towards road maintenance, technology enhancements, or even sustainability strategies such as investing in alternate modes for the Corridor. If recreational travelers do not wish to a pay toll, they may not use the Corridor which can actively manage the demand of the roadway and reduce delays. Toll lanes are more cost effective compared to adding lanes to a roadway.

Considerations

There are sometimes hesitations towards toll lanes. Some motorists have privacy concerns with automated pricing practices as they fear it can be a way to track vehicles. For others, the concerns are centered around equity or the perception that people already pay a gas tax to use the transportation network. The operational scenario of only charging people outside the study would require the use of FasTrak for pricing. This strategy would be used corridor-wide to capture the full benefits. This strategy

would be implemented by Caltrans District 3 with coordination from regional agency partners. There are larger policy implications and this strategy is not consistency with the District's Managed Lanes Plan.

iv. Reversible Lanes

Reversible lanes have been implemented throughout the country for a variety of reasons, typically surrounding events of all kinds. Reversible lanes may be used for planned events around stadiums, weather events in suspectable areas, and other areas where it is necessary to move many people into or out of a particular area. Many bridges have reversible lane capabilities such as the Queensboro Bridge in New York City, where the upper level converts all four lanes to move commuters during the PM Peak outbound. It can also use a normal configuration where two lanes travel in each direction.

Figure 18 - Photo Example from Flickr of Reversible Lane in Rural Setting

Reversible lanes would be most feasible in Segments 1 and 4, where the surrounding context is urban, and there is enough space to install the infrastructure to support a reversible lane. Due to the high speeds, a movable barrier may be considered to enforce safe driving practices. While it would be ideal to have a reversible lane along Segment 2 of the Corridor, it would be unlikely feasible, as there is only one lane in each direction and no way to let first responders through to oppose evacuating traffic. Additionally, there is very little right-of-way to install an overhead structure to support the signage to

initiate the reversible lane. In-pavement solutions may be considered, but the challenge with only having a total of two lanes will remain a barrier to implementing reversible lanes in this segment of the Corridor. Segment 3 is also quite limited and would be unfeasible for most of this segment except for a few areas with a sizable shoulder that might be able to support an overhead structure with dynamic signage.

Figure 19 - Image of a Movable Barrier / Zipper Median from Metropolitan Transportation Commission

Benefits

Reversible lanes are fully adaptable and can dramatically increase capacity to meet the needs of traffic conditions. Reversible lanes can be used in emergencies, during planned events, or during recurring congestion. They also provide the ability to restrict lanes for first responders specifically, if they need to travel into an evacuation zone.

Considerations

Reversible lanes require large infrastructure, in many cases a cantilever or overhead bridge structure will span across all lanes with CMS overhead indicating whether the lane is open or closed to that direction of traffic. There are more informal ways to direct traffic such as with cones or with zipper medians that can act as a movable barrier. Most of these methods are expensive and require either advanced technology or extensive staff resources. For US-50, a reversible lane will be most challenging in areas with only two lanes, as it is important to keep a lane open for first responders to travel into the evacuation zone.

D. Multi-modal Strategies

The following section focuses on providing mode options to travelers along the Corridor. These strategies target recreational, commuter, and local trips. Mode choices can span from e-scooters, e-bikes to

shuttles and public transit services. The goal of these strategies is to get travelers out of their cars and into more sustainable and shared modes of transportation.

i. Transit Signal Priority (TSP), Emergency Vehicle Preemption (EVP)and Queue Jump Lanes

Transit Signal Priority (TSP) prompts a signal to turn green when a transit vehicle approaches the intersection. The goal of TSP is to prioritize transit at the intersection to provide reliable and efficient service. The average bus can hold anywhere from 40-60, whereas the average automobile can hold anywhere from 4-6 people. For this reason, TSP can help move more people through an intersection. TSP is often coupled with Queue Jump Lanes, which is roadway geometry improvement that can serve transit vehicles. These pull-out areas for transit vehicle are placed right at the intersection. This allows the transit vehicle to get a head-start over the rest of traffic. Queue jump lanes can also promote efficiency for the same reasons as TSP.

TSP and Queue Jump Lanes should be implemented in areas where there are transit routes and traffic signals. Currently, signals are located in Placerville and South Lake Tahoe. Placer County has already planned TSP for the Tahoe Basin. The portion that passes through Placerville should also be considered for TSP implementation. Queue Jump Lanes should also be considered for these two segments of the Corridor (through Placerville and South Lake Tahoe) but will have to be selected on a case-by-case basis. Some of the considerations for queue jump lane placement, such as right-of-way, are discussed in the following sections.

Benefits

TSP can provide more efficient and reliable travel times by developing a system where the light turns green when the transit vehicle approaches the intersection. In some cases, this reliability can help create mode shift for users that were previously skeptical about travel times. Queue jump lanes can help with the effectiveness of TSP. If long queue lengths exist at the signal, it can be challenging for TSP to be successful. Queue jump lanes help fill this gap, by providing a designated area for transit vehicles to pass the vehicle queues.

Considerations

TSP can only be deployed at signalized intersections. There are many factors that play into the effectiveness of TSP, including road geometry, signal spacing, and traffic volumes. Additionally, TSP requires a high-level of coordination between agencies to be successful. Fleet vehicles must have an on-board device and each signal must be equipped with the hardware and software to communicate with the on-board device.

Queue jump lanes are only effective in areas where there is an existing source of delay. If there is not a significant queue at the signal, then there is no reason behind the improvement. Additionally, queue jump lanes require right-of-way as they are essentially widening the road at the intersection. This may be challenging at certain intersections, where right-of-way is limited.

Emergency Vehicle Preemption (EVP)

EVP technology allows first responder fleet vehicles to cross the intersections without just relying on their sirens. The technology triggers the traffic signal to disrupt the typical signal cycle and either extend the green time or change the phasing all together to accommodate the vehicle. This is achieved through an on-board device that communicates with another device typically mounted on the traffic signal mast arm.

Benefits

EVP allows first responders to cross the intersection without having to simply rely on their sirens. EVP can prevent collisions and also improve response times for first responders as they can navigate intersections more swiftly.

Considerations

While EVP can be effective, it can have impacts on the signal timing and traffic flow. It is important to consider how EVP behaves with signal timing and traffic patterns before implementing the technology.

ii. Traffic and Feasibility Study for Transit Signal Priority (TSP), Emergency Vehicle Preemption (EVP), and Queue Jump Lanes

A traffic and feasibility study for TSP, EVP, and queue jump lanes can help determine if the benefits outweigh the consequences of project implementation.

Benefits

The major benefit of conducting a traffic and feasibility study beforehand is to understand the impacts of the project before investing money and creating permanent changes to the road network. The study can provide both quantitative and qualitative data for agencies to make an educated decision before moving forward with the project. While the study requires some investment, it is a fraction of the cost of designing and constructing the project. Additionally, if the project creates negative impacts such as congestion or safety concerns, the study can prevent implementation.

Considerations

Conducting a traffic and feasibility study can take time just like construction. It often requires extensive research, modeling, and stakeholder feedback. Sometimes planning projects take just as long as construction due to internal and external obstacles. Internal obstacles may be getting the necessary comments and approvals in a timely manner. External obstacles may be community resistance despite the project showing potential benefits.

i. Micromobility

Micromobility services can provide additional mode choice options to recreational users. Micromobility can mean a variety of services such as e-bikes, e-scooters, bikes, and even e-shuttles. The focus of micromobility services is to provide first-mile / last-mile solutions. Many of the modes are electric, leading

to a limited range in how far the mode can travel. E-shuttles can travel a bit further than scooters or bikes but are still used in more condense downtown areas and destinations such as theme parks. Some of these shuttles are autonomous which makes it easier to navigate smaller areas. In places like theme parks this may be even easier where there is limited access or no access for cars.

Micromobility would most likely be a candidate for the urban areas of the Corridor such as South Lake Tahoe near the major attractions like Heavenly Resort and downtown shops and restaurants, along with the City of Placerville. E-scooters and e-bikes may serve these areas too but would be difficult to use during the winter.

Benefits

Micromobility can provide access to places that may be otherwise difficult to access such as busy downtown main streets. Many of these services are “net zero” as they strictly run on electricity. This aligns with the Region’s desire to keep the area clean and protected from pollutants. Stakeholders also established the need to enhance multimodal options for recreational and local travel.

Considerations

Micromobility services cannot serve regional areas like other multimodal services such as transit or shuttles. The primary purpose of micromobility is to complete shorter trips. While there is opportunity for this along the Corridor in the more urban areas, there is still a great need to connect recreational travelers from their origin far west of the project all the way to their destination, which is typically around the Tahoe Basin. Micromobility services also come with regulation challenges. Policymakers have historically struggled in managing designated areas for e-scooters and e-bikes. Consequently, e-scooters and e-bikes can often block the public right-of-way and sometimes even the road.

Figure 20 - Stock Photo of Coach Bus

i. Interregional Transit

Interregional Transit can serve the recreational population that travels from near Sacramento / the Bay Area into the Tahoe Basin. These services would likely start outside of the project area and make stops along US-50 and offer different amenities than your typical shuttle such as comfortable seating accommodations, on-board WiFi, and requested and / or infrequent stops. These transit or shuttle services often referred to as concierge services are highly desirable in the Bay Area for longer commutes.

Benefits

Interregional Transit can be provided for regional trips and can hold many passengers, making them both efficient and sustainable modes of travel. Typically, these concierge transit services are provided by private entities, which opens opportunity for public-private partnership. Additionally, these specialized services can cater directly to their customer. In this case, it would be the recreational traveler. These travelers are typically heading to the Lake Tahoe Basin for recreational travel from Sacramento or Bay Area. This concentration of people in the origin and destination points, makes it easier to provide the service and provide convenient pick-up and drop-off locations.

Considerations

One of the greatest challenges with any shared mobility services right now is the COVID-19 pandemic. General transit services have seen a decrease in ridership. On the other hand, COVID-19 has caused recreational travel to increase. With limited access, or desire, for international / airplane travel, many people have decided road trips are more suitable for this time. Most of these trips are made in private automobiles to recreational areas. During the current pandemic, transit would likely have to limit capacity which can be less efficient and cost effective. Additionally, transit requires pre-trip planning, which can be challenging for many. Some may see it as an inconvenience that shuttles require that they get to a specific place at a certain time and opt for their vehicle out of convenience, and to carry recreation equipment. This strategy would be implemented by other public or private sector operators.

i. Multimodal Signal Coordination

Multimodal signal control is a holistic approach to signal timing that encompasses advanced traffic signal system software and multimodal detection to create a fully coordinated intersection. The advanced traffic signal system is responsive to the real time needs for the specific users of the intersection through the use of transit signal priority, emergency vehicle preemption, and passive and active detection for active modes. For multimodal coordination, this means that the signal is able to adjust to meet the demands of the modes at the intersection. This may include extending green time to accommodate pedestrians and cyclists.

Multimodal signal coordination can be applied to signalized locations along the US-50. As of now, the only Corridor locations with signalized intersections are in the City of Placerville (with 3 signals) and in the City of South Lake Tahoe (with 19 signals). Figure 21 shows an example of how there can often be queues waiting for the signal to change.

Figure 21 - Example of Vehicle Queuing at a Traffic Signal in South Lake Tahoe

Benefits

Multimodal signal coordination can be especially helpful during unpredictable times such as weather events, emergency evacuation scenarios, special events, or unexpected bouts of congestion. It also allows agencies to make more proactive decisions to prioritize other modes like transit or active transportation. Along a corridor like US-50 this can be helpful during peak seasons. During storms or unexpected disasters like wildfires, advanced signal control can help flush out cars from an evacuated area. The multimodal part of signal coordination can provide better transit services, which can lead to mode shift. Other benefits of this signal coordination include improved efficiency, reduction in emissions, improved safety, and mode shift.

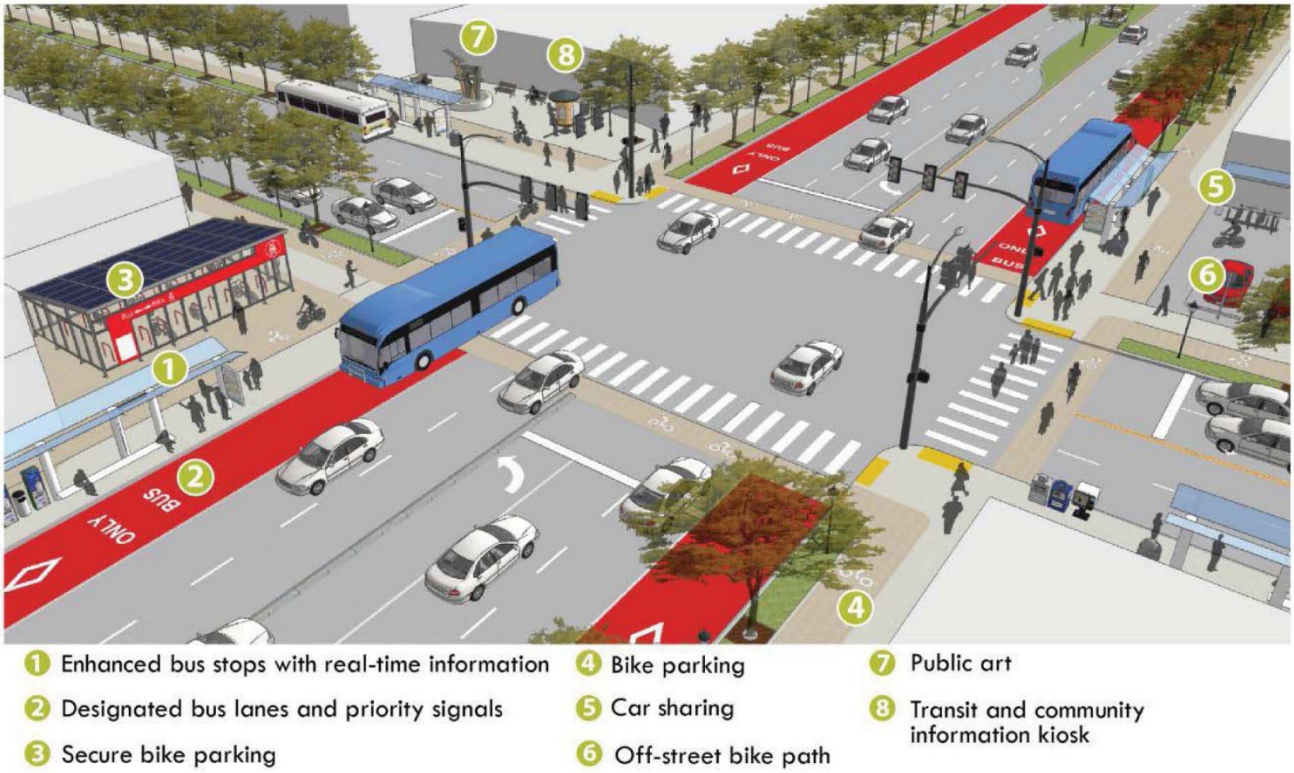
Considerations

Signal coordination and advanced signal systems cannot solve all problems. It is important to note that signal coordination cannot create more time or capacity. The goal of adaptive signal systems and signal coordination is to allocate the green time as efficiently as possible. Multimodal signal coordination requires communication, detection, software investments, and controller upgrades. This can be costly, resulting in investments in the number of tens of thousands per intersection. While signal coordination is an automated process, it also requires staff training.

ii. Mobility Hubs

Mobility Hubs serve as points of connectivity, while bringing different modes of transportation together and presenting opportunities for placemaking. They often integrate both large scale transportation such as light-rail and buses with smaller forms of transportation such as e-scooters and rideshare services. Mobility hubs could serve US-50 by bringing mode options to the Corridor and providing a stopping point along the Corridor. Electric vehicle (EV) charging can provide greater incentive for travelers to use electric vehicles to get to their destination. Additionally, providing a stopping point for buses along the Corridor could provide a short break to travelers, and provide a maintenance area in the middle of the Corridor. For the location in Placerville, the current downtown area gets congested and it is often difficult to park on their Main Street. Integrating a mobility hub could help alleviate some of the travel to Downtown Placerville in single occupancy vehicles. Additionally, mobility hubs open the opportunity to integrate land use with transportation such as opening restaurants and retail space.

Figure 22 - Mobility Hub Concept from City of Boulder, CO



Benefits

Mobility Hubs could present new mode choice options to prompt mode choice along the Corridor. This falls in lines with both the goals of this project and also the goals of other initiatives in the area that promote sustainability. Mode choice can also promote a shift away from the single occupancy vehicle, which could help alleviate congestion on the Corridor.

Considerations

Some considerations for mobility hubs include cost and community character. It is important to decide whether the cost of a mobility hub is warranted and which modes it serves. If a mobility hub is serving a mode that cannot be used in the area, then it cannot benefit its visitors in the ways that it should. A way to consider this is in the placement of the mobility hub. As mentioned earlier, it might be beneficial to put a more regional-oriented mobility hub in the center of the Corridor. This may address modes for longer trips such as commuter bus, shuttle services, and electric vehicles. Whereas in Placerville, the mobility hub may also accommodate more regional trips, while also providing some micromobility options such as e-scooters / e-bikes for first mile / last mile solutions to the Downtown Placerville area.

In terms of community corridor, the location and design of the structure can determine whether a mobility hub feels like in falls in, or out of line, with a community's corridor. Right-of-way impacts will also have to be considered as it is limited along this route.

E. TSMO Strategies

Transportation Systems Management and Operations (TSMO) Strategies are a comprehensive set of strategies that focus on operations and agency coordination. There are many strategies throughout this document that can be considered "TSMO." Generally, they are cost efficient, are less focused on capital improvements, and are more centered around coordinated operations, improved communication among agencies, and integrated data to improve system performance. The following section discusses implementing TSMO in general, but it is important to remember that many strategies can fall under the umbrella of TSMO.

