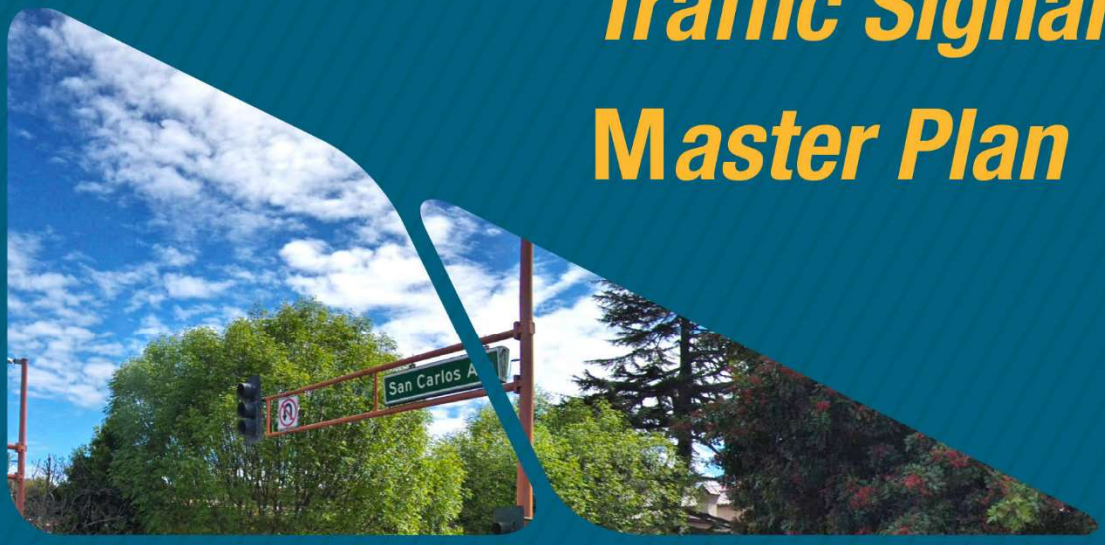
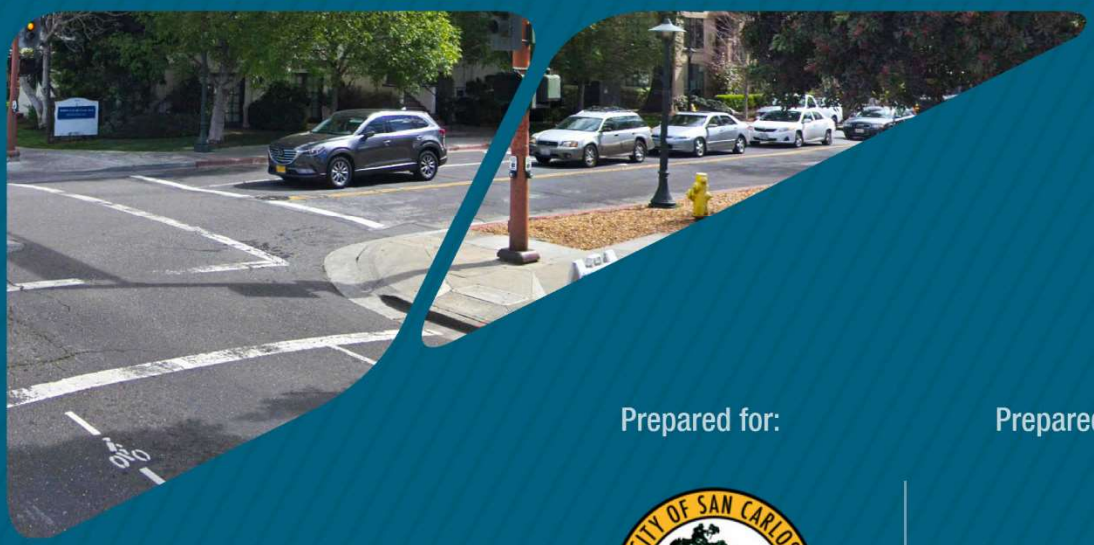
City of San Carlos

Traffic Signal Master Plan





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March 1, 2024

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EXECUTIVE SUMMARY

OBJECTIVE: Present a **unified plan for the deployment and integration of traffic signals** to serve City needs.

BENEFITS: Key benefits of a traffic signal master plan are:

- **Define traffic signal requirements** for consistent deployments by public and development projects.
- Improve the transportation network for pedestrians, bikes, and transit by planning for **emerging traffic signal technology** (e.g., video detection of vulnerable road user near-miss incidents and transit signal priority).
- **Coordinate short-term improvements and long-term planning decisions** with regional agencies (e.g., Caltrans, C/CAG), neighboring jurisdictions (e.g., City of Belmont, Redwood City), and transit agencies (e.g., SamTrans, Caltrain).
- **Ensure maintenance** of a safe and efficient traffic signal system to meet existing and future demands.

PROPOSED PROJECTS: Based on an existing conditions evaluation, needs and gaps assessment, and survey of smart signal technologies, the following projects are proposed:

Phase 1 ($1.19 M)

- Upgrade all **pedestrian** heads to countdown timers
- Upgrade all pedestrian pushbuttons to **accessible** pedestrian signals (APS)
- Upgrade communications at signals
- Update **signal timing coordination**
- Upgrade controllers to integrate with **advanced traffic management system**

Phase 2 ($5.05 M)

- Pilot **video detection** and bike detected signal indicator system at one intersection
- Deploy video detection and bike detected signal indicator at 23 intersections.
- Develop a funding strategy document
- Develop a staffing plan
- Formalize maintenance and operations responsibilities and budgets
- Upgrade communications at signals
- Procure and install controller battery back-up systems
- Procure and install additional C/CAG Smart Corridor workstation

Phase 3 ($2.33 M)

- Upgrade communications at signals
- Establish a **traffic operators center**

Total Cost = $8.57M

1 INTRODUCTION

1.1 PROJECT BACKGROUND

The City of San Carlos (City), located in San Mateo County of the San Francisco Bay Area, is home to over 30,000 residents. While the majority of land is dedicated to residential use, the City has industrial and commercial areas concentrated on its eastern side. City arterial and local streets are intersected by US 101, Interstate 280, El Camino Real, and the Caltrain railroad tracks. City streets are critical to facilitating circulation to these four, major, San Francisco Peninsula thoroughfares. In an effort to improve people movement throughout the City, the City is conducting a comprehensive review of their existing traffic signal system and communications infrastructure. The goal is to build a robust traffic signal network with tools to effectively manage the transportation network.

In the City of San Carlos General Plan[1], several goals are identified relating to transportation within, from, to, and through the City. These include:

- To develop a circulation system that is safe, environmentally friendly and responsive to the needs of various land uses planned within the City of San Carlos. (General Plan Goal CSH-1)
- To provide a safe, efficient, and aesthetically pleasing circulation network for various transportation modes in addition to the automobile. (General Plan Goal CSH-2)
- Maintain a street and highway system which accommodates future growth while maintaining acceptable levels of service. (General Plan Goal CSH-3)
- Provide for safe walking and bicycle riding for transportation and recreation. (General Plan Goal CSH-4)
- Ensure all modes of transportation connect safely and efficiently both within San Carlos and with neighboring jurisdictions. (General Plan Goal CSH-5)
- Integrate transportation and land use. (General Plan Goal CSH-6)
- Contribute to a comprehensive regional trail system for alternative transportation and outdoor recreation purposes. (General Plan Goal CSH-7)
- To develop a system of scenic highways and roads that reflects the aesthetic and visual qualities of the existing and developing San Carlos landscape and the surrounding region. (General Plan Goal CSH-8)

Accompanying each of the goals, the General Plan outlines policies and actions to achieve these goals. While not explicitly mentioned in the Plan, an efficient traffic signal network is a tool to support and advance many of the identified transportation goals and policies. This Traffic Signal Master Plan aims to advance the City's goals by analyzing and inspecting the existing traffic signal systems, determining what infrastructure may need upgrading, and identifying new technology for implementation that may benefit the City and its residents.

1.2 DOCUMENT PURPOSE

The purpose of this document is to present a unified plan for the deployment and integration of traffic signals to serve City needs. This document is the culmination of previous project deliverables, including an existing equipment and infrastructure inventory, needs analysis, implementation strategy and project prioritization, traffic signal technical specification requirements, and City/County Association of Governments (C/CAG) of San Mateo County Smart Corridor project integration requirements.

This document is intended to be used as a tool by City staff to effectively implement transportation network improvements. This is a dynamic document that will need to be reevaluated and updated every five years to reassess the City's priorities and adjust them as appropriate.

1.3 BENEFITS

The benefits of having a traffic signal master plan are listed below:

- Accommodate development in the City by clearly defining traffic signal technical specifications.
- Coordinate short-term improvements and long-term planning decisions with regional agencies (e.g., Caltrans, C/CAG), neighboring jurisdictions (e.g., City of Belmont, Redwood City), and transit agencies (e.g., SamTrans, Caltrain).
- Ensure maintenance of a safe and efficient traffic signal system to meet existing and future demands.
- Comply with current federal and state regulations, as well as latest industry guidelines and practices relating to traffic signal systems (e.g., minimum pedestrian walk time, push buttons, detection, advanced traffic controllers).
- Leverage C/CAG's investment into the Smart Corridor system, by planning to comply with system integration requirements.
- Improve the transportation network for pedestrians, bikes, and transit by planning for emerging technology (e.g., video detection of vulnerable road user near-miss incidents and transit signal priority).
- Prepare for City Capital Improvement Program budgeting efforts.

2 EXISTING CONDITIONS

The City is home to 33 traffic signals, nine of which are owned by Caltrans. The remaining 24 traffic signals are owned and operated by the City, each including signals on poles and/or mast arms, a controller cabinet, safety lighting, pedestrian heads, push buttons and crosswalks, vehicle and bicycle detection, interconnect communication and other traffic signal accessories. **Figure 1** shows the traffic signals and communications infrastructure throughout the City of San Carlos.

