SMART REGION SACRAMENTO

SMART REGION

EL DORADO COUNTY

TECHNOLOGY IMPLEMENTATION PLAN

FINAL

February 2019

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List of Abbreviations

ATMS – Advanced Transportation Management System
ATP – Active Transportation Program
ATSPM – Automated Traffic Signal Performance Measures
AV - Autonomous Vehicle
CCTV – Closed Circuit Television
CIP – Capital Improvement Program
CMAQ – Congested Mitigation and Air Quality Improvement
CMS – Changeable Message Signs
CV – Connected Vehicle
GHG - Green House Gas
GIS – Geographical Information System
GPS - Global Positioning System
IoT – Internet of Things
ITIP – Interregional Transportation Improvement Plan
ITS – Intelligent Transportation Systems
MPO – Metropolitan Planning Organization
MTP – Metropolitan Transportation Plan
O&M – Operations and Maintenance
PTZ – Pan-tilt-zoom
RSTP – Regional Surface Transportation Program
RT - Regional Transit
RTIP – Regional Transportation Improvement Plan
SACOG – Sacramento Area Council of Government
SCS – Sustainable Communities Strategy
SHA – State Highway Account
SOV – Single Occupancy Vehicle
STARNET – Sacramento Transportation Area Network
STIP – State Transportation Improvement Plan
TMC – Traffic Management Center
TNCs Transportation Network Carriers
TOC – Traffic Operations Center
VMT – Vehicle Miles Travelled
V2X - Vehicle-to-Everything

SMART REGION SACRAMENTO

El Dorado County TECHNOLOGY IMPLEMENTATION PLAN EXECUTIVE SUMMARY

February 2019

Transportation management is growing in terms of technology, software, and applications. The future of transportation includes connected vehicles, autonomous vehicles, decision-making based on performance metrics, and a committed focus on more effective operations and management of systems rather than just capital improvements. Often there is no way to build out of congestion, one to effectively improve mobility is to manage it more efficiently.

El Dorado County is one of eight agencies that is contributing to the Sacramento Area Council of Governments' (SACOG's) Smart Region Sacramento: Intelligent Transportation System (ITS) Architecture and Future Technology Project (referred to as Smart Region Sacramento). This Technology Implementation Plan provides the El Dorado County with the framework necessary to proactively and positively affect how residents and all travelers move within and access the County transportation network. This framework and its resulting tools, if prioritized and managed well by the County, will assist with every aspect of County public service: mobility, incident response, efficient maintenance, and cost savings across the County's bottom line. Because technology investments are low-cost compared to capacity-related projects and offer potentially significant benefits to the broad transportation system and its users, prioritizing technology investments supports the vision of an integrated and reliable transportation system.

Goals and Objectives

El Dorado County participated in the development of this Technology Implementation Plan that follows the Smart Region mission statement intended to clearly define the path toward technology investments and resources moving forward from 2019.

SMART REGION MISSION STATEMENT: To improve system performance, safety, sustainability, and reliability by ensuring efficient investments in regional smart transportation projects.

The El Dorado County Smart Mobility Goals include:

- Identify projects to improve County's communications network to connect field devices on primary corridors and more effectively manage the County's transportation system
- Provide additional tools for management of special and seasonal events Evaluate ways to improve efficiency of operations and maintenance of County's transportation system
- Develop projects that are appropriate for the type of community (urban versus rural)
- Evaluate ways to improve efficiency of operations and maintenance of County's transportation system
- Develop staffing plan to include recommendations on staffing levels and requisite skillsets for engineering and technical staff
- Identify implementable strategies to improve coordination and communication with neighboring agencies (Caltrans and neighboring Cities) to enhance regional traffic management)

The Smart Region Objectives include:

- Accommodate Different Communities Throughout the Region (Urban, Suburban, Rural, and Underserved)
- Adapt the Region to New Technology
- Achieve Consistency and Reliability for all Modes
- Increase Safety
- Improve Traveler Information Dissemination
- Improve Emergency/Disaster Preparedness

System Needs

The County is challenged with significant gaps that are inhibiting the system from addressing operational and management goals. System needs are identified by Infrastructure/Data (D), Operational (O), and Institutional (I) categories:

- D1: Baseline communications infrastructure
- D2: Robust coverage to acquire real-time conditions
- D3: Central system management of tools and data to support operations
- D4: Sharing of camera images to support pre-trip, en route, and incident management purposes
- D5: Timely emergency notifications (including weather)
- D6: Share data between agencies that share a corridor
- D7: Encourage travel mode shift
- D8: Real-time traveler information
- D9: Leverage and bolster private sector traveler information services
- O1: Access to central systems 24x7
- O2: Lack of environment for TOC operations
- O3: Improve traffic operations
- O4: Trained staff to support operations
- O5: Improve special event coordination
- I1: Funding strategy
- I2: Consistent CAD systems across public safety agencies

SMART REGION SACRAMENTO

El Dorado County TECHNOLOGY IMPLEMENTATION PLAN EXECUTIVE SUMMARY

February 2019

Determining the Path Forward

Traffic operations and management technology is constantly advancing and evolving, which makes it an important consideration during the formulation of implementation strategies. It is crucial that the implementation process takes full advantage of the existing ITS technologies available while also formulating strategies that align with where technological advancements may be heading. The following are current technology trends that were evaluated for applicability in addressing needs and gaps:

- *Big data* – more data collected from roads, vehicles, and other sources
- *Transportation network carriers* – rideshare services
- *Connected vehicles* – field infrastructure and policies for data sharing
- *Autonomous vehicles* – vehicle fleets, availability, additional data
- *Smart wayfinding and citizen engagement platforms* – smart kiosks
- *Adaptive traffic signal control* – signals that can retime themselves
- *Traffic signal performance metrics* – software that finetunes how traffic signal timing serves the traveling public
- *Vehicle-to-everything communications* – data exchange
- *Internet of things* – connected devices that communicate in new ways
- *Electrification* – electric vehicles and charging stations
- *Multi-modal considerations* – on-board and fleet transit technologies

Determining the priority of which strategies are applicable to the County requires a careful evaluation of not only the existing conditions of the region but also the available technology trends that lend themselves toward potentially being solutions to the needs of the County.

Operations & Maintenance

The major elements of the future network include:

- 20 miles of fiber optic communications
- 59 traffic monitoring cameras
- 29 traffic information signs
- 24 upgraded traffic signal controllers
- 63 traffic detection devices

To effectively operate and maintain the various project elements and projects identified in this Implementation Plan, the County must be adequately staffed and prepared to sustain the system after it is deployed. Operations and maintenance procedures are essential to define the appropriate staffing levels, training, operational processes, and maintenance plans necessary to sustain an effective system. This Plan includes guidance for staffing resources necessary to support operations and maintenance activities recommended to maximize investment in assets.

Deployment Strategies

Strategies were developed and prioritized based on the County's conveyed needs and will aid in the phasing of future technology deployments and investments in the future of a Smart Region. Project corridors recommended to be outfitted with technology generally include enhanced communication infrastructure, deployment of vehicle video detection, installation of traffic monitoring cameras, installation of changeable message signs, installation of connected vehicle radio units, and traffic signal controller upgrades. Other strategies were developed to improve processes, outline standard operating procedures, or prepare for a future of connected and autonomous vehicles.

Exhibit ES-1 – *Ultimate Communications Infrastructure*

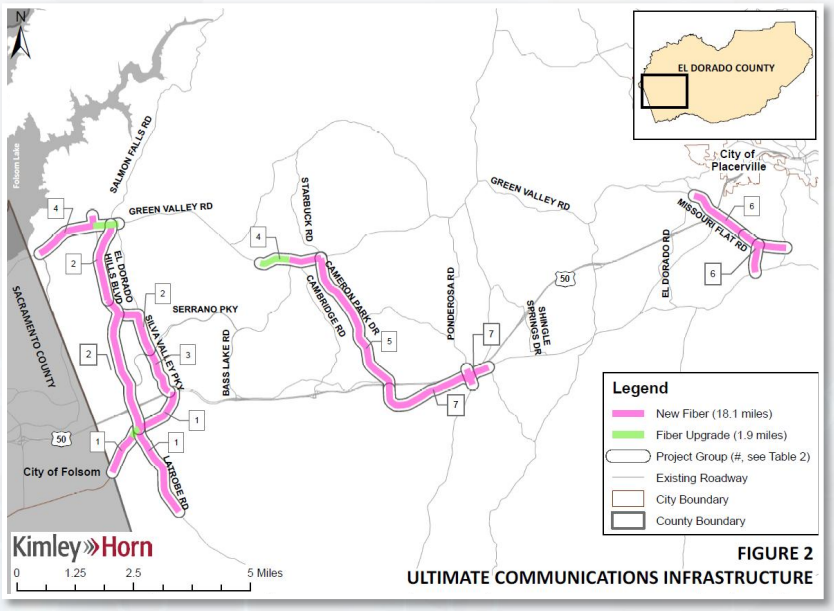

FIGURE 2
ULTIMATE COMMUNICATIONS INFRASTRUCTURE

Exhibit ES-2 – *Ultimate Cameras and Message Signs*

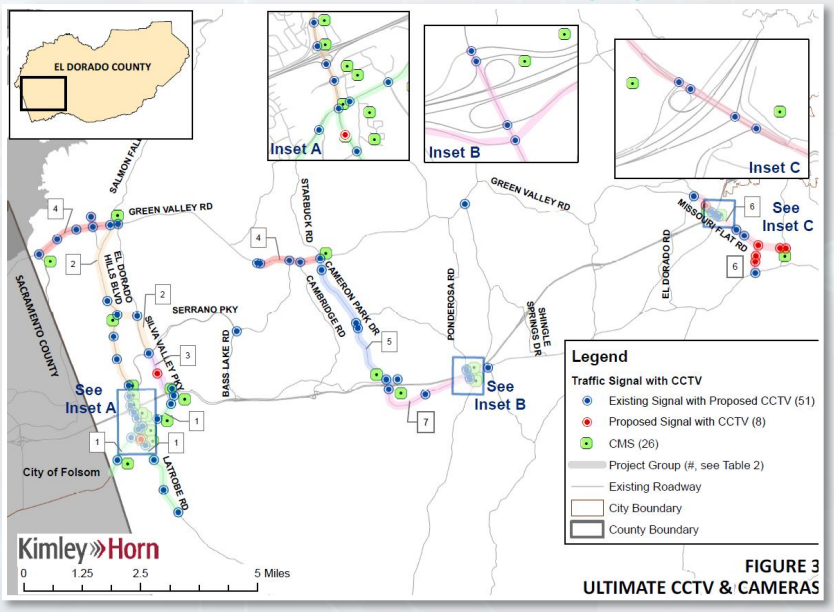

FIGURE 3
ULTIMATE CCTV & CAMERAS

INTRODUCTION

El Dorado County is one of eight agencies that is contributing to the Sacramento Area Council of Governments' (SACOG's) Smart Region Sacramento: ITS Architecture and Future Technology Project (referred to as Smart Region Sacramento). The eight partner agencies participating in this regional program are:

- City of Sacramento
- City of Citrus Heights
- City of Elk Grove
- City of Rancho Cordova
- City of Folsom
- Sacramento County
- **El Dorado County**
- Caltrans District 3

MISSION STATEMENT

To improve system performance, safety, sustainability, and reliability by ensuring efficient investments in regional smart transportation projects.

Development of the Smart Region plan follows a methodical Systems Engineering approach illustrated in **Figure 1**.

The initial discovery phase included a comprehensive review of adopted regional and local plans, existing transportation infrastructure, existing assets, and a definition of program needs. Gaps were then identified within individual agencies based on the existing conditions and input received from agency stakeholders at one-on-one meetings and the Concept of Operation group workshop. These initial phases established a benchmark for what the County currently has and defined the needs and deficiencies for the transportation system. This document culminates with a roadmap in the form of a list of implementable projects that close the gaps and fulfill the needs of the County.

On a separate and related path, the Concept of Operations was developed to document the parameters in which the system will function, define stakeholder roles and responsibilities, and outline data usage expectations.

El Dorado County participated in developing this plan and provided input to all stages of the Smart Region Sacramento program development. Information and details presented in this Technology Implementation Plan incorporate and build on the current infrastructure deployment projects and objectives to update the County's overall strategy going forward.