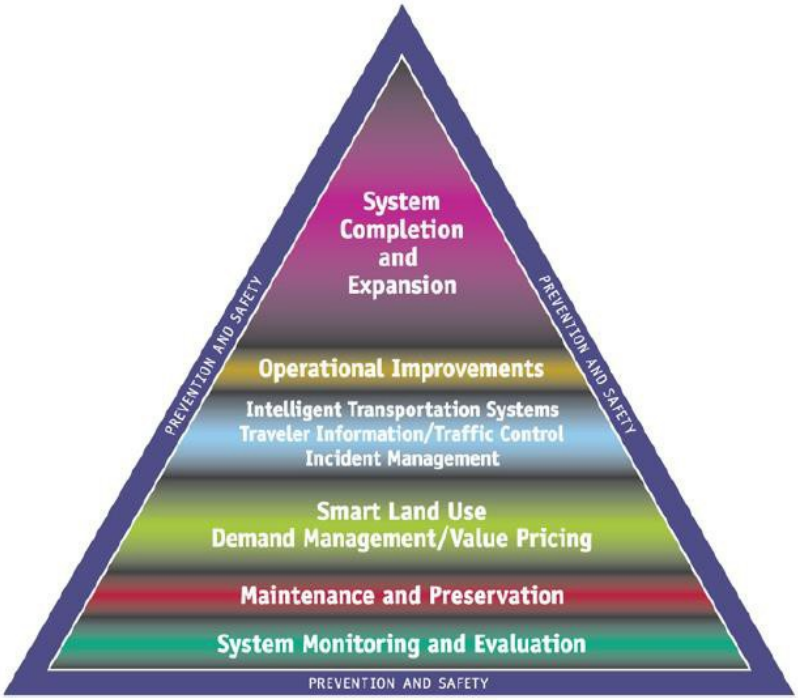
i. Transportation Systems Management and Operations – Coordinated Operations

Transportation Systems Management and Operations (TSMO) is a coordinated approach to operations that considers the end to end user experience regardless of jurisdiction or mode. Some examples of TSMO projects may include a data sharing and signal coordination between multiple municipalities or the formation of a TSMO working group. Another example would be developing and analyzing performance metrics for the corridor to measure performance and mode choice. TSMO essentially focuses on data and people, and in some cases may be supported by the infrastructure improvements suggested in other strategies. Most importantly, operations and collaboration will be the biggest focus for TSMO projects.

The corridor is regionally significant because of the recreational travel. For most circumstances, local operations coordinated with Caltrans remains suitable. For extreme congestion events, additional coordination across a wider area is necessary. That may include providing detailed traveler information to travelers in the Bay Area or Central Valley about freeway closures on I-80. It may also include more coordination when I-80 is closed with Nevada Department of Transportation (NDOT) and Federal government for additional routes to be plowed for emergency rerouting. In addition, a key component of TSMO is consistent measurement of performance. Currently, there is very little corridor-wide data collected or used. Stakeholders remember occurrences of severe congestion but are not aware of the

extent or frequency of those events. TSMO and coordinated operations would require the stakeholders to agree upon and track specific performance measurers from travel time to incident clearance times.

Figure 23 - Caltrans' TSMO Pyramid



Benefits

TSMO provides tangible benefits for little to no cost and with little to no lead times for completion. It is supported by Caltrans management through Draft Director's Policy DP-08-R1 and the Statewide Strategic Management Plan. As part of the Strategic Management Plan, the System Management Pyramid was developed that supports TSMO at the foundation with system monitoring and evaluation, and throughout the pyramid with an emphasis of maintenance and preservation, intelligent transportation system, and operational improvements.

Considerations

Changing "business as usual" communications is often easier than it sounds. It has to be supported at all levels from management to staff. It may require a project charter for all parties to be explicit about the goals and the roles and responsibilities of staff, which may include regular meetings, formal standard operations procedures, or performance targets. This strategy provides maximum benefits when implemented in coordination with Caltrans District 3, Caltrans Headquarters, EDCTC, TRPA, TTD, NDOT, and local agencies to coordinate operations and information sharing.

F. Emergency Management Strategies

The strategies identified previously focus on adaptive roadway management strategies that address recreational congestion. While the area consistently faces recreational congestion, forest fires are also a

challenge along the West Coast that only seem to escalate in size and severity with each year. Fire season typically starts in September and finishes in early November.

Forest fires require fast reaction times and immediate evacuation. Along a corridor like US-50 this is especially important where there are limited alternate routes. The following section identifies strategies that allow for the dissemination of fast and reliable traveler information, coordinated operations between stakeholders, and infrastructure that can flush motorists out of the area. These strategies are implemented by multiple agencies including emergency services, EDCTC, TRPA, Caltrans, NDOT, TTD, and local agencies.

i. Emergency Management Traveler Information

Traveler information is discussed in the previous section but relates more towards recreational travel applications and recurring congestion and incident scenarios. For natural disasters or emergencies, traveler information also plays a key role in sending updates to the public. Traveler information for natural disasters should also integrate ITS field devices such as CMS and CCTV cameras. Conversely, emergencies may include more first responder agencies than a typical incident. When an emergency occurs, such as a wildfire, traveler information may rely on new data streams such as from CalFire and local fire departments to provide accurate, real-time information.

It is imperative that real-time data is provided to Google Maps and Waze to keep app users informed during evacuation and emergency scenarios. This information should alert users of road closures, alternate routes, road hazards, evacuation areas, and resources such as shelters.

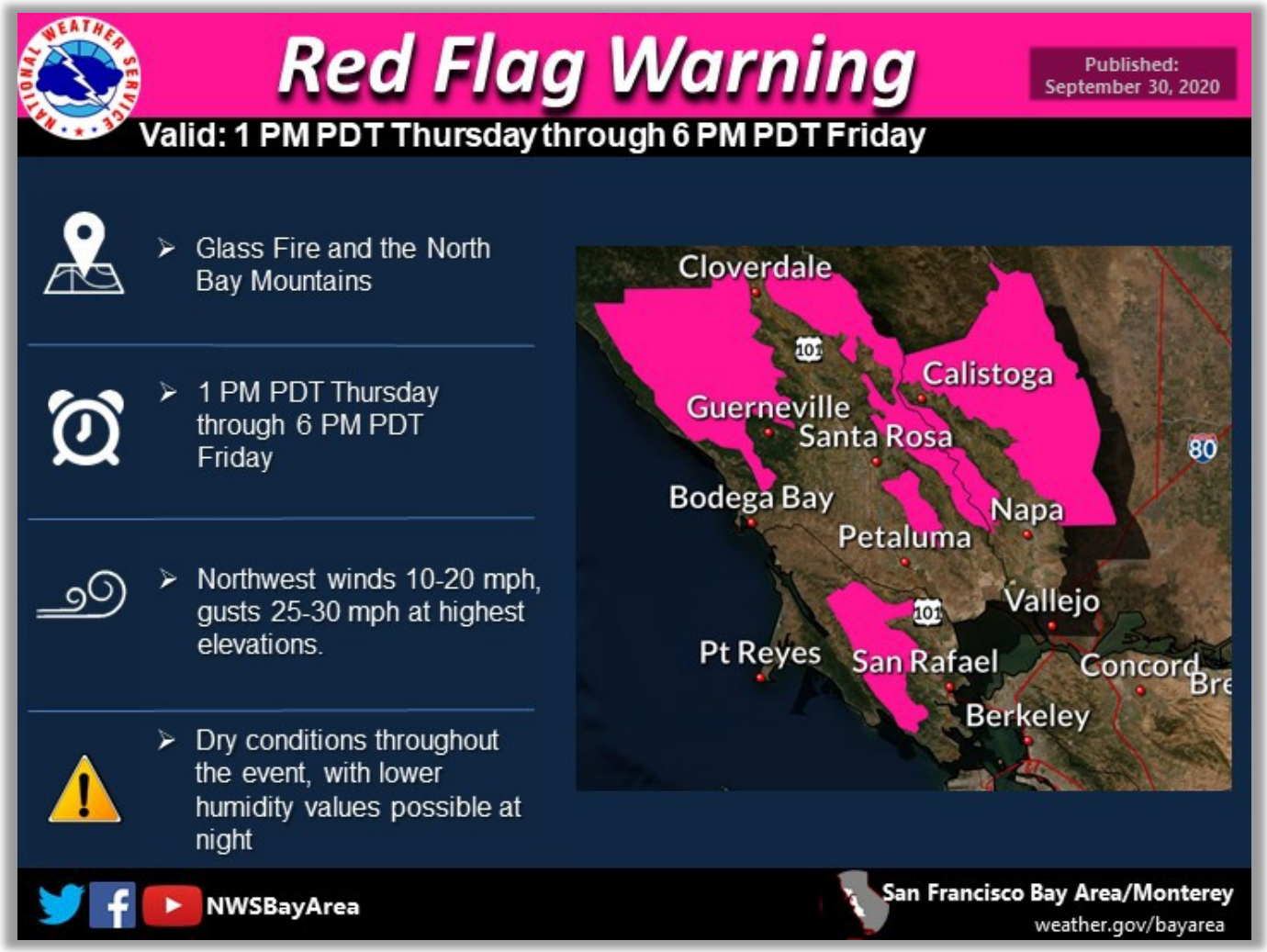
Traveler information may take on other less conventional forms too, such through social media feeds. Twitter has been an increasingly used platform by agencies to get quick and short messages to the public. During the most recent fires in California in September, Cal Fire would “tweet” information to the public. Other agencies such as National Forest Service then “retweeted” this information which provides an avenue to reach a larger audience quickly. It also confirms which agency is the leading the operations.

These strategies are well documented for wildfire applications, but there is a need to enhance the traveler information provided for weather events. It is recommended that partner agencies along the Corridor identify roles and responsibilities to establish information dissemination protocols. This will establish a baseline for who is responsible for releasing information during specific scenarios. For example, during a snow closure scenario, the agencies may decide that Caltrans leads the information dissemination effort with the support of local PIO departments. The involved agencies will define leading and supporting roles for information dissemination outside of the local areas. These definitions can then translate into how information is released to the public. This information dissemination strategy can be refined for construction activities, special events, and weather closures.

Earlier traveler information was described in its day-to-day functions. Traveler information during emergencies is also recommended to be at least a corridor-wide strategy. It may be considered to further expand and create a more regional approach for this strategy. Data streams from Nevada may be valuable during emergencies. Wildfires, and other types of disasters can often spread throughout an area

fast. Wildfires, in particular, can also jump around with high winds, causing damage in unpredictable places. For this reason, extensive coverage for traveler information would be beneficial, including areas that cross state borders. This "project" for this strategy is to develop specific traveler information protocols and operating procedures for multiple agencies to share information with each other and the traveling public. That may include agreements with other Caltrans districts to publish messages to CMS outside the region or retweeting information. It may also include surveying the public about their needs and how they are being met. This strategy will also take into account the barrier to providing traveler information within the corridor is the lack of cell network coverage.

Figure 24 - Example of Wildfire Warning from City of San Rafael



Benefits

Traveler information can be one of the fastest and most effective ways to reach large audiences. Compared to capital improvements projects, traveler information is inexpensive and can be used by many agencies.

Considerations

Before disseminating information to the public, it is important to understand how you want to use the technology and who will be providing the information. For this reason, agency coordination is very important. Regular meetings, trainings, and after-action reviews are discussed in this section and will create an important foundation for effective use of traveler information during emergency scenarios. Traveler information should release clear information, fast, effectively, and ideally from one source, typically the agency that manages the emergency.

Additionally, the preferred traveler information platform (this could be 511 or a third party) must be reliable. If the technology that releases information is faulty, this can cause a lot confusion and problems during an emergency.

Cell phone reception is limited along US-50. To reach travelers along the Corridor, it would be beneficial to look into how WiFi services can be enhanced and be made available to the public. This might require using traffic signals or CMS locations to become WiFi access points for vehicles.

ii. Pre-Season and After Action Reviews

Many major weather events impact the US-50 corridor. Between fire season, snow season, and apple picking season, there are many different scenarios to prepare for. This includes but is not limited to developing an estimate for necessary supplies, confirming roles and responsibilities, and developing signal timing and reversal plans. It is typically recommended to have pre-event procedures developed to prepares for possible outcomes. In the case of the Apple Festival, pre-event planning begins several months in advance. For major snowstorms, there may be a few days of warning. For fires, there may be only a few hours. After the event, the stakeholders host an after-action review with all the involved agencies once operations are restored to normal to assess what went well and what can be improved upon for next time.

During after action reviews, agencies come together to discuss both successes and shortfalls during the event. This allows the group to build a list of action items for the next event. The information gathered through these meetings can be used to develop manuals for staff. North Carolina Department of Transportation (NCDOT)did exactly this following their experience with Hurricane Florence. The agency had met with partner agencies prior to the event and held an after-action review following the event. From this after-action review the agencies identified successes and challenges during the event. The takeaways from Hurricane Florence helped established protocols for future events and ultimately led to developing a manual.

Figure 25 - Photo from National Wildfire Coordinating Group

Pre-Season meetings for the Lake Tahoe region should occur in late spring to early summer. A few months allows adequate time to prepare for wildfires, which includes various tasks such as: taking inventory of equipment, ensuring that any damaged equipment is replaced, and training volunteers and staff to be prepared for their responsibilities.

After Action Reviews should occur after an emergency event and once operations have been restored back to normal. This can be especially important as fires can often happen within a close time frame of one another. Agencies should select key players during these events to attend both the pre-season and after-action reviews. Agencies that may be involved during fire scenarios include: Caltrans D3, El Dorado County Transportation Commission, City of South Lake Tahoe Public Works, City of Placerville Public Works, El Dorado County Fire Department, Cal Fire, El Dorado County Sheriff's Department, City of South Lake Tahoe Police Department, City of Placerville Police Department and other applicable first responder agencies.

Benefits

Pre-event planning and after-action reviews can strengthen operations and enhance relationships across agencies. When done effectively, these meetings clearly define roles and responsibilities for the involved agencies to create a seamless response during emergency scenarios. The process is cyclical and allows for

improvement after each event; after action reviews allow agencies to discover how they can be more successful in the future.

Considerations

A major difference between hurricane and wildfire season is that hurricanes are easier to predict than wildfires. Sometimes winds can predict wildfires, but typically they are a surprise. This makes it difficult to a host a pre-event meeting but could prompt the group to strengthen their Pre-Wildfire Season preparation so that they are ready for any events that occur unexpectedly.

Pre-event planning and after-action reviews still require strong infrastructure and supporting technologies. In the example of North Carolina, the agencies used 511 to release alerts, signal technology to implement timing changes, incident management fleet vehicles to test drive routes, and hard shoulder running (HSR) and reversible lanes to evacuate vehicles. The goal of having pre-event and after-action reviews is to strengthen the operations and to ensure that each agency has a clear understanding of their roles during an event.

While these meetings seem effective, they can often be challenging to organize. They require coordination between multiple agencies, many of which have busy schedules. It may be difficult to get representation from each agency, but it is also important. This includes not only state and local DOTs, but also fire departments, police departments, volunteers.

iii. Incident Management Training / Planning

In states like Idaho, the State DOT has developed a manual for traffic incident management (TIM) that covers procedures and best practices for TIM, along with identifying alternate routes throughout the State. This was developed through extensive stakeholder outreach and a series of workshops. The group developed the manual along with a database of the alternate routes. The plan brought in state, regional, and local transportation agencies, first responders, and law enforcement.

This strategy recommends Incident Management Training which would require participation from multiple agencies along the Corridor. Ideally, these trainings would include representatives from Caltrans D3, El Dorado County Transportation Commission, City of South Lake Tahoe Public Works, City of Placerville Public Works, El Dorado County Fire Department, El Dorado County Sheriff's Department, City of South Lake Tahoe Police Department, City of Placerville Police Department, traffic incident management drivers (such as Freeway Service Patrol), and other applicable first responder agencies.

Some other examples of incident management strategies may include developing performance metrics to evaluate response times or incident clearance times. Agency coordination also serves a vital part of incident management. This may occur through in-person meetings or sharing permissions for video cameras at intersections. Newer technologies have also emerged such as automatic incident detection cameras, which send automated alerts to automated traffic management systems (ATMS) when a slow down or stop has occurred. This can prompt agencies to react efficiently.

Benefits

TIM Manuals record best practices and protocols within an agency (or group of agencies). This makes it easier to train new staff and prevents loss of institutional knowledge. Developing manuals also makes it easier to track changes as needed. Once they are developed, agencies can update them with new developments that occur after each weather event season. They can provide visual information that is difficult to communicate verbally or through e-mail such as maps identifying alternate routes.

Considerations

It is important to note that while TIM Manuals can be helpful, it is often difficult for incident management staff and first responders to follow manuals exactly. They are often put in stressful situations where they are forced to act quickly, and decisions may be made on more of a case-by-case basis. For wildfires, evacuation routes will have to be fine-tuned and consider all possible situations. It is not uncommon for fires to jump to different areas, especially with high winds. This may require creative alternate route planning. TIM Manuals are also a supplemental strategy, meaning that they require strong infrastructure to be set in place first. TIM Manuals also strengthen operations and stress the importance of establishing roles and responsibilities.

TIM Manuals can sometimes be longer documents. This is important to note as agency approvals are often required. TIM Manuals take time and coordination, and so it is critical that they do not stand in the way for other TIM improvements to take place.

iv. Emergency Rerouting

In Michigan, the State DOT developed a report on best practices in emergency rerouting. The report is intended to serve as a reference to DOTs for best practices in emergency rerouting, establish ways to assess effectiveness of reroutes, and present recommendations on signage. Stakeholder involvement played a critical role during this project. The report also includes a literature review, which provides a cross section of a handful of emergency rerouting practices across the country.

The report found that the following key characteristics were important to consider when developing a rerouting plan:

- Collaboration from different agencies and representation from different disciplines
- Roadway geometry (which is especially important along US-50, wherein parts of the Corridor are constrained by the physical landscape)

Storing rerouting data (this could be in database in the Transportation Operations Center (TOC), local transportation agency office); they explained that while hard copies were an identified as an option they should be used with caution. They are at risk of being lost, outdated, or unutilized. Rerouting plans along US-50 would integrate different parallel routes and highway alternates. As there is no single parallel route along the Corridor, this would require multiple routes. In Placerville and through Camino, Carson Road can be used as an alternate route, followed by Pony Express Trail, which ends in Pollock Pines. In Pollock Pines, Park Creek Road and Mormon Emigrant Trail (which are closed during winters), takes

travelers to US-88, which can eventually lead them up to US-89. Maintenance for these roads may be considered as they provide viable alternate routes along US-50. I-80 is another alternate route that takes travelers around to the north side of Lake Tahoe.
Developing rerouting plans that integrates these alternate routes will require coordination and collaboration with El Dorado County, the City of Placerville, the City of South Lake Tahoe, and Caltrans District 3.