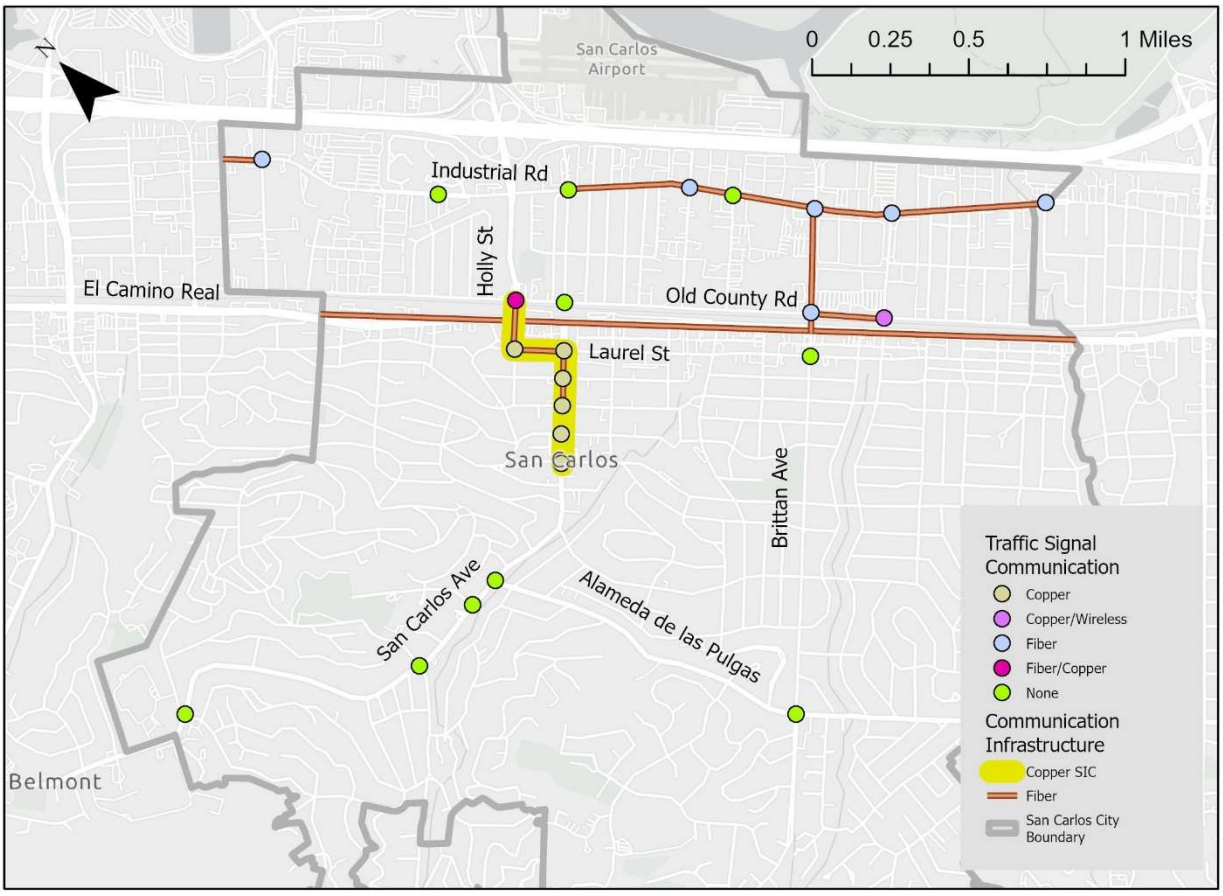

Figure 1: City of San Carlos Traffic Signals

Appendix A – Field Review Summary reflects a field inventory of each City-owned traffic signal. A summary of the existing elements is listed below:

- ***Controller Cabinets*** – A mix of Caltrans and NEMA cabinets are used by the City and the breakdown of cabinet types and quantities are:
  - Fifteen Caltrans Type 332
  - Five NEMA Type P44
  - Two NEMA Type M
  - Two NEMA Type G

- ***Vehicle Signal Heads*** –The majority of pole mounted and mast arm mounted signal heads are equipped with 12" diameter indications, however there are 8" diameter lenses at 12 intersections. While the use of 8" indications is allowed by the California Manual on Uniform Traffic Control Devices (CA MUTCD), they can only be used under certain conditions (see CA MUTCD Section 4D.07), otherwise 12" indications are required for all new installation.

- ***Pedestrian Signal Heads*** - Both countdown type and standard (i.e., Hand/Walking Person) pedestrian heads are in use throughout the City, with countdown types most widely installed. A potentially defective pedestrian signal head is present at the intersection of San Carlos Avenue and Elm Street because field observations noted that one head displayed a singular red hand pedestrian head (non-blinking).

- ***Vehicle and Bicycle Detection*** – All but two intersections have inductive loops for detection. The other two intersection are recent traffic signal installations on Industrial Road at Commercial Street and E. San Carlos Avenue and video detection was installed.

- ***Pedestrian Detection*** - Both standard and Accessible Pedestrian Signal (APS) push button assemblies are deployed, but standard push buttons are more prevalent as they are present at 19 of the 24 City intersections. Separate audible pedestrian signals are present at the intersection of Industrial Road and Quarry Road.

- ***Safety Lighting*** – All intersections have LED safety lights.

- ***Battery Backup System*** - While all intersections have a battery-backup cabinet present, only 7 intersections have batteries though most were expired or not connected to the signal. As such, in the event of a power shutoff, nearly all of the City signals are not equipped with backup power.

A variety of controller models are installed throughout the City. The majority are Model 2070 controllers, manufactured by companies such as Safetran, Naztec, Intelight and McCain and they operate a breadth of firmware versions. Controllers at intersections connected to the San Mateo Smart Corridor utilize D4 software, while the other intersections tend to have software consistent with the controller manufacturer (i.e., Naztec 2070N with Apogee software), However, there are three intersections along Old County Road that are running Caltrans TSCP firmware.

In 14 of the controller cabinets, fiber or copper signal interconnect was observed. All of the existing fiber interconnect within the City was installed by the San Mateo Smart Corridor project. The City has a Smart Corridor workstation at City Hall that is integrated with the countywide system via a fiber optic cable between City Hall and a Caltrans communication trunkline along El Camino Real. This workstation provides access for City staff to monitor and control the City intersections on the Smart Corridor system. It was observed that there are two recently installed intersections, Industrial Road at Commercial Street and Industrial Road at E. San Carlos Avenue, that are on segments of the Smart Corridor fiber network but were not connected to the fiber trunkline. Both intersections were installed after the Smart Corridor project and were installed by development projects. They both have GPS time clocks, but the controller was not connected to the time clock at the E. San Carlos intersection. In addition to the fiber optic cable interconnect, there is copper interconnect along Holly Street, Laurel Street, and San Carlos Avenue. Lastly, the intersection of Old County Road at Howard Avenue has a wireless cellular modem in addition to copper interconnect.

3 NEEDS AND GAP ASSESSMENT

3.1 GOALS AND OBJECTIVES

The City General Plan outlines a vision and goals for the City's transportation network in its Circulation & Scenic Highways Element. While these goals are broad, the scope of these goals encapsulates important concepts including:

- Safety.
- Efficiency.
- Aesthetics.
- Accommodating future growth while maintaining acceptable levels of service.
- Ensuring that the network serves all modes of transportation.

Expanding on these broader themes, specific goals and objectives for the traffic signal system have been developed to guide future planning and implementation projects. The goals are tangible categories that compose the City's overall vision for the system, and objectives are specific and measurable means by which to analyze the City's progress with regards to achieving the goals. The goals and objectives in **Table 1** have been developed based on input from Public Works staff.

Table 1: Goals and Objectives

Goal	Objective
[1] Conduct evaluation of the existing City transportation network	▶ Take inventory of existing traffic signal equipment and infrastructure ▶ Identify and classify gaps in the traffic signal system ▶ Develop strategies for gap closures and system upgrades ▶ Create an evaluation structure to prioritize opportunities for addressing gaps
[2] Improve traffic operations on signalized corridors	▶ Implement transportation system tools to provide reliable coordination along corridors ▶ Evaluate individual intersection operations (cycles, splits, lead/lag, ped/bike timing, etc.) ▶ Consider opportunities for signal operations and coordination across jurisdictional boundaries, particularly to/from Caltrans facilities
[3] Update traffic signals to current industry standards	▶ Implement traffic signal controllers based on latest Advanced Transportation Controller (ATC) standards ▶ Deploy video detection equipment to enhance bicycle and vehicle detection ▶ Replace outdated traffic signal equipment (e.g., pedestrian push buttons, touchless controller cabinets, 8" signal heads, high pressure sodium lights) ▶ Develop traffic signal standards to guide capital improvement projects and private development projects

Goal	Objective
[4] Establish operations & maintenance policies and funding	▶ Identify funding sources for equipment repairs and replacement ▶ Develop policies and guidelines for proactive signal system maintenance
[5] Position City for implementation of future emerging technologies	▶ Upgrade interconnect system to allow for ease of implementation of emerging technologies ▶ Establish evaluation criteria for evaluating emerging technology ▶ Engage City staff in gaps assessment to help identify future traffic needs
[6] Establish a Traffic Operations Center (TOC)	▶ Identify a space for a TOC at City Hall ▶ Monitor and control traffic signals from a centralized location ▶ Coordinate with neighboring cities and Caltrans for opportunities for regional traffic management
[7] Expand the integration with San Mateo County Smart Corridors	▶ Connect recently installed City traffic signal cabinets to existing San Mateo County Smart Corridors interconnect routes ▶ Leverage Smart Corridor traffic management system for City traffic control and operations

3.2 NEEDS AND GAP ASSESSMENT

Due to the varying age of traffic signals throughout San Carlos, there is also variation in the condition of the infrastructure. There are inconsistencies in the traffic signal equipment across the City, leading to more difficult maintenance and a lower level of readiness for potential implementation of new and emerging technologies.

Table 2 lists the traffic signal system gaps and traces them to the goals of this plan. These gaps will inform proposed improvements and serve as a framework for deciding how to prioritize projects.

Table 2: City of San Carlos Traffic Signal System Gaps

Gap	City Need	Associated Goals
[A] No Existing Deployment Policies and Standards	The City does not have policies and systems in place to initiate ongoing upgrades to traffic signal equipment. Having policies and standards would assist the efficient and consistent implementation of traffic signal infrastructure.	2, 3, 4, 5
[B] Intersections are Not Suited for Active Transportation Users	City Policy CSH-2.2 aims to "provide for adequate pedestrian and bicycle facilities as viable transportation alternatives." Additionally, City Policy CSH-4.3 states that "the safety of bicyclists, pedestrians, as well as motorists shall be considered in street design wherever possible." Currently, the City lacks widespread implementation of technologies that improves the access and user experience of active transportation modes at traffic signals such as reliable bicycle detection and accessible/touchless pedestrian push buttons.	1, 3
[C] Limited Coordinated Traffic Signals	The City experiences congestion at its signalized intersections, particularly those adjacent to major arterials such as El Camino Real and US-101.	1, 2, 3

Gap	City Need	Associated Goals
[D] Not All Traffic Signals Have Interconnect	City Goal CSH-5 aims to ensure that "all modes of transportation connect safely and efficiently." Signals with communications could facilitate more cohesive signal operations.	2, 3, 5, 7
[E] Limited Ongoing Collaboration with Adjacent Agencies for Operations Across Jurisdictions	City Policy CSH-3.10 states that "The City shall support efforts for a coordinated transportation system (…) with local, regional and Caltrans agencies." The City currently participates in the San Mateo County Smart Corridor, but the City can further this collaboration to day-to-day traffic operations instead of just major incidents. Of particular interest is improving operations to and from to inter-jurisdictional roadways that currently experience the most congestion in San Carlos, such as El Camino Real which is Caltrans owned and operated.	2, 6, 7
[F] Inconsistent Funding for Improvements and Staffing	While the City does budget for on-going signal maintenance and operations, there is no long-term budget and funding set aside for comprehensive system upgrades. Additionally, the City does not have dedicated staff for regular oversight, monitoring, or operations of the network. As a result, necessary upgrades may not be prioritized.	3, 4
[G] Lack of Traffic Operations Center (TOC)	Although the City does have some coordinated signals and several traffic detection systems, there is no centralized location or team dedicated to managing and analyzing this information.	2, 4, 6

4 IMPLEMENTATION STRATEGY

4.1 IMPLEMENTATION STRATEGIES

Based on the traffic signal system infrastructure gaps and City needs, a list of implementation strategies was developed to facilitate implementation. **Table 3** is comprehensive list of strategies, highlighting the benefit to the City and traceability back to system gaps.