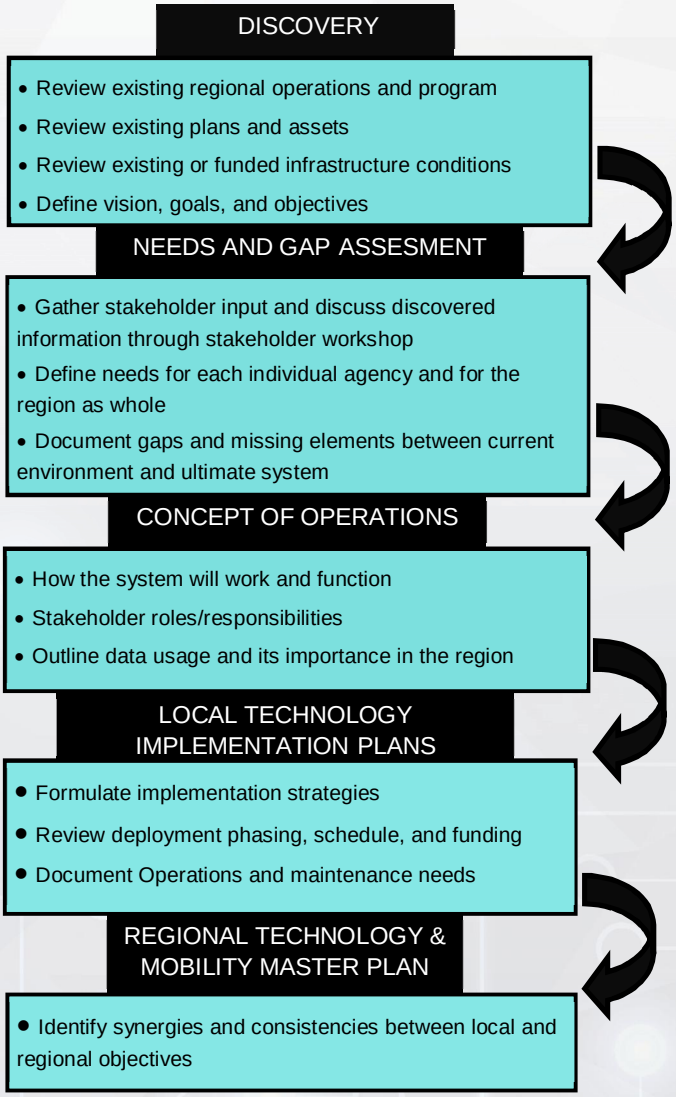

Figure 1 – Smart Region Sacramento Development Process

Additional background information was gathered from the County to enhance the previous work. This included the following:

- **One-on-one and group meetings** – At the one-on-one stakeholder meeting held in March 2018, the County's existing transportation system and ITS infrastructure was discussed. The County expressed its primary vision of the ITS network that is practical and relevant to the County's environment which is a mix of urban and rural. The system should utilize established and emerging technologies where appropriate but should not implement technology just for the sake of deploying the latest tools available. The County has experienced rapid growth in recent years and is seeking opportunities to improve its traffic management strategies along several key arterial corridors including Green Valley Road, El Dorado Hills Boulevard, and White Rock Road, amongst others.

The County has identified areas of concern in their existing transportation system. The current management processes are understaffed. Adding staff and resources depending on budget should be addressed. The County desires to improve special event management (e.g., near Apple Hill) as well as improve coordination with Caltrans and the City of Folsom. Public expectation in the County should be addressed as it affects the support for County development projects. Newcomers to the area that are unfamiliar with the planning process often don't want more development. Another area the County has pointed out is their need for real-time traffic data to make informed decisions about signal timing.

Document Organization

This document includes the following primary sections:

- **Vision, Goals, and Objectives** – Summarizes the guiding principles for developing the Plan.
- **Existing Conditions** – Summarizes existing field devices, system performance, and operations and maintenance performance.
- **Needs and Gaps Assessment** – Discusses and tabulates El Dorado County's Needs and Gaps Assessment.
- **Determining the Path Forward** – Provides a link between needs and gaps assessment and how implementation projects were developed.
- **Implementation Project Development** – Describes the methodology for grouping strategy elements into implementable projects for delivery.
- **Deployment Prioritization** – Provides information on how projects are prioritized based on 10 criteria.
- **Funding** – Describes regional, state, and federal funding opportunities for ITS Projects.
- **Operations and Maintenance** – Describes strategies for staffing and ongoing maintenance.
- **Performance Metrics** – Describes evaluation and performance standards that will be used to evaluate transportation system performance, traffic signal operations, safety, and maintenance.
- **Next Steps** – Describes how to use the results of the Technology Implementation Plan to develop and deliver projects.

PROGRAM GOALS AND OBJECTIVES

The goals and objectives of the County's transportation systems are the framework which guide the development of deployment strategies and projects. Based on the existing transportation management and operational needs, El Dorado County defined the following objectives for the Plan:

- Identify projects to improve County's communications network to connect field devices on primary corridors and more effectively manage the County's transportation system;
- Provide additional tools for management of special and seasonal events;
- Develop projects that are appropriate for the type of community (urban versus rural);
- Evaluate ways to improve efficiency of operations and maintenance of County's transportation system;

- Develop staffing plan to include recommendations on staffing levels and requisite skillsets for engineering and technical staff; and
- Identify implementable strategies to improve coordination and communication with neighboring agencies (Caltrans and the City of Folsom) to enhance regional traffic management).

The Smart Region Plan has six key regional objectives that emerged as most critical throughout the project process, particularly during the strategy implementation phase. These six key objectives were crucial in guiding the strategy development process. The Smart Region objectives are:

- Accommodate Different Communities Throughout the Region (Urban, Suburban, Rural, Underserved)
- Adapt the Region to New Technology
- Achieve Consistency and Reliability for all Modes
- Increase Safety
- Improve Traveler Information Dissemination
- Improve Emergency/Disaster Preparedness

These primary objectives are important considerations throughout Smart Region development and implementation because they provide guidelines for identifying projects and creating performance measures to evaluate program efficacy. In addition, these objectives are helpful in determining strategy prioritization and deployment phasing priorities, which will be discussed in more detail later in this document.

EXISTING CONDITIONS

Traffic Signals

El Dorado County currently owns, operates, and maintains 51 traffic signals within the County, with the majority of those signals located on key arterial and collector roadways. **Appendix A** provides an inventory of County-owned traffic signals and **Exhibit 1** of **Appendix A** presents the locations of these signals. The County primarily uses 332 traffic signal cabinets to house a combination of McCain Type 170, Trafficware Type 2070, Trafficware Type 970, and Trafficware Type 980 traffic signal controllers. All controllers are running either C8V4, Naztec v76, or NTCIP v61 firmware. However, the County is in the process of replacing all remaining Type 170 controllers with Type 980 and Type 2070 controllers, as well as migrating to Peak Type P Cabinets.

All County intersections run full-actuation and are not coordinated. While there is a limited traffic signal interconnect network, the County doesn't currently deploy signal coordination and has no other means for time-syncing. The County uses Trafficware's ATMS.now traffic signal central system software, but the application is not currently connected to any of the County's traffic signals and is only used for database and inventory purposes as of July 2018.

Signalized intersections in the County use in-pavement loops for nearly all vehicle detection. The intersection of Cameron Park Drive at Green Valley Park, and Black Bart Avenue and Pioneer Trail

are two locations that have Gridsmart video detection. The County owns several additional Gridsmart cameras that they hope to deploy at intersections where the existing detection loops have failed or are not working properly. Lastly, the County has two intersections with radar detection: El Dorado Hills Boulevard at Saratoga Way/Park Drive, and Silva Valley Parkway at Harvard Way. The County is exploring the use of combined video and radar detection devices to enhance bicycle and pedestrian detection.

Communications Network

The existing traffic signal communications network consists of approximately 1.8 miles of inactive copper signal interconnect located along Francisco Drive, Green Valley Road, and White Rock Road. **Exhibit 1** of **Appendix A** depicts the location of the existing County communications infrastructure. The only existing fiber optic cable in the area is a Caltrans fiber optic cable backbone that runs along US 50. Caltrans utilizes Bluetooth detection along US 50 and has interconnect at all the interchanges. The County hopes to gain access to the Caltrans fiber as well as integrate with Caltrans intersections along key corridors. A new policy is being considered to require all Capital Improvement Program (CIP) projects to include empty conduit for the County to use for future communications needs.

Closed Circuit Television (CCTV) Cameras

The only existing CCTV camera located in El Dorado County is at the intersection of Black Bart Avenue and Pioneer Trail in South Lake Tahoe, which is located outside of the SACOG study area. This CCTV camera is not connected via fiber optic communications.

Changeable Message Signs (CMS)

The County owns two (2) portable CMS and rents additional devices as needed. The County primarily uses the portable CMS for event traffic control and moves them around as needed.

Annual Daily Traffic (ADT) Vehicle Count Stations

The County currently operates an ADT Count Program that utilizes 20-year old tube counters to collect vehicle data. The County has eight to ten operational traffic counters.

Traffic Management/Operations Center

The County does not have a Traffic Management Center (TMC), though, as mentioned in the Traffic Signal section above, the County does use the Trafficware ATMS.now traffic signal central system software for traffic signal database management. However, the system is not interconnected to any of the County signals and is only used for database purposes currently.

System Performance

The County has identified a need for redirecting vehicles to back roads and other quicker routes rather than using key arterial routes. In doing so, they are interested in installing CCTV cameras throughout the County as there are no deployed CCTV's currently. The Caltrans Interchange project was

identified as a potential project in which El Dorado County could implement CCTV cameras for traffic monitoring. The County currently maintains one to two portable Changeable Message Signs, but is looking to own more, including a few stationary signs at key locations. As the County only uses tube counts and has no permanent count locations, there is a desire to investigate the usage of detection at traffic signals for collecting counts. Bluetooth capabilities in El Dorado County exist on Highway 50 and the program is maintained by Caltrans.

NEEDS AND GAPS ASSESSMENT

El Dorado County's Needs and Gaps Assessment process was conducted using a combination of methods. Existing documents and plans related to transportation and technology relevant to the County and the region were thoroughly reviewed. These needs and gaps form the foundation for identifying project solutions.

The needs and gaps were identified and categorized by the following distinctions:

- **Infrastructure/Data (D)** – field infrastructure, communications equipment, data, systems/software
- **Operations (O)** – operational enhancement projects and processes, staffing
- **Institutional (I)** – policies, agreements, funding/programming mechanisms, reporting/documenting, training

The following **Table 1** summarizes El Dorado County's Needs and Gaps Assessment.

Table 1 – El Dorado County Needs and Gaps Summary

ID#	Need	Gap
	Infrastructure/Data	
D1	Baseline communications infrastructure	Can't communicate with all field devices. Closing the gaps in the County's communications network will create redundancy in the County's communications and replacing legacy copper communications with fiber will result in a more robust network.
D2	Robust coverage to acquire real-time conditions	Lack of device coverage and range of devices to collect different types of data. Lack of comprehensive detection and CCTV camera equipment at signalized intersections prevents the County from providing traffic-responsive signal timing and from adequately monitoring real-time conditions.
D3	Central system management of tools and data to support operations	Existing central system does not have communications to the field equipment.
D4	Sharing of camera images to support pre-trip, en route, and incident management purposes	County only has one CCTV camera deployed. Also, communications infrastructure not in place to share video with public or public safety agencies or partner agencies.
D5	Timely emergency notifications (including weather)	The delay in emergency notifications delays response capabilities and prevents accurate real-time data from being shared.
D6	Share data between agencies that share a corridor	Lack of real-time or planned knowledge of corridor restrictions operate efficiently across jurisdictions.

ID#	Need	Gap
D7	Encourage travel mode shift	Limited information is available or disseminated to support mode shift. Lack of TNC coordination locations for last-mile transit connections.
D8	Real-time traveler information	Limited real-time traveler information available to public and limited methods to disseminate information. Limited CMS equipment for communication of traveler information.
D9	Leverage and bolster private sector traveler information services	Inconsistency in data between agency services and third-party services. System data not available for use by other agencies. Lack of open data portal platform to allow for integration of third-party data.
	Operations	
O1	Access to central systems 24x7	Existing central system does not have communications to the field equipment and does not have capability to monitor field elements.
O2	Lack of environment for TOC operations	There is no area set aside for a TOC.
O3	Improve traffic operations	Automate some functions to streamline operations. Current lack of adaptive traffic control or coordinated traffic signal timing along key corridors.
O4	Trained staff to support operations	Lack of sufficient number of staff members to provide adequate IT and project management staffing. Outdated or lack of skill set to support operational or maintenance needs.
O5	Improve special event coordination	Lack of tools to monitor traffic conditions during seasonal traffic (e.g., Apple farms area) and special events (e.g., Placerville Speedway).
	Institutional	
I1	Funding strategy	Lack of reliable funding mechanism to support Smart City or Smart Region initiatives on a regional or agency-by-agency basis. Lack of regional technology procurement contract and regional technology and systems funding program.
I2	Consistent CAD systems across public safety agencies	Inability and incompatibility to share CAD data and coordinate responses across public safety agencies.

DETERMINING THE PATH FORWARD

There are many directions that SACOG and the region could move toward in implementing solutions to address the needs and gaps. While some gaps point to specific types of strategies that will directly and completely address that gap, other gaps are more difficult to solve and will require a combination of infrastructure, operations, and institutional processes to be implemented to completely address the gap.