Benefits

Rerouting plans help avoid conflicts during a major event. These plans identify clear protocols and viable routes for when an emergency occurs. This aims to mitigate any obstacles during the event. It can also provide a clear set of rerouting maps, rather than verbally discussing it and opening risk for misinterpretation. Rerouting plans also provide opportunity for adaptability, the document should include Plan A, B, C, and so on for agencies to quickly adjust to the changing nature of the emergency.

Considerations

The Michigan DOT report identified challenges shared among the agencies. The agencies shared that format of plans and investment from partner agencies were two major challenges for their groups. When working with other agencies, participation is a common challenge. Participation is essential for emergency preparedness, as many agencies will likely be involved during an event. Emergency management requires early coordination and consistency to develop strong relationships and a sense of ownership among stakeholders.

Developing an evaluation process for rerouting can be challenging, as there is often room for discretion. Signage can also be challenging, as there are different perspectives on where it is appropriate to place signs that inform rather than confuse travelers.

III. Project Prioritization Methodology

This section describes the approach to evaluating adaptive roadway management strategies previously discussed for US-50. The methodology uses stakeholder needs and goals and rank the significance of the screening criteria for evaluating potential strategies. The methodology will help guide the evaluation processes and will determine which strategies can best address corridor needs. The prioritization will result in a prioritized list of strategies that can improve US-50. All of the Managed Lanes strategies are not recommended for implementation because they are not consistent with the District's Managed Lanes Plan.

a. Prioritization Criteria

Adaptive roadway management strategies will be considered based on their ability to meet corridor goals. This assessment will be qualitative in nature and will discuss how applicable criteria are related to the potential strategies. Prioritization criteria includes:

Agency readiness – Agency readiness will consider the current conditions of agency procedures, operations, and available resources. Potential strategies may be assessed based on their ability to work with agency resources.

Corridor readiness – Corridor readiness will consider the existing conditions along US-50. Considerations for baseline infrastructure will be an important factor in selecting potential strategies. Additionally, roadway geometry, geography, and right-of-way limitations will also help determine which strategies are feasible for the corridor.

Data availability –Data can be a helpful resource in assessing agency performance in terms of technical, operational, and institutional capacities. Data availability may impact which strategies are considered and ultimately evaluated.

Safety – Strategies can be evaluated for their ability to enhance safety. This may consider sight distance, driver behavior, and public perception of roadway safety.

Congestion relief - Congestion relief can be evaluated based on a strategy's ability to enhance traveler information, travel time reliability, and time savings.

b. Strategy Scoring

Strategy scoring develops a system for comparing and assessing strategies to determine if they meet corridor needs. Additionally, a scoring system can prioritize potential strategies. For the purposes of this project, strategies will be evaluated based on whether they meet corridor needs. This will be articulated through three different terms: totally, partially, or not at all. “Totally” means that a strategy directly addresses the corridor need; “partially” means that the strategy indirectly meets the need; and “not at all” means there is no relationship between the strategy and the project need.

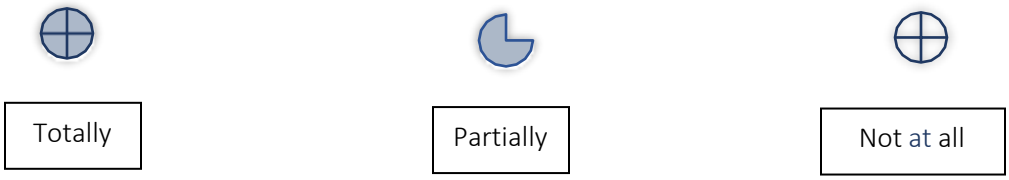
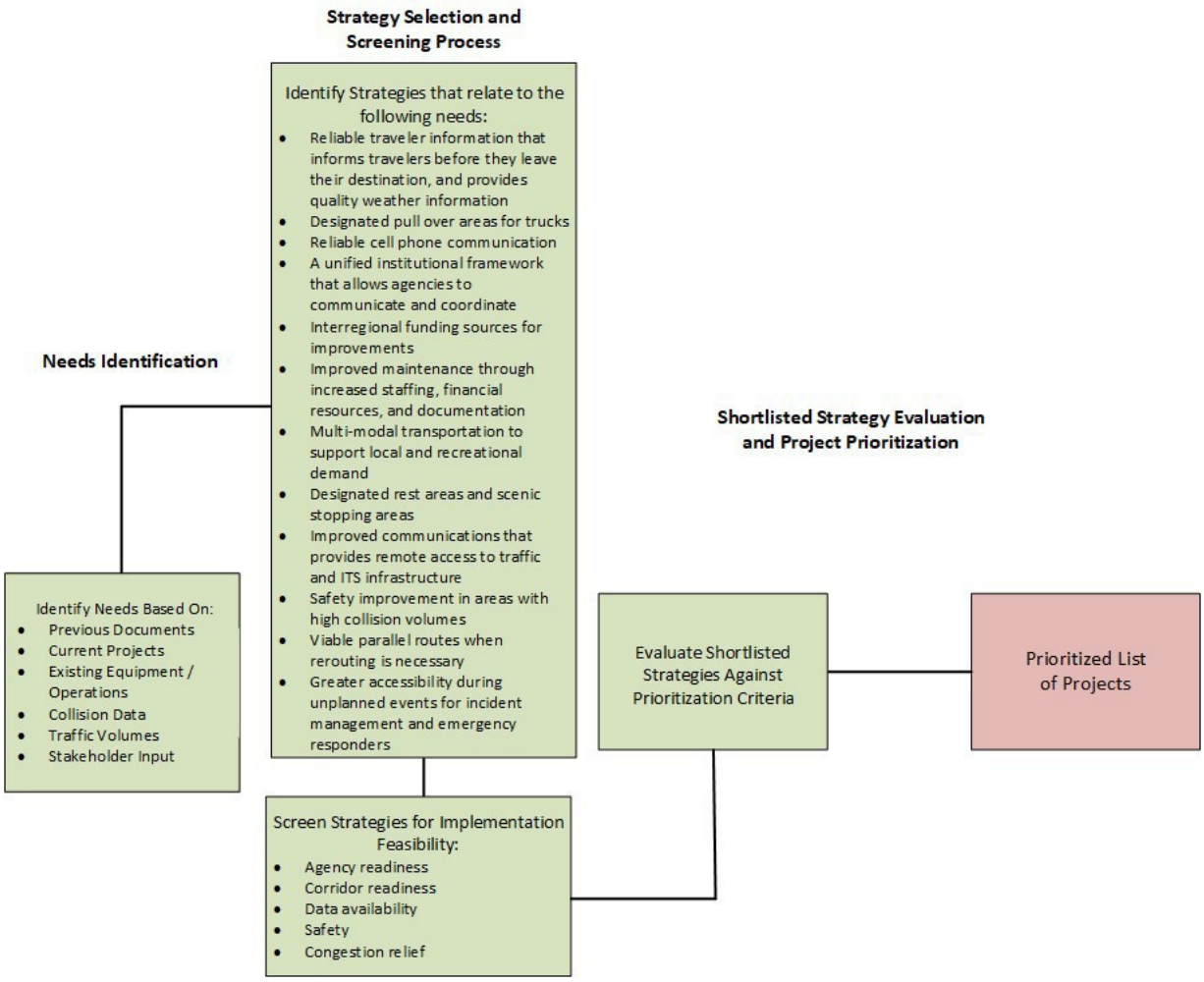


Table 11 - Sample Goal Weighting Scheme

US-50 Corridor Need	Potential Strategy 1	Potential Strategy 2	Potential Strategy 3
Reliable traveler information that informs travelers before they leave their destination, and provides quality weather information	⊕	◔	⊕
Designated pull over areas for trucks	⊕	⊕	⊕
Reliable cell phone communication	⊕	⊕	◔

Figure 26 illustrates the project’s evaluation process.

Figure 26 - Recreational Hotspots Strategy Evaluation



The prioritization process is a two-step process. The first step is to consider the timeline for implementation. The implementation timeline considers ease of implementation, cost implementation, and prioritization for either the short-term, medium-term, or long-term. The agencies responsible for implementing the strategy are also identified. The purpose of this initial assessment is to put the strategies into implementation timeline categories. This helps to assess the strategies in smaller groups.

Circles were filled in based on the number of the goals a strategy could meet. If a strategy met four or more goals, then the circle was filled in completely. For ease of implementation, the circles were more filled in based on their level of challenge. For projects that were more involved, requiring permitting, design, potential ROW / utility impacts, and high construction costs, the circles were entirely filled in. The same approach was applied for Cost of Implementation: if the project is anticipated to be expensive, the circle is entirely filled in.

Table 12 - Short-Term Strategies Evaluated

Strategy	Ability to Meet Project Goals	Ease of Implementation	Cost of Implementation	Stakeholders
Emergency Traveler Information				SACOG, Data provided by CalFire, Caltrans D 3, El Dorado County, City of Placerville, City of South Lake Tahoe
Pre-Season and After-Action Review				SACOG, CalFire, Caltrans D 3, El Dorado County, City of Placerville, City of South Lake Tahoe
Incident Management and Planning				Caltrans D3, El Dorado County, City of Placerville, City of South Lake Tahoe
Emergency Rerouting				SACOG, CalFire, Caltrans D3, El Dorado County, City of Placerville, City of South Lake Tahoe

Data Collection				Caltrans D3, El Dorado County, City of South Lake Tahoe, City of Placerville, EDCTC, TRPA, TTD

Table 13 - Medium-Term Strategies Evaluated

Strategy	Ability to Meet Project Goals	Ease of Implementation	Cost of Implementation	Responsible Agency
TSMO				Caltrans D3, City of Placerville, City of South Lake Tahoe, El Dorado County, TTD, NDOT
Traveler Information				SACOG. MTC, Caltrans D3
Multi-modal Signal Coordination				City of Placerville, City of South Lake Tahoe, TTD, Caltrans D3
Smart Streetlights				City of Placerville, City of South Lake Tahoe, Caltrans D3
LED Striping				Caltrans D3
Micromobility				Public Private Partnership; City of South Lake Tahoe and City of Placerville

Interregional Transit				Public Private Partnership; TTD, El Dorado County Transit

Strategy	Ability to Meet Project Goals	Ease of Implementation	Cost of Implementation	Responsible Agency
Traffic and Feasibility Study for Transit Signal Priority, Emergency Vehicle Preemption, and Queue Jump Lanes				Caltrans D3, City of South Lake Tahoe, City of Placerville, Transit Agencies
Designated area for Chain Control				Caltrans D3 and El Dorado County

Table 14 - Long-Term Strategies Evaluated

Strategy	Ability to Meet Project Goals	Ease of Implementation	Cost of Implementation	Responsible Agency
Mobility Hubs				El Dorado County, Caltrans D3, City of Placerville, Transit Agencies
VSL				Caltrans D3
Truck Climbing Lanes				Caltrans D3 / El Dorado County
Truck Pull-Outs				Caltrans D3 / El Dorado County

After the initial assessment to determine implementation time frame, the strategies were further evaluated using the methodology agreed to by the stakeholders. The criteria identified in the methodology report are:

- Agency readiness
- Corridor readiness
- Data availability
- Safety
- Congestion relief

The following table uses a similar circle methodology to assess each strategy against the prioritization methodology. If a circle is filled in completely this means that it meets the criteria entirely. For example, if an agency is ready to implement a strategy the corresponding circle will be entirely filled in. If data is already available, then a circle will be filled in. Additionally, if not much data is required, then the circle may be completely filled in because the criteria has already been met.

Table 15 - Prioritized Strategies Methodology Assessment

Strategy	Agency Readiness	Corridor Readiness	Data Availability	Safety	Congestion Relief
Short-Term Strategies Evaluated					
Pre-Season and After-Action Review					
Incident Management and Planning					
Managed Lanes Study					
Data Collection					
Traveler Information					

Strategy	Agency Readiness	Corridor Readiness	Data Availability	Safety	Congestion Relief
Medium Term Strategies Evaluated					
TSMO					
Smart Streetlights					
Traffic and Feasibility Study for Transit Signal Priority, Emergency Vehicle Preemption, and Queue Jump Lanes					
Data Collection					
Emergency Traveler Information					
Emergency Rerouting					
Multimodal Signal Coordination					
LED Striping					
Micromobility					

Strategy	Agency Readiness	Corridor Readiness	Data Availability	Safety	Congestion Relief
Interregional Transit					
Designated area for chain control					
Long-term Strategies Evaluated					
HOV Lane					
Truck/Bus Climbing Lane					
Bus Only Lane					
Superstreet Concept					
Tolling					
Mobility Hubs					
Variable Speed Limit					
Reversible Lane					

Strategy	Agency Readiness	Corridor Readiness	Data Availability	Safety	Congestion Relief
Truck Pull Outs and Truck Climbing Lanes					

Based on the two steps of prioritization, the short-term strategy evaluation shows:

- The short-term strategies meet the project goals
- Are relatively easy to implement
- Are relatively cost effective to implement
- Focus on operations and agency collaboration
- Strategies recommended in the short-term have identified funding or are operational changes.
- Pre-season and after action reviews, incident management, and emergency rerouting are all recommended to move forward based on the agency readiness, corridor readiness, and ability to meet goals while providing safety benefits.
- Traveler information and data collection are strategies that support multiple other strategies. These strategies do not provide the direct benefit when they are implemented as standalone strategies, but they provide the baseline needed to pursue other strategies. Traveler information is not recommended for implementation due to existing efforts made by SACOG with the SacRegion511 program. Data collection may already be covered under the future ITS projects discussed in previous memos, but the timeline should be accelerated to provide more immediate benefit.
- Traveler information and data collection require communication infrastructure, which is often costly but needs to be implemented first.

Short-term strategies recommended for implementation:

- Pre season and After Action Reviews – Location: Segment 5 and Leading Agency: depends on the season (i.e. fire season = CalFire, weather conditions – Caltrans D3)
- Incident Management and Planning - Location: Segment 5: and Leading Agency: Caltrans D3
- Data Collection – Location: Segment 5 and Leading Agency: Caltrans D3, EDC, and TRPA

The evaluation of the medium strategies shows:

- TSMO is recommended to move forward as a lower cost, high impact strategy supported by a deputy directive. It provides safety and congestion benefits while meeting project goals.
- Smart streetlights are not recommended for implementation because they do not provide enough direct benefits for the project and Caltrans is not able to implement them at this time.
- LED Striping is not recommended for implementation because of the challenges of installing and maintaining a new technology in such harsh geography.
- Shuttle service is recommended for implementation because it directly caters to the recreational needs of the corridor and has the potential to reduce the impacts of recreational travel on local communities.
- Micromobility is not recommended for implementation because it does not currently meet the needs of the corridor. Most recreational travel is associated with longer distance trips that micromobility would not impact. In addition, it requires an agency champion, which is currently lacking. Micromobility may be an option to be implemented locally in the Lake Tahoe region, but not on the US-50 corridor.
- A Traffic and Feasibility study for transit signal priority, emergency vehicle preemption and queue jump lanes is recommended because it can better determine the level of impact that these strategies can have on the urban parts of the corridor. These impacts may include providing better bus service for both commuter and recreational populations. Additionally, it might help promote better response times for first responders through EVP.
- Emergency traveler information, pre-season and after-action reviews, incident management, and emergency rerouting are all recommended to move forward based on the agency readiness, corridor readiness, and ability to meet goals while providing safety benefits.
- Repurposing an existing space along the Corridor for chain control is recommended for its anticipated safety and congestion relief benefits. Repurposing an existing lot can provide benefits for the corridor, while reducing some of the construction costs and other implementation barriers.

The medium-term strategies recommended for implementation is:

- TSMO – Location - Segment 5 and Leading Agency: Caltrans D3
- Emergency Traveler Information - Location: Segment 5 and Leading Agency: For social media it depends on the type of emergency; SACOG for 511
- Traffic and feasibility study for Transit Signal Priority, Emergency Vehicle Preemption and Queue Jump Lanes – Location: Segment 1 and Leading Agency: Caltrans D3, City of South Lake Tahoe, and El Dorado County
- Multimodal signal coordination – Location: Segment 1 and Leading Agency: Caltrans D3, TTD, City of South Lake Tahoe, El Dorado County Partners
- Interregional Transit – Location: Segment 5 and Leading Agency –Public Private Partnership, El Dorado Transit, TTD
- Designated area for chain control – Location: Segment 2 and Leading Agency – Caltrans D3 and EDCTC

The evaluation of the long-term strategies show:

- Mobility Hubs – This strategy is recommended for implementation to provide support to transit service. It provides congestion relief.

- Variable speed limit – VSL is not recommended for implementation at this time because it does not provide project benefits due to policy constraints on enforcement and the challenges related to implementation.
- Multimodal signal coordination pairs with existing efforts in South Lake Tahoe for transit signal coordination. While not programmed, the project has received attention from high-level planning efforts.
- Truck pullouts and truck climbing lanes are recommended because of the safety benefits and high demand for recreational vehicles. Right-of-way is a consideration but should not be too much of a challenge to acquire.

The long-term strategies recommended for implementation are:

- Mobility Hubs – Location: Segment 2 and 3 and Leading Agency: EDCTC
- Truck pull-outs and truck climbing lanes – Location: Segment 2 and Leading Agency: Caltrans D3

Strategy Implementation Summary

The prioritized list of strategies is shown in Table 11 , which includes the recommended strategies, implementation timeline, and leading agencies.