Table 3: Implementation Strategies

Strategy No.	Strategy	Description	Benefit to City	Associated Gap(s)
1	Standardize Traffic Signal Controllers	▶ Procure and Install Traffic Signal Controllers based on latest industry standards	▶ Facilitate the efficient and consistent implementation of traffic signal infrastructure, that is compatible with the C/CAG Smart Corridor system. ▶ Facilitate implementation of smart traffic signal technologies (e.g., transit signal priority).	A, C
2	Develop Traffic Signal Standard Specifications	▶ Develop Standard Specifications for use by City and Developers	▶ Facilitate the efficient and consistent implementation of traffic signal infrastructure, given recent development.	A
3	Conduct Comprehensive Signal Timing Assessment on Primary Corridors and City-Owned Signals	▶ Update Signal Timing on Primary Corridors ▶ Support Caltrans Signal Timing Optimization along El Camino Real ▶ Update Signal Timing on Secondary Corridors and Isolated Intersections	▶ Decrease congestion and environmental impacts at City-owned signalized intersections and primary corridors (e.g., El Camino Real). ▶ Facilitate implementation of smart traffic signal technologies (e.g., adaptive traffic control system).	C, E

Strategy No.	Strategy	Description	Benefit to City	Associated Gap(s)
4	Upgrade Pedestrian and Bicycle Traffic Signal Components to Current Industry Standards	▶ Upgrade Pedestrian Heads to Countdown Timers ▶ Upgrade Standard Pedestrian Push Buttons to Accessible Pedestrian Signals (APS) ▶ Upgrade Detection Infrastructure to Better Detect Bicycles	▶ Improve pedestrian and bicyclist safety and access, in alignment with City policies. ▶ Support future detection applications (e.g., pedestrian and bike near-miss detection software).	A, B
5	Develop a Funding Strategy Document and Staffing Plan	▶ Provide timeline and key milestones for project funding opportunities ▶ Plan for funding to train and to coordinate with qualified staff	▶ Identify funding sources (i.e., grants, developer fees, etc.) and staffing availability will facilitate implementation of the improvements identified in this plan.	E, F
6	Develop Standard Operating Procedures for Ongoing Maintenance and Operations	▶ Establish groundwork for needs and cost of continued operations of traffic elements ▶ Formalize Maintenance and Operations Responsibilities and Budgets	▶ Develop standard operations and maintenance practices ensures capital investments in transportation technology are most effectively leveraged over time.	A, E, F
7	Expand Communications to Intersections on Primary Corridors	▶ Establish Communication to All Signals Along Existing Interconnected Corridors ▶ Convert Existing Legacy Copper Interconnect to Ethernet over Copper	▶ Establish communications to signals facilitates remote management and control, improving the City's ability to operate its transportation network. ▶ Facilitate implementation of smart traffic signal technologies (e.g., vulnerable road user video detection).	B, C, D

Strategy No.	Strategy	Description	Benefit to City	Associated Gap(s)
8	Revisit Signal Timing Every 3-5 Years	► Update Signal Timing Coordination ► Evaluate Advanced Traffic Signal Operation Systems	► Revisit the signal timing will ensure that signalized intersections are operating most effectively, given changing travel patterns and populations.	B, C
9	Establish Communications to Isolated Intersections and Expand Fiber to All Primary Corridors	► Install Cellular/Wireless Communications to Isolated Intersections ► Replace Copper Interconnect with Fiber	► Establish communications to signals facilitates remote management and control, improving the City's ability to operate its transportation network. ► Facilitate implementation of smart traffic signal technologies (e.g., adaptive signal control, vulnerable road user video detection).	C, D
10	Establish a Traffic Operations Center	► Establish Traffic Operations Center	► Allow the City to centrally control and monitor traffic signals and other traffic operations equipment. ► Facilitate coordination with Caltrans, County of San Mateo, C/CAG, transit agencies, and adjacent jurisdictions during emergencies or major events.	G

4.2 IMPLEMENTATION PROJECTS

Due to staff and budget limitations, the proposed projects will need to be prioritized. Implementation of these projects require City staff time. These demands can be supplemented by professional consulting services, facilitated through the existing City on-call contract mechanism. Given City staff size, execution of this plan will require a mixture of both City staff time and consultant support.

The phases are defined as such:

1. ***Phase 1 -*** short-term projects that can offer a near-term benefit to the travelling public, one to three years from master plan approval (2024 through 2026).

2. ***Phase 2 –*** mid-term projects that require coordination with multiple City departments and/or public outreach, three to eight years from master plan approval (2027 through 2032).
3. ***Phase 3 –*** long-term projects that do not fit within City staffing and/or budget limitations within the next eight years, more than eight years from master plan approval (2033 and beyond).

Each implementation strategy listed above is related to one or more specific projects that are practical to implement. **Table 4** outlines a list of projects. The project number is structured as associated implementation number dash project number (X-X).

Table 4: Proposed Project List

Project No.	Project	Phase	Notes
1-1	Procure and install controller with KITS compatible firmware for Industrial/Bransten	1	Firmware upgrade will allow re-integration into KITS, communications connection to the San Mateo system hub is already established.
1-2	Procure and install 10 traffic signal controllers with KITS compatible firmware	1	San Carlos/Laurel, San Carlos/Walnut, San Carlos/Elm, San Carlos/Cedar, Brittan/Laurel, San Carlos/Club, Brittan/Alameda, Industrial/PAMF, Old County/E. San Carlos, San Carlos/Chestnut
1-3	Procure and install GPS clocks at San Carlos/Phelps and San Carlos/Alameda	N/A	Project in progress with completion anticipated March 2024.
1-4	Procure and install controller battery back-up systems	2	-
2-1	Develop standard specifications for use by City and Developers	N/A	This project is being accomplished as part of this master plan development.
3-1	Update signal timing plan on primary corridors	N/A	This project is being accomplished as part of this master plan development.
3-2	Optimize signal timing along El Camino Real (ECR)	N/A	This project is being complete in parallel to this master plan development though an Adaptive Signal Timing deployment along ECR in partnership with Caltrans.
3-3	Update signal timing on secondary corridors and isolated intersections	N/A	This project is being accomplished as part of this master plan development.
4-1	Upgrade 75 pedestrian heads to countdown timers	1	-
4-2	Upgrade 148 pedestrian pushbuttons to accessible pedestrian signals (APS)	1	-
4-3	Pilot video detection and bike detected signal indicator system at one intersection	2	-
4-4	Deploy video detection and bike detected signal indicator at 23 intersections.	2	Dependent on 4-3.
5-1	Develop a funding strategy document	2	-

Project No.	Project	Phase	Notes
5-2	Develop a staffing plan	2	-
6-1	Formalize maintenance and operations responsibilities and budgets	2	-
7-1	Connect Industrial/Commercial, Industrial/E. San Carlos, and Old County/Howard to existing C/CAG Smart Corridor fiber trunkline	2	This project will influence the Northeast Area Specific Plan.
7-2	Use existing copper interconnect for Ethernet connections for near term implementation at five intersections	1	San Carlos/Laurel, San Carlos/Walnut, San Carlos/Elm, San Carlos/Cedar, San Carlos/Chestnut
7-3	Replace copper interconnect with fiber at six intersections	2	Laurel/Holly, San Carlos/Laurel, San Carlos/Walnut, San Carlos/Elm, San Carlos/Cedar, San Carlos/Chestnut This project will influence the Downtown Specific Plan.
8-1	Update signal timing coordination in 2026	1	Signal timing coordination to be updated every 3-5 years thereafter to adjust for current traffic conditions and maintain effectiveness.
9-1	Install cellular/wireless communications at three, remote intersections.	1	San Carlos/Phelps, San Carlos/Alameda, San Carlos/Devonshire
9-2	Install cellular/wireless communications at three, remote intersections	1	San Carlos/Club, Brittan/Alameda, Industrial/PAMF. This is the permanent communications solution at these three remote intersections.
9-3	Install fiber along San Carlos Ave between Devonshire Blvd and Alameda, and connect three intersections	3	This will replace the temporary wireless connection from Project 9-1.
9-4	Connect Brittan/Laurel to fiber trunkline along El Camino Real	3	-
9-5	Connect Old County/E. San Carlos to fiber along Holly	3	-
9-6	Integrate Industrial/Commercial and Industrial/E. San Carlos into KITS	2	These two signals are along the C/CAG Smart Corridor routes. Dependent on 7-1.
9-7	Integrate Holly/Laurel into KITS	1	-
9-8	Integrate five intersections into KITS	1	San Carlos/Laurel, San Carlos/Walnut, San Carlos/Elm, San Carlos/Cedar, San Carlos/Chestnut Dependent on 1-2.

Project No.	Project	Phase	Notes
9-9	Integrate three intersections into KITS	1	San Carlos/Alameda, San Carlos/Phelps, San Carlos/Devonshire Dependent on 9-1.
9-10	Integrate five intersections into KITS (as they come online)	3	Brittan/Laurel, San Carlos/Club, Brittan/Alameda, Industrial/PAMF, Old County/E. San Carlos Dependent on 1-2, 9-2, 9-4, and 9-5.
10-1	Establish a traffic operators center	3	Assumes small scale TOC that utilizes an existing conference room or other work space that would be used during emergencies or major events.
10-2	Procure and install additional KITS workstation	2	-

Figure 2 through **Figure 4** illustrates the proposed communications infrastructure upgrades at City of San Carlos traffic signals, summarized in the table above.