Traffic operations and management technology is constantly advancing and evolving, which makes it an important consideration during the formulation of implementation strategies. It is crucial that the implementation process takes full advantage of the existing ITS technologies available while also formulating strategies that align with where technological advancements may be heading. The following are current technology trends that were evaluated for applicability in addressing needs and gaps as defined for the Smart Region Program:

- **Big Data** is becoming readily available as more data is acquired from connected field infrastructure on a near-real-time-basis as well as additional data-rich information from new sources such as probe vehicles, fleet vehicles, and connected vehicles becomes more mainstream. Big Data is about predictive analytics; or more simply, improving our ability to predict and anticipate outcomes. Historically, transportation data has been difficult and costly to obtain but as it becomes increasingly available through GPS, phone apps, and many other sources this is quickly changing. Big Data is already changing the way we plan, analyze, and operate our transportation, and big data will play a large role in affecting the evolution of STARNET.
- **Transportation Network Carriers (TNCs)** – TNCs pair passengers with drivers who provide on-demand service, most often via websites or mobile apps. Services such as Uber and Lyft are examples of the sharing economy. Increasingly, transit providers, including Sacramento Regional Transit (RT), are beginning to provide on-demand transportation services to augment their systems. These services have the potential to address the long-standing challenge of first-mile, last-mile service to expand the reach of existing bus and light rail service.
- **Connected Vehicle (CV)** readiness, both in terms of infrastructure and institutions, was identified as a need and yet full connected vehicle CV deployment is gradually becoming a reality in the industry. As a result, it is important that the partner agencies are equipped with the infrastructure and projects needed to adapt to those changes and needs. It is important to recognize the changing landscape of technology options with connected vehicles because the federal guidelines have not been finalized. Agency adoption of providing data to or collecting data from a connected vehicle will need to have benefits outlined and likely deployed on a scalable basis until more formal guidelines for adoption and expectations are defined.
- **Autonomous Vehicle (AV)** readiness, in terms of institutions and policies, was identified as a need as AVs are being tested on more and more roadways throughout the Country. Although functioning autonomously, there may be a variety of useful data that could be provided to the vehicle, collected by the vehicle, or shared between AVs that could require an agency role and responsibility.
- **Smart Wayfinding and Citizen Engagement Platforms –** Smart kiosks offer new, interactive ways for municipalities, business improvement districts, and marketing organizations to communicate with the public. Citizens and visitors use touchscreen displays to access a wide variety of information ranging from smart wayfinding and transit planning to locating nearby businesses and entertainment. Cities have the ability to broadcast important service announcements and relay emergency alerts enhancing public safety.
- **Adaptive Traffic Signal Control** enables traffic signals to proactively adjust signal timing parameters to accommodate unplanned variances in traffic demand. There are several adaptive systems in the market, each of which tends to accommodate specific corridor needs (e.g., maximize throughput, minimize side-street delay).
- **Automated Traffic Signal Performance Measures (ATSPM)** is a software module add-on to many traffic signal software applications that processes and analyzes traffic signal data to display and report performance metrics of an individual traffic signal, corridor, and/or across the traffic signal network. This feature enables agencies to proactively identify trouble areas, report on corridor performance, and facilitate efficient traffic management.

- **Vehicle-to-Everything (V2X) Communications** is becoming a highly-desirable system feature that establishes an exchange of data between vehicles and field infrastructure. One example includes Signal Phase and Timing data that enables subscribed vehicles to display when a downstream traffic signal will change. Another example is collecting vehicle location information for collision avoidance or for origin-destination analysis.
- **Internet of Things (IoT)** – Often referred to as "connected devices", items are embedded with technology such that objects can exchange and collect data. From a streetlight bulb that notifies that it needs changing to roadway sensors that monitor traffic speeds, the opportunities to collect and use data to improve the maintenance and operations of the transportation system are rapidly expanding.
- **Electrification** – The transportation sector is responsible for approximately 36 percent of California's Green House Gas (GHG) emissions (50 percent when you include refineries) and more than 80 percent of NOx and particulate emissions. In conjunction with the continued addition of renewable energy sources as the basis for electrification, the positive impact of air quality will be significant. As the location of charging stations continues to expand, electric vehicles will also become increasingly easy to own and operate.
- **Multi-Modal Considerations –** Municipalities and transit providers are also faced with the challenge of embracing technological advancements. These technologies are aimed at improving bicycle and pedestrian safety and mobility, as well as maximizing the efficiency and convenience of transit service. Technological advancements that provide more meaningful real-time and situational awareness information for multi-modal users include detection techniques, minimizing conflicts at traffic signals, fleet management, mobile traveler information, and Automatic Vehicle Location (AVL), among other methods. Multi-modal transportation users are diverse in their ability to provide information as well as receive it, and service providers are already applying technology in equipment as well as systems to provide a greater experience for the user.

El Dorado County is a participant in SACOG's Civic Lab program, a regional effort launched by SACOG in August 2017. Civic Lab aims to improve effectiveness and efficiency of the region's transportation systems by finding creative solutions to smart mobility issues. The County is involved in the apple farms area project which is proposing to reduce traffic volumes during peak tourist periods through wayfinding apps, increased signage, and transit improvements.

Determining the priority of which strategies are applicable to the SACOG region requires a careful evaluation of not only the existing conditions of the region (the infrastructure available, the data available, and the propensity for agencies to adopt certain technologies over others) but also the available technology trends that lend themselves toward potentially being solutions to the needs of the SACOG region.

IMPLEMENTATION PROJECT DEVELOPMENT

The previous information gathering efforts and the needs and gaps assessment influence the development of El Dorado County's implementation projects. The needs and gaps illustrate the foundation for project opportunities to enhance the overall transportation system. The foundation of

knowledge and understanding of previously built projects ensures that the implementation projects are realistic and relevant to the County's conditions.

To support development and expansion of the transportation network, several deployment parameters were considered in conjunction with previously discovered information to formulate overarching implementation criteria. These include:

- Key Emerging Technologies – Provisions for CV/AV technology, multi-modal considerations (including transit), as well as other important initiatives in the region that are advancing innovative technology deployment.
- Emergency/Disaster Preparedness – Strategies facilitate the ability to improve the effectiveness of emergency and disaster response.
- Data Availability –The type and quality of available data, how data set can be improved and/or expanded, and how data can be effectively leveraged once it has been analyzed.
- Project Dependencies – Certain project elements must be constructed before other elements can be advanced.
- Overlap with Other projects – Other projects within the same project area offer efficiencies for construction.
- Safety – Strategy contributes to improved safety or reduction of collisions.
- Context of Individual Agency – Specifically customized for applicability to each agency.

Strategy Development

Overarching project strategies have been developed to identify a broad set of technology solutions that will address infrastructure/data, operations, and institutional stakeholder needs and system gaps. The strategy summary format is provided below and is detailed for each strategy in **Appendix B – Strategy Summary Sheets**:

- **ID #** – This is the identification number of the strategy.
- **Title** – This is the title of the strategy.
- **Description** – This is a succinct description of the strategy for context.
- **Relation to Needs** – This is a mapping of strategies to the original needs, recognizing that one strategy may serve multiple needs.
- **Scope/Limits** – This is a succinct summary of what is included in the strategy and/or locations (if applicable) of where the strategy would be deployed.
- **Considerations** – This is a bullet listing of other strategy ID #'s and Titles that are relevant for the County to reference during implementation or that could be packaged together to be implemented as part of a larger project in a particular timeframe.
- **Prerequisite Dependencies** – This is a bullet list summary of the high-level steps required to implement the strategy.

When all of these strategies are constructed, El Dorado County will have established an overall communications network and field equipment that enables staff to effectively monitor and manage

traffic congestion. Infrastructure strategies, inclusive of communications media, CMS, CCTV cameras, detection, and traffic signal controllers, are visually presented in **Figures 2** and **3**, which shows the ultimate communication and ITS device deployment in the County, respectively.

DEPLOYMENT PRIORITIZATION

After developing the various strategies, strategy element segments and locations are grouped into specific projects that will be prioritized for implementation. The list of implementation projects is included in **Appendix D**. In general, strategy elements pertaining to ITS infrastructure improvements have been grouped based on a corridor or geographical location. Projects related to operational and institutional strategies are anticipated to be deployed on a standalone basis. El Dorado County has a unique set of projects specifically tailored to the priorities outlined above as they relate to the County.

Prioritization

Projects are prioritized based on a set of 10 local and regional criteria and emphasize providing the infrastructure foundation, systems and data integration to enhance functionality, and innovative advanced technology solutions when other critical elements are in place. Each criterion was weighted to represent some criteria being more important than others. The 10 local objectives and their weighting value are shown below:

1. **Extent that project achieves local objectives (14)** – project emphasizes addressing local needs
2. **Adaptable to new technology (13)** – can handle new technology without needing to be replaced
3. **Safety (13)** – contributes to improved safety
4. **Addresses multijurisdictional networking (10)** – contributes to a multijurisdictional solution
5. **Improves reliability and consistency of driver trips (10)** – traveler information to drivers helps them make informed and real-time decisions
6. **Improves traveler information and dissemination (10)** – provides more and better information about roadway conditions and multimodal options
7. **Contributes to operational and institutional efficiency (10)** – enables staff to more efficiently manage the transportation network
8. **Enhances major corridors (10)** – corridors that serve more people than other corridors
9. **Emergency/disaster preparedness (5)** – better information to public and more robust system
10. **Other projects rely on this project (5)** – this project must be done before other projects can begin