Table 16 - Summary of Recommended Strategies

Recommended Strategy	Timeline Short term: 0-5 years Medium term: 5-10 years Long Term: 10+ years	Leading Agency
Pre season and After Action Reviews	Short-term	Depending on season (i.e. fire season = CalFire, weather conditions – Caltrans D3)
Incident Management and Planning	Short-term	Caltrans D3
Data Collection/CMS	Short-term	Caltrans D3, EDC, TRPA
TSMO	Medium-term	Caltrans D3
Traffic and feasibility study for transit signal priority, emergency vehicle preemption, and queue jump lanes	Medium-term	Caltrans D3, City of South Lake Tahoe, El Dorado County
Multimodal signal coordination	Medium-term	Caltrans D3, TTD, City of South Tahoe, El Dorado County Partners
Interregional service	Medium-term	Public Private Partnership, El Dorado Transit, TTD

Mobility Hubs	Medium-term / Long-term	EDCTC, Caltrans D3, and El Dorado Transit, TTD
Truck climbing lanes	Long-term	Caltrans D3
Truck pullouts	Long-term	Caltrans D3

IV. Project Development

Using the recommended strategies and the implementation timeline as a guideline, specific projects were developed for implementation. Regardless of whether strategies could be implemented short-, medium-, or long-term, projects were recommended for each of the project segments based on characteristics including terrain and existing infrastructure (number of lanes, types of traffic control devices present, etc.). This was done because some of the recommended strategies were not appropriate in each of the project segments. For example, it's not possible to have multimodal signal coordination for Segment 3 because there are no traffic signals in this segment. Using the recommended strategies, a list of project elements was created. The project elements list outlines the components that each of the recommended projects should include to successfully implement the recommended strategies along the corridor. This project list is only a guide. Projects may be packaged differently depending on available funding, the ability to construct these projects with other projects that are planned for construction in the same location, and project sponsors' change in priority. A summary of recommended strategies, characteristics, and project elements organized by project segment is included in Table 12.

Table 17 - Recommended Project Elements by Project Segment

Project Segment	Characteristics	Recommended Strategies	Project Elements
1	▶ Urban (City of South Lake Tahoe ▶ Many traffic signals	▶ Multimodal signal coordination	▶ Traffic signal infrastructure upgrade/installation ▶ Communications infrastructure installation/upgrade ▶ Roadway restriping ▶ TMC upgrade/integration
2	▶ Urban (City of South Lake Tahoe, Meyers) ▶ Steep terrain ▶ Two lane, semi-rural	▶ Truck pull out/climbing lanes ▶ Multimodal signal coordination ▶ Designated area for chain control	▶ Roadway resurfacing ▶ Roadway widening ▶ Traffic signal infrastructure upgrade/installation ▶ TMC upgrade and integration ▶ TOS element install/upgrade

Project Segment	Characteristics	Recommended Strategies	Project Elements
3	▶ Four-lane, and two-lane road with mountainous terrain ▶ Few parallel routes	▶ Mobility hub	▶ Roadway resurfacing ▶ TOS element installation/upgrade ▶ Communications infrastructure installation/upgrade
4	▶ Rolling terrain area with 3 signalized intersections in City of Placerville ▶ Urban	▶ Multimodal signal coordination	▶ Roadway widening ▶ Traffic signal infrastructure upgrade/installation ▶ TOS element installation/upgrade
5	▶ Entire corridor	▶ All strategies are applicable	▶ All previously listed elements ▶ Interagency coordination ▶ TSMO Program Plan ▶ Capability Maturity Model (CMM) ▶ Incident Management Manual

Based on the list of project elements, a series of recommended projects were developed. These recommended projects were meant to incorporate one or more of the recommended strategies within a specific segment.
Summary of Recommended Projects

Each of the recommended projects below was packaged by combining the elements associated with the recommended strategies for each of the project segments. Projects may be grouped together if there is opportunity to reduce costs and construction delays. This may be determined by available funding. Table 13 below summarizes each of the recommended projects and makes direct reference to which of the recommended strategies it incorporates.

Table 18 - Summary of Recommended Projects

Project ID	Project Description	Segment	Strategies	Construction Cost Estimates	Planning / Design Costs	Maintenance Costs	Assumptions
1-1	Install signal interconnect and upgrade signals from Stateline Avenue to Lake Tahoe Boulevard	1	Multimodal signal coordination, data collection	$13,900,000 - $16,400,000	$650,000	$200,000	-No existing conduit
1-2	Traffic and feasibility study for Transit Signal Priority (TSP), Emergency Vehicle Preemption (EVP), & Queue Jump Lanes	1	Multimodal signal coordination, data collection	--	$550,000	--	Assumes only planning costs, does not include design or construction costs
2-1	Designated area for chain control	2	Chain control	$2,000,000 - $2,500,000	$80,000	$40,000	-No utility relocation costs

2-2	Installation of truck pull out at PM 61.9.	2	Truck pull out/	$1,200,000 - $1,450,000	$80,000	$10,000 / year	-Includes estimated ROW costs -No utility relocation costs
2-3	Truck Climbing Lanes on EB US-50 from PM 61.9 to PM to 65.0,	2	Truck Climbing Lanes	$9,000,000 - $15,400,000	$500,000	$40,000 / year	-Includes estimated ROW costs -No utility relocation costs
2-4	Intersection Improvements at Sierra at Tahoe	2	Multimodal signal coordination, TSP &	$350,000 - $500,000	$10,000	$4,000 / year	-Assumes no ROW costs -No utility relocation costs
2-5	Installation of mobility hub at Sierra at Tahoe Road	2	Mobility hub	$ 5,850,000	$700,000*	$300,000 ** / year	-Utilities are available at the site -Bus maintenance facility will be included elsewhere -ROW are estimated and included in total cost; cost is subject to the market volatility

2-6	Installation of mobility hub in Meyers	2	Mobility hub	$4,200,000	$500,000	$600,000**	-Utilities are available at the site -Bus maintenance facility will be included elsewhere -ROW are estimated and included in total cost; cost is subject to the market volatility

3-1	Installation of mobility hub at Camino	3	Mobility hub	$4,450,000	$600,000*	$300,000** / year	-Utilities are available at the site -Bus maintenance facility will be included elsewhere -ROW costs are estimated and included in the budget; cost is subject to the market volatility

4-1	Install signal interconnect and upgrade signals from Canal Street to Bedford Avenue in Placerville	4	Multimodal signal coordination, data collection	$1,900,000 - $2,300,000	$60,000	$20,000	-No existing conduit
5-1	US 50 TSMO	5	Pre-season and after action reviews, Capability Maturity Model (CMM) Assessment TSMO Program		$600,000		-Assumes only planning costs to develop comprehensive TSMO Plan
5-2	TMC Upgrade	5	Multimodal signal coordination, data collection	$1,500,000	$150,000	$20,000 / year	-Assumes that leading agency already has TMC facility
5-3	Interregional Transit	5	Shuttle service	$2,216,000	$250,000	$250,000 / year	-Assumes shuttles are not electric -Bus maintenance facility is used elsewhere from existing transit agency or through private partnership -Schedule is limited to serve only recreational travel Friday / Sunday with four stops

5-4	Incident Management	5	Incident Management Reviews and Incident Management Manual		$500,000		Assumes only planning costs for developing manual
5-5	CMS /Data Collection & Detection	5	Traveler Information / Data Collection	$731,000 / $87,000 - $1,050,000 / $103,000	$90,000/ $7,000	$19,000 / year $1,000 / year	- Assumes no ROW costs - No utility relocation costs

Construction costs with ranges have been updated (Q4 2021) due to the increase in cost of materials, resources, and contingency rates for Caltrans funded projects since the initial cost estimates were calculated.

Costs for all projects were developed in 2021 and are subject to change.

*Assumes some planning work to be included in the design costs.

**Only operations and maintenance costs of facilities.

G. Description of Recommended Projects

The following section identifies recommended projects for US-50. These projects were developed through prioritizing specific project strategies. These strategies were taken and assessed for locations along the Corridor, based on feasibility and need.

1) Segment 1 Projects

1-1 : Install Interconnect and upgrade signals from Stateline Avenue to Lake Tahoe Boulevard – The US-50 corridor from Lake Tahoe Boulevard. to Stateline Avenue (the California-Nevada state line) features 18 signalized intersections. This project recommends the installation of fiber to connect all 18 of the traffic signals along this corridor. The traffic signal upgrades recommended under this project would consist of the following upgrades at each intersection: traffic signal controllers (if they are not already 2070), new video detection, new CCTV cameras.

Benefits:

Traffic signal improvements and interconnect installation can provide a congested corridor with much needed relief. Interconnected signals can be controlled remotely in the event of incidents or equipment malfunction that may interfere with regular operations. In the event of congestion events that do not align with typical traffic patterns, these upgraded signals can operate under a specific or a set of specific traffic control plans activated from a remote location. The installation of CCTV cameras can be used for incident monitoring, which in turn, can reduce congestion along the corridor through faster response times for emergency staff and corridor maintenance staff. A state-of-the art traffic signal with a robust communications network can also be modified to support systems that provide adaptive traffic signal timing and corridor performance data collection. These signals can be prepared for future implementation of connected vehicle applications.

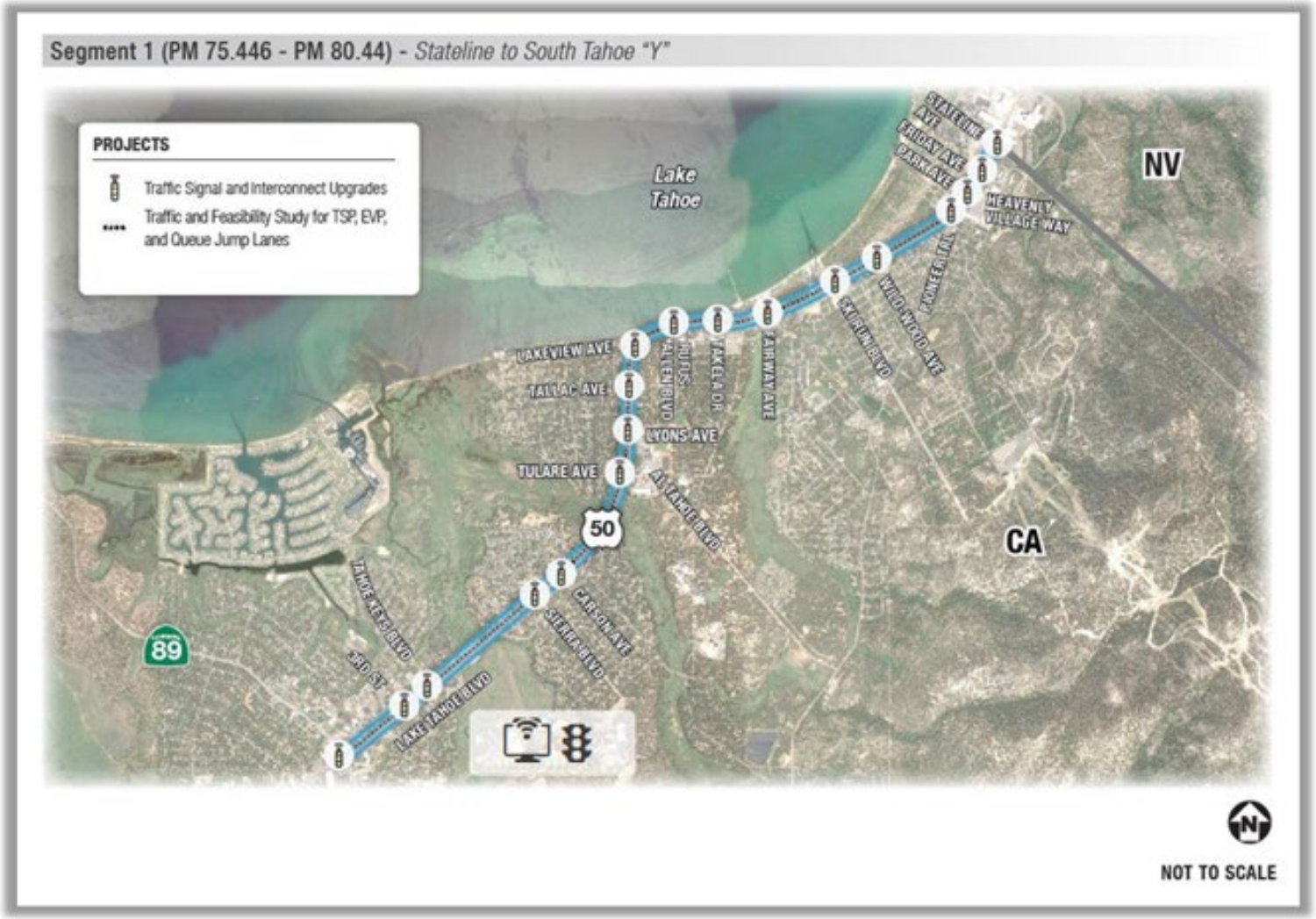
1-2 Feasibility Study for Transit Signal Priority, Emergency Vehicle Preemption, and Queue Jump Lanes - A traffic and feasibility study will provide agencies with a quantitative and qualitative understanding of the benefits of TSP, EVP, and queue jump lane implementation. This will likely be achieved through inputting data into a model to determine how the traffic network will behave with and without these new projects. The Study will provide data for agencies to determine if the project is suitable for the area before investing in new infrastructure.

Benefits:

The benefits of a traffic and feasibility study is that is provides an argument for whether to move forward with the project. It can provide agencies with an understanding of how the roadway will be positively or negatively impacted by the new infrastructure and operational changes associated with TSP, EVP, and queue jump lanes.

Figure 27 Illustrates projects along Segment 1.

Figure 27 - Segment 1 Projects



2) Segment 2 Projects

Project 2-1: Designated area for chain control: Weather is a big contributor to safety concerns and congestion impacts on US-50, especially near Lake Tahoe. The project proposes constructing a new designated area for chain control, either using vacant land or repurposing an existing space. There is opportunity to fund the project through the State Highway Operations and Protection Program (SHOPP) and Minor Program administered through Caltrans.

Benefits:

The designated area will provide vehicles with an area to safely pull over to put chains on before entering the Tahoe Basin area. This provides the opportunity to reduce impacts on both safety and congestion. Repurposing a lot has the potential to reduce construction costs if the area has some of the existing infrastructure.

Project 2-2: Installation of truck pull out at PM 61.9 – This project proposes recommends installing a truck pull out on eastbound US-50 at PM 64.0. Truck pull outs should be accompanied by visible regulatory signage marking the location to ensure that larger commercial and recreational vehicles are using the pull outs.

Project 2-3: Truck Climbing Lanes on EB US-50 from PM 61.9 to PM 65.0 – This project recommends installing a truck climbing lane on eastbound US-50 approaching Echo Summit.

Benefits:

The portion of US-50 covered under Segment 2 includes the Echo Summit, which requires a very steep climb on the route to and from South Lake Tahoe. Segment 2 is a two-lane roadway the entire way through. Chain control is important in this area as the elevation increases so do the weather impacts on the roadway. Providing a designated area for chain control enhances safety, while reducing congestion on US-50. Heavy vehicles traveling through this area experience reductions in speed as they are climbing the steep Echo Summit. The reductions in speed cause an increase in delay to all motorists attempting to get through this segment of US-50. This project recommends the installation of a climbing lane to allow heavy vehicles to climb the area approaching Echo Summit separately from other vehicles that may not impact the overall flow of traffic through this segment. The truck pull out supports the reduction in delay by allowing heavy vehicles to move out of the travelled way so that other vehicles may pass them. The truck pull out is recommended prior to the start of the curved section of the Echo Summit climb, which features very little shoulder space and which likely causes even more delay from heavy vehicles attempting to traverse the curved area.

Project 2-4: Intersection Improvements at Sierra at Tahoe – The improvements at this intersection may include a future traffic signal or other traffic control to support the installation of a future mobility hub at Sierra at Tahoe.

Benefits:

Because a mobility hub is being recommended at Sierra at Tahoe, this intersection may result in an increased number of vehicles turning in and out of this intersection. To prevent any potential conflicts and mitigate potential delay, this intersection will require upgrades to support the recommended mobility hub case use.

Project 2-5: Installation of mobility hub at Sierra at Tahoe Road – A mobility hub is recommended west of Echo Summit at Philips. The mobility hub will be a place where travelers can stop, park long-term, and take advantage of different modes of transportations to and from South Lake Tahoe area. It is recommended that the mobility hub includes the following elements: EV charging station, rest stop for travelers, parking lot for long-term use with a dynamic real time parking availability system, rideshare drop-off locations/flexible curb space, public Wi-Fi, enhanced pedestrian lighting, and interactive trip planning kiosks. The mobility hub can also accommodate other elements based on the available budget and direction of the agency leading this recommended project.

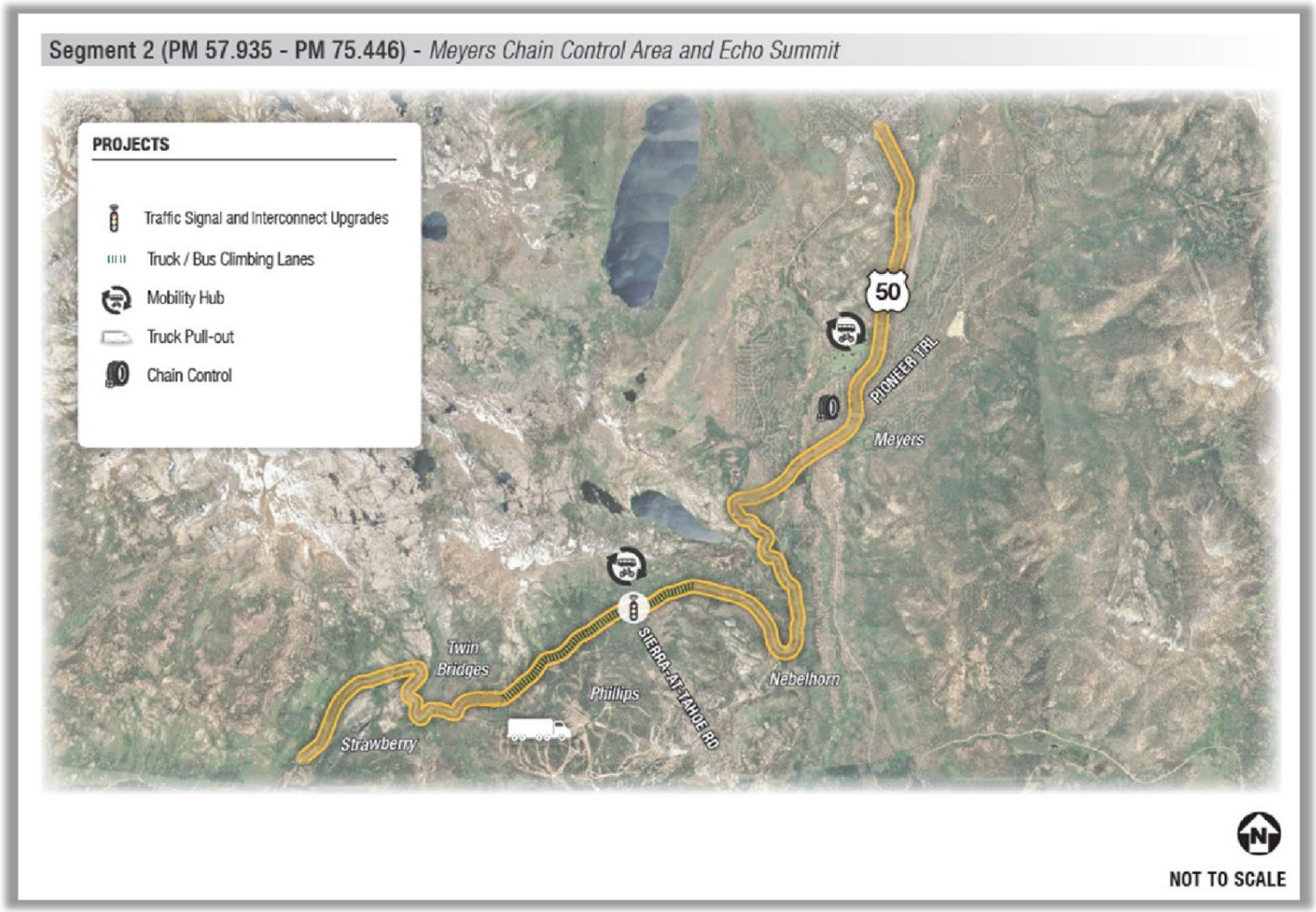
Project 2-6: Installation of mobility hub in Meyers - A mobility hub is recommended east of Echo Summit to serve the Tahoe Basin. The project falls in line with a proposed project identified in the Tahoe Regional Planning Agency (TRPA) Regional Transportation Plan (RTP). This location has been selected based on its ability to serve the Tahoe Basin, and balance both recreational and local travel. The costs described in Table 13 identify a mobility hub full of amenities. The project may begin gradually. For example, the first stage of the mobility hub may start with repurposing a parking lot and with time it will slowly grow its amenities to match those called out in Project 2-5. It is important to note that while the other mobility hub projects are considered long-term, this location has been determined to fall into the medium-term category due to its existing developments.