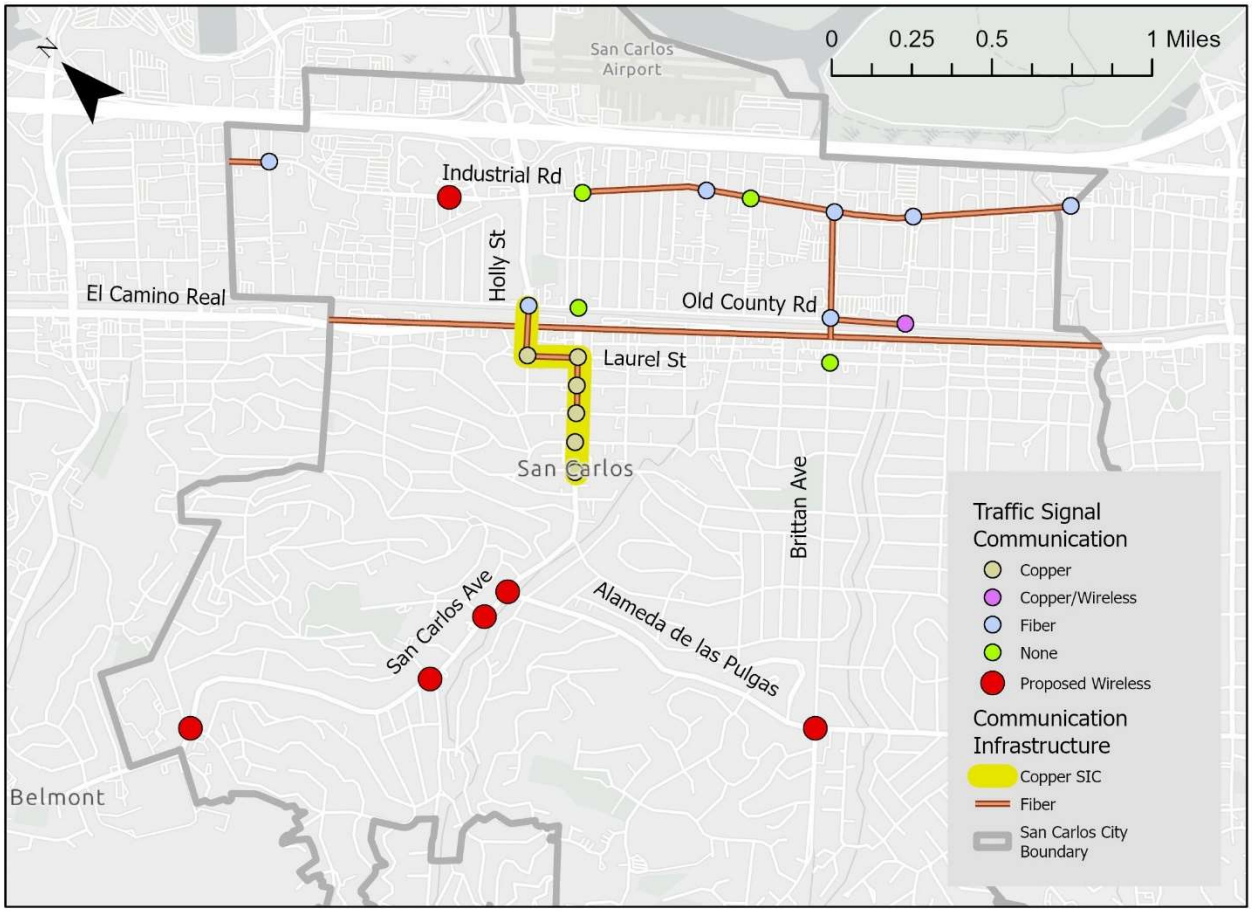

Figure 2: Proposed City of San Carlos Traffic Signal Communications Infrastructure – Phase 1

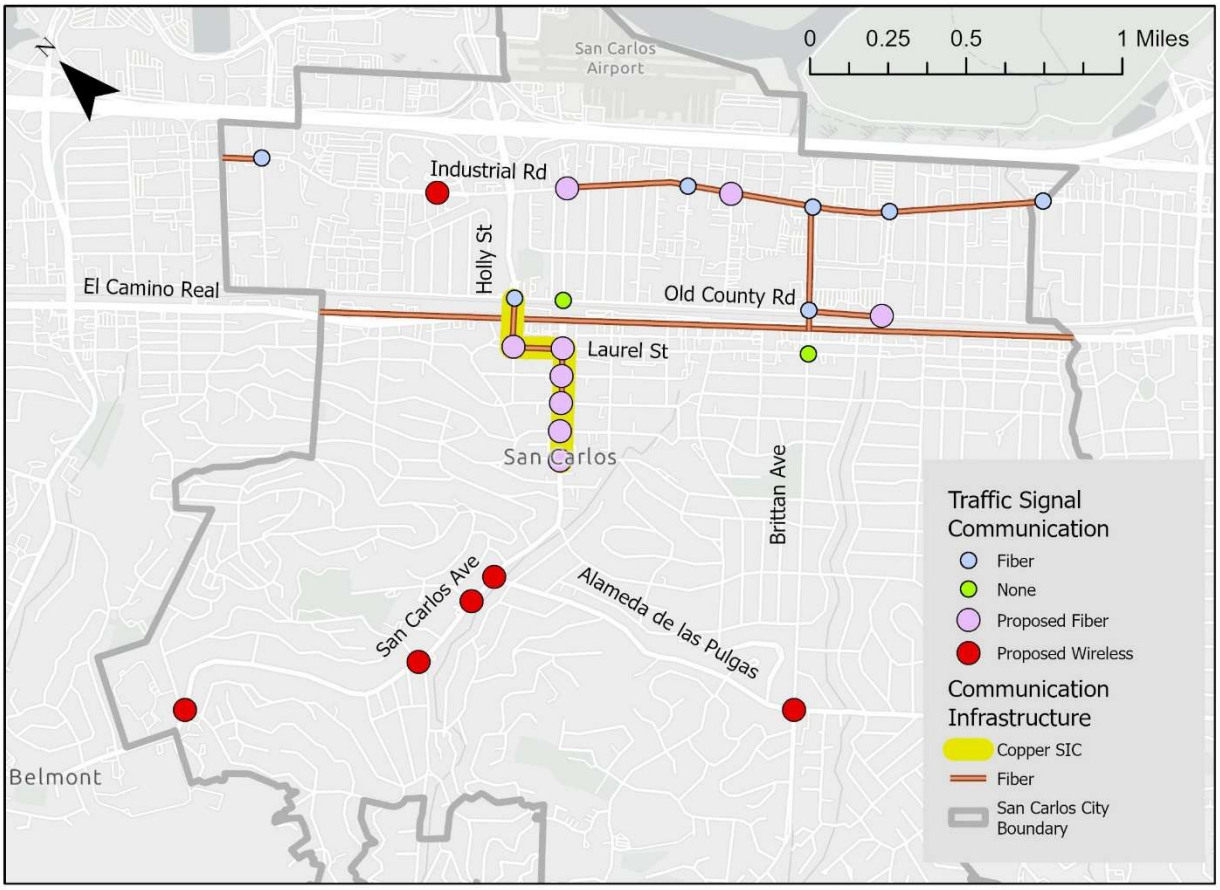

Figure 3: Proposed City of San Carlos Traffic Signal Communications Infrastructure – Phase 2

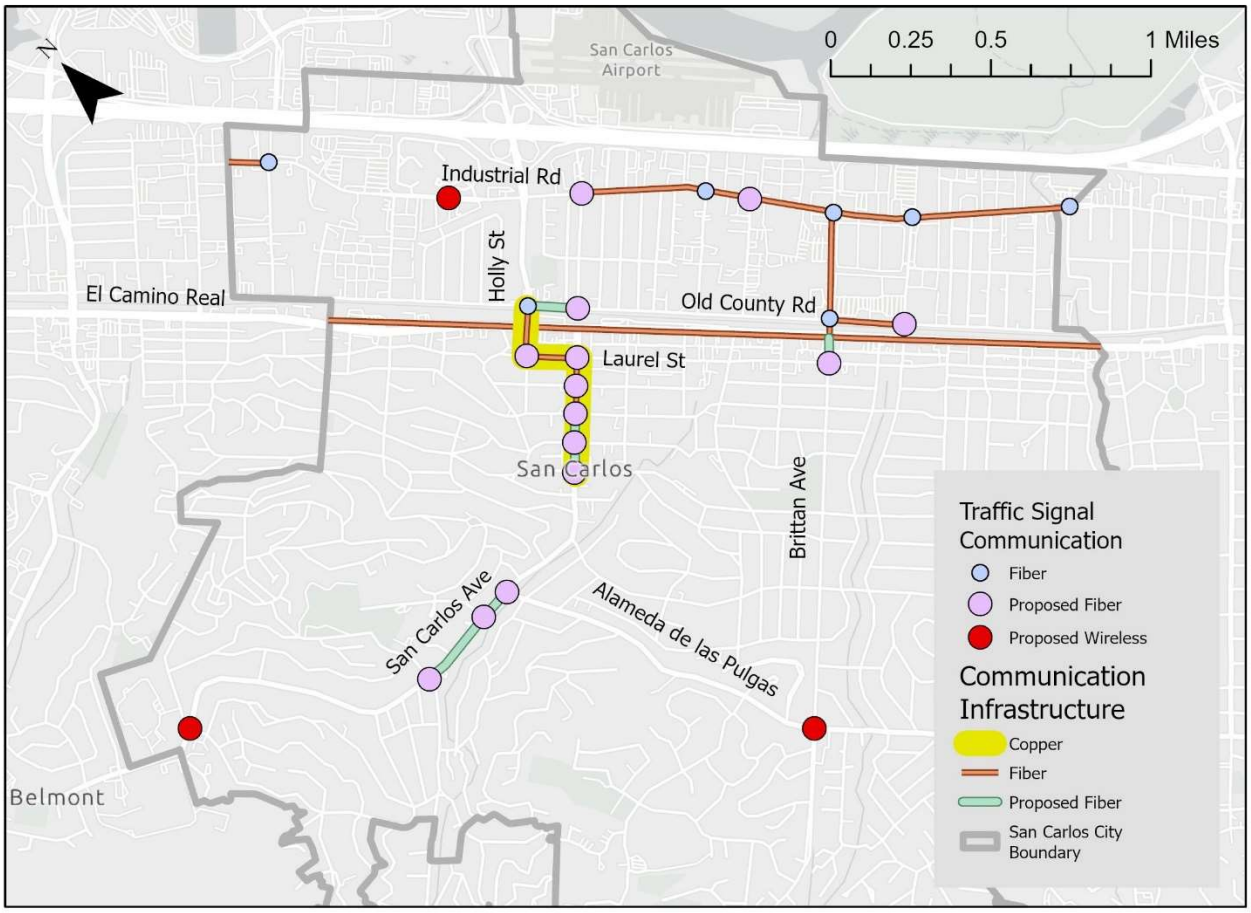

Figure 4: Proposed City of San Carlos Traffic Signal Communications Infrastructure – Phase 3

5 PLANNING LEVEL COST ESTIMATE

A planning level cost estimate was developed for each of the projects identified and the costs are shown in **Table 4**. This is a high-level cost estimate meant to inform City budgeting and planning efforts.