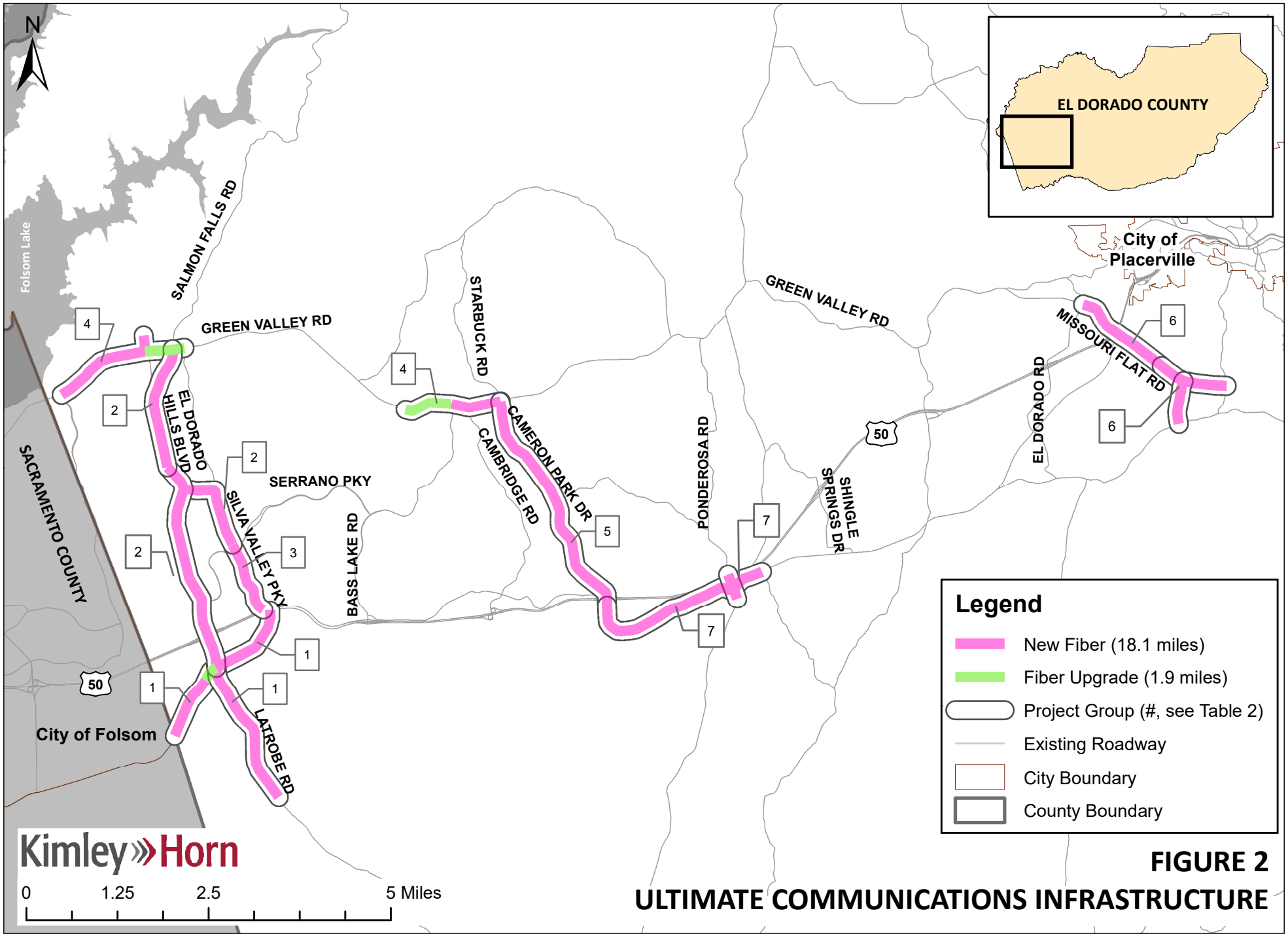

FIGURE 2

ULTIMATE COMMUNICATIONS INFRASTRUCTURE

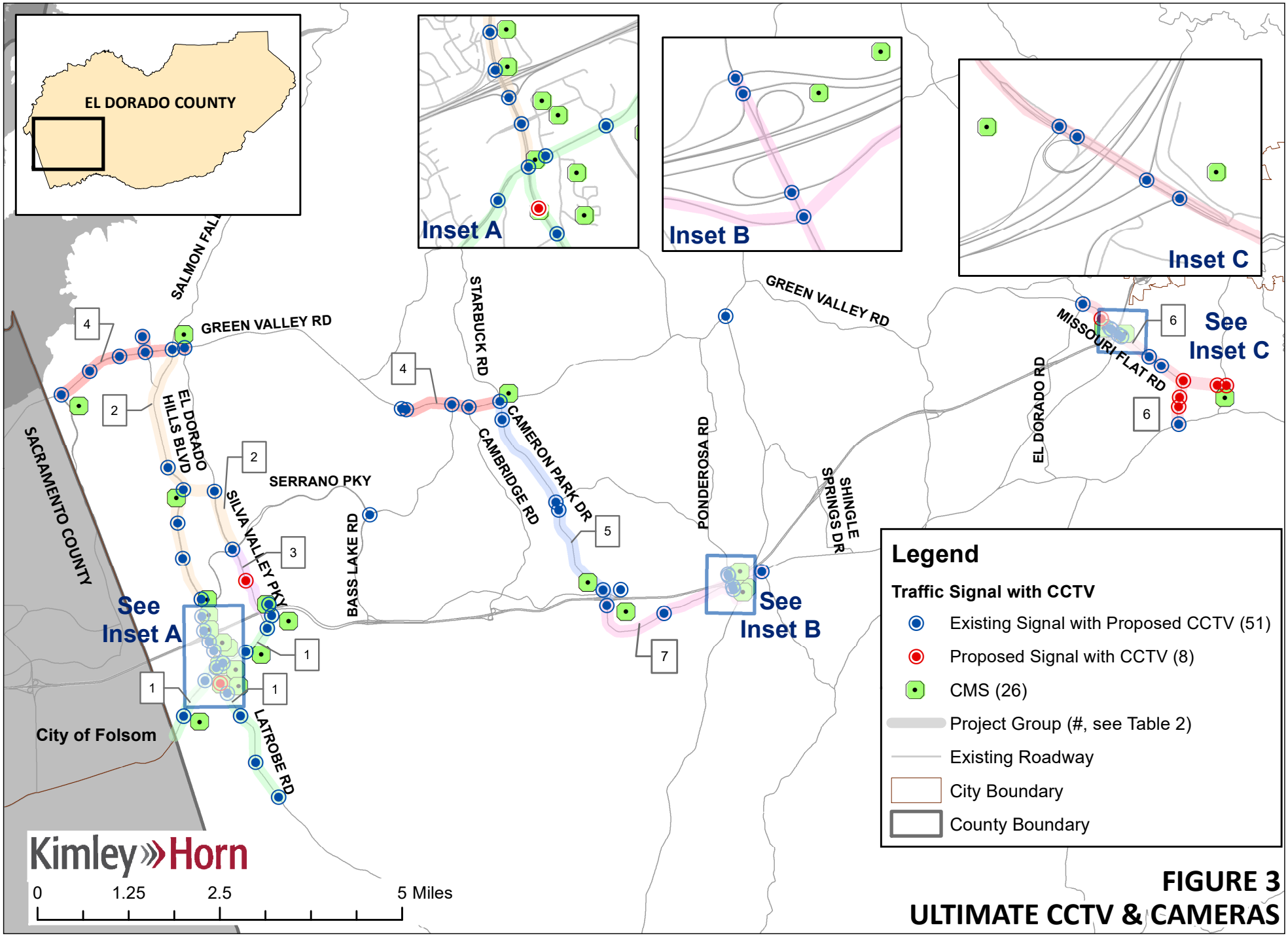

FIGURE 3
ULTIMATE CCTV & CAMERAS

Each project was given a subjective score of zero (0) to four (4) for each criteria based on its relevancy to the criteria. Project scores were totaled and ranked to identify the highest priority projects.

This Plan is intentionally structured to be agile and flexible in its implementation to enable the County to quickly identify a candidate project with a concise set of actions and next steps as funding becomes available and opportunities arise, or to reprioritize projects based on specific areas of emphasis.

Cost Estimations

Planning level cost estimations were prepared to reflect an order-of-magnitude costs for each project. A summary of specific costs or considerations related to implementing Smart Region elements is provided for each strategy where a cost can be reasonably estimated. **Appendix C – Cost Assumptions** summarizes the cost assumptions that were used to provide planning level cost estimations for each project, if applicable.

These assumptions include a detailed breakdown of capital component costs and acknowledges the project development, design, construction, integration, and operations and maintenance costs associated with each project. The cost information is a planning-level estimate to deploy each project, based on available current (2018) pricing information for similar technology projects in the region.

Throughout development of projects, a distinction was made between projects that carry a cost and those that carry little to no cost. Projects that have costs may require initial capital investments and subsequent ongoing operations and maintenance (O&M) costs. Examples of these projects would be the deployment of new field infrastructure or upgrades to existing Traffic Operations Systems elements. No cost projects tend to fall more into the institutional category and can be deployed with little to no cost and no future O&M costs. Examples of these projects would be the creation of a set of security guidelines, an interjurisdictional agreement, changes to a policy, or completing performance measurement analysis.

List of Prioritized Projects

A summary of prioritized projects is presented in **Table 2**.

Table 2 – Project Summary

Priority No.	Project Corridor	Project Description	Planning Level Cost Estimate
1	**El Dorado Hills Boulevard**- Green Valley Road to White Rock Road **Harvard Way**- El Dorado Hills Boulevard to Silva Valley Parkway **Silva Valley Parkway**- Harvard Way to Serrano Parkway	Project includes enhanced communication infrastructure through installation of new interconnect; deployment of vehicle video detection; installation of CCTV cameras; installation of CMS; and traffic signal controller upgrade.	$ 4,320,900
2	**White Rock Road**- Stonebriar Drive to Silva Valley Parkway **Latrobe Road**- White Rock Road to Investment Boulevard	Project includes enhanced communication infrastructure through installation of new interconnect and replacement of legacy equipment; deployment of vehicle video detection; installation of CCTV cameras; installation of CMS; and traffic signal controller upgrade.	$ 4,036,600
3	**Silva Valley Parkway**- Serrano Parkway to White Rock Road	Project includes enhanced communication infrastructure through installation of new interconnect and installation of vehicle video detection.	$ 1,181,600
4	**Green Valley Road-** Sophia Parkway to Silva Valley Parkway, and Pleasant Grove School to Cameron Park Drive **Francisco Drive**- Village Center Drive to Green Valley Road	Project includes enhanced communication infrastructure through installation of new interconnect and replacement of legacy equipment; deployment of vehicle video detection; installation of CCTV cameras; installation of CMS; and traffic signal controller upgrade.	$ 2,989,700
5	**Cameron Park Drive-** Green Valley Road to Coach Lane	Project includes enhanced communication infrastructure through installation of new interconnect; installation of vehicle video detection; and installation of CCTV cameras.	$ 3,140,200
6	**Missouri Flat Road**- El Dorado Road to Highway 49 (including Diamond Springs Parkway)	Project includes enhanced communication infrastructure through installation of new interconnect; installation of vehicle video detection; and installation of CCTV cameras; installation of CMS; and traffic signal controller upgrade.	$ 2,127,600
7	**Ponderosa Road/S. Shingle Road-** N. Shingle Road to Durock Road **Durock Road-** Cameron Park Drive to S. Shingle Road **Mother Lode Drive-** S. Shingle Road to French Creek Road	Project includes enhanced communication infrastructure through installation of new interconnect; installation of vehicle video detection; and installation of CCTV cameras; installation of CMS; and traffic signal controller upgrade.	$3,316,600
8	**N. Shingle Road at Green Valley Drive**	Project includes installation of vehicle video detection.	$ 36,000

Priority No.	Project Corridor	Project Description	Planning Level Cost Estimate
N/A	Replace End-Of-Life/Legacy Equipment	Establish inventory of modern equipment to replace failing field devices	$ 333,900
	Communication Improvement for Interregional Connectivity	Eliminate communication gaps to improve interregional connectivity	See Regional Document
	Replace Agency ATMS	Establish updated central management system	$ 200,000
	Sharing CCTV Imagery with Other Agencies	Establish center-to-center network for sharing CCTV imagery between agencies	See Regional Document
	Timely Emergency Notifications	511 Upgrade	See Regional Document
	Traffic Operations Center (Local) **TOC Site Evaluation** **TOC Standard Operating Procedures and Functional Requirements**	Establish a new agency traffic operations center	$ 130,000

FUNDING

Implementation of many of the projects identified by this Plan are contingent upon acquiring additional funding. The following are potential funding opportunities for ITS infrastructure and systems that are described in additional detail below.

- Local Funding Programs
- SACOG Funding Programs
- State Funding Programs
- Federal Funding Programs
- Grants/Pilot Programs
- Other Funding Types

Local Funding Programs

There is an annual CIP that El Dorado County develops. The 2018 CIP includes a prioritization of transportation improvement projects based on their ability to attract grant funding. The projects that have a higher likelihood of attracting grant funding are more desirable. Funding opportunities are identified as Federal, State, or other. Each project includes a summary of various types of costs and the funding strategy for each.

SACOG Funding Programs

SACOG offers a variety of different annual funding programs for public agencies within the region. The funding programs relevant to ITS projects are shown in **Table 3**.

Table 3 – SACOG Funding Programs

Program	Funding Amount	Criteria	Performance Outcomes Measured for Selection
Regional Program	$92,586,000 Amount given and to how many projects will vary depending on applicants	• Eligible for CMAQ, RSTP or STIP funds • Listed in recent MTP/SCS or fit within a lump-sum project category • Must match 11.47% of award with non-federal funds • Begin construction or operation before April 2025	• Reduce regional VMT per capita • Reduce regional congestion VMT per capita • Increase multi-modal or alternative travel choices • Provide long term benefits, sustaining both rural and urban economies • Improve movement of goods, in and through the region • Improve safety and security • Maintain and improve upon the existing transportation system

Program	Funding Amount	Criteria	Performance Outcomes Measured for Selection
Green Region	$11,760,000 Amount given and to how many projects will vary depending on applicants	• Eligible for CMAQ, RSTP or STIP funds • Must match 11.47% of award with non-federal funds • Begin construction or operation before April 2021 • Request for construction funding demonstrates that environmental, engineering and right-of-way will be ready by the time funds are requested • Agency is capable of on-going O&M costs	• Reduce regional VMT per capita • Increase multi-modal or alternative travel choices • Advances the use of electric and other zero-emission vehicles • Project exists within at least one of the Green Region Plan program areas
TDM Innovations Grant	$750,000 Awards of $25,000-$150,000 per project	• El Dorado, Placer, Sacramento, Yuba, Yolo and Sutter Counties • Must match 11.47% of award with non-federal funds • Program must be active within 2 years of an agreement being signed • Include a detailed project budget and how funding will be used • Must demonstrate link between project and grant program's goal to reduce SOV trip and miles • Demonstrate how the project will serve underserved or insecure communities • Demonstrate creativity and appeal to a broad audience	• Innovative and Uniqueness of Project (40pts) • Potential for project to reduce motor vehicle trips and miles (15pts) • Target/Market Audience Development (15pts) • Description of plan to measure VMT reductions, data collection/analysis and project modification/adaptability (25pts) • Budget & project cost/participant (5pts)
Regional Active	$11,664,000 ($439,560 Statewide)	• Projects must first complete in Statewide ATP program before	• Disadvantaged communities • Potential to increase users (biking/walking)

Program	Funding Amount	Criteria	Performance Outcomes Measured for Selection
Transportation Program	Amount given and to how many projects will vary depending on applicants	being eligible for smaller MPO programs • Must match 11.47% of award with non-federal funds	• Public participation and planning • Potential to reduce crashes (fatalities and injuries)
Metropolitan Transportation Improvement Program	Varies based on available federal and state funds	• Projects must be included in the Metropolitan Transportation Plan (MTP) • Application opportunity every odd year	• Prioritized alongside other submitted projects. Funds are allocated based off prioritization.

State Funding Programs

The State Highway Account is essentially a bank account that funds a variety of California transportation programs for transportation and mobility purposes. The SHA receives its funds from the State Base Excise Tax and the Federal Highway Trust Fund. The programs that are relevant to Smart Region projects are described in **Table 4.**

Table 4 – State Transportation Funding Opportunities

Program	Important Dates	Funding Information	Criteria
State/ Regional/ Interregional Transportation Improvement Program (STIP/RTIP/ ITIP)	• Multi-year CIP • Cycle begins in odd-numbered years with the release of fund estimate in July. • December 15th of odd-numbered years the ITIP/RTIP/STIP is submitted • Next opportunity for this funding will be July, 2019	• Local agencies work with their MPO to get their projects included in the RTIP for nomination	• Must include a Project Study Report (PSR) or an equivalent for non-State Highway projects • Caltrans/Regional consultations for projects are to be included in the STIP/RTIP/ITIP • Evaluated on how the project aligns with furthering regional objectives, particularly for Sustainable Communities Strategies • STIP Guidelines
California Transportation Commission Active Transportation Program (CTC ATP)	• Distributed annually	• 40% of funds go to MPO's in urban areas • 10% of funds go to small urban or rural communities and awarded by the Commission on a competitive basis • The remaining 50% is competitively distributed on a statewide basis	• Selected through a competitive process and meet one or more ATP program goals. • Minimum funding request is $250,000 • ATP Guidelines

Federal Grant/Pilot Funding Programs

Many federal programs distribute money directly to the State, which distributes the funds based on local policies or award programs. One example of this type of funding is described above in the State Highway Account which receives a portion of its funding from federal programs. Other programs are described below.

Surface Transportation Block Grant Program (STBG): The STBG is an approved funding program through at least 2020. Infrastructure-based ITS capital improvements, including the installation of vehicle-to-infrastructure communication equipment, are eligible for the grant. In addition, operational improvements (including capital and operations costs) for traffic operations facilities, environmental measures, and some parking strategies are eligible. The project must be identified in a Statewide Transportation Improvement Program (STIP) and be aligned by long range Metropolitan Transportation Plans. Federal share is generally 80% although there are stipulations that allow for a full 100% share or as low as 50% federal share and is determined by project type per 23 U.S.C. 120.