Benefits:

A mobility hub along this heavily congested corridor has a variety of benefits. Perhaps the greatest benefit a mobility hub may have is the opportunity to provide travelers with different modes of transportation to and from the South Lake Tahoe area. By providing travelers with multiple modes of transportation, it is possible to decrease the overall number of vehicles on the road if travelers choose to use elements such as a private shuttle. By decreasing the overall number of vehicles on the roads, congestion can be reduced and delays may decrease. Additionally, a mobility hub can provide an area for travelers to rest, take advantage of public WiFi in an area that has relatively poor cell phone or other signal reception, and an opportunity to reconsider travel options in the event of a weather-related incident.

Figure 28 Illustrates the projects along Segment 2.

Figure 28 - Segment 2 Projects



3) Segment 3 Projects

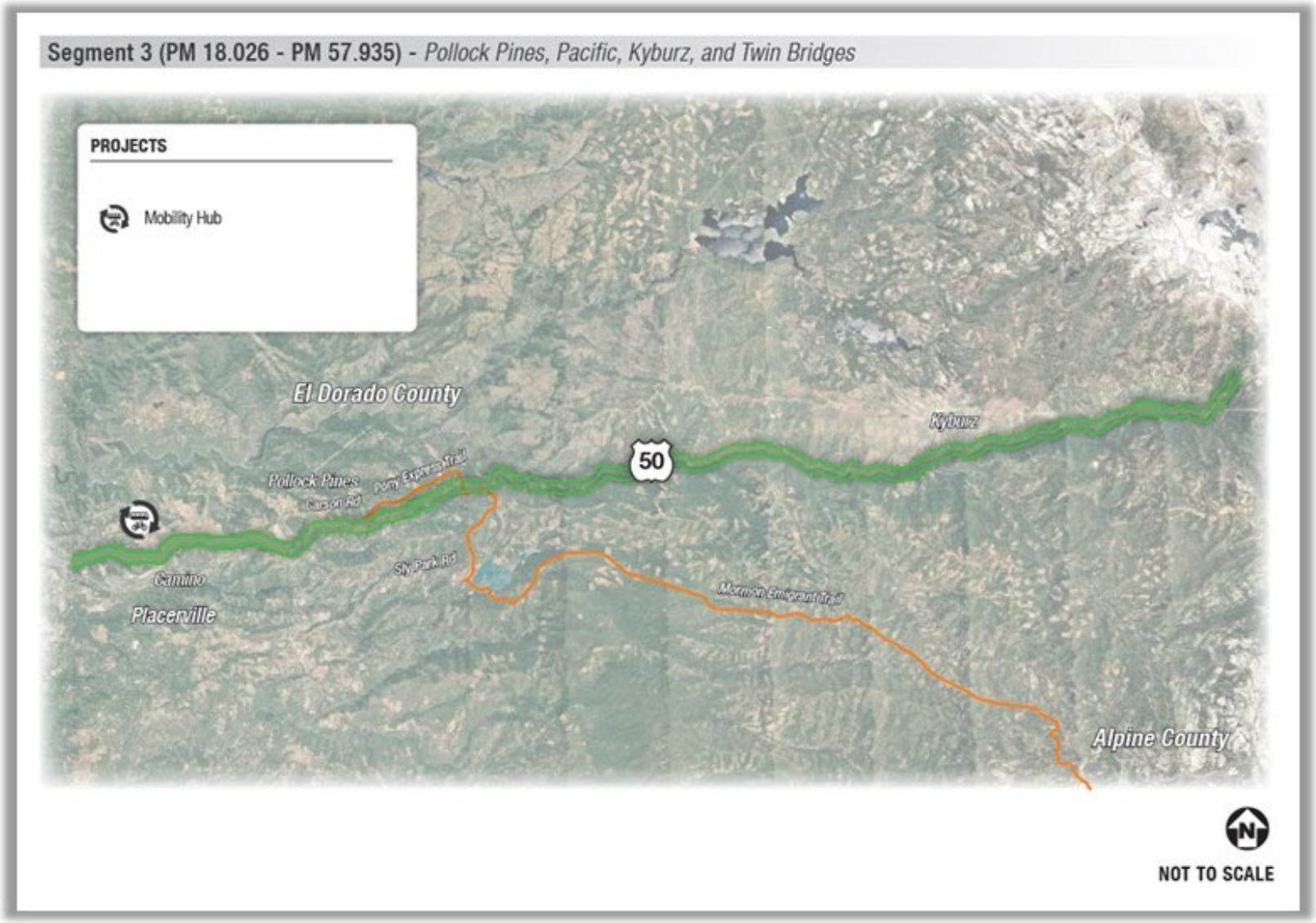
3-1 : Installation of mobility hub at Camino – A mobility hub is recommended at Camino. Along with the recommended Project 5-5, this mobility hub will be a place where travelers can stop, park long-term, and take advantage of different modes of transportations to and from South Lake Tahoe area. It is recommended that the mobility hub includes the following elements: EV charging station, rest stop for travelers, parking lot for long-term use with a dynamic real time parking availability system, rideshare drop-off locations/flexible curb space, public Wi-Fi, enhanced pedestrian lighting, and interactive trip planning kiosks. The mobility hub can also accommodate other elements based on the available budget and direction of the agency leading this recommended project.

Benefits:

As previously noted, mobility hubs along a heavily congested corridor have a variety of benefits. A mobility hub may have the opportunity to provide travelers with different modes of transportation to and from the South Lake Tahoe area. By providing travelers with multiple modes of transportation, it is possible to decrease the overall number of vehicles on the road if travelers choose to use elements such as a private shuttle. By decreasing the overall number of vehicles on the roads, congestion can be reduced and delays may decrease. Additionally, a mobility hub can provide an area for travelers to rest, take advantage of public WiFi in an area that has relatively poor cell phone or other signal reception, and an opportunity to reconsider travel options in the event of a weather-related incident.

Figure 29 Illustrates projects along Segment 3.

Figure 29 - Segment 3 Projects



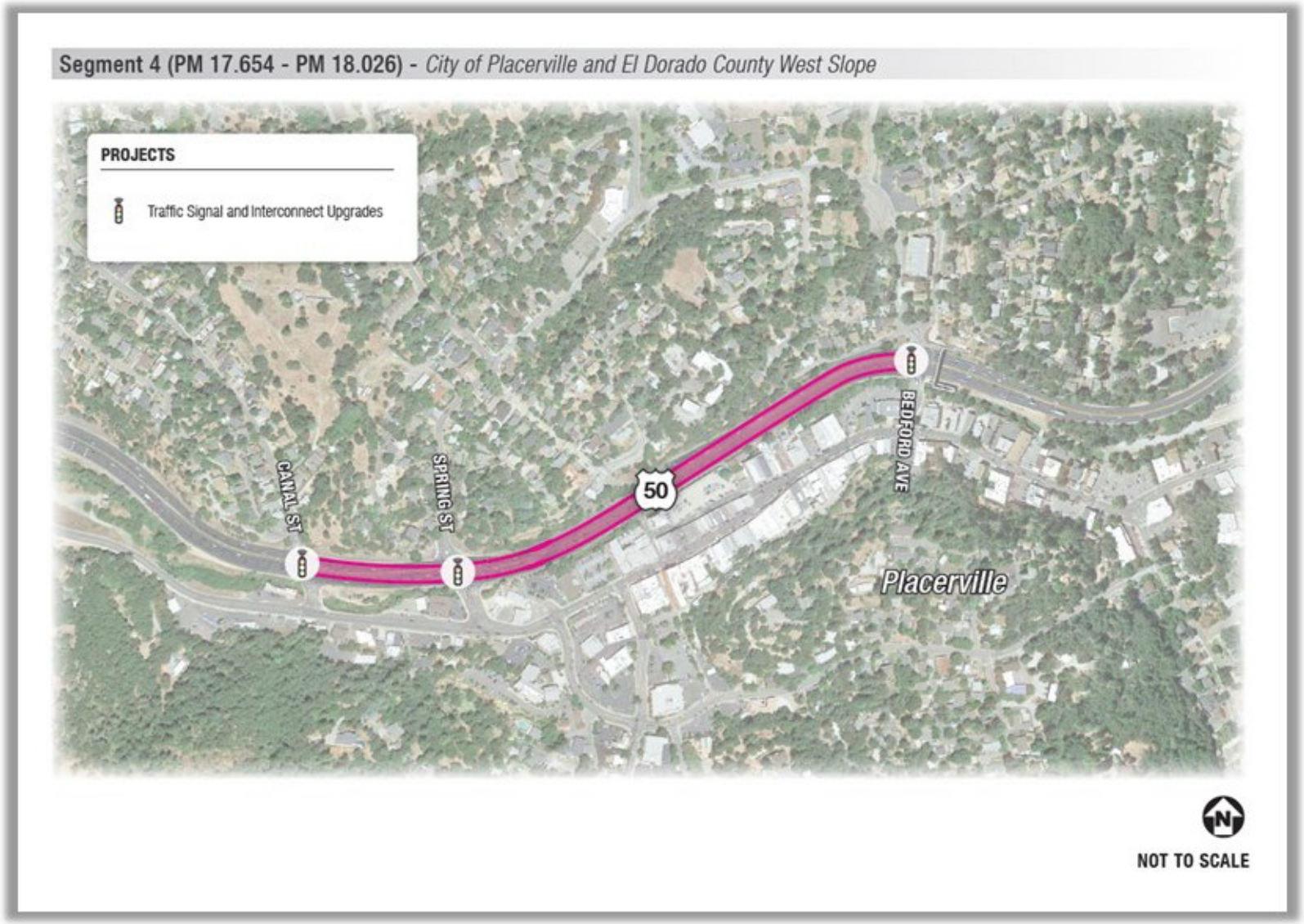
4) Segment 4 Projects

4-1 : Install Interconnect and upgrade signals from Canal Street to Bedford Avenue in Placerville – The US-50 corridor from Canal Street to Bedford Avenue in Placerville features 3 signalized intersections. This project recommends the installation of fiber to connect the traffic signals along this corridor. The signal upgrades recommended under this project would consist of the following upgrades at each intersection: traffic signal controllers (if they are not already 2070), new video detection, new CCTV cameras.

Benefits:

Traffic signal improvements and interconnect installation can provide a congested corridor with much needed relief. Interconnected signals can be controlled remotely in the event of incidents or equipment malfunction that may interfere with regular operations. In the event of congestion events that do not align with typical traffic patterns, these upgraded signals can operate under a specific or a set of specific traffic control plans activated from a remote location. The installation of CCTV cameras can be used for incident monitoring, which in turn, can reduce congestion along the corridor through faster response times for emergency staff and corridor maintenance staff. A state-of-the art traffic signal with a robust communications network can also be modified to support systems that provide adaptive traffic signal timing and corridor performance data collection. These signals can be prepared for future implementation of connected vehicle applications.

Figure 30 - Segment 4 Projects



5) Segment 5 Projects

5-1 : Develop a TSMO Program Plan – Transportation Systems Management and Operations (TSMO) integrates many of the projects mentioned in the Implementation Plan. Through collaboration and operational enhancements, TSMO can optimize existing and planned projects along the Corridor. The first step in implementing TSMO is to assess the agency's current state through a Capability Maturity Model (CMM) Assessment this establishes and baseline and helps the agency understand their current performance. After going through this assessment, a TSMO Program Plan may be developed, along with identifying key players to establish a TSMO Working Group. The TSMO Program Plan will guide the TSMO Working Group in its TSMO projects and related efforts. The TSMO Program Plan will identify the objectives, overarching vision, and potential strategies for the Corridor, and establish performance metrics as a part of the system's operational routine.

Benefits:

TSMO is a cost effective and sustainable approach to solving mobility efficiency and safety concerns. TSMO is not a stand-alone practice, it integrates other multimodal and technology investments to create a coordinated and efficient system through assessing performance and training operators. TSMO can often use existing infrastructure and staff to develop an optimized approach to operations. It also promotes practices that can benefit organizations such as interagency coordination. With these practices, comes performance metrics which allows agencies to consistently assess their performance institutionally and operationally. These performance metrics allow for consistent improvements and proactive asset management and maintenance, which can lead to long-term savings.

5-2 : TMC Upgrade – Several of the projects recommended in this implementation plan include traffic signal upgrades and new TOS elements. This recommended project includes the integration of the elements recommended through the other projects in this implementation plan at Traffic Management Center (TMC). This project recommends upgrading the existing Caltrans D3 TMC software to further support remote operation features. Another option for upgrading the TMC includes installing of video walls for monitoring of upgraded traffic signals. The TMC Upgrade also proposes the upgrade of communications and field devices to strengthen the network and expand the TMC's capabilities for operations. The CMS / detection locations proposed in this report could integrate with the TMC to provide better data collection and dissemination to the public and partner agencies.

Benefits:

An upgraded TMC can assist agencies in a variety of ways. It can help to reduce the response time to signal outages and incidents on the corridor. Remote signal operations can make it easier to implement different signal timing plans. For this corridor, implementing traffic signals to flush vehicles out during a heavy congestion event may be particularly beneficial. In addition to the remote signal control, it's also important to have all ITS elements integrated at a TMC so that they can be used to monitor conditions along the corridor.

5-3 : Interregional Transit Service – an interregional transit service is recommended for implementation along Segment 5. It is recommended that the service operate on Fridays and Sundays during peak recreational periods. It is also recommended that the shuttle operates in one direction to follow recreational traffic patterns. This means that on Fridays, the service should only operate in the eastbound direction of US-50, while on Sunday, the

service should operate in the westbound direction of US-50. It is also recommended that the service has 3 departure times on Friday and three departure times on Sunday. The service should make a stop in Sacramento, the recommended Placerville mobility hub, the recommended mobility hub at Sierra at Tahoe, and at South Lake Tahoe.

Benefits:

An interregional transit service along the US-50 corridor may result in decreased congestion. By setting up stops at key areas along the corridor, it is expected that the implementation of the service would reduce the overall number of vehicles on the road. A reduction in the number of vehicles in the road could result to decreased congestion and thereby improved travel times along the corridor. The recommended mobility hubs along the US-50 corridor would serve as stops for the recommended service, giving travelers along the corridor more options for travel to and from South Lake Tahoe.

5-4 : Incident Management - Incident management takes a proactive approach to responding and addressing incidents on the road. This means clearing a scene as quickly as possible to reduce congestion and potential secondary collisions. Developing a working group of incident management responders and traffic operators can help optimize and organize practices such as identifying alternate routes, developing timing plans, and establishing general agency protocols. These incidents should be followed by after action reviews to identify key successes and challenges. The information collected from these meetings may be collected to develop an incident management manual. Additionally, incident management alternate routes and timing plans should be developed using both existing infrastructure and planned infrastructure for the future. Existing infrastructure may be video detection / CCTV cameras to detect incidents and planned infrastructure may be additional permanent and portable CMS locations along the Corridor to use for rerouting. In some cases, incident management requires the training of staff to follow a specific set of guidelines during incident conditions. Incident management requires collaboration among responders such as freeway service patrol and transportation agencies to identify incidents and to mitigate and clear incidents before they affect the general public or cause additional delays along the corridors.

Benefits

Incident Management is an essential practice for traffic operations. Unfortunately, incidents occur, and in some areas, they may occur more frequently than others. No matter the location, an incident impacts not only impacts those involved but all other vehicles on the road. For this reason, effective incident management benefits everyone on the road. The practice of effective incident management insures that drivers and passengers are given the care they need and that the road is cleared as efficiently as possible. These practices centered around efficiency and safety also leads to potential money and time savings for both incident management agencies and for travelers on the road. Effective incident management also creates unity in their departments and protocols and performance metrics are established to create consistency and efficiency. It can also lead to interagency partnerships that promote collaboration to optimize and harmonize practices.