Each project has been identified to address the City's need and will advance the priorities of the City's transportation network. These projects are relatively small investments that allow the City to leverage larger, regional investments into emerging technology and private entity's investments into development. A coordinated plan is the most efficient way to allocate funding for traffic signal master plan improvements. Disjointed investments on standalone projects and developments lead to mismatched, incompatible technologies which limit the technology's potential benefits.

5.1 ASSUMPTIONS

The following assumptions were made for the planning level cost estimate:

- Preliminary engineering costs are 30% of capital equipment construction costs for all communications infrastructure and ITS device deployments.
- Each new controller that is procured will require on-call signal technician time to program.
- Each project to upgrade a pedestrian head to countdown timer includes the following items: remove and salvage existing signal indication, furnish and install pedestrian signal indication (countdown), miscellaneous cabling, and design.
- Each project to upgrade a PPB to APS includes the following items: remove existing pedestrian push button assembly, furnish and install APS assembly with sign, miscellaneous cabling, and design.
- Each video detection and bike detected signal indicator system project includes the following items: furnish and install bicycle detected signal indicator system (two indicators, controller unit), draw and program new video detection zones, procure video detection system, furnish and install video detection system, furnish and install 3" conduit, furnish and install No. 6E pull box (four per intersection), miscellaneous cabling, and design. To be conservative, it is assumed that a third of existing conduits exceed fill and new conduits will be required.
- Developing a funding strategy document, staffing plan, and maintenance and operations plan includes professional services time to research, develop a draft, address comments, and prepare a final document. The development of each document encourages intentional conversations and actionable steps to advance the Traffic Signal Master Plan.
- Any fiber installation includes a cable length contingency for slack and coils, which was assumed to be an additional 20% of the total cable length estimated. At all trunk splice points, slack of about 100ft per direction of slice is provided. At a typical intersection, about a total of 100 feet of slack is provided for pull boxes, connection to signal, and as needed. Coils of about 100 to 300 feet are provided as needed at predetermined access points for future implementation.
- Installing fiber includes the following items: furnish and install 3" conduit, 288 SMFO cable for trunkline, 12 SMFO cable for branch, No. 6E pull box (every 200 feet and four per

intersection), fiber optic splice vault (one per intersection), splice closures, 12-port fiber termination panel and patch cords, Ethernet switch, make and test fiber splicings and terminations (four splices and twelve terminations per intersection), and design.

- Updating signal timing coordination includes the following items: traffic counts, professional services time for signal timing plan updates and controller programming.
- Installing wireless cellular communications includes the following items: wireless modem, antenna, miscellaneous cabling, start-up cost with third-party provider, and design.

Table 5 outlines unit cost assumptions that were used for the planning level cost estimate. The source of these costs is recent construction bid results of similar projects, to reflect current market pricing as of December 2023.

Table 5: Planning Level Unit Costs

Item	Unit Cost	Unit
Communications Installation		
Furnish and Install 12-Strand SFMO Cable	$10	LF
Furnish and Install 288-Strand SMFO Cable	$18	LF
Furnish and Install 3" Conduit	$125	LF
Make and Test Fiber Splices and Terminations	$250	EA
Furnish and Install Splice Closure	$2,500	EA
Furnish and Install No. 6E Pull Box	$3,500	EA
Furnish and Install 12-Port Fiber Termination Panel and Patch Cords	$1,200	EA
Furnish And Install Fiber Optic Splice Vault	$3,200	EA
Upgrade Copper Interconnect to Ethernet Connection (per intersection)	$10,000	EA
Leased Wireless Communications		
Antenna For Cellular/Wireless Communication	$750	EA
Start-Up Cost For Cellular/Wireless Communication	$750	EA
Wireless Modem For Cellular/Wireless Communication	$2,250	EA
Update Pedestrian Heads to Countdown Timers		
Remove and Salvage Existing Signal Indication	$200	EA
Furnish and Install Pedestrian Signal Indication (Countdown)	$1,200	EA
Misc. Cabling	$750	EA
Update PPB to APS		
Remove and Salvage Existing Pedestrian Push Button Assembly	$250	EA
Furnish And Install Accessible Pedestrian Signal (APS) Assembly With Sign	$1,500	EA
Misc. Cabling	$750	EA
Replace Controller		
Furnish and Install McCain Controller	$7,500	EA
Furnish and Install Firmware	$1,000	EA
Controller Battery Back-Up System		
Upgrade Existing Battery Back-Up System	$2,000	EA
Furnish and Install New Battery Back-Up System	$10,000	EA
Video Detection and Bike Detected Signal Indicator System		
Furnish and Install Bicycle Detected Signal Indicator System (2 Indicators, Controller Unit)	$4,000	EA
Furnish and Install Video Detection System (Per Intersection)	$40,000	EA
Furnish and Install No. 6E Pull Box	$3,500	EA
Misc. Cabling	$750	EA

Item	Unit Cost	Unit
Establish Traffic Operation Center (TOC)		
Integrate TOC	$50,000	LS
Procure additional TOC workstation	$20,000	LS
ATMS Integration		
Integrate intersection into KITS	$1,500	EA
Procure additional KITS workstation	$2,000	EA

5.2 PROJECT COST

Table 6 outlines the capital, soft, total, and projected/escalated planning level cost estimate for each project. As defined in **Section 4.1 Implementation Strategies**, the projects will progress as either Phase 1 (near-term), Phase 2 (mid-term), or Phase 3 (long-term) projects. Each project's phasing is detailed below. The following assumptions were made when extrapolating the project costs over the three phases:

- 4% cost escalation per year.
- 15% contingency for Phase 1 near-term projects.
- 30% contingency for Phase 2 mid-term projects.
- 45% contingency for Phase 3 long-term projects.

All projected/escalated costs were rounded up to the nearest thousand. A more detailed breakdown of the costs can be found in **Appendix C – Detailed Cost Estimate**.

Table 6: Project Costs

Project No.	Project	Capital Cost	Soft Costs (Design and Oversight)	Total Cost	Projected Year	Projected/ Escalated Cost
Phase 1						
1-1	Procure and install controller with KITS compatible firmware for Industrial/Bransten	$8,500	$500	$9,000	2024	$ 11,000
1-2	Procure and install 10 traffic signal controllers with KITS compatible firmware	$85,000	$5,000	$90,000	2025	$ 111,000
4-1	Upgrade 75 pedestrian heads to countdown timers	$161,300	$48,400	$209,700	2024	$ 250,000
4-2	Upgrade 148 pedestrian pushbuttons to accessible pedestrian signals (APS)	$370,000	$111,000	$481,000	2024	$ 573,000
7-2	Use existing copper interconnect for Ethernet connections for near term implementation	$50,000	$15,000	$65,000	2025	$ 81,000
8-1	Update signal timing coordination in 2026	-	$80,000	$80,000	2026	$ 102,000

Project No.	Project	Capital Cost	Soft Costs (Design and Oversight)	Total Cost	Projected Year	Projected/ Escalated Cost
9-1	Install cellular/wireless communications at three, remote intersections.	$13,500	$4,100	$17,600	2025	$ 22,000
9-2	Install cellular/wireless communications at three, remote intersections	$13,500	$4,100	$17,600	2026	$ 23,000
9-7	Integrate Holly/Laurel into KITS	-	$1,500	$1,500	2024	$ 2,000
9-8	Integrate five intersections into KITS	-	$7,500	$7,500	2026	$ 10,000
9-9	Integrate three intersections into KITS	-	$4,500	$4,500	2026	$ 6,000
					Phase 1 Total	**$1.19M**
Phase 2						
1-4	Procure and install controller battery back-up systems	$160,000	$48,000	$208,000	2027	$ 306,000
4-3	Pilot video detection and bike detected signal indicator system at one intersection	$68,200	$21,000	$89,200	2027	$ 132,000
4-4	Deploy video detection and bike detected signal indicator at 23 intersections.	$1,436,200	$615,500	$2,051,700	2028	$ 3,112,000
5-1	Develop a funding strategy document	-	$25,000	$25,000	2027	$ 37,000
5-2	Develop a staffing plan	-	$17,500	$17,500	2027	$ 26,000
6-1	Formalize maintenance and operations responsibilities and budgets	-	$32,500	$32,500	2028	$ 50,000
7-1	Connect Industrial/Commercial, Industrial/E. San Carlos, and Old County/Howard to existing C/CAG Smart Corridor fiber trunkline	$118,700	$35,700	$154,400	2028	$ 235,000
7-3	Replace copper interconnect with fiber at six intersections	$575,400	$172,700	$748,100	2028	$ 1,135,000

Project No.	Project	Capital Cost	Soft Costs (Design and Oversight)	Total Cost	Projected Year	Projected/ Escalated Cost
9-6	Integrate Industrial/Commercial and Industrial/E. San Carlos into KITS	-	$3,000	$3,000	2029	$ 5,000
10-2	Procure and install additional KITS workstation	$2,000	$3,000	$5,000	2029	$ 8,000
					Phase 2 Total	**$5.05M**
Phase 3						
9-3	Install fiber along San Carlos Ave between Devonshire Blvd and Alameda, and connect three intersections	$439,400	$131,900	$571,300	2033	$ 1,103,000
9-4	Connect Brittan/Laurel to fiber trunkline along El Camino Real	$179,700	$54,000	$233,700	2033	$ 452,000
9-5	Connect Old County/E. San Carlos to fiber along Holly	$224,300	$67,300	$291,600	2033	$ 563,000
9-10	Integrate five intersections into KITS (as they come online)	-	$7,500	$7,500	2033	$ 15,000
10-1	Establish a traffic operators center	$70,000	$30,000	$100,000	2033	$ 194,000
					Phase 3 Total	**$2.33M**

6 STANDARDIZATION AND INTEGRATION

The City is overseeing a growing traffic signal system, and as the system grows, technology and best practices standardization will allow all new development to be compatible with the existing infrastructure. San Carlos has a unique opportunity to align with the City/County Association of Governments (C/CAG) of San Mateo County Smart Corridor project, to leverage regional investment into expensive fiber communications infrastructure and advanced traffic management system (ATMS). The goal of the Smart Corridor project is to improve arterials street performance with intelligent transportation system (ITS) elements and interconnected traffic signal system. C/CAG uses Kimley-Horn's ATMS, KITS, to manage the Smart Corridor traffic signals.