Better Utilizing Investments to Leverage Development (BUILD) Grants: The BUILD program has replaced the Transportation Investment Generation Economic Recover (TIGER) grant program and grants are awarded on a competitive basis for projects with significant regional or local impacts. These grants are designed to benefit surface transportation systems while providing further support to rural communities. A greater share of BUILD grants will be awarded to projects located in rural areas. $1.5 billion dollars has been made available for BUILD grants through September 2020. BUILD funds may cover up to 80% of project costs in urban areas and 100% of project costs in rural areas. During the 2018 cycle, the maximum project award is $25 million and a single state cannot receive more than $150 million. The application deadline for BUILD grants is late July of each year.

The Nationally Significant Freight and Highway Projects (INFRA) Program: The INFRA Grants program provides dedicated, discretionary funding for projects that address critical issues facing our nation's highways and bridges. In 2018 approximately $1.5 billion in INFRA Grants will be awarded to projects across the country.

Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD): ATCMTD is a competitive grant program that funds projects related to many ITS objectives. The grant serves to fund installation of transportation technologies that can improve efficiency, safety, and system performance. A state, local, transit, or Municipal Planning Area (MPA) agency is eligible to apply. In addition, a multijurisdictional group can apply with a signed agreement. A maximum of $60 million is available each fiscal year through 2020. A 50% minimum local match is required. Single project awards will not exceed $12 million and there will be between 5 and 10 grants awarded. Applications are invited during the Spring of each year.

Other Funding Types

Other funding opportunities that the County could utilize to help support their ITS Program include:

Safety/Emergency Projects/Initiatives: Partnering with other departments or emergency/safety agencies to include ITS components or to identify additional data that can be obtained from emergency/safety service systems could be mechanisms used to expand the ITS program or data that is available. An example might be a project to upgrade the radio network of the Police Department, or dynamic emergency vehicle routing.

Establishing Open Funding Streams: Some states and MPOs have developed alternative methods for financing congestion reduction efforts, including ITS projects. Supplemental traditional funding sources could include tolling; local/regional sales tax measures, or other fees; and develop partnerships with private industry.

Public/Private Partnerships (P3s): P3s can provide alternative funding sources for transportation projects when a public agency enters into a partnership/agreement with a third party private company. Essentially, the public agency brings in a private-sector firm who provides development, operation, and financing mechanisms for the transportation project. P3s have become more popular as public resources become more limited and the demand for improved transportation systems continues to increase. There are benefits and limitations to engaging in a public/private partnership, so it is important to weigh those factors prior to P3 implementation.

OPERATIONS AND MAINTENANCE

To effectively operate and maintain the various project elements and projects identified in this Implementation Plan, El Dorado County must be adequately staffed and prepared to sustain the system after it is deployed. Operations and maintenance procedures are essential to define the appropriate staffing levels, training, operational processes, and maintenance plans necessary to sustain an effective system.

Staffing

Staffing serves the operations side of the Implementation Plan. The successful implementation of operations strategies is largely dependent on providing appropriate staffing relative to the increase in operational capabilities.

El Dorado County has seen steady population growth over the last few decades. The last decade in which there was a decrease in overall population was from 1910 to 1920. Since then, the County has experienced steady growth, and its growth rate for the past ten years was 2.5%, per El Dorado County 2017-2018 Recommended Budget Book.

The County is aware of its growing population and is looking to improve its transportation and ITS networks in various ways. They are looking to increase staff to better serve the proposed developments in the area. There are currently two staff members in the Department of Transportation Maintenance and Operations dedicated to the existing traffic signal network: Traffic Operations Technician, and Traffic Superintendent. The County does not have dedicated traffic engineering staff,

but some traffic analysis support is provided by staff in the County's Development, Right-of-Way, and Environmental group.

While growth in El Dorado County is a positive, the County must make sure that it is planning for the projected growth as it takes on more projects, expands its infrastructure and services, and offers more to residents and visitors.

To date, there has not been clear recognition of the staff time and costs associated with traffic signal and ITS projects as part of the project development and budgeting process and the inventory of transportation assets in the County has been steadily increasing without a corresponding increase in staff to operate and maintain them. This has created a situation where the County is understaffed for operations as well as for maintenance of the traffic signal and ITS network infrastructure.

Staffing the Smart Region Program

El Dorado County should follow a well-crafted staffing plan that addresses five key objectives:

- Ensure appropriate staffing levels based on increasing and aging assets;
- Ensure the organization employs staff with the requisite knowledge, skills, ability, and other characteristics in the appropriate positions when needed;
- Ensure that the organization adapts to changes internally and externally;
- Provide a systematic approach for human resource management; and
- Provide a shared vision of human resource functions.

Table 5 provides recommended ratios for the number of devices or signals to warrant one staff person for small, medium, and large jurisdictions based on the total number of devices or signals the jurisdiction is expected to operate and maintain. Operations staff are responsible for daily monitoring and use of transportation management assets. Engineers are responsible for conducting analysis of system performance and developing solutions. Maintenance staff are responsible for preventative and routine servicing of field assets.

Table 5 – Staffing Ratios for Operations and Maintenance

El Dorado County Total Values	Number Of:	Small	Medium	Large
Total	Signals	< 50	50 – 200	> 200
Total	Devices	< 100	100 – 300	> 300
Recommended Staffing Ratios	**Number Of:**	**Small**	**Medium**	**Large**
Operations	Devices	25 : 1	50 : 1	75 : 1
Engineer	Devices	100 : 1	100 : 1	100 : 1
Maintenance/Technicians	Signals	40 : 1	40 : 1	40 : 1
Maintenance/Technicians	Devices	100 : 1	100 : 1	100 : 1

** Using ITE recommendations for staffing ratios per device from Traffic Control Systems Operations – Installation, Management and Maintenance which recognizes the difference between large, medium, and small agency size ratios. Values were verified to be consistent with other more recent sources such as Traffic Signal Operations and Maintenance Staffing Guidelines (FHWA-HOP-09-006) and other agency publications around the country.*

With 51 traffic signals and 5 devices, El Dorado County is considered a small-sized agency. **Table 6** provides a summary of staffing recommendations based on number of devices and staff existing and the full build out needs to support the desired infrastructure and functionality called out in this Plan. As shown, recommended staff under full buildout conditions includes up to 1 ITS/traffic operations staff, 1 engineering staff, 1 signal maintenance staff and 1 device maintenance staff.

Table 6 – Staffing Recommendations for SACOG Agency Stakeholders

El Dorado County	Devices*	Operations Staff – Devices (25:1)	Engineering Staff – Devices (100:1)	Traffic Signals	Maintenance Staff - Signals (40:1)	Maintenance Staff - Devices (100:1)
Municipalities						
Existing Conditions	5	1	0	52	1	0**
Full buildout needs	34	1	1	52	1	1

**ITS equipment includes: vehicle detection devices, emergency vehicle preemption devices, CCTV cameras, CMS, ARID devices, miles of fiber and wireless radios.*

***El Dorado County's Traffic Operations Technician is responsible for maintenance of traffic signals and ITS devices.*

Staffing Considerations

Based on the above, El Dorado County is not adequately staffed to support the existing infrastructure. Adding additional ITS infrastructure and functionalities that are desired by the County and identified within this Plan will only exacerbate these staffing challenges unless a process is put in place to identify and account for staffing needs for the Smart Region program. To address this challenge, it is recommended that a process be put in place as part of the capital project programming process for traffic signals and other ITS communications projects that requires consideration of the staffing resources needed to operate and maintain the new infrastructure in addition to existing infrastructure.

There are regional staffing structures for operations and maintenance that are being recommended to SACOG to help support individual local agencies and their ability to support Smart Region initiatives. These regional structures may alleviate some of the need for additional staffing at the County level.

When planning for additional or adjusted staffing to account for Smart Region improvements, the County should consider the following:

- **Heightened Skill Set** – Central management systems are undergoing fundamental changes, including the introduction of more sophisticated technologies, a shift to integrated operations (multiagency, multimodal), and improvements to customer service capabilities. The increased demand for services and changes to central management system operations affects staffing practices. Increasing demand requires more employees and the necessary knowledge, skill sets, abilities to handle the demand. In many cases, personnel required to manage multijurisdictional systems have an Information Technology background and skill set that includes network management, software development, database administration, and application troubleshooting. Although engineering skill sets, or a professional license may be warranted for specific activities such as signal timing plan development, an engineer may not always be necessary to fulfill other agency functions. Each agency should consider a combination of personnel skill sets as they relate to the individual agency requirements to fulfill operational functions.
- **Redundant Support Structure** – It will be important to foster and maintain staff skills and redundancy through greater training and cross-training so that there is more than one person with the knowledge and skill set required to operate and maintain ITS equipment and systems.
- **Central System Management Architecture** – Another major factor that has a significant impact on staff planning is whether the central management system operations function out of a traditional TMC with workstations and a video wall, or if the central management system is operated on a virtual basis with a few County offices having permissions level access to certain parts of the system.

Maintenance Plan

Planning for ITS operations and maintenance costs is a critical component when developing an implementation project. Operation and maintenance of ITS technologies and systems extends beyond simply keeping the equipment working. The County will need to maintain ITS devices and systems and will require appropriate training to serve in that role. Reacting to emergency failure conditions, maintaining accurate maintenance logs, and conducting preventative maintenance programs all require fully-trained staff. Maintenance of ITS devices will require an allocation of funds within the County budget. A maintenance management system can also be used to track failures and decrease the time needed to repair the failures.

A maintenance plan identifies the criteria for replacement and preventative maintenance and the need for ongoing support for ITS devices and systems. The number of devices and systems that need to be maintained throughout the County will increase in the near-term based on the programmed ITS infrastructure projects. These devices and systems need to be appropriately maintained and effectively operated to provide accurate, reliable, and timely information.

The following three maintenance types are included in this section to recommend maintenance activities based on general guidelines for each type of device, rather than required activities, to allow

the County to identify areas where maintenance activities could be introduced based on resource availability:

- **Preventative Maintenance** – What to do to prevent failure – This encompasses a set of checks and procedures performed at scheduled intervals including inspection, record keeping, cleaning, and replacement.
- **Responsive Maintenance** – What to do when something fails – This is the initial reply by field maintenance staff to an ITS subsystem or malfunctioning device. Response maintenance includes minor maintenance activities, major maintenance activities, and major rehabilitation/upgrade activities.
- **End-of-Life Replacements and Upgrades** – What to do when something cannot be fixed – This can be required if the device has experienced frequent malfunctions, failures, or has reached end-of-life and it is more cost-effective to replace the technology rather than continue to maintain it.

Roles and responsibilities, maintenance guidelines, and requirements of the staff should be developed to define preventative maintenance, responsive maintenance, and replacement of ITS devices and systems.

Preventative Maintenance

Preventative maintenance is performed to ensure the reliability and longevity of the mechanical and electrical operations of the system and will reduce equipment failures, response maintenance, road user costs, and liability exposure. Preventative maintenance involves repetitive upkeep to allow devices and systems to operate efficiently and effectively to maximize the operating lifespan of ITS devices. Preventative maintenance includes minor and major maintenance needs, making the frequency of maintenance an important consideration.

The preventative maintenance activities and frequency varies by device, device components, and system, which are outlined in **Table 7**. The County can refer to this table when incorporating new signals, new ITS infrastructure, or new staff. The County should review and revise the preventative maintenance procedures on an annual basis to ensure new issues are being addressed and equipment is being properly maintained.

Table 7 – Preventative Maintenance Recommendations

Intersection PM Checklist	Recommended Interval
Interior Cabinet Check	
Clean Cabinet Interior Check controller lamp and door switch Check filter Check door fit and gasket Check locks and hinges Check/verify for cabinet timing and log sheet Check field block terminal connections Signal controller battery backup check	Annual
Check conflict monitor indications Check all detectors	Quarterly

Intersection PM Checklist	Recommended Interval
Exterior Cabinet Field Check	
Check condition of cabinet exterior Check all signal indications Check all pedestrian indications Check pole conditions and hand hole covers	Annual
Check all signal head back plates and visors Check alignment of signals and pedestrian heads Check condition of pull boxes and lids	Quarterly
Intersection Field Check	
Visual check of all traffic signs at intersection Visual check of intersection luminaries	Monthly
Visual check of all traffic loops	Quarterly
Visual check of other traffic system related cabinets	Annual
Typical CCTV Checklist Items	
Visual check of assembly CCTV receiver Video transmitter Fiber distribution unit Cabinet equipment Pole or exterior condition	Annual
Typical Message Sign Check List Items	
Field intersection Sign panel Pull boxes Cabinet exterior Cabinet interior Re-lamping	Every six-months

Responsive Maintenance

ITS devices and systems have specific maintenance requirements per the manufacturer's maintenance manual of each device. There are three types of maintenance that ITS devices require to fulfill their intended design for operations and lifecycle:

- **Minor Maintenance** – Minor maintenance includes tasks which can be carried out without large scale testing or the use of heavy equipment. It includes visual inspections and checking of many items, elementary testing, cleaning, lubricating, rebooting/resetting, and minor repairs that can be carried out with hand tools or portable instruments.
- **Major Maintenance** – As well as all items normally done under minor maintenance, major maintenance also includes extensive testing, overhauling and replacement of components, which may require a scheduled power outage and the use of bucket trucks or other heavy equipment.
- **Major Rehabilitation** – Major rehabilitation or complete replacement is contemplated for devices that experience frequent or recurring malfunctions or failures.