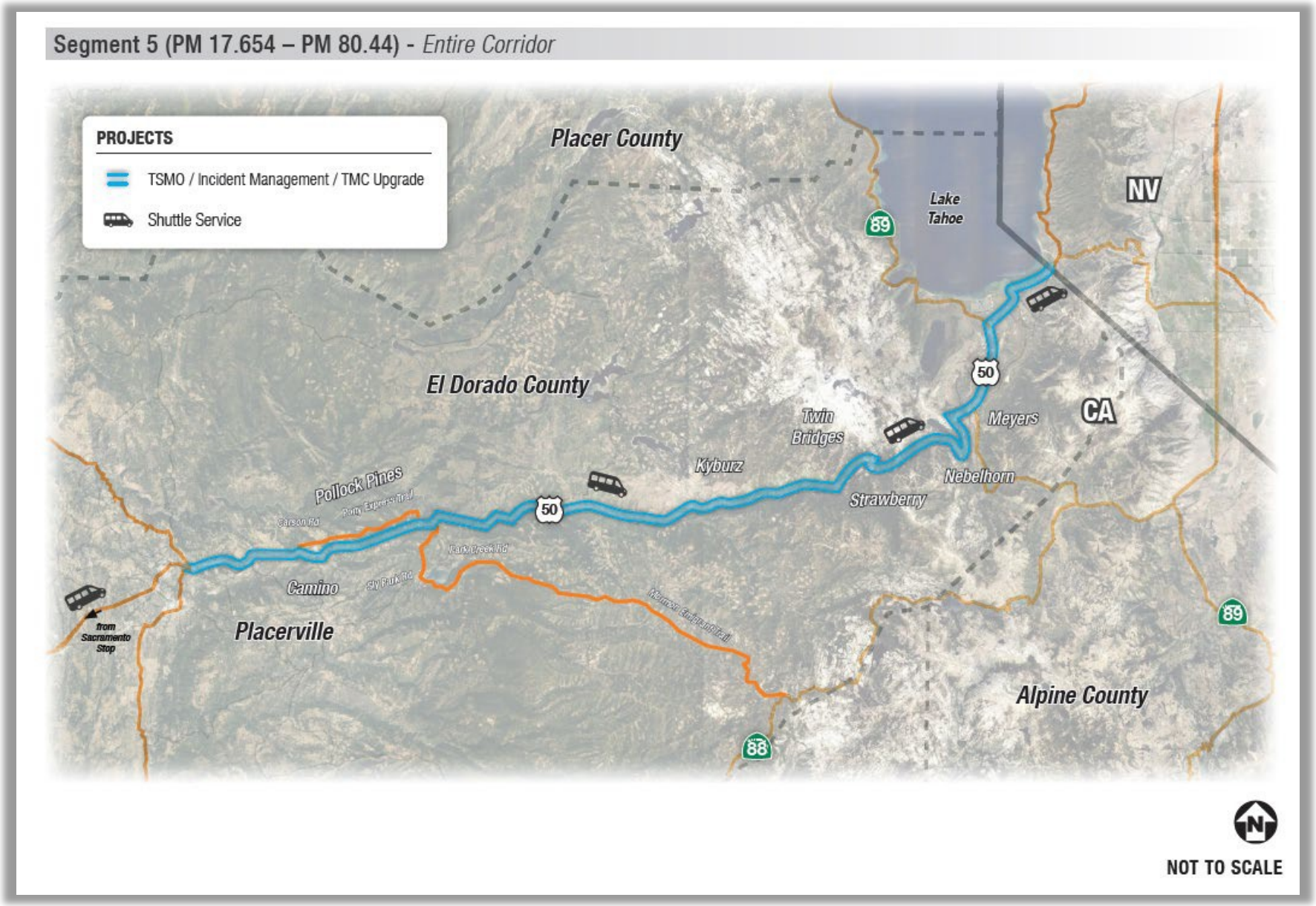
5-5 : CMS/Detection/Data Collection – This strategy will manifest in opportunities to strategically place CMS Boards and Loop Detectors along the US 50 Corridor to supplement projects.

Benefits

CMS and loop detectors can provide valuable data collection and traveler information. The loop detectors are triggered when vehicles drive over. Traffic conditions can be observed through a TMC, based on the number of vehicles that pass the detectors and if there is a vehicle stopped on the loop detectors. The CMS can provide traveler information to the public and can be remotely controlled at the TMC. This is especially helpful in the rural parts of the Corridor, where cell phone reception and WiFi is limited. By adding inductive loop detection, additional data can be collected along the segment and the US-50 corridor in general. The data collected can inform studies or other efforts to further reduce congestion throughout the US-50 corridor. The installation of a new CMS can help to disseminate information to travelers in a rural portion of the US-50 corridor. This information may be particularly important to travelers as cellular service in these areas tends to be weak or not available at all. Roadway closures and weather-related incidents are among the types of information that can be disseminated to travelers through this corridor.

Figure 31 Illustrates projects along Segment 5.

Figure 31 - Segment 5 Projects



V. Cost Analysis / Funding Options

Recommended projects were packaged in a way to take advantage of available funding sources. While all of the recommended projects are meant to be fully implemented to fully realize the potential benefits, it is possible to take pieces of each of the projects and implement them as funding becomes available. For instance, the Segment 1 projects could be segmented so that there are 5 or less signals upgraded until all signals have been upgraded. For the larger recommended projects, depending on who the lead agency is, it is recommended that they be added to State Highway Operation and Protection Program (SHOPP) funding lists or other long-term funding programs that may result in the projects being fully implemented at one time.

A. Project Funding Sources

There are a variety of funding options that can be used to carry out the recommended projects. Depending on the project type, leading agencies may apply to receive funding at the local or federal level. ITS projects typically require a detailed narrative with grant-funding applications as their benefits may not always be perceived directly. For example, HSIP funding has been a popular funding source for traffic signal improvements. At first glance, this founding source might not seem like it would directly support traffic signal improvements because installing a new traffic signal does immediately result in improved safety at an intersection, but when evaluating the elements associated with signal improvements, safety overall tends to increase.

1) State Funding Programs

The State of California offers a variety of funding programs used for transportation and traveler mobility purposes. This section outlines some of the major funding opportunities administered by the state and available to Caltrans projects.

State Transportation Improvement Program (STIP): The State Transportation Improvement Program receives state and federal funds that are allocated throughout the state. STIP funds new construction projects that add capacity to the transportation network. STIP funds are split into Regional TIP (RTIP) and Interregional TIP (ITIP) funds. Caltrans projects are only eligible for Interregional Transportation Improvement Program funds. Projects are evaluated based on how well the project aligns with furthering regional objectives, particularly for Sustainable Communities Strategies.

SHOPP is the state's "fix-it-first" program that provides funds for pavement rehabilitation, operation, and safety improvement on state highways and bridges. All projects funded by the SHOPP are limited to capital improvements that do not add capacity (no new highway lanes) to the state highway system, though some new auxiliary lanes are eligible for SHOPP funding. The SHOPP project portfolio is updated every two years, carrying forward projects programmed in the last two years and then add projects based on the needs identified in the State Highway System Management Plan (SHSMP) and projects that help reach performance targets per the Transportation Asset Management Plan (TAMP).

Part of the SHOPP program is the Minor Program. This Program provides Caltrans with funding to implement relatively low-cost capital projects to quickly address small-scale needs that are beyond the scope of what the Caltrans Maintenance Program can address but are also of a scale that does not necessitate an extensive project development process.

The State Highway Account (SHA): The State Highway Account is essentially a bank account that funds a variety of California programs for transportation and traveler mobility purposes. The SHA receives its funds from the State Base Excise Tax and the Federal Highway Trust Fund, and the funding is allocated to three programs:

- Local streets and roads (44%)
- STIP (44%)
- SHOPP (12%)

Highway Safety Improvement Program (HSIP): HSIP funds are administered by Caltrans. Caltrans-initiated safety projects are eligible for HSIP funding if they are participating with a local agency. These projects typically included updated traffic signals or other projects that lend themselves to cost sharing between agencies. The application for HSIP funding must come from the local agency who is partnering with Caltrans on a safety project.

Senate Bill 1 (SB-1): SB-1 is the Road Repair and Accountability Act of 2017, which confirmed a legislative packaged that invests $54 billion over the next decade to fix roads, freeways, and bridges across California, while also addressing safety, congestion, accessibility, economic developed, air-quality and land use issues. Caltrans will receive roughly half of the allotted SB-1 funds, receiving $26 billion for state-maintained transportation projects. The California Transportation Commission administers the funds and evaluates funding allocation.

2) Local Funding Sources

The Office of Local Assistance administers state and federal funds to District 3. The Tahoe Basin also provides funding opportunities for projects in the area.

Linking Tahoe Regional Grant

The Linking Tahoe Regional Grant Program (RGP) is administered by the Tahoe Regional Planning Agency (TRPA), which acts as a Metropolitan Planning Organization (MPO) for the area. The organization is unique in that is serves the Tahoe Basin, which crosses state lines, incorporating both California and Nevada territories. The RGP administers funds to transportation projects that strive to support the region's goals through a competitive process. The next call for projects is in Winter 2021.

Local Sales Tax

The local sales tax is portioned to various sources with the highest percentage going to the state's general fund at 4.19%. 0.5% of the sales tax is portioned to the Local Safety Fund and 1% is dedicated to City and County Operations. The Bradley-Burns Uniform Sales and Use Tax Law provides 1.25% of sales taxes to city / counties and one quarter cent goes to the county-wide regional transportation fund. Each year, El Dorado County develops a budget which identifies which projects are priority for the regional transportation fund.

VI. Project Delivery

Projects recommended in this Implementation Plan fall under the following categories: field infrastructure improvements, planning, and integration. The field infrastructure improvement projects can be completed using

traditional design-bid build procurement strategy. In design-bid built projects, plans, specifications, and construction estimates (PS&E) documents are prepared for advertisement by a leading agency. Once the PS&E documents have been advertised, the project is constructed by a Contractor that is administered by the leading agency. Recommended projects under this category will have to undergo Caltrans review, which may vary based on the complexity of the project. For the purposes of discussion, recommended projects 1-1, 2-1, 2-2, 2-3, 2-4, 2-5, 2-6, 3-1, 4-1, and 5-2 fall under the category of field infrastructure improvement.

The planning-based projects follow a different delivery process. These projects are still administered by a leading agency, but instead of developing design documents, these projects focus more on establishing stakeholder groups who will then be responsible for providing review and feedback on a variety of guidance documents. This stakeholder group can be led by one agency or a variety of agencies. The documents that are generated through the planning process can then be used to change policies, guide design projects, or serve as a blueprint for what the future of a corridor or City looks like. For the purposes of discussion, recommended projects 1-2, 5-1, 5-3, and 5-4 fall under the category of planning.

Integration projects can involve components from both the field infrastructure and the planning-based projects. In these types of projects, a vendor must be selected by the leading agency to provide system enhancements determined by a set of documents that are reviewed and approved by the project owner which follow the systems engineering (SE) process. The project owner in these types of projects is typically the leading agency. In integration projects, it is important to have a set of documents that fully outline the components and functionality of the system they are looking to upgrade. Having a thorough set of documentation will allow the project owner to select the proper vendor to upgrade their system and ensure that the system satisfies all of the objectives they set out to achieve at the start of the project. The documentation will also ensure that systems are tested and accepted in a way that is consistent with the system objectives and requirements. For the purposes of discussion, recommended project 5-2 falls under the category of integration.

Sections A-D will only be applicable to field infrastructure improvements only. Section E will only be applicable to integration projects. For all recommended projects, Sections V and VI will provide information on the roles and responsibilities of leading agencies and a high-level schedule of completion.

B. Project Initiation

A project initiation document (PID) is required to do any major work on the State Highway System. A PID establishes a well-defined purpose-and-need statement and a proposed project scope tied to a reliable cost estimate and schedule. The PID acts as a record of the existing information, initial assumptions, identified risks, and constraints that drove the development of the project work plan. A PID will likely be needed for all of the recommended field infrastructure improvement projects. To be conservative, it is assumed that the agency that will lead project delivery will develop a project initiation document. The PID will also likely help to determine what kind of Caltrans review will be required for each of the recommended projects. Projects that do not include any of the following elements can typically avoid having to be processed through the Project Delivery Quality Management Assessment Process (which will likely result in longer review periods and more documentation prior to the start of construction):

- Right-of-way conveyances
- New earth retaining structures that are not in compliance with Caltrans' Standard Plans
- Conduits 60 inches or greater in diameter installed by trenchless methods or tunneling with a depth of cover less than 15 feet
- High priority utilities or liquid and/or gas lines on or through a bridge
- Modification of Caltrans' structures
- New permanent stormwater treatment facilities or create 5000 square feet or more of new non-highway impervious surface or, 1 acre or more of new highway impervious surface
- Known slip/slide prone areas
- Using non-standard agreement templates
- Non-standard roadway design features requiring a Design Standard Decision Document
- A California Transportation Commission's action other than for funding
- New or modifications to existing sound walls on bridges
- Highway capacity increase or converting the operation nature of highway travel lanes

Even projects that do not feature any of the above elements may be subject to additional Caltrans review. This is one of the main reasons that having a thorough PID is an important starting step for any recommended project.

Projects have a couple of different paths that they may take to achieve necessary Caltrans approval. If projects include any of the complex element, they will have to undergo the full Project Delivery and Quality Management Assessment Process. Once it is determined that projects do not include any of the elements that categorize them as complex and the project is fully designed (at least at 100%), then the next check is the overall construction costs of the project. If the project costs within existing or future state highway right-of-way exceed $1M, the project may be processed through the Encroachment Permits Office Process. The project may be processed through the Encroachment Permits Office Process if the project is:

- Less than $1M in construction costs; or
- If construction costs are greater than $1M on existing or future state highway right-of-way and it is feasible for the applicant (or lead agency) to submit and complete an application package without the guidance of Caltrans and if Caltrans can approve or deny the package within 60 days

Previously, recommended projects could also be approved by Caltrans through the Encroachment Permit Office Process if the project was between $1M and $3M in construction costs on existing or future state right-of-way with the completion of a Permit Engineering Evaluation Report (PEER) process. A recent set of guidelines was

published by Caltrans to allow for the delivery of projects of larger construction values under a less stringent review process if they meet the following requirements also known as the Design Engineering Evaluation Report (DEER) process:

- Project has approved environmental document or project is Categorically Exempt by CEQA and/or NEPA and has completed studies or public outreach
- Project has a Single-Build Alternative
- Project does not require CTC action
- Project doesn't involve any ROW conveyances from the Department to the local agencies
- Project doesn't require FHWA approval for Relinquishments or NPRCs involving a modification to the access control
- Project doesn't involve construction of new structures or bridge widenings

The DEER review process effectively replaced the PEER review process and is meant to allow projects of higher construction values to receive Caltrans approval process faster if they are deemed to not include complex design elements. Regardless of any of the above elements, the lead agency must coordinate with Caltrans on which review process will be appropriate for the recommended projects.

It is expected that recommended projects 2-1, 2-2, 2-3, 2-5, 2-6, and 3-1 will undergo a longer Caltrans review process prior to approval for construction. These projects have potential right-of-way takes and / or additional approvals associated with construction.

All other projects will likely not require full Caltrans review as they meet many of the requirements listed above. This will result in faster approval from Caltrans and faster completion of the projects.

C. Environmental Analysis

All proposed field infrastructure improvement projects must have an approved environmental document prior to obtaining Caltrans approval for construction. Depending on the funding source used for the project, additional environmental clearance may be required. Two of the environmental clearances that may be required on recommended projects include California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA). Environmental studies prepared during the PID will dictate which of the level of documentation necessary to meet these requirements.

- *CEQA* – Projects with no potential for significant impact, or with potential to reduce impacts to a level of insignificance, require an initial study (IS). The results of this effort provide the administrative record to substantiate issuance of a negative declaration (ND). Projects which clearly exhibit potential for residual or unmitigable significant impacts will require an environmental impact report (EIR).
- *NEPA* – Projects with significant impacts require the preparation of an environmental impact statement (EIS). All other projects can be determined to be categorically excluded. Depending upon the nature and

degree of a project's potential impacts, a finding of no significant impact (FONSI) may be prepared, equivalent of a CEQA ND.

D. Design

The detailed design phase spans the project development process from the development of preliminary plans through the submittal of contract plans, specifications, and estimate (PS&E) for advertisement. Caltrans Standard Plans and Standard Specifications and Standard Special Provisions are used as reference while developing the contract documents. Project design includes acquisition of all relevant approvals, such as encroachment permits and right-of-way certification. Local agencies will have the chance to review the construction documents during their development as applicable.

The final contract documents go through the environmental reevaluation process to confirm that the conclusions in the final environmental document remain valid. Changes to the project during design, may require additional environmental study, documentation, and mitigation.

E. Construction

This stage includes the installation of all relevant communications infrastructure. The Caltrans Construction Manual provides guidance for the administration of construction contracts.

Prior to breaking ground, the contractor will establish the sequence of construction. This stage is expected to take around one year to complete and is usually completed by a contractor hired by the agency that will lead project delivery.

The construction portion of the PDPM corresponds to the Field Implementation phase of the SE process. This portion is the turning point from project development and design to verification and validation of the implemented system.

F. Post-Construction

After all relevant communications infrastructure is installed, the next stage is system integration. This phase is clearly defined within the SE process and should follow each level of testing, verification, and system validation as outlined. Each of these steps corresponds directly with the first series of project development and design in the SE process. The level of detail prescribed with each phase of the testing represents the level of project detailed defined within the corresponding SE process step. For example, the Unit/Device Testing is intended to validate the Detailed Design, which depicts how and where each of the devices should be installed and integrated.

VII. Roles and Responsibilities

Roles and responsibilities will develop organically throughout a project's development process. It is important to identify the lead agency and their role in propelling a project through the planning or design process. Table 14 provides a high-level description of the lead agency's role in project initiation.