6.1 TRAFFIC SIGNAL SPECIFICATIONS

To support the deployment of consistent traffic signal equipment through the City, standard traffic signal technical specifications have been developed **Appendix B - Traffic Signal Technical Specifications**. These specifications should be provided to developers, designers, and City staff that are leading projects to install or modify traffic signals. In addition, it is recommended that maintenance contractors are made

aware of these specifications. Standardizing equipment avoids costly upgrades after incompatible equipment is installed.

6.2 COMMUNICATIONS STANDARDIZATION

There are a variety of communications infrastructure alternatives that can provide communications to traffic signals. The most relevant communications infrastructure alternatives to the City are described below:

- Agency-owned **wireline** communication is often a preferred method for communications networks due to the reliability, security, and bandwidth capacity. They are primarily installed in underground conduit or installed on overhead lines. Fiber optic and copper twisted pair are the two mediums used in wireline networks.
    - **Fiber Optic** cable is comprised of multiple glass strands encased in tubes within a protective jacket.
    - **Copper Twisted Pair** consists of a series of two insulated copper wires housed in a cable in which the cables of each pair are twisted around each other.
- **Leased cellular** are wireless communication links offered by network providers (i.e., Verizon, AT&T, Sprint, etc.). This alternative has lower initial capital costs to deploy but require reoccurring service payments per modem.

The most viable options for the City are fiber and leased cellular. Copper is an outdated wireline communications alternative that is being phased out. The advantages and disadvantages of fiber and leased cellular are summarized in **Table 7**.

Table 7: Fiber and Leased Wireless Comparison

Communications Technology Alternative	Advantages	Disadvantages
Fiber	► Fastest data transmission rates and lowest latency ► Reliable connection ► Low recurring operations and maintenance costs ► Reduces access points which increases security ► Capacity only limited by end equipment -therefore most useful medium for hub-to-hub connections	► High installation costs
Leased Cellular	► Low capital costs	► High recurring leasing costs ► Wireless service connection may be unreliable during special events or extreme weather conditions ► Wireless service can be affected by large call/data volumes

Communications Technology Alternative	Advantages	Disadvantages
		▶ Expensive to scale because of third party rates

While leased cellular communications technology has drawbacks, it is a cost-effective alternative for traffic signals that are in relatively remote locations. The most appropriate communications technology alternative for remote signals in San Carlos is leased cellular. Meanwhile, fiber is the more appropriate alternative for signals near the existing fiber trunkline and/or other signals.

6.3 SMART CORRIDOR INTEGRATION

The City has eight signalized intersections, along Industrial Road and Old County Road, that are integrated into the C/CAG Smart Corridor system. A Smart Corridor workstation is installed at City Hall, which is integrated with the countywide system via a fiber connection to a Caltrans trunkline along El Camino Real. This workstation allows City staff to remotely monitor and manage the signals integrated with the C/CAG Smart Corridor system. **Figure 5** is a high-level system diagram showing the existing connection.

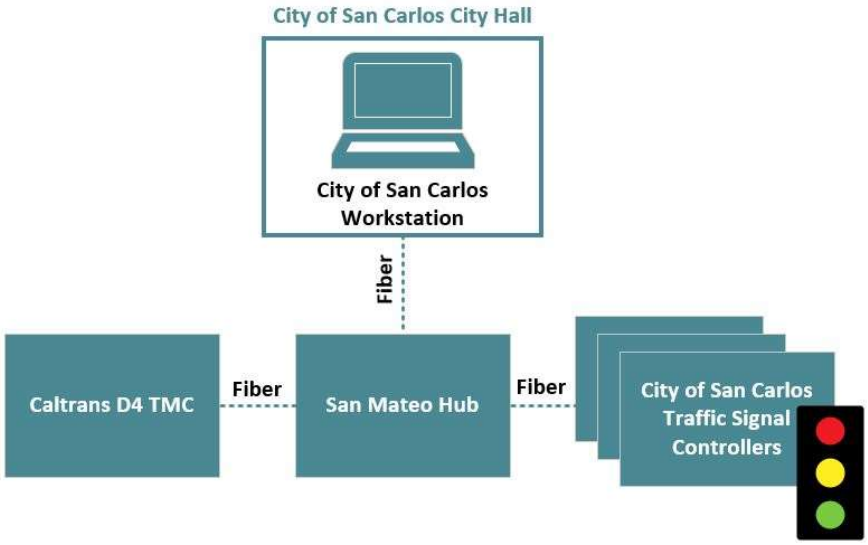

Figure 5: Existing C/CAG Smart Corridor System Diagram

The City has decided to use the C/CAG Smart Corridor system as their ATMS. As such, all signals must be compatible and integrate into the system. There are minimum requirements for integrating the City's traffic signal network into the existing San Mateo Smart Corridors system. The key factors for integration include a compatible traffic signal controller and a direct communication link between the intersection and the Smart Corridors hub. The standard traffic signal specifications are in alignment with C/CAG Smart Corridor project. Additional workstations and servers are optional items to enhance the remote operation capabilities of the City.

If the new signal is along a C/CAG Smart Corridor designated alternate route, the City will coordinate with a C/CAG representative for the planned signal integration because the new signal will require updates to

Smart Corridor's incident route plans. At the time of the development of this Master Plan , the C/CAG point of contact for the Smart Corridors is Audrey Shimizu (ashiramizu@smcgov.org).

6.3.1 CONTROLLER

There are no particular controller hardware requirements, as C/CAG Smart Corridor system integration is more dependent on compatibility with the controller firmware. When upgrading existing controllers and installing new controllers, the City must consider that KITS supports the following controller firmware (as of December 2023): Next Phase, Econolite ASC/3, Econolite Cobalt, Econolite EOS (pending), Fourth Dimension Traffic (D4), Intelight MaxTime, BiTrans 233 and 2033, LACO 4E, Siemens SEPAC, Caltrans TSCP, Peek, and SDC. KITS is not compatible with Apogee or Naztec controller firmware at this time. As specified in the standard specifications (**Attachment B**), the City desires to utilize controllers based on the latest Advanced Traffic Controller (ATC) standards.

6.3.2 COMMUNCIATION

The C/CAG Smart Corridor system requires a wireless or wireline connection to the City controller. Typically, the bandwidth requirement is 1 kb/second for second-by-second polling.

Table 8 summarizes the C/CAG Smart Corridor system communication protocol and ports. The default SQL database server port 1433 configuration may vary based on SQL server configuration.

Table 8 - C/CAG Smart Corridor System Communication Protocol and Ports

Client to Comm/App Server	TCP/IP – database configurable, typically 2000 – 2040 are used
Comm/App Server to Database Server	TCP/IP – default SQL database server port 1433
Client to Field	IP Multicast for cameras UDP/IP – ports configurable at signal controller
Client to Database Server	TCP/IP – default SQL database server port 1433
Comm/App Server to Field	UDP/IP – ports configurable at signal controller

6.3.3 SERVERS

Table 9 summarizes the C/CAG Smart Corridor system server requirements for systems up to 100 traffic signals. Servers can be on either physical hardware or on virtual machines. A communication server manages communications to agency controllers, while a database server organizes and stores connected signals data.

Table 9 - C/CAG Smart Corridor System Server Guidelines

Server	Hardware/OS	Memory	CPU	Hard Drive
Database Server	Windows Server 2016	16 GB RAM	4 Core/ 4 Threads	10K RPM HDD or SSD RAID 1 Configuration C:\ - 100 GB D:\ - 500 GB (database file .mdf) E:\ - 500 GB (database transaction log .ldf)

Server	Hardware/OS	Memory	CPU	Hard Drive
Communication Server	Windows Server 2016	8 GB RAM	4 Core/ 4 Threads	C:\ - 150 GB Required Software: MapDotNet (3rd party mapping engine).

C/CAG hosts a Smart Corridor system server at the San Mateo hub and there is an existing workstation at City Hall. Server requirements noted above are only applicable to the City if it is preferred to have a server installed at City Hall for redundancy to limit system outages. Given the current system configuration where the intersections and field elements connect to the San Mateo Hub, the City will lose C/CAG Smart Corridor system access if there is communication break that interrupts the City Hall to countywide Smart Corridor system connection. Adding a local database server would provide a secondary central control in the event the main connection to the San Mateo hub is lost.

If the City desires additional workstations, the workstations minimum requirements are a Windows 7 or later operating system, 8 GB of RAM memory, 4 core/4 threads of CPU, and 150 GB C:\ hard drive.

7 NEXT STEPS

This Traffic Signal Master Plan outlines specific and practical actions the City can take to improve its transportation network. The City should implement near-term and mid-term projects over the next five years. This Master Plan is intended to be a living document, so ideally at the five-year mark, this document will need to be updated to reflect progress that has been made to date and reassess goals and priorities.

APPENDIX A – FIELD REVIEW SUMMARY

APPENDIX A: FIELD REVIEW TABLE

[1]: Project North-South Direction is aligned with Industrial Rd
[2]: Visually observed detection functionality based on status lights from detection card