Table 8 identifies a rule-of-thumb frequency of minor and major maintenance and major rehabilitation for a range of ITS devices that the County will be implementing. These guidelines should be reviewed and updated annually to reflect actual needs in El Dorado County.

Table 8 – ITS Device and Network Communications Maintenance Guidelines

Equipment	Minor Maintenance	Major Maintenance	Major Rehabilitation
Traffic Signal Systems			
Cabinets	26 weeks	2-5 years	10 years
Signal Heads	26 weeks	2-5 years	10 years
Electronics	13 weeks	N/A	N/A
Traffic Signal Controller	26 weeks	2-5 years	10-15 years
Poles	26 weeks	5 years	15 years
CCTV Camera Systems			
PTZ Units	26 weeks	1 years	3 years
Changeable Message Signs			
Sign Case	-	26 weeks	1.5 years
Protective Devices	26 weeks	1 year	2 years
Pixels, Modules and Drivers	-	26 weeks	3 years
Controllers	-	26 weeks	3 years
Vehicle Detection Systems			
Cabinets	-	26 weeks	10 years
Power Supply	26 weeks	5 years	10 years
Emergency Vehicle Preemption (EVP) / Transit Signal Priority (TSP)	26 weeks	2-5 years	10 years
Loop Detection (per approach)	26 weeks	1 year	5 years
Video Detection (per intersection)	26 weeks	1 year	5 years
Travel Time Readers (per location)	26 weeks	1 year	5 years
Pedestrian Detection (per intersection)	26 weeks	1 year	5 years
Grounding	-	2-5 years	10 years
Controllers	-	26 weeks	3 years
Telecommunication Systems			
Fiber Optic Cable Plant	1 year	5 years	25 years
Communication Switches (field)	26 weeks	1 year	3 years
Wireless Radio Spread Spectrum	26 weeks	4 years	10 years
TMC Equipment			
Servers	26 weeks	1 year	2 years
Communication Switches (TMC/Hub)	26 weeks	1 year	3 years
Rack Equipment	-	1 year	2 years
Workstations	26 weeks	2 years	2 years
Workstation Displays	26 weeks	1 year	3 years
Uninterruptable Power Supply	1 year	5 years	10 years

Data source: Recommended Practice for Operations and Management of ITS (ITE Publication); and International Municipal Signal Association (IMSA) Preventative Maintenance of Traffic Signal Equipment Program.

Development or integration of a maintenance tracking system would be beneficial to keep an inventory of maintenance activities that have occurred on each device. The County's responsive maintenance tracking should consist of the following maintenance activities:

- Failure detection;
- Work order creation;
- Dispatched resources;
- Response activities;
- Diagnosis;
- Interim repairs; and
- Work order close out.

This tracking will allow the County to identify devices that are not reliable or accurate or have had frequent malfunctions. The tracking will also allow the County to identify appropriate cases for technology replacements where maintenance of an existing technology may be costlier than upgrading to a newer technology. Developing periodic reports and then reviewing those reports are critical to being able to identify frequently failing devices for replacement.

End-of-Life Replacements and Upgrades

End-of-life replacement strategies and upgrades are an important aspect of technology projects because equipment and infrastructure need to be maintained and/or replaced in a routine manner. Equipment replacement is required if a device has exceeded its life expectancy, either through a sunsetting of manufacturer servicing or a failure in legacy equipment. Equipment upgrades are required when additional functionality is needed that cannot be provided by legacy equipment. This section provides information about what El Dorado County's replacement needs are, recommended equipment lifecycle timeframes, and mechanisms available for procurement and maintenance.

Agency Replacement Needs

El Dorado County should establish an inventory of modernized, supplemental traffic and ITS equipment for replacement of devices in the field as they reach end-of-life or become broken. A typical method for establishing an inventory is to keep 10% of existing field devices for each type. A proper inventory of devices and spare parts that can be accessed to conduct routine and emergency maintenance also needs to be built into the County's budget cycle. As an example, for every 100 cameras deployed across the transportation network, the County should have at a minimum ten (10) cameras in inventory to be able to be responsive and make repairs/replacements when needed.

Lifecycle Replacement

To adequately prepare for necessary infrastructure updates in the future, the County should consider the estimated lifespan of its infrastructure. Lifecycle replacement mechanisms will need to be developed to stay up-to-date on equipment replacement needs and emerging technology availability. **Table 9** should be used as a reference tool for El Dorado County so that equipment remains current and performs at an optimal level.

Table 9 – Anticipated Technology Lifecycle Timeframes

Equipment	Anticipated Lifecycle Timeframe (Years)
Traffic Signal Systems	
Cabinets	20
Signal Heads	20
Electronics	10
Traffic Signal Controller	15
Poles	50
CCTV Camera Systems	
PTZ Units	10
Changeable Message Signs	
Sign Case	10
Protective Devices	10
Pixels, Modules and Drivers	6
Controllers	6
Vehicle Detection Systems	
Cabinets	20
Power Supply	20
Emergency Vehicle Preemption (EVP) / Transit Signal Priority (TSP)	10-15
Loop Detection (per approach)	5-15
Video Detection (per intersection)	10
Pedestrian Detection (per intersection)	10
Grounding	25
Controllers	7
Telecommunication Systems	
Fiber Optic Cable Plant	25
Communication Switches (field)	5-8
Wireless Radio Spread Spectrum	20
TMC Equipment	
Servers	5
Communication Switches (TMC/Hub)	5-8
Rack Equipment	5
Workstations	5
Workstation Displays	5
Uninterruptable Power Supply	20

Agency Replacement Strategy

As noted in the existing conditions section above, the County is in the process of replacing all existing Type 170 controllers with new Type 980 and Type 2070 controllers. The existing Type 170 controllers were installed between 1996 and 2005. As such, the oldest Type 170 controllers are at the end of their expected lifecycle of 20 years. It is recommended that the County target a completion of controller replacement within the next five years. Since there are 25 traffic signals that need to be converted to Type 980 or Type 2070 controllers, at least 5 controllers should be replaced in each year until the conversion is complete. These replacements could be completed in conjunction with the implementation projects recommended as a part of this plan.

The existing video detection cameras and radar detection devices were installed in the past couple years and will not reach the expected lifecycles for 5 or more years. However, it is still recommended that the County initiate a replacement strategy now to establish a program with will allocate the appropriate funds in next 3 to 5 years to prepare for detection upgrades and replacement.

PERFORMANCE METRICS

Performance metrics are used to evaluate and demonstrate the effectiveness of El Dorado County's implementation projects in addressing county and regional objectives. Recommended data types, data sources, and calculations to evaluate performance of projects are provided in **Table 10**. As projects are delivered, El Dorado County can use these metrics as a guideline to evaluate projects.

Table 10 – Performance Metrics to Perform Project Evaluations

Objective	Performance Metric	Data Type	Source	Calculation
Connect primary corridors for more effective operations	Increase Capacity of Communications Network	Fiber/Wireless/Bandwidth Usage	TMC System	Measure communications network capacity before and after ITS device deployment
	Reduced Travel Time	Travel Time	Agency TMC	Travel time in minutes between Point A and Point B prior to and after project implementation
	Reduced Queues, Stops, % Arrivals on Greens, Emissions, and Saturation Levels	Turning Movement Counts, and ADT Volumes	Agency TMC	Compare traffic signal operations before and after project implementation, calculate percentage change.
	Incident detection by CCTV cameras	CCTV Images	Agency TMC	Count incidents that are detected via CCTV camera before being identified by public
Provide tools for special and seasonal events	Reduced vehicle traffic (congestion) due to CMS Message	Traffic Volume	Agency TMC	Difference between Pre/Post CMS Traffic Volumes on Corridor and Alternate Corridor
	Increased Partnerships between Third Party Data Companies and Public Agencies	Partnerships	Institutional Policies/Documents	Count the number of private party /public agency data sharing agreements that have occurred since implementing strategies
Improve operations and maintenance efficiency	Reduced Travel Time	Travel Time	Agency TMC	Travel time in minutes between Point A and Point B prior to and after project implementation
	Reduced Downtime	System Errors/Failure	System Operations	Compare Downtime Incident Occurrences before and after project implementation

Objective	Performance Metric	Data Type	Source	Calculation
Improve operations and maintenance efficiency (continued)	Reduce Response Time to Device Failures	Response Time	TMC and Dispatch Records	Measure reduction in response times before and after project implementation
Determine appropriate staffing levels and skillsets	Number of hours (in 6-month intervals) of continued education or training completed by staff	Training Hours	CE courses, Vendor Training Seminars, etc.	Count hours staff spent attending new technology trainings or pursuing certifications
	Reduced Downtime	System Errors/Failure	System Operations	Compare Downtime Incident Occurrences before and after project implementation
Improve coordination with neighboring agencies	Reduced Travel Time	Travel Time	Agency TMC	Travel time in minutes between Point A and Point B prior to and after project implementation along cross-jurisdictional corridors
	Improved Incident Clearing Times	Incident Response and Clearing Times	Agency TMC	Compare time it takes to respond to and clear an incident before and after project implementation
Address **smart** transportation **strategies** for urban, suburban, and rural communities	Reduced Travel Time	Travel Time	Agency TMC	Travel time in minutes between Point A and Point B prior to and after project implementation
	Increased Transit Ridership	Sales/Revenue	Transit TMC and Transit Provider Records	Count ridership levels before and after project implementation, calculate percentage change
	Incident detection by CCTV cameras	CCTV Images	Agency TMC	Count incidents that are detected via CCTV camera before being identified by public
	Accurate Travel Time Estimates (particularly focused on rural and suburban communities w/ commuting needs)	Travel Times	Agency TMC	Compare travel times estimated and actual travel times to verify accuracy for those commuting into urban centers from rural or suburban communities

Objective	Performance Metric	Data Type	Source	Calculation
Prepare for **smart** region **infrastructure** adapting to new technology	Number of hours (in 6-month intervals) of continued education or training completed by staff	Training Hours	CE courses, Vendor Training Seminars, etc.	Count hours staff spent attending new technology trainings or pursuing certifications
	System Readiness for CV/AV Technology Integration	CV/AV Technology (Device and Data)	TMC System	When applicable, monitor CV/AV technology integration and compare qualitatively or quantitively with other region's technology integration experiences
	Increase Capacity of Communications Network	Fiber/Wireless/Bandwidth Usage	TMC System	Measure communications network capacity before and after ITS device deployment
Reduce user frustration by providing **consistency and reliability**	Reduced Downtime	System Errors/Failure	System Operations	Compare Downtime Incident Occurrences before and after project implementation
	Reduced Public Complaints	Public Complaints	TMC and other Operator Records	Compare the amount of public complaints related to inconsistency/unreliability from before and after implementation project
	Reduce Response Time to Device Failures	Response Time	TMC and Dispatch Records	Measure reduction in response times before and after project implementation
	Increase percent of field device that are operational	Operational Devices	Asset Management System	Calculate percent of devices that are operational based on total devices in the inventory. Compare that figure to the same percentage ratio prior to implementation project
Proactively improve transportation system **safety**	Reduced vehicle-to-vehicle crashes	Crash Records	Crash Record System	Calculate percentage change of crashes before and after implementation
	Reduced vehicle-to-bicycle crashes	Crash Records	Crash Record System	Calculate percentage change of crashes before and after implementation

Objective	Performance Metric	Data Type	Source	Calculation
Proactively improve transportation system **safety** (continued)	Reduced vehicle-to-pedestrian crashes	Crash Records	Crash Record System	Calculate percentage change of crashes before and after implementation
	Reduced Safety Incidents Involving Transit Operations	Transit Incident Records	Transit TMC and Transit Provider Records	Count amount of safety incidents involving transit operations after project implementation and compare to before implementation
Improve **traveler information** and dissemination to public and within region	Reduced vehicle traffic (congestion) due to CMS Message	Traffic Volume	Agency TMC	Difference between Pre/Post CMS Traffic Volumes on Corridor and Alternate Corridor
	Increased Social Media Presence via Agency Managed Apps/Websites	Social Media Posts and Push Notifications (Facebook, twitter)	PR/PIO Records	Track social media outputs, compare to posts prior to implementation strategies
	Increased Partnerships between Third Party Data Companies and Public Agencies	Partnerships	Institutional Policies/Documents	Count the number of private party /public agency data sharing agreements that have occurred since implementing strategies
	Increased 511 Inputs (on all available platforms)	Website Updates, Radio Updates, and Push Notifications	511 System/Records	Count traveler information inputs that are sent out through 511 systems and compare it to counts prior to implementation
	Increased 511 Usage/Subscriptions	App Download/Website Usage	App/Website Management	Count of 511 website views
Emergency / Disaster preparedness	Improved Emergency Response Time	Travel Time	Agency TMC	Time between initial notification to first responder arrival
	Improved Incident Clearing Times	Incident Response and Clearing Times	Agency TMC	Compare time it takes to respond to and clear an incident before and after project implementation

NEXT STEPS

The outcome of this Technology Implementation Plan is a roadmap of prioritized projects that El Dorado County can follow to systematically implement technology projects that achieve local and regional objectives through expansion of infrastructure, integration of systems and subsystems, and deployment and readiness for emerging technologies. The appendices of this Plan contain supporting information on project priority development, costs, project details, and other information that are essential to moving projects into development and deployment.