Table 19 - Lead Agency Roles and Responsibilities

Project ID	Project	Leading Agency Responsibilities	Potential Lead Agencies / Partners
1-1	Install signal interconnect and upgrade signals from Stateline Avenue to Lake Tahoe Boulevard	• Owns the signals in the jurisdiction • May or may not operate and maintain the signals depending on existing agreements with other agencies • Initiates project development and design internally • Reviews plans, provides approvals, and coordinates with other agencies if external approvals are needed • Advertises and Awards construction contract to Contractor • Administers construction support Operates and maintains signal interconnect / signal upgrades or identifies another lead agency that is qualified to do so	• Caltrans / City of South Lake Tahoe

Project ID	Project	Leading Agency Responsibilities	Potential Lead Agencies / Partners
1-2	Traffic and feasibility study for TSP, EVP, and Queue Jump Lanes	• Initiates project development • Creates a stakeholder group of partner agencies • Reviews report, provides comments and coordinates with other agencies if external approvals are needed • Either determines or confirms report findings	• City of South Lake Tahoe, TTD, and El Dorado County
2-1	Designated Chain Control Area	• Owns, or acquires, necessary right-of-way for designated chain control area • Initiates project design • Reviews plan sets, provides approvals, and coordinates with other agencies if approvals are needed • Advertises and Awards construction contract to Contractor • Administers construction support • Operates and maintains chain control area or identifies another lead agency that is qualified to do so	• Caltrans

2-2	Install truck pull out at PM 61.9	• Owns roadway and neighboring right-of-way • If right-of-way is not existing, this agency will acquire it to initiate the project • Initiates project design • Reviews plan sets, provides approvals, and coordinates with other agencies if approvals are needed • Advertises and Awards construction contract to Contractor • Administers construction support • Operates and maintains roadway or identifies another lead agency that is qualified to do so	• Caltrans

Project ID	Project	Leading Agency Responsibilities	Potential Lead Agencies /Partners
2-3	Install truck climbing lane on EB US-50 from PM 61.9 to PM 65.0	• Owns roadway and neighboring right-of-way • If right-of-way is not existing, this agency will acquire it to initiate the project • Initiates project design • Reviews plan sets, provides approvals, and coordinates with other agencies if approvals are needed • Advertises and Awards construction contract to Contractor • Administers construction support • Operates and maintains roadway or identifies another lead agency that is qualified to do so	Caltrans

Project ID	Project	Leading Agency Responsibilities	Potential Lead Agencies /Partners
2-4	Intersection improvements at Sierra at Tahoe	• Owns the signals in the jurisdiction • May or may not operate and maintain the signals depending on existing agreements with other agencies • Initiates project development and design internally • Reviews plans, provides approvals, and coordinates with other agencies if external approvals are needed • Advertises and Awards construction contract to Contractor • Administers construction support Operates and maintains signal interconnect / signal upgrades or identifies another lead agency that is qualified to do so	• Caltrans

2-5	Installation of mobility hub at Sierra at Tahoe Road	• Lead agency owns and acquires right-of-way to develop the mobility hub • Coordinates with agencies and private sector partners as part of the planning, design, and implementation process • Reviews plans, provides approvals, and coordinates approvals with stakeholder agencies and private sector partners	• TTD /El Dorado Transit and EDCTC
		• Advertises and Awards construction contract to Contractor • Administers construction support • Leads the maintenance and operations of the mobility hub or identifies another qualified lead agency to carry out these actions • Lead maintenance and operations agency will be responsible for coordinating with other agencies / private entities that use the mobility hub (including but not limited to transit agencies, rideshare, EV charging providers, and real-time parking operators) • Lead maintenance and operations agency will carry out property management and site maintenance or will delegate to a qualified agency or private entity	

Project ID	Project	Leading Agency Responsibilities	Potential Lead Agencies /Partners
2-6	Installation of Mobility Hub in Meyers	• Agency responsibilities are the same as the description for Project 2-6	• EDCTC / TTD / El Dorado Transit
3-1	Installation of mobility hub at Camino	• Lead agency owns and acquires right-of-way to develop the mobility hub • Coordinates with agencies and private sector partners as part of the planning, design, and implementation process • Reviews plans, provides approvals, and coordinates approvals with stakeholder agencies and private sector partners • Advertises and Awards construction contract to Contractor • Administers construction support • Leads the maintenance and operations of the mobility hub or identifies another qualified lead agency to carry out these actions • Lead maintenance and operations	• EDCTC / TTD / El Dorado Transit

		agency will be responsible for coordinating with other agencies / private entities that use the mobility hub (including but not limited to transit agencies, rideshare, EV charging providers, and real-time parking operators) • Lead maintenance and operations agency will carry out property management and site maintenance or will delegate to a qualified agency or private entity	

4-1	Install signal interconnect and upgrade signals from Canal Street to Bedford Avenue in Placerville	• Owns the signals in the jurisdiction • May or may not operate and maintain the signals depending on existing agreements with other agencies • Initiates project development and design • Reviews plans, provides approvals, and coordinates with other agencies if external approvals are needed • Awards construction contract to Contractor • Administers construction support Operates and maintains signal interconnect / signal upgrades or identifies another lead agency that is qualified to do so	• City of Placerville / Caltrans

Project ID	Project	Leading Agency Responsibilities	Potential Lead Agencies /Partners
5-1	US-50 corridor TSMO	• Lead agency develops a TSMO Working Group that identifies key TSMO agencies • Spearheads all TSMO Planning efforts including TSMO Program Planning • Coordinates initiatives identified in program plan, such as data sharing, performance metrics and after-action reviews • Consistently checks in with TSMO stakeholder agenciesabout their progress in adopting TSMO strategies	• Caltrans

5-2	TMC Upgrade	• Owns the signals in the jurisdiction • Coordinates with partner agencies for data sharing and operations • Initiates project development and design for upgrades • Reviews plans, provides approvals, and coordinates with other agencies if external approvals are needed • Advertises and Awards construction contract to Contractor • Administers construction support • Operates and maintains the TMC • Collect and share data and manage operations	• Caltrans

5-3	Interregional Transit	• Lead agency will either own, operate, and maintain recreational shuttle service or will work with a partner sector partner • Initiates project development and design • Reviews plans, provides approvals, and coordinates with other agencies / private entities if external approvals are needed • Advertises and Awards construction contract to Contractor • Administers construction support • Operates and maintains shuttle service or coordinates with private sector partner to provide operations and maintenance • The lead agency or the private sector partner may own the fleet vehicles and infrastructure	• Private entity • Partners: Caltrans, TTD, El Dorado Transit

5-4	Incident Management	• Lead agency is directly involved in incident management or oversees a department that conducts incident management • Lead agency develops an incident management working group • Facilitates discussions on adopting incident management protocols • Records standard protocols to develop an incident management manual • Facilitates consistent meetings, after action reviews, and collects data for performance metrics	• Caltrans
5-5	Corridor-wide CMS/Detection	• Owns roadway and neighboring right-of-way • Initiates project design • Reviews plan sets, provides approvals, and coordinates with other agencies if approvals are needed • Advertises and Awards construction contract to Contractor • Administers construction support • Operates and maintains roadway or identifies another lead agency that is qualified to do so	• Caltrans

VIII. Schedule

A high-level project schedule is provided for all recommended projects. It is important to note that some of the construction times for recommended projects may be longer than similar in other areas. The reason for the longer periods of construction is the presence of winter weather along this corridor. Construction for most of these recommended projects can only happen in the summer months as elements like hot-mix asphalt require temperatures higher than 50 or 60 degrees to be installed in the field.

Table 15 through Table 26 identify project schedules for each of the design projects.

Table 20 - 1.1 Project Schedule

1-1: Install signal interconnect and upgrade signals from Stateline Avenue to Lake Tahoe Blvd																																	
Task	**Approximate Duration**	Start Year				+1				+2				+3				+4				+5				+6				+7			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Project Management	Duration of Project																																
Project Initation	6-9 months																																
Environmental Documentation	12-18 months																																
Design	24 months																																
Construction	36 months																																

Table 21 - 2.1 Project Schedule

2-1: Designated area for chain control																																	
Task	**Approximate Duration**	Start Year				+1				+2				+3				+4				+5				+6				+7			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Project Management	Duration of Project																																
Project Initation	6-9 months																																
Environmental Documentation	12-18 months																																
Design	24 months																																
Construction	36 months																																

Table 22 - 2.2 Project Schedule

2-2: Installation of truck pull out at PM 61.9																																	
Task	Approximate Duration	Start Year				+1				+2				+3				+4				+5				+6				+7			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Project Management	Duration of Project																																
Project Initation	6-9 months																																
Environmental Documentation	12-18 months																																
Design	24 months																																
Construction	36 months																																

Table 23 - 2.3 Project Schedule

2-3: Truck Climbing Lanes on EB US-50 from PM 61.9 to PM 65.0																																	
Task	Approximate Duration	Start Year				+1				+2				+3				+4				+5				+6				+7			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Project Management	Duration of Project																																
Project Initation	6-9 months																																
Environmental Documentation	12-18 months																																
Design	24 months																																
Construction	48 months																																

Table 24 - 2.4 Project Schedule

2-4: Intersection Improvements at Sierra at Tahoe																																	
Task	**Approximate Duration**	Start Year				+1				+2				+3				+4				+5				+6				+7			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Project Management	Duration of Project																																
Project Initation	6-9 months																																
Environmental Documentation	12-18 months																																
Design	6 months																																
Construction	12 months																																

Table 25 – 2.5 Project Schedule

2-5: Installation of mobility hub at Sierra at Tahoe Road																																	
Task	**Approximate Duration**	Start Year				+1				+2				+3				+4				+5				+6				+7			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Project Management	Duration of Project																																
Project Initation	6-9 months																																
Environmental Documentation	12-18 months																																
Design	14 months																																
Construction	36 months																																

Table 26 - 2.6 Project Schedule

2-6: Installation of mobility hub at Sierra in Meyers																																			
Task	**Approximate Duration**	Start Year				+1				+2				+3				+4				+5				+6				+7			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Project Management	Duration of Project																																
Project Initation	6-9 months																																
Environmental Documentation	12-18 months																																
Design	14 months																																
Construction	36 months																																

Table 27 - 3.1 Project Schedule

3-1: Installation of mobility hub at Camino																																	
Task	**Approximate Duration**	Start Year				+1				+2				+3				+4				+5				+6				+7			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Project Management	Duration of Project																																
Project Initation	6-9 months																																
Environmental Documentation	12-18 months																																
Design	14 months																																
Construction	36 months																																

Table 28- 4.1 Project Schedule

4-1: Install signal interconnect and upgrade signals from Canal Street to Bedford Avenue in Placerville																																	
Task	**Approximate Duration**	Start Year				+1				+2				+3				+4				+5				+6				+7			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Project Management	Duration of Project																																
Project Initation	6-9 months																																
Environmental Documentation	12 months																																
Design	6 months																																
Construction	18 months																																

Table 29 - 5.2 Project Schedule

5-2: TMC Upgrade																																	
Task	**Approximate Duration**	Start Year				+1				+2				+3				+4				+5				+6				+7			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Project Management	Duration of Project																																
Project Initation	6-9 months																																
Environmental Documentation	12 months																																
Design	6 months																																
Construction	14 months																																

Table 30 - 5.5 Project Schedule

5-5: CMS and Detection																																			
Task	Approximate Duration	Start Year				+1				+2				+3				+4				+5				+6				+7			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Project Management	Duration of Project																																
Project Initation	6-9 months																																
Environmental Documentation	12 months																																
Design	12 months																																
Construction	12 months																																

Table 31 – 5.5 Project Schedule

5-5: Detection																																	
Task	Approximate Duration	Start Year				+1				+2				+3				+4				+5				+6				+7			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Project Management	Duration of Project																																
Project Initation	6-9 months																																
Environmental Documentation	12 months																																
Design	10 months																																
Construction	12 months																																

IX. Next Steps

The next steps for implementation of the results of this study will involve working with local partner agencies to find opportunities to incorporate the selected strategies into projects along the US-50 corridor.

Appendix 1 - Best Practices Memorandum

District 3 Recreation Travel Hot Spot Transportation Management Study

Best Practices Report DRAFT

April 2019

Prepared for:

Caltrans

Prepared by:

Kimley»Horn

Expect More. Experience Better.

District 3 Recreation Travel Hot Spot Transportation Management Study
Best Practices Report

Document Control Panel				
Version No	Author	Reviewed By	Submittal Date	Description/Disposition
0.5	Bouchet/Dunzo	Phaneuf/Aguigui	4/5/19	Initial Draft submittal to Caltrans

I. Purpose of Report

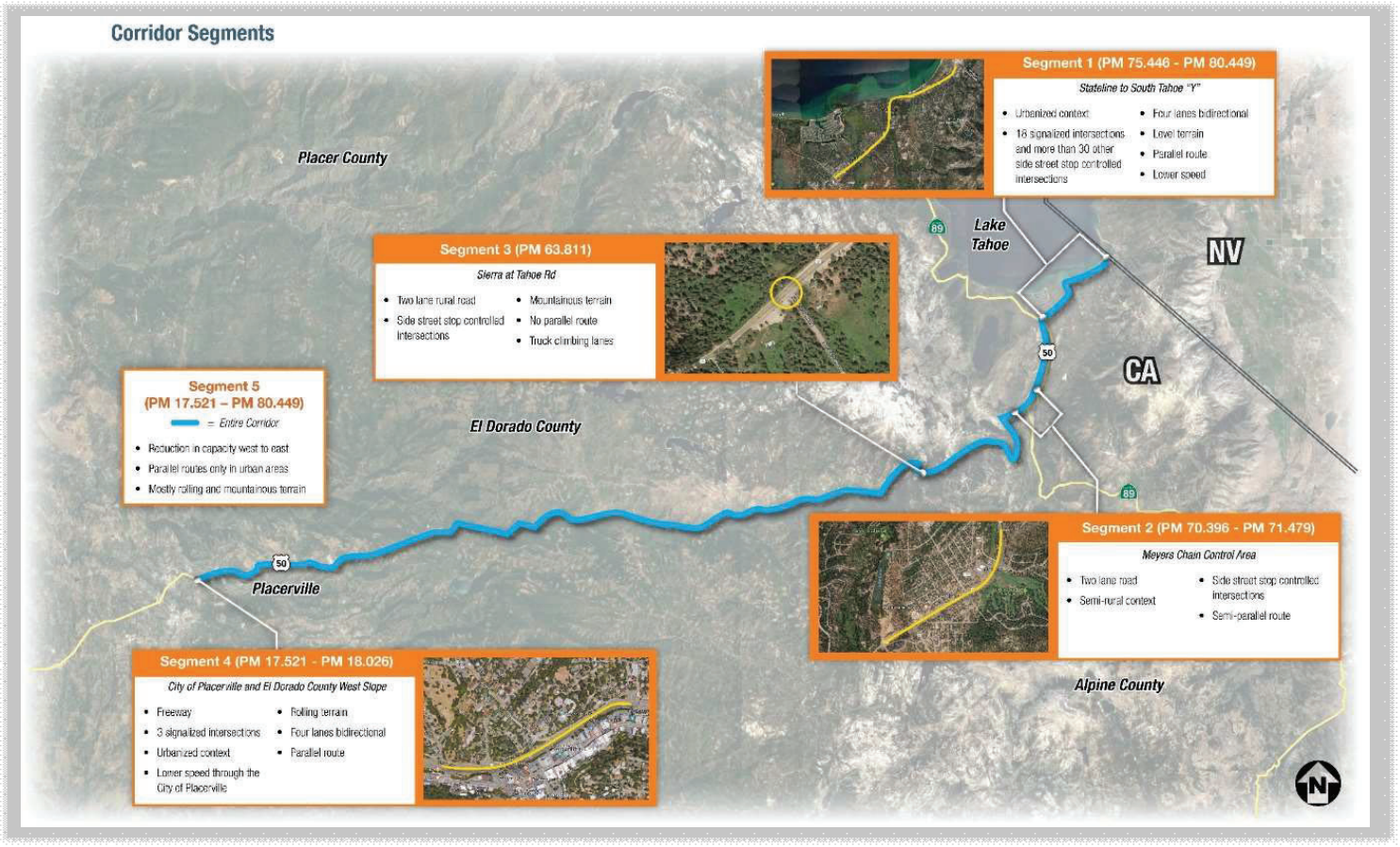
ThIS Best Practices Report presents a few examples of adaptive roadway management strategies that address challenges and issues with recreational travel, parcularly on rural roadways and freeways. These examples demonstrate similarities in whole or in part to the project study area along US-50 between Placerville and South Lake Tahoe (see figure below). The examples presented offer successful strategies that have been deployed elsewhere that may be effective in addressing issues in the US-50 project study limits. As technology continues to evolve, it is expected that opportunities to utilize adaptive roadway management strategies for safety and efficiency improvements will continue to expand.

II. Background

Adaptive roadway strategies use technology-based applications to improve safety and mobility on a corridor. These strategies include, but are not limited to, improved monitoring of traffic and weather conditions, improved signal coordination, reversible lanes and hard-shoulder running, improved traveler information, and improved CCTV surveillance for incident response. Adaptive roadway strategies are not intended to add capacity to a facility, but to manage the demand on a facility. These types of strategies integrate technology and infrastructure that adjusts with the changing needs of the roadway and related facilities. These practices can be especially helpful in recreational areas where demand can escalate during concentrated time periods not associated with typical work based commute periods and where the geography presents restrictions for adding capacity.

Typically, recurring congestion occurs on roadways consistent with work hour commute-based traffic with workers traveling from residential centers to work centers. Most long-range planning is based on adding physical capacity to expand facilities to accommodate such commutes. Facilities that service recreation venues present a different challenge. Depending on their location, they can be served by low capacity roads that are not highly used as part of the typical commute pattern. Conversely, the recreation traffic may compound the commute based traffic on Friday afternoons. Lastly, some recreation locations have such demand that the recreation based traffic is an order of magnitude greater than the typical daily traffic of a facility.

US-50 between Placerville and South Lake Tahoe (state line) serves as a key route for travelers accessing recreational opportunities east of Placerville coming to and from the greater Sacramento area and points further west. There are congestion hot spots that cause delays for residents and visitors. Caltrans District 3 (D3) and regional partners have teamed up to assess ITS strategies that may be effective in reducing congestion and improving safety through the corridor.