PG&E Meter No.	Intersection	Street Name Signage		Cabinet		Controller		Signal Heads & Pedestrian Push Buttons			Safety Lighting		Vehicle Detection					
													Video			Loops		
		Mast Arm/ Pole Mounted	Illumination Type	Type	Corner[1]	Model (Hardware)	Firmware Version Number	Vehicle Signal Heads: Number and Size, Phase and Direction	Pedestrian Signal Heads: Number and Size, Phase and Direction	Pedestrian Push Buttons	Type	Wattage	List Approaches	Manufacturer Name and Model	Working?[2]	List Approaches	Manufacturer Name and Model	Working?[2]
8	Old County/ Howard	Mast Arm (x4)	Internally Illuminated	332	NE	Safetran 2070E - ATC	TSCP v. 2.21	Mast arm 12" (x4, 1 of which is a programmable signal head) Pole Mounted 12" (x4) Pole Mounted 8" (x5)	Countdown (x3) Blinking hand (x5)	All standard	LED Cree (x4)	101W	None	-	-	All approaches	Cards: 222 (x8) 222b (x2)	Yes
9	Old County/ Brittan	Mast Arm (x4)	Internally Illuminated	332	SE	Safetran 2070E - ATC	TSCP v. 2.23	Mast arm 12" (x4, 1 of which is a programmable signal head) Pole Mounted 12" (x10, 2 of which are programmable signal heads)	Blinking hand (x8)	-7 Standard (Older models) -1 more modern push button (larger button) -1 older push button is installed upside down (rain cover is below	LED Leotek (x4)	103W	None	-	-	All approaches	Cards: 222 (x10)	Yes
10	Old County/ E. San Carlos-Ped	Mast Arm (x2)	Internally Illuminated	332	SE	Naztec 2070	Naztec 76.70 Build 3195 Local	Mast arm 12" (x2) Pole Mounted 12" (x8)	Countdown (x4) Blinking hand (x2)	All standard	LED Cree (x2)	73W	None	-	-	All approaches	Cards: Diablo 222 cards (x3)	Yes
11	Old County/ Holly	Mast Arm (3x) Bridge (1x, "Old County")	Internally Illuminated	332	NE	Safetran 2070E - ATC	TSCP v. 2.21	Mast arm 12" (x5) Bridge Mounted 12" (x2) Pole Mounted 12" (x10)	Blinking hand (x8)	All standard	LED Cree (x3)	73W	None	-	-	All approaches (May not be active)	Cards: Diablo 222 cards (x9)	Yes
12	Industrial/ G Street	Mast Arm (2x)	Internally Illuminated	332	NE	Intelight 2070L	D4	Mast arm 12" (x4) Pole Mounted 12" (x10)	Countdown (x3) Blinking hand (x3)	-Crosswalks on San Carlos side have audio-enabled push buttons -Crosswalks on Redwood City side have older push buttons	LED Cree (x4)	73W	None	-	-	All approaches	Cards: EDI 222 cards (x9)	Φ6 advance may not be present/working
13	Industrial/ Howard	Mast Arm (x4)	Internally Illuminated	NEMA P44	SE	McCain ATCeX NEMA Controller	D4	Mast arm 12" (x6) Pole Mounted 12" (x6) Pole Mounted 8" (x2)	Countdown (x3) Blinking hand (x3)	All standard	LED Cree (x4)	73W	None	-	-	All approaches	Cards: "Detector Systems" Model 910A (x12)	Yes
14	Industrial/ Brittan	Mast Arm (x4)	Internally Illuminated	332	SE	Intelight 2070L	D4	Mast arm 12" (x6) Pole Mounted 12" (x5) Pole Mounted 8" (x3) "METER ON" heads for downstream on-ramp (x2)	Countdown (x4) Blinking hand (x4)	All standard	LED Cree (x4)	73W	None	-	-	All approaches	Cards: 222 (4x) 222D (2x) LM602 (1x) 222B (1x)	Yes
16	Industrial/ Commercial	Mast Arm (x4)	Static Signs (Not Illuminated)	332	SE	McCain 2070LX	D4 (1.5L - 41[IC])	Mast arm 12" (x6) Pole Mounted 12" (x8)	Countdown (x8)	All APS	LED (x4, Make/ Model could not be determined)	100W	All approaches	Iteris Vantage Next/ Vector	Yes	Detector cards (222) in cabinet, but not active	-	-
17	Industrial/ Bransten	Mast Arm (x4)	Internally Illuminated	NEMA P44	SW	Naztec 2070N-NEMA	Naztec/ Apogie 7/13/06 V: 76.7D (Build 3195) & Local	Mast arm 12" (x6) Pole Mounted 12" (x8)	Countdown (x7) Blinking hand (x1)	PPB post and APS missing at NW corner; otherwise all APS New PPB posts	LED (x4, Make/ Model could not be determined)	73W	None	-	-	All approaches	Cards: Reno 222	Yes
18	Industrial/ E. San Carlos	Mast Arm (x4)	Static Signs (Not Illuminated)	332	SW	McCain 2070E	D4 (Rel 1.5L-3)	Mast arm 12" (x6) Pole Mounted 12" (x8)	Countdown (x8)	All APS	LED Leotek M1 (x4)	87W	All approaches	Iteris Vantage Next/ Vector	Yes	None	None	None
19	Industrial @ 301 (PAMF)	Mast Arm (x2, only Across Industrial)	Internally Illuminated	332	NE	Naztec 2070	Naztec 12/19/12 V: 76.7D (Build 3195) & Local	Mast arm 12" (x4) Pole Mounted 12" (x7) No lights on SW corner	Countdown (x8)	All standard	LED (x3, Make/ Model could not be determined)	Wattage label not present	None	-	-	All approaches Main phase has stop bar	Cards: Diablo 222	Yes
20	Industrial/ Quarry	Mast Arm (x2, only Across Industrial)	Internally Illuminated	332	NW	Intelight 2070L	D4 (Rel 1.5L-3[IC])	Mast arm 12" (x4) Pole Mounted 12" (x9)	Countdown (x3) Blinking hand (x3) No crosswalk across north leg	All standard Separate audible pedestrian signals	LED (x3, Make/ Model could not be determined)	73W	None	-	-	All approaches	Cards: EDI 222	Yes
21	Holly/ Laurel	Mast Arm (x4)	Internally Illuminated	NEMA Type M TS2-2	SE	McCain 2070-8 2070N1 NEMA Controller Unit	Program 2033 RV	Mast arm 12" (x4) Pole mounted 12" (x6) Pole mounted 8" (x2)	Countdown (x8)	All standard	LED (x4, Make/ Model could not be determined)	73W	None	-	-	All approaches	Cards: Y/2 200 cards - PPBs EDI SDLC: Vehicle	Yes

APPENDIX A: FIELD REVIEW TABLE

[1]: Project North-South Direction is aligned with Industrial Rd
[2]: Visually observed detection functionality based on status lights from detection card

PG&E Meter No.	Intersection	Battery Backup System		Communications									Notes
				SIC							Wireless Connection Manufacturer and Model	Intersection Connectivity	
		Manufacturer Name & Model	Battery Expiration Date	SIC Type (Fiber, Copper, Wireless)	Manufacturer	Number of SIC pairs/ Number of SMFO Strands	SIC (Copper) Landing Type	Location of Existing SIC and Fiber Optic Splice Kits	Fiber Termination Panel	Communication Switch			
8	Old County/ Howard	"Dimensions" w/ Batteries	Batteries showing visible corrosion on terminals	Copper & Wireless	Airlink MP70 Sierra Wireless	2 pairs (4) terminated	Telephone & SIC - 12 position panel	-	-	Actelis ML684	Airlink MP70	Copper/Wireless	-Actelis ML684 comm switch present. Back side is connected to telephone termination panel. Grey cable connects telephone panel to SIC panel. 12-pair copper SIC- -Observed very long pedestrian wait time -Wireless modem present
9	Old County/ Brittan	Meyers MP2000E	Could not be determined	Fiber	Could not be determined	2 strands terminated	-	Cabinet	Corning 6 position panel	Hirschmann RS30 switch	-	Fiber	
10	Old County/ E. San Carlos-Ped	Could not be determined (BBS Cabinet padlocked)	Could not be determined	Not present	-	-	-	-	-	-	-	-	-2x EVP optical detectors present on Old County approaches -Opticom 762 phase selector present and active -Bicycle phase for EB bikes (exiting Caltrain station). One of the two signal heads for this movement is misoriented.
11	Old County/ Holly	"Dimensions Unlimited"	8.6.2021 written on batteries	Fiber. Copper SIC also present.	Could not be determined	2 strands terminated	-	Cabinet	Corning 6 position panel	Hirschmann RS30 switch	-	Copper/Fiber	-No crosswalk across SW side of Holly -Observed very long wait times for pedestrians (observed 1+ minute wait)
12	Industrial/ G Street	None, but cabinet is present	-	Fiber	Corning	2 strands terminated	-	Lower part of cabinet	Corning 6 position panel	Hirschmann RS30 switch	-	Fiber	-Intersection located at border of Redwood City and San Carlos -Did not observe advance loops in SB (Industrial) direction -Controller screen indicated "San Mateo Smart Corridor (Rel 1.5L - 3[IC])" -Could not determine what equipment is San Carlos/ Redwood City
13	Industrial/ Howard	None, but cabinet is present	-	Fiber	Could not be determined	2 strands terminated	-	Rack Hirschmann RS30 Communication Switch	Corning 6 position panel	Hirschmann RS30 switch	-	Fiber	-Split phase -Advance detection for major phase (Industrial) -GPS time clock antenna (PCTEL) present, but not connected. -Controller screen indicated "San Mateo Smart Corridor (Rel 1.5L - 3[IC])"
14	Industrial/ Brittan	None, but cabinet is present	-	Fiber	Corning	Looks like a 12 strand, 2 strands terminated	-	Lower part of cabinet	Corning 6 position panel	Hirschmann RS30 switch	-	Fiber	-A separate 332 cabinet is present (fiber equipment; appears to be a field hub). -"Meter On" ped head devices present -San Mateo Smart Corridor (Rel 1.5L - 3[IC]) -Video monitoring; likely not detection as it goes into another cabinet w/ fiber in it
16	Industrial/ Commercial	None present	-	Not present	-	-	-	-	-	-	-	GPS time clock	-GPS clock antenna, connected to controller
17	Industrial/ Bransten	None present	-	Fiber	Corning	6 Fiber	-	Shelf (loose)	Corning 6 position panel (I-6 position)	-	-	Fiber	-Controller label says "Industrial/ Howard" -One mast-arm mounted signal indication (across Industrial) has a green light burned out (NE corner pole, 2nd signal on mast arm)
18	Industrial/ E. San Carlos	None present	-	Not present	-	-	-	-	-	-	-	-	-No as-builts, no timing sheets -GPS clock antenna does not appear to be connected
19	Industrial @ 301 (PAMF)	None present	-	Not present	-	-	-	-	-	-	-	-	-No as-builts, no timing sheets -2x 762 GTT detectors/ phase selectors. Active/green -Does not appear to be connected to controller
20	Industrial/ Quarry	None, but cabinet is present	-	Fiber	Corning	6 fiber	-	Beneath load switches, mounted	Corning 6 position panel	Hirschman RS-30 switch	-	Fiber	-No crosswalk across north leg -Spare Naztec 2070 controller present -RPS 120 EEL power unit
21	Holly/ Laurel	Meyers Power Products MP2000E	Could not be determined	Copper (from ECR)	Could not be determined	-2 pair to controller -12 pair from ECR	-	-	-	-	-	Copper SIC	-GPS clock antenna appears to be connected