El Dorado County's Technology Implementation Plan is a dynamic and flexible set of projects that contribute to SACOG's broader Smart Region Plan. The projects set forth are a mix of infrastructure, operations and institutional projects that are adaptable to changing needs and evolving technologies. This plan and the associated tools should remain a living set of resources that staff can update as projects are implemented or expanded, agency priorities change, or other changes occur that impact the region or El Dorado County. The projects identified in this plan can and should be modified, or priorities adjusted, to accommodate changing priorities, emerging technology opportunities, other construction and development projects, or other initiatives that influence the guidance and recommendations provided in this Plan. In addition, it is particularly important to maintain a process to update the Plan because of the deployment phasing methodology used.

Plan Components to Update

- **Deployment Phasing** – It will be particularly important to update the Plan to reflect projects that have been completed. Priorities across projects may also change and should be reflected in the document. As time goes by and projects change in priority, updating the project list will provide an opportunity to evaluate if new projects are available based on emerging technology, increased staffing levels, and so on.
- **Funding Opportunities** – Funding opportunities are always changing. Existing programs or grants may expire, while new ones may emerge. It is imperative that funding opportunities are kept current to maximize the opportunity to utilize new funding sources. In addition, it will continue to be important to leverage emerging opportunities for third party or private sector support.
- **Equipment Replacement Strategies** – The success of this Plan is largely based on ensuring that all equipment continues to work effectively and efficiently. Legacy equipment should be continuously updated or replaced to accommodate emerging technology and enhanced system functionality.
- **Operations and Maintenance -** Adequate staffing levels allow for optimal functionality. As the plan grows and progresses, staffing levels must continue to reflect the need for sustaining a functioning system.

APPENDIX A – EXISTING CONDITIONS

Table 1: El Dorado County Traffic Signal Inventory

No.	Roadway	Cross Street	Cabinet	Controller
0	Green Valley Rd	North Shingle Rd	P	980
43	Silva Valley Parkway	US 50 EB ON Ramps	332	2070
44	Silva Valley Parkway	US 50 WB ON/OFF Ramps	332	2070
47	Bass Lake Rd	Serrano Parkway	P	980
48	Green Valley Rd	Silver Springs Prky	P	981
49	White Rock Rd	Clarksville Xing	332	2070
99	White Rock Rd	Post St	332	980
502	White Rock Rd	Winfield	332	980
503	Durock Rd	Business Dr	P	980
7001	El Dorado Hills Bl	Park Dr	332	170E
7002	El Dorado Hills Bl	Lassen Ln/Serrano Pw	332	170E
7003	El Dorado Hills Bl	Harvard Wy	332	170E
7004	El Dorado Hills Bl	St Andrews Dr/Governor Dr	332	170E
7005	Green Valley Rd	Francisco Dr	332	2070L
7006	Green Valley Rd	El Dorado Hills Bl/Salmon Falls Rd	332	170E
7007	Green Valley Rd	Cameron Park Dr/Starbuck Rd	332	Naztec 980 TS-2
7008	Cameron Park Dr	Coach Ln	332	170E
7009	Cameron Park Dr	Palmer Ln	332	170E
7010	Missouri Flat Rd	Plaza Dr	332	170E
7011	Missouri Flat Rd	Mother Lode Dr	332	170E
7012	Missouri Flat Rd	Forni Rd	332	170E
7013	Pioneer Tr	Black Bart Av/Cold Creek Tr	332	170E
7014	Latrobe Rd	White Rock Rd	332	Naztec 980 TS-2
7015	Latrobe Rd	Investment Bl	332	170E
7016	Latrobe Rd	Golden Foothill Pw (N)	332	170E
7017	Green Valley Rd	Bass Lake Rd/Alexandrite Dr	332	170E
7018	El Dorado Hills Bl	Saratoga Wy	332	170E
7019	Latrobe Rd	Town Center Bl	332	170E
7020	Green Valley Rd	Mormon Island Dr	332	170E
7021	Green Valley Rd	Sophia Pw	332	170E
7022	El Dorado Hills Bl	Olson Ln	332	170E
7023	South Shingle Rd	Durock Rd	332	170E
7024	Green Valley Rd	Pleasant Grove Middle School	332	170E
7025	El Dorado Hills Bl	Wilson Bl	332	170E
7026	Cameron Park Dr	Meder Rd	332	170E
7027	Latrobe Rd	Suncast Ln	332	170E
7028	White Rock Rd	Stonebriar Dr	P	170E
7029	Green Valley Rd	Cambridge Rd	332	2070L
7030	Silva Valley Pw	Serrano Pw	332	2070L
7031	Silva Valley Pw	Harvard Wy	332	2070L
7032	Green Valley Rd	Silva Valley Pw/Allegheny Rd	332	2070L
7034	Missouri Flat Rd	El Dorado Rd	332	2070L
7036	Francisco Dr	Village Center Dr	332	2070L
7037	Francisco Dr	Green Valley Market Place	332	2070L
7038	White Rock Rd	Valley View Pw	332	2070L

No.	Roadway	Cross Street	Cabinet	Controller
7039	Green Valley Rd	Miller Rd/Brown's Ravine Rd	332	2070L
7040	Missouri Flat Rd	Golden Center Dr	332	2070L
7041	Cameron Park Dr	Oxford Rd	332	2070L
7045	Cameron Park Dr	La Canada Rd	P	Naztec 980 TS-2
7046	Mother Lode Dr	French Creek Rd	332	2070L
7047	Latrobe Rd	Golden Foothill Pw (S)	P	Naztec 980 TS-2

APPENDIX B – DETAILED PROJECT SHEETS

ID # – This is the identification number by strategy.

Title – This is the title of strategy.

Description – This is a succinct description of the strategy for context.

Relation to Needs – This is a mapping of strategies to the original needs, recognizing that one strategy may serve a variety of needs.

Scope/Limits – This is a succinct summary of what is included in the strategy and/or locations (if applicable) of where the strategy would apply.

Considerations – This is a bullet listing of other strategy #'s and titles that are relevant for the County to reference during implementation or could be packaged together to be implemented in a larger strategy in a particular timeframe.

Actions Required – This is a summary bullet list of high-level steps to implement the strategy.

Strategy ID #1

Improve Existing Communications Capabilities on Key-Corridors

Strategy Description – Eliminate communications gaps that exist along key traffic movement corridors. Utilize copper/fiber or wireless technologies to achieve more robust communications coverage. Connect communications to devices and traffic signals along the key corridors.

Relation to Needs – Improving existing communications capabilities addresses the following needs.

- Baseline communications infrastructure (Need D2)
- Robust coverage to acquire real-time conditions (Need D2)
- Share data between agencies that share a corridor (Need D6)
- Improve traffic operations (Need O3)

Scope/Limits – Fiber will be installed between traffic signals where there isn't any. Existing communication lines between signals will be upgraded. Below is a list of primary corridors in El Dorado County that are involved with this strategy.

- Green Valley Road
- El Dorado Hills Boulevard
- Latrobe Road
- Cameron Park Drive
- White Rock Road
- Missouri Flat Road
- Silva Valley Parkway
- Ponderosa Road/S. Shingle Road

In addition, all controllers with McCain or DTS manufacturers will be replaced. That's 25 existing controllers in the County.

Considerations – This is a bullet listing of other strategy ID #'s and titles that are relevant for the County to reference during implementation or could be packaged together to be implemented in a larger strategy in a particular timeframe.

Prerequisite Dependencies – The following is a high-level list of prerequisite actions that will need to be taken prior to implementing this strategy.

- Establish traffic operations center
- Deploy projects that connect to the central system
- Existing infrastructure supporting subsequent projects should be functional

Strategy ID #2

Improve Existing Communications Capabilities for Interregional Connectivity

Strategy Description – Eliminate communications gaps that exist along corridors that would be required to connect to the regional communications network. Utilize copper/fiber or wireless technologies in order to achieve more robust communications coverage. Connect communications to devices and traffic signals along the secondary corridors. This includes upgrading communications from legacy copper or T1 leased lines to more robust agency-owned infrastructure such as fiber or wireless. If the agency TOC is not already connected to the regional communications network, this strategy would incorporate the required active electronics or communications necessary to share information in a center-to-center capability with STARNET or would upgrade that equipment as needed.

Relation to Needs – Improving existing communication capabilities addresses the following needs.

- Baseline communications infrastructure (Need D1)
- Central system management of tools and data to support operations (Need D3)
- Share data between agencies that share a corridor (Need D6)
- Access to central systems 24x7 (Need O1)

Scope/Limits – Improving communications through eliminating gaps and installing fiber on a local level will improve the interregional connectivity. See Strategies #1 and #2 for plans to close communication gaps on primary and secondary corridors.

Considerations – The following is a list of other strategies within the County's Implementation Plan that should be considered along with this strategy.

- ID #1
- ID #5
- ID #9

Prerequisite Dependencies – The following is a high-level list of prerequisite actions that will need to be taken prior to implementing this strategy.

- Establish TOC
- Establish a functional baseline communications network
- Identify order of implementation based on priority of the County
- Improve communications on primary corridors prior to beginning secondary corridors

Strategy ID #3

Deploy New Vehicle Detection Devices: Video and CCTV

Strategy Description – Deploy new video detection equipment at signalized intersection locations that do not have current detection available. Video detection equipment will require devices to be mounted on all mast arms or overhanging one pole location to be able to view all legs of the intersection, depending on the type of technology procured. Video detection will be able to detect vehicles, bicycles, and pedestrians in zones set up by the traffic operations center to support signal timing plan implementation. Also, depending on the type of technology procured, video detection may be able to collect real-time turning movement counts to support more real-time signal timing adjustments required. Additional detection can support more traffic-responsive signal timing to detect the main street and side streets more effectively.

Deploy new CCTV equipment at signalized intersection locations that do not have current video capabilities available. CCTV equipment will require devices to be mounted on one pole location to be able to view all legs of the intersection and, as feasible as possible, to view to the next intersection location. CCTV video will provide real-time streaming video to allow traffic operations centers to view road network conditions and to share information about real-time conditions with partner departments, such as public safety, that may need to respond to an incident or event. The new CCTV will need to be integrated into the agency's central management system for viewing and control.

Relation to Needs – The installation of a range of vehicle detection devices addresses the following needs.

- Robust coverage to acquire real-time conditions (Need D2)
- Sharing of camera images to support pre-trip, en-route, and incident management purposes (Need D4)
- Improve traffic operations functions (Need O3)

Scope/Limits – Vehicle detection devices will be installed in the form of CCTV cameras and Video Detection cameras. Video Detection Cameras will be installed at all intersections with existing loop detection, which is assumed all signalized intersections for this strategy. CCTV Camera will be installed at all signalized intersections, except for the intersection of N. Shingle Road and Green Valley since that intersection is isolated and not along a communication corridor.

Considerations – The following is a list of other strategies within this agency's Implementation Plan that should be considered along with this strategy.

- ID #1
- ID #6

Prerequisite Dependencies – The following is a high-level list of prerequisite actions that will need to be taken prior to implementing this strategy.

- Establish baseline communication network
- Close communication gaps
- Determine whether real-time detection is appropriate

Strategy ID #4

Upgrade Agency ATMS

Strategy Description – Upgrade agency ATMS to incorporate new functionality as required by Smart Region initiatives and incorporate a variety of data deemed important by agencies to receive automate alert notifications. Additional data to incorporate into an agency ATMS upgrade include CCTV video streaming, weather notifications from weather devices, emergency notifications, and equipment maintenance status and alerts. Additional modules may be needed to support travel time devices, connected vehicle devices, or other types of devices not currently in use by the agency.

Relation to Needs – Upgrading agency ATMS addresses the following needs.

- Central system management of tools and data to support operations (Need D3)
- Timely emergency notifications (including weather) (Need D5)
- Access to central system 24x7 (Need O1)
- Improve traffic operations (Need O3)

Scope/Limits – Upgrading the County's ATMS will include central system software and license, server equipment, and one or more work stations.

Considerations – The following is a list of other strategies within this agency's Implementation Plan that should be considered along with this strategy.

- ID #1
- ID #6
- ID #9

Prerequisite Dependencies –The following is a high-level list of prerequisite actions that will need to be taken prior to implementing this strategy.

- Establish baseline communication network
- Close communication gaps
- Establish traffic operations center

Strategy ID #5

Share CCTV Camera Video with Individual Agencies

Strategy Description – Utilizing a robust communications center-to-center network between agencies, CCTV streaming video images should be shared between agencies. Shared control of CCTV may not be desirable nor feasible, but could be allowed through this center-to-center asset viewing capability.

Relation to Needs – The development of a center-to-center sharing network addresses the following needs.

- Sharing of camera images to support pre-trip, en-route, and incident management (Need D4)
- Share data between agencies that share a corridor (Need D6)
- Real-time traveler information (Need D8)

SCOPE/LIMITS – A network will be set up on a regional basis to share CCTV imagery between agencies.

Considerations – See regional document for further details.

Prerequisite Dependencies – The following is a high-level list of prerequisite actions that will need to be taken prior to implementing this strategy.

- Establish baseline communication network
- Deploy modernized CCTV cameras at identified locations
- Establish an inventory of supplemental CCTV cameras

Strategy ID #6

Replace End-Of-Life/Legacy Equipment with Modernized and Updated Equipment

Strategy Description – Establish an inventory of modern equipment that can be used to replace field devices upon their failure or end-of-life. Keeping a modern inventory will ensure that replacements are up-to-date and that in the event of an existing device reaching end-of-life, the device can be quickly replaced with stock equipment**.**

Relation to Needs – This strategy is linked to the need of robust infrastructure to acquire real-time conditions (Need D2).