Corridor Segments
Placer County
Segment 1 (PM 75.446 - PM 80.449)
Stateline to South Tahoe "Y"
Urbanized context
18 signalized intersections and more than 30 other side street stop controlled intersections
Four lanes bidirectional
Level terrain
Parallel route
Lower speed
Lake Tahoe
NV
CA
Segment 3 (PM 63.811)
Sierra at Tahoe Rd
Two lane rural road
Side street stop controlled intersections
Mountainous terrain
No parallel route
Truck climbing lanes
Segment 5
(PM 17.521 – PM 80.449)
= Entire Corridor
Reduction in capacity west to east
Parallel routes only in urban areas
Mostly rolling and mountainous terrain
El Dorado County
Placerville
Segment 2 (PM 70.396 - PM 71.479)
Meyers Chain Control Area
Two lane road
Semi-rural context
Side street stop controlled intersections
Semi-parallel route
Segment 4 (PM 17.521 - PM 18.026)
City of Placerville and El Dorado County West Slope
Freeway
3 signalized intersections
Urbanized context
Lower speed through the City of Placerville
Rolling terrain
Four lanes bidirectional
Parallel route
Alpine County

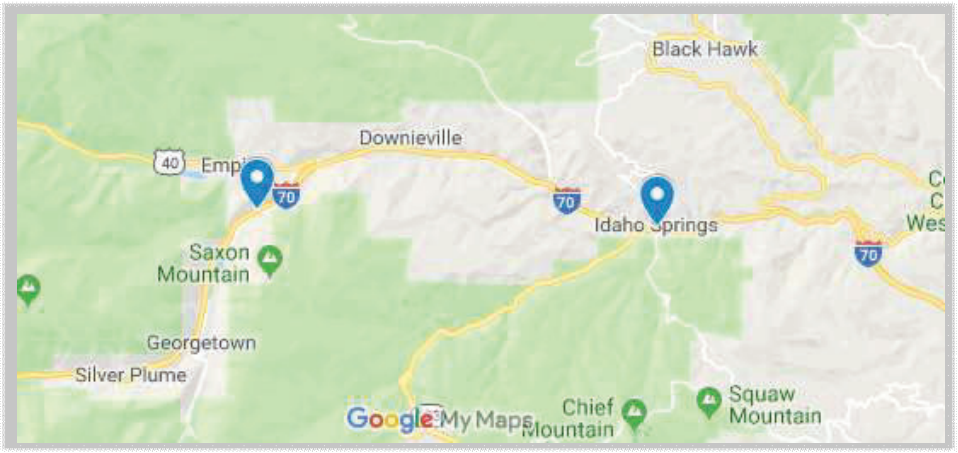
The area experiences typical commuter congestion during weekdays, but hits peak periods during weekends, especially on Fridays and Sundays. These peaks reach extremes during holiday weekends, summer, and ski season. To ease the impacts of this recreational hot spot based congestion, Caltrans D3 has partnered with Kimley-Horn to develop adaptive roadway management strategies to improve safety and mobility on the corridor. These strategies should account for local and recreational needs, while planning for both everyday operations and extreme conditions such as peak periods and weather events.

The next section presents adaptive roadway management strategies that have been deployed throughout the country that may be applicable to the US-50 corridor.

III. Best Practice Examples and Case Study References

A. Express Lanes

I-70 Mountain Express Lane – Empire to Idaho Springs, CO



I-70 serves as a major recreational corridor that connects vacationers from the Denver area to the mountain resort destinations. The most widely known destination along the corridor is Aspen. Aspen and surrounding mountain towns have peak seasons in summer and winter. For travelers heading eastbound to Denver from the resorts, they will often drive I-70 and pass through Empire. Empire is approximately 42 miles from Denver and holds a small population of around 300 residents with quaint shops that serve both residents and travelers.

Image Source: OpenSnow

The stretch of I-70 from Empire to Idaho Springs is roughly 13 miles and experiences extreme congestion that can cause eastbound travelers to remain stopped in their vehicles on Sunday afternoons. This facility has demonstrated traffic growth throughout the years: in 2000, nearly 10.3 million vehicles traveled along this stretch of I-70 annually and by 2018 that number had increased to about 13.4 million.[1]

Policymakers decided to address this challenge by deploying an express lane that provides a reliable travel alternative focused on the recreational travel pattern. The lane officially opened in 2015. Unlike a traditional express lane, which is open during typical commute times (Monday-Friday), this express lane is open during weekends and holidays to serve recreational travelers during peak seasons. When the express lane is not open, the lane serves as a shoulder. Toll pricing varies based on demand to better manage the express lane. Drivers experience one of two tolls: an express lane toll for vehicles with a transponder, and a license plate toll that adds a processing fee for those who do not have the equipment.

Originally, the lane was set to be open a little over 70 days out of the year. That number has since increased to about 100 days out of the year, but has demonstrated about 30 minutes of travel time savings.[2] The project cost totaled $72 million to implement.[3]

[1] https://www.aspentimes.com/news/colorados-traffic-nightmare-getting-worse-friends-dont-let-friends-drive-i-70/
[2] https://www.codot.gov/projects/archived-project-sites/I70mtnppsl
[3] https://www.denverpost.com/2016/05/05/i-70-mountain-tolls-made-travel-quicker-even-in-free-lanes-cdot-says/

B. Adaptive Signal Control

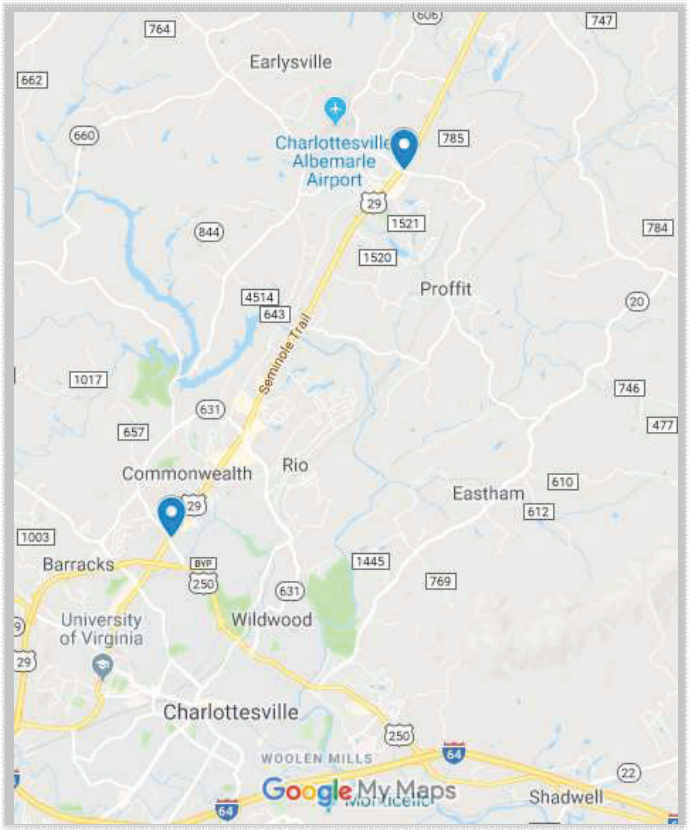
VDOT Adaptive Traffic Signal Control Technology Pilot Program

Source: VDOT / Rhythm Engineering

Adaptive traffic signal control has been around for over 40 years, and has been under constant evolution. The technology has enjoyed a renaissance in the last decade spurred by the FHWA Everyday Counts Initiative. Adaptive signal control is most effective in responding to hard to predict changing traffic conditions. Adaptive traffic signal control uses data acquired from traffic sensors to update signal timing parameters such as cycle, split, and offset based on periodic intervals. This operates differently than the traditional time-of-day signal timing, which requires staff resources, data analysis, and reimplementation. Time-of-day signal timing can often be time consuming, and ineffective in areas with hard to predict traffic flows. Adaptive signal timing carries out these steps in an automated process. Additionally, adaptive traffic signals can respond to incidents and other unplanned events to accommodate the changes in traffic flow.[4] Adaptive traffic signal control can integrate performance measures that allow for agency review of system performance. Performance measures can provide additional data about travel behavior, number of travelers on the road, and hotspots.

In 2011, Virginia Department of Transportation (VDOT) launched a pilot program for adaptive traffic signal control on 13 roadways. While there are several dozen adaptive signal control deployments throughout the country, this case study was selected because it has a wide variety of roadways cross-sections with some similar to the signalized portions of the US 50 corridor. The VDOT initiative aimed to look at innovative approaches to signal timing other than traditional set time of day timing plans. The adaptive traffic signal control systems were brought into various cities that ranged in population size from the larger City of Charlottesville to the smaller City of Winchester.

[4] https://www.fhwa.dot.gov/innovation/everydaycounts/edc-1/pdf/asct_brochure.pdf



The pilot program evaluated effectiveness of the newly implemented systems. The evaluation found that adaptive signals led to improved travel times, reduced vehicle emissions, and improved safety.[5] However, the study also acknowledged facility characteristics that did not promote improvement with the new system.[6] These factors include if an intersection is overly saturated, if the facility is already performing well, and if the area is lacking broadband communications.[7]

Overall, the VDOT Pilot Program proved to be effective and promoted further adaptive traffic signal systems throughout the state. Charlottesville was one of the areas in the state that explored further adaptive signal improvements. In 2014, Route 29 was selected for deploying this technology based on its heavy traffic volumes on the main corridor, interaction with intersecting streets, and for its importance to both commuters and the neighboring university: University of Virginia.[8] Eighteen intersections were selected along Route 29. The project started with Phase I, which upgraded the communication network to allow traffic engineers to make adjusts remotely. Phase II of the project upgraded the hardware to adaptive traffic signal control for further optimization and automated processes.[9]

[5] http://www.virginiadot.org/projects/resources/Culpeper/Route_29_Adaptive_Signal_Control/August_2014_BOS-InSync_Update.pdf
[6] http://www.virginiadot.org/projects/resources/Culpeper/Route_29_Adaptive_Signal_Control/August_2014_BOS-InSync_Update.pdf
[7] http://www.virginiadot.org/projects/resources/Culpeper/Route_29_Adaptive_Signal_Control/August_2014_BOS-InSync_Update.pdf
[8] https://www.cvilletomorrow.org/articles/adaptive-traffic-signals
[9] http://www.route29solutions.org/learn_more/5._adaptive_technology.asp

C. Traveler Information

New England 511

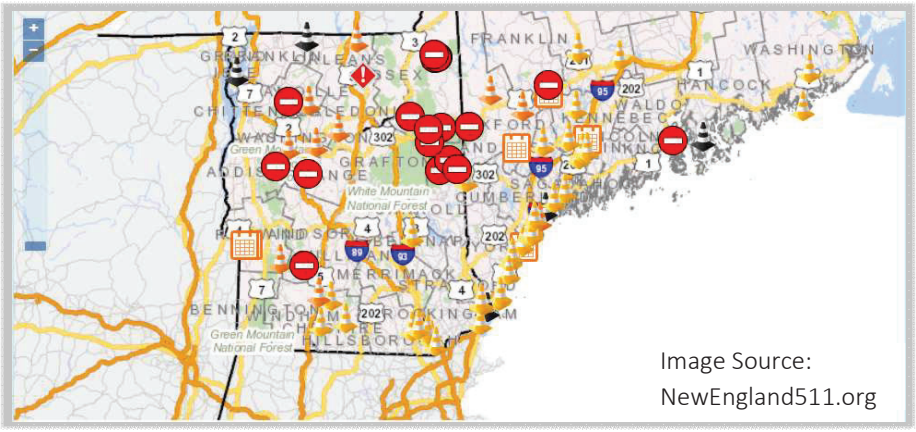


Image Source: NewEngland511.org

New England 511 is a tri-state traveler information system that provides weather and driving conditions for New Hampshire, Vermont, and Maine. The system was released in July 2016 to combat state silos, as many trips in New England cross state borders.[10] The web system serves an upgrade to the original state-run 511 systems. The individual states no longer provide a call-in number, but now have an alert and en-route system that can send updates via text or e-mail. While home to many small and medium urbanized area, this tri-state area is also known for its rural nature, scenic routes, and many recreational offerings.

The traffic map provides emergency announcements, weather predictions, weather updates from weather stations, driving conditions, changeable message signs (CMS) with messages and last updated times, special events, roadwork, and incidents. The driving conditions layer can be helpful in determining hazardous areas. The map color codes areas into categories for fair, difficult, and ice/hazardous road conditions. This can inform travelers of generally unsafe areas before they depart for a destination.

D. Variable Speed Limits

I-80 Elk Mountain VSL - Rawlins to Laramie, Wyoming

Image Source: ResearchGate
Authors: Ahmed, Eldeeb, Ghasemzadeh, and Young

[10] https://i95coalition.org/2016/08/23/new-england-511-is-here/

Variable speed limits have a variety of applications including speed harmonization as well as assisting drivers in poor visibility conditions or low vehicle traction conditions.

I-80 in Wyoming travels along Elk Mountain and the stretch of the project corridor spans a total of 52 miles. It begins east of Rawlins and ends west of Laramie. Laramie, Wyoming is a small city with about 30,000 residents and Rawlins has about 9,000 residents. I-80 also passes through Medicine Bow-Routt National Forest, Bamforth National Wildlife Refuge, and various mountains. These scenic areas bring in tourists from Cheyenne, which is about 52 miles east of Laramie.[11]

The area faces varying weather conditions, which can make it dangerous for motorists on the road. The Wyoming Department of Transportation (WYDOT) addressed these issues by implementing variable speed limits (VSL) that incorporate information from the road weather information system (RWIS). CMS provide weather and safety advisory messages. There are currently two CMS on either end of the corridor, ten VSL signs, and ten speed sensors. Together these field elements create a comprehensive system that recommend speeds for display on the VSL signs based on current weather and traffic conditions.

Image Source: WYDOT

Following system implementation in 2009, researchers examined the system's effectiveness. The report studied compliance from cars, trucks, and both types of vehicles together. The general trend showed that people were most compliant with the posted speed limits during initial implementation. Trucks seemed generally more willing to comply than cars. The system determined that overall compliance was high, which could promote VSL implementation in other locations.[12]

[11] https://safety.fhwa.dot.gov/speedmgt/ref_mats/fhwasa1304/resources2/33%20-%20Application%20of%20ITS%20In%20Rural%20Areas%20Variable%20Speed%20Limit%20System%20on%20I-80%20in%20Southeastern%20Wyoming.pdf
[12] https://safety.fhwa.dot.gov/speedmgt/ref_mats/fhwasa1304/resources2/33%20-%20Application%20of%20ITS%20In%20Rural%20Areas%20Variable%20Speed%20Limit%20System%20on%20I-80%20in%20Southeastern%20Wyoming.pdf

IV. LED Striping

LED Striping Improvements – Golden, CO

In 2017, CDOT implemented in-pavement light-emitting diodes (LEDs) lights to improve visibility for drivers along a portion of CO-93 that eventually meets with CO-72. These corridors lead to Golden, CO, which is a city frequented by tourists for its entertainment venues and recreational facilities (such as Clear Creek). The LED lights were implemented in response to numerous collisions due to dark roadways and adverse weather conditions.[13] The project uses plastic "puck" LEDs, which illuminate at dusk. The pucks are protected by a steel ring, which makes them resilient to snowplows during the winter.[14]

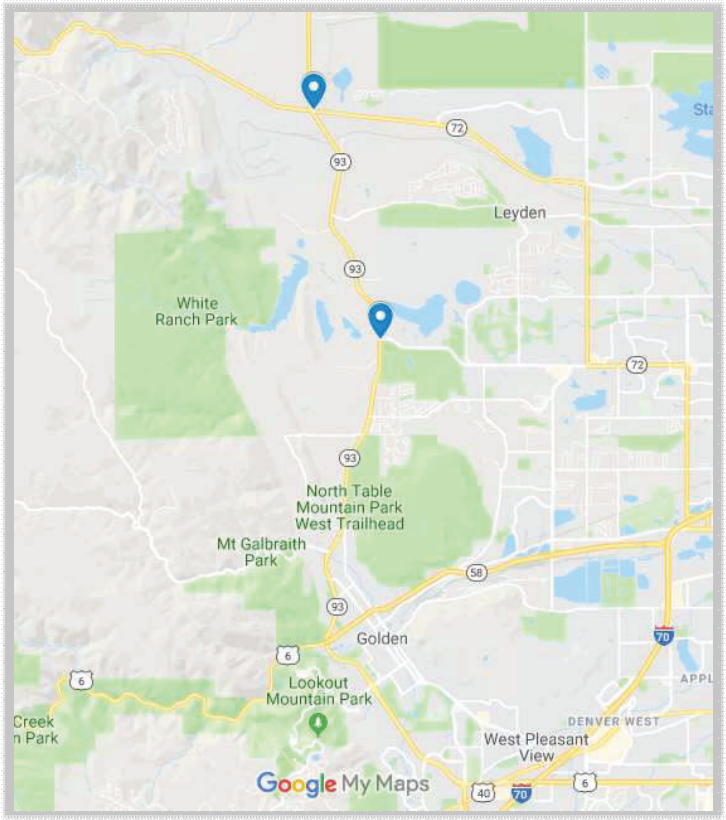



Image Source: CDOT

The installation costs for these pucks ranges from $15,000-$25,000 per linear mile, so they are strategically placed along the corridor in the most problematic areas.[15] This same practice can be applied to other areas with low visibility, sharp turns, extreme weather conditions, and unique intersections.

From Hidden Valley to Beaver Brook, it has been estimated that these LED pucks will reduce collisions by approximately 35 percent for property damage crashes and 50 percent for crashes with injuries.[16] CDOT is initiating further efforts to place LED pucks in the Denver area to promote safety in the metropolitan region. They

[13] https://www.codot.gov/news/2017-news/december/drivers-to-benefit-from-in-pavement-led-lights-on-co-93-from-64th-avenue-to-co-72-in-golden
[14] https://www.codot.gov/news/2017-news/december/drivers-to-benefit-from-in-pavement-led-lights-on-co-93-from-64th-avenue-to-co-72-in-golden
[15] https://www.codot.gov/news/2017-news/december/drivers-to-benefit-from-in-pavement-led-lights-on-co-93-from-64th-avenue-to-co-72-in-golden
[16] https://www.codot.gov/news/2017-news/december/drivers-to-benefit-from-in-pavement-led-lights-on-co-93-from-64th-avenue-to-co-72-in-golden

have created a methodology for selecting other project areas that integrates benefit-cost analysis to prioritize sites in the next three years.

V. Next Steps

The Best Practices Report presents a few types of adaptive roadway strategies. This list of best practices is not all inclusive, but is intended to present deployments in area with some similar characteristics to the US-50 project study area. These projects demonstrate innovative, technology-based approaches to addressing safety and congestion concerns for facilities serving recreation destinations as well as those that are in rural areas. The objective is to take these practices and consider them in context with the existing conditions of US-50.

The next step in the process will be to develop an existing conditions report, which will incorporate field observations and stakeholder feedback. This will allow for better assessment of adaptive roadway strategies for US-50, which will eventually lead to selection of strategies for implementation. These strategies will be incorporated into a Final Report as recommendations for adaptive roadway management improvements along US-50 from Placerville to South Lake Tahoe.