Scope/Limits – Inventory of supplemental, modernized field devices includes but is not limited to Closed Circuit Television Cameras, Video Cameras, and Changeable Message Signs. A sufficient number of each device category will be kept in the inventory and will be refilled as the inventory gets low. The recommended number of devices to maintain is 10 percent of the total number of each device. Therefore, with the existing and proposed devices, it would be suggested that the County maintains one (1) CCTV Camera, two (2) Changeable Message Signs, and five (5) Video Cameras.

Considerations – The following is a list of other strategies within this agency's Implementation Plan that should be considered along with this strategy.

- ID #1
- ID #2
- ID #3

Prerequisite Dependencies – The following is a high-level list of prerequisite actions that will need to be taken prior to implementing this strategy.

- Establish a baseline communications network
- Deploy projects that connect to the central system

Strategy ID #7

Timely Emergency Notifications

Strategy Description – Upgrade 511 to be able to provide push notifications and upgrade the data available to travelers through the platform. This involves integrating Waze data into the platform to provide more incident information to the traveling public. This involves providing local agency data through STARNET or the regional communications center-to-center network such as incidents, lane restrictions, construction/maintenance, transit vehicle and schedule performance, and real-time speeds/travel times along key corridors in each jurisdiction. This will require minimal infrastructure, but significant data formatting and firewall modifications likely through the agency's IT department.

Relation to Needs – Deploying timely emergency notifications addresses the following needs.

- Timely emergency notifications (Need D5)
- Real-time traveler information (Need D8)
- Leverage and bolster private sector traveler information services (Need D9)
- Improve special event coordination (Need O5)

Scope/Limits – See regional document for further details.

Considerations – See regional document for further details.

Prerequisite Dependencies – The following is a high-level list of prerequisite actions that will need to be taken prior to implementing this strategy.

- Establish baseline communication network
- Upgrade agency ATMS
- Deploy vehicle detection devices

Strategy ID #8

Deploy New CMS Equipment

Strategy Description – Deploy new CMS equipment at key locations within the County's jurisdiction at new locations. CMS equipment will require devices to be mounted cantilever, on a pole, or over the travel lane. CMS provides the traveling public with an en-route message that is pertinent to their travel or local transit connection information. The CMS will need to be integrated into the County's central management system to post messages.

Relation to Needs – The installation of a range of vehicle detection devices addresses the following needs.

- Timely emergency notifications (Need D5)
- Encourage travel mode shift (Need D7
- Real-time traveler information (Need D8)
- Improve special event coordination (Need D14)

Scope/Limits – The following list includes the CMS's that will be installed at key strategic decision locations to relay traveler information, which may include incident and special event information. In addition, the County would like to purchase 2-3 more portable changeable message signs.

- Green Valley Road & Sophia Parkway
- Green Valley Road and El Dorado Hills Boulevard
- Green Valley Road and Cameron Park Drive
- El Dorado Hills Boulevard and Harvard Way
- El Dorado Hills Boulevard and Serrano Parkway
- El Dorado Hills Boulevard and Saratoga Way
- El Dorado Hills Boulevard and Hwy 50 WB Ramps
- El Dorado Hills Boulevard and Hwy 50 EB Ramps
- Latrobe Road and Town Center Boulevard
- Latrobe Road and White Rock Road
- Latrobe Road and Golden Foothill Parkway
- Silva Valley Parkway and Hwy 50 WB Ramps
- Silva Valley Parkway and Hwy 50 EB Ramps
- White Rock Road and Old Bass Lake
- White Rock Road and Valley View Parkway
- White Rock Road and Post Street
- White Rock Road and Winfield Way
- White Rock Road and Stonebriar Drive
- Ponderosa Road and Hwy 50 WB Ramps
- Ponderosa Road and Hwy 50 EB Ramps
- S. Shingle Road and Mother Lode Drive
- S. Shingle Road and Durock Road
- Cameron Park Drive and Hwy 50 WB Ramps
- Cameron Park Drive and Hwy 50 EB Ramps
- Diamond Springs Parkway and Highway 49

- Missouri Flat Road and Hwy 50 WB Ramps
- Missouri Flat Road and Hwy 50 EB Ramps

Considerations – The following is a list of other strategies within this agency's Implementation Plan that should be considered along with this strategy.

- ID #1
- ID #3
- ID #9

Prerequisite Dependencies – The following is a high-level list of prerequisite actions that will need to be taken prior to implementing this strategy.

- Establish a baseline communications network

Strategy ID #9

Establish and Staff Agency TOC

Strategy Description – Establish new agency TOC including such components as a video wall, extra screens for view only, network equipment, workstation layouts, workstation equipment, file storage, communication wiring, network room rack space, cooling and fire suppression systems, and other characteristics of a TOC that require consideration. New staff may need to be accommodated and access to systems warrants a specific design and allocation of space within an existing facility or office space. This strategy includes design, procurement, installation, and integration of new TOC components to modern standards and functionality to be able to support Smart Region initiatives. Establish staffing levels to support the operations and maintenance of the transportation network and Smart Region initiatives. Offered in the plan are ratios of devices to the number of staff required to operate or maintain those devices. The agency should consider potential IT or Traffic Engineering staff that would need to be involved in the implementation of Smart Region initiatives such as data access/sharing and project management of infrastructure implementations. Additional staff may be required such a data analysis staff. The agency will need to identify reallocated staff or hire new staff to support operations and maintenance in order to implement Smart Region strategies.

Relation to Needs – Establishing and staffing a TOC for the agency will address the following needs:

- Lack of environment for TOC operations (Need O2)
- Trained staff to support operations (Need O4).

Scope/Limits – The TOC developed for the County will have at least two workstation locations, a large LCD screen, and a conference room, which is the standard setup for a local TOC. Sites will be evaluated by senior level and production staff to determine a location for the TOC. This implementation will also include developing standard operating procedures and functional requirements.

Considerations – The following is a list of other strategies within this agency's Implementation Plan that should be considered along with this strategy.

- ID #4

Prerequisite Dependencies – The following is a high-level list of prerequisite actions that will need to be taken prior to implementing this strategy.

- Perform a site evaluation for a local TOC and deploy TOC
- Employ staff to work at the local TOC

Strategy ID #10

Establish Regional Technology Procurement Contract

Strategy Description – Establish a regional technology procurement contract that will be managed by a single agency and can be utilized by local agencies to procure technology for transportation use such as detection, CCTV, CMS, software, or other technologies. This strategy will alleviate the requirement for all agencies to individually establish procurement specifications for this equipment. This contract is envisioned as a qualified vendor list that offers the agencies multiple vendor options for each type of device, not that a single vendor would be chosen for each type of device. This will expedite the procurement and acquisition of technologies in the region. No dedicated budgeting is anticipated for this contract as it is focused on contractual use by individual agencies.

Relation to Needs – Establishing a regional technology procurement contract will address the need of a funding strategy for the Smart Region implementation plans (Need I1).

Scope/Limits – El Dorado County should support the development of a regional technology procurement contract.

Considerations – See regional document for further details.

Prerequisite Dependencies – The following is a high-level list of prerequisite actions that will need to be taken prior to implementing this strategy.

- Identify a staff member to coordinate with regional staff and other agency staff to develop the technology procurement contract

Strategy ID #11

Establish CAD System and TOC Connections for Automated Alerts/Notifications

Description – Establish filtered CAD system access from agency TOCs to be able to see when incidents are restricting lanes and warrant traffic management measures. This strategy will involve communications between the public safety network and the agency TOC. The CAD system will need to be filtered to anonymous data for lane restriction and location information only, and separate monitors and server will be required at the agency TOC because CAD will not be integrated into the agency's ATMS system for viewing.

Relation to Needs – Integrated CAD systems will improve coordination and response by the County and public safety agencies to incidents (Need I2)

Scope/Limits – Integrate El Dorado County Sheriff and California Highway Patrol CAD system with County's ATMS system and TOC. This scope of work includes software integration to update El Dorado County Sheriff CAD system and County's ATMS system to allow data push from sheriff CAD system to ATMS system, and view the data in ATMS interface. The scope includes purchase, installation, configuration and integration of servers and software required at County's TOC.

Considerations – This strategy is not codependent on any other strategy identified for the County and can stand alone in implementation.

Prerequisite Dependencies – The following is a high-level list of prerequisite actions that will need to be taken prior to implementing this strategy.

- Server located at TOC

Strategy ID #12

Real-Time Data Connection between Transit and Transportation Agencies

Description – Establish connection between transit and transportation agencies for sharing data related to transit services. The purpose is for transportation agencies to organize traffic operations to accommodate transit services through collected data, such as vehicle location and on-time schedule performance that can better support the coordination of transit mobility and traffic mobility. This strategy specifically addresses transit signal priority needs for better mobility.

Relation to Needs – – This is a mapping of strategies to the original needs, recognizing that one strategy may serve multiple needs.

- Share data between agencies that share a corridor (Need D6)
- Encourage travel mode shift (Need D7)
- Real-time traveler information (Need D8)
- Improve traffic operations (Need O3)

Scope/Limits – Develop inter-agency agreements to share real-time data collected through video detection and CCTV cameras.

Considerations – The following are other strategies that should also be considered in conjunction with this strategy.

- ID #1 – Improve Existing Communications Capabilities on Key-Corridors
- ID #5 – Share CCTV Camera Video with Individual Agencies
- ID #8 - Deploy New CMS Equipment
- ID #10 – Share CCTV with Individual Agencies
- ID #11 – Share CCTV with Agency Public Traveler Information Platforms

Prerequisite Dependencies – This is a bullet list summary of the high-level steps required to implement the strategy.

- Establish CCTV Sharing Agreements between the individual agencies.
- Deploy modernized CCTV cameras at identified locations
- Establish an inventory of supplemental CCTV cameras

APPENDIX C - COST ASSUMPTIONS

Table 1: Cost Summary

Infrastructure Projects - Improve Existing Communications Capabilities									
Project No.	Project Description	VID	Controller Upgrade	CCTV	CMS	Communication (Miles)			Planning Level Cost
						New	In empty	Replace	
Communication Gap Glosures, Communications Equipment Upgrade, Upgrade to Fiber									
1	El Dorado Hills Boulevard Upgrade	7	7	7	5	4.2			$ 4,320,900.00
2	White Rock Road / Latrobe Road Upgrade	13	5	13	8	3.2		0.5	$ 4,036,600.00
3	Silva Valley Upgrade	4		4	2	1.0			$ 1,181,600.00
4	Green Valley Road Upgrade	14	5	14	3	2.0		1.4	$ 2,989,700.00
5	Cameron Park Drive Upgrade	5	3	2	2	3.2			$ 3,140,200.00
6	Missouri Flat Road and Diamond Springs Parkway Upgrade	13	6	13	3	1.4			$ 2,127,600.00
7	Ponderosa Drive / S. Shingle Road / Durock Road / Mother Load Drive Upgrade	6	1	6	4	3.2			$ 3,316,600.00
8	Video Detection - N. Shingle Road at Green Valley Drive	1							$ 36,000.00
9	Replace End-Of-Life/Legacy Equipment (10% of Total Devices)	6		5	2				$ 400,500.00
Non-Infrastructure Projects									
10	Communication Improvement for Interregional Connectivity								See Regional Document
11	Upgrade Agency ATMS								$ 200,000.00
12	Sharing CCTV Imagery with Other Agencies								See Regional Document
13	Timely Emergency Notifications								See Regional Document
14	Traffic Operations Center (Local)								$ 54,000.00
15	TOC Site Evaluation								$ 41,760.00
16	TOC Standard Operating Procedures and Functional Requirements								$ 34,200.00
17	Support of Regional Technology Procurement Contract Development								See Regional Document

APPENDIX D - PRIORITIZATION SUMMARY

Table 1: Prioritization Summary

Project	Project Corridor	Address multijurisdictional networking	Adapt to new technology	Improve reliability and consistency of driver trips	Safety	Improve traveler information and dissemination	Emergency / disaster preparedness	Contribute to operational and institutional efficiency	Enhances major corridors	Extent that project achieves local objectives	Other projects rely on this project	Total Strategy Score Compared to Objectives
		10	13	10	13	10	5	10	10	14	5	100
1	El Dorado Hills Boulevard Upgrade	4	3	3	1	4	1	3	4	4	4	78
2	White Rock Road / Latrobe Road Upgrade	4	3	3	1	4	1	3	4	4	4	78
3	Silva Valley Upgrade	3	3	3	1	3	1	3	4	4	4	73
4	Green Valley Road Upgrade	4	3	3	1	3	1	3	3	3	3	69
5	Cameron Park Drive Upgrade	3	3	3	1	2	1	2	2	3	2	57
6	Missouri Flat Upgrade	3	3	3	1	2	1	2	2	3	2	57
7	Ponderosa Drive / S. Shingle Road / Durock Road / Mother Load Drive Upgrade	3	3	2	1	2	1	3	2	2	1	53
8	Video Detection - N. Shingle Road at Green Valley Drive	3	3	2	1	0	1	3	2	2	0	46
9	Replace End-Of-Life/Legacy Equipment	2	3	3	1	2	2	3	2	2	0	53