PG&E Meter No.	Intersection	Street Name Signage		Cabinet		Controller		Signal Heads & Pedestrian Push Buttons			Safety Lighting		Vehicle Detection					
													Video			Loops		
		Mast Arm/ Pole Mounted	Illumination Type	Type	Corner[1]	Model (Hardware)	Firmware Version Number	Vehicle Signal Heads: Number and Size, Phase and Direction	Pedestrian Signal Heads: Number and Size, Phase and Direction	Pedestrian Push Buttons	Type	Wattage	List Approaches	Manufacturer Name and Model	Working?[2]	List Approaches	Manufacturer Name and Model	Working?[2]
22	San Carlos/ Laurel	Mast Arm (x4)	Internally Illuminated	NEMA Type G Pedestal	NW	2070-N Naztec	65.0P Local (Build 1589) (Apogee)	Mast arm 12" (x4) Pole Mounted 8" (x8)	Countdown (x4) Blinking hand (x4)	All standard	LED Cree (x4)	73W	None	-	-	All approaches	Cards: Sarasota-4 (535T) Diablo DSP 100-2	Yes
23	San Carlos/ Walnut	Mast Arm (x4)	Internally Illuminated: All except "Walnut St" on SE corner (present but not illuminated)	NEMA M	NW	2070N Naztec	65.0P Local (Build 1589)	Mast arm 12" (x4) Pole Mounted 12" (x2) Pole Mounted 8" (x6)	Countdown (x8). 1 signal shows combination of walk and countdown	All standard	LED Cree (x4)	73W	None	-	-	All approaches	Cards: Sarasota 535T	Yes
24	San Carlos/ Elm	Mast Arm (x4)	Internally Illuminated	NEMA P44	East/ SE	2070N Naztec	65.0V Build 4224 Master/ Local (Apogee)	Mast arm 12" (x4) Pole mounted 12" (x2) Pole Mounted 8" (x6)	Countdown (x6) Blinking hand (x1) Red hand (x1)	All standard	LED Cree (x4)	73W	None	-	-	All approaches	Cards: Sarasota 535T (x4)	Yes
25	San Carlos/ Chestnut	Mast Arm (x4)	Internally Illuminated: "Chestnut St" signs Not illuminated: "San Carlos" signs	332	SW	Naztec 2070	Naztec - could not toggle to firmware	Mast arm 12" (x4) Pole Mounted 12" (x8)	Countdown (x8)	All standard	LED Cree (x4)	73W	None	-	-	All approaches Advance detectors on San Carlos	Cards: 1x Diablo 222 Card 1x IDC 222 Card 1x Eberle 2-Channel Card	Yes
26	San Carlos/ Cedar	Mast Arm (x4)	Internally Illuminated	Two NEMA Type G, one pole mounted, one ground mounted	SW	2070-N Naztec	Apogee/ Naztec 65.0P Local (Build 1589)	Mast arm 12" (x4) Pole Mounted 8" (x8)	Countdown (x8)	All standard	LED Cree (x4)	73W	None	-	-	EB San Carlos WB San Carlos NB Cedar SB Cedar	Cards: Sarasota 535T	Yes
27	San Carlos/ Alameda	Mast Arm (x2)	Static Signs (Not Illuminated)	332	SE	McCain 2070E	Program 2033 RV	Mast arm 12" (x3) Pole mounted 12" (x6) Pole mounted 8" (x2)	Countdown (x4)	All APS	LED Leotek (x3)	70W	None	-	-	All approaches Stop bar and advance detection	Cards: LMD 622	Yes
28	San Carlos/ Devonshire	None	Static Signs (Not Illuminated) on Street Name Sign Post	332	SW	McCain 170E Quad Acia	Program 233 SA	Mast arm 12" (x4) Pole mounted 12" (x3) Pole mounted 8" (x6)	Countdown (x3) Blinking hand (x5)	All standard	LED (x2, Make/ Model could not be determined)	56W	None	-	-	-All approaches -No stop bar detectors on San Carlos through movements, stop bars present for left turn lane	Cards: 228B "Detector Systems" (x3) Reno 1100SS (x2)	Yes
29	San Carlos/ Club	Mast Arm (x2, Only Across San Carlos)	Internally Illuminated	332	SW	Naztec 2070	Naztec/ Apogie 7/13/06 V: 65.0P Local (Build 1589)	Mast arm 12" (x5) Pole mounted 12" (x6) Pole mounted 8" (x5)	Countdown (x4) Blinking hand (x2)	All standard	LED (x4, Make/ Model could not be determined)	73W	None	-	-	-All stop bar. Did not observe advance for San Carlos	Could not be determined	Could not be determined
30	Brittan/ Laurel	Mast Arm (x4)	Internally Illuminated	NEMA P44	SW	2070-N Naztec	Apogee/ Naztec 65.0P Local (Build 1589)	Mast arm 12" (x6) Pole mounted 12" (x4) Pole mounted 8" (x4)	Countdown (x5) Blinking hand (x3)	All standard	LED Cree (x4)	73W	None	-	-	All approaches	Cards: "Detector Systems" Model 910 (x6)	Yes
31	Brittan/ Alameda	None	None	NEMA P44	SW	Naztec 2070N NEMA Controller Unit	Naztec/ Apogie 7/13/06 V: 65.0P Local (Build 1589)	Mast arm 12" (x4) Pole Mounted 12" (x8)	Countdown (x4) Blinking hand (x4)	All standard	LED (x3, Make/ Model could not be determined)	117W	None	-	-	All approaches	8x detector systems "Digital Loop Detectors" Φ1-1 NB LT Φ2-1 SB Φ3-1 WB Φ4-1 EB	
33	San Carlos/ Phelps	Mast Arm (x2, Only Across Phelps)	Static Signs (not Illuminated)	332	NW	McCain 2070E	Program 2033 RV	Mast arm 12" (x7) Pole Mounted 12" (x9)	Countdown (x4)	All APS	LED Leotek (x3)	70W	None	-	-	All approaches	Cards: EDI 222	Yes

PG&E Meter No.	Intersection	Battery Backup System		Communications									Notes
		Manufacturer Name & Model	Battery Expiration Date	SIC							Wireless Connection Manufacturer and Model	Intersection Connectivity	
				SIC Type (Fiber, Copper, Wireless)	Manufacturer	Number of SIC pairs/ Number of SMFO Strands	SIC (Copper) Landing Type	Location of Existing SIC and Fiber Optic Splice Kits	Fiber Termination Panel	Communication Switch			
22	San Carlos/ Laurel	"Dimensions" Unlimited w/ batteries DUI-24MII	Could not be determined - from 2003	Copper	Could not be determined	6 or 12	6-position SIC panel	-	-	-	-	SIC Copper	-"Black Box" SIC is in the battery backup cabinet -Cabinet included electrical plans by BKF.
23	San Carlos/ Walnut	"Dimensions" Unlimited, Inc. Controller only, no batteries.	-	Copper	Could not be determined	6 or 12	6-position SIC panel	-	-	-	-	SIC copper	-"Black Box" communication equipment present
24	San Carlos/ Elm	None, but cabinet is present	-	Copper	Could not be determined	12	6-position SIC panel	-	-	-	-	SIC Copper	-Garmin GPS time clock -Hayes modem 2400 -WiFi router on NE signal pole? -Ped push buttons mounted higher than 3'-6"
25	San Carlos/ Chestnut	None present	-	Copper	Could not be determined	12	12-position SIC panel	-	-	-	-	Copper	-"Black Box" communication equipment present, active -GPS Clock - Connected to controller
26	San Carlos/ Cedar	None, but cabinet is present	-	Copper	Could not be determined	6	6-position panel	-	-	-	-	Copper	-"Black Box" communicatoin equipment present
27	San Carlos/ Alameda	None present	-	Not present	-	-	-	-	-	-	-	-	-3 EVPs present -Spare Naztec 2070 controller present -2x Opticom 762 phase selector cards active -Antenna does not appear to be connected
28	San Carlos/ Devonshire	None, but cabinet is present	-	Not present	-	-	-	-	-	-	-	-	-GPS clock antenna not connected to controller
29	San Carlos/ Club	Cabinet present. Dimensions DUI-24M11. 4 batteries, but not plugged in.	-	Not present	-	-	-	-	-	-	-	-	-GPS clock antenna does not appear to be connected to controller
30	Brittan/ Laurel	Dimensions DUI-24MII w/ batteries	Could not be determined	Not present	-	-	-	-	-	-	-	-	-WiFi/ Modem/ Wireless device on NE corner -Had TS as-built in cabinet
31	Brittan/ Alameda	Cabinet present, Dimensions DUI-24MII. No batteries	-	Not present	-	-	-	-	-	-	-	-	-GPS clock antenna does not appear to be connected to controller
33	San Carlos/ Phelps	None present	-	Not present	-	-	-	-	-	-	-	-	-3 EVPs present -EVP Opticom detectors present for all approaches -2x 762 Opticom phase selector cards in cabinet

APPENDIX B - TRAFFIC SIGNAL TECHNICAL SPECIFICATIONS

TRAFFIC SIGNAL TECHNICAL SPECIFICATIONS

MARCH 1, 2024

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SECTION 344113 – TRAFFIC SIGNAL AND LIGHTING

PART 1 - GENERAL

1.01 REFERENCES

A. Traffic signal and street lighting modifications shall conform to the latest provisions of §86, "Electrical Work" and §87, "Electrical Systems" of the State Standard specifications, City of San Carlos Standards Details, and these Special Provisions:

1.02 DESCRIPTION

A. Traffic signal and street lighting modifications are to be performed at <INSERT Street 1-main street> and <INSERT Street 2-intersecting street> in the City of San Carlos along with civil improvements per the Contract documents. The work to be performed includes, but not limited to, removing and salvaging existing traffic signal and lighting poles and signal equipment, installing new service cabinet and foundation, traffic signal equipment, pull boxes, traffic signal conduit, conductors and cables, traffic signal poles and foundations, as shown on plans.

1.03 SALVAGED MATERIALS

A. Salvaged equipment is to be delivered to the City of San Carlos Corporation Yard at 1000 Branston Road, San Carlos, CA. Contractor may be asked by the City to hold large items that are salvaged.

1.04 REQUIRED SUBMITTALS

A. Contractor shall provide equipment submittals of all traffic signal and lighting equipment for City approval prior to installation.

PART 2 – PRODUCTS

2.01 FOUNDATIONS

A. Foundations for standards, poles, pedestals, and cabinets shall conform to the provisions in §87-1.03E (3), "Concrete Pads, Foundations, and Pedestals" of the State Standard Specifications and these Special Provisions.

2.02 PULL BOXES

A. Pull boxes shall conform to the provisions of State Standard specifications §86-1.02C, "Pull Boxes".

B. Grout shall be placed in bottom of pull boxes.

C. Covers of pull boxes for City System shall be marked "Traffic Signal" as appropriate. Covers of pull boxes that only contain electrical service wiring shall be marked “Service”. Covers of pull boxes that only contain signal interconnect cable, fiber optic, and/or copper, shall be marked “Interconnect”.

D. Pull boxes shall be a minimum of No. 6E or larger for traffic signal projects unless otherwise noted on the plans or in the Contract Documents. Pull boxes containing splice closures for the interconnect systems shall be a N48 splice vault with 10” extension. N48 vault cover shall be in two sections and be made of polymer concrete. Vault shall have an ANSI/SCTE-77 Tier 22 rating.

2.03 CONDUIT

A. Conduit shall conform to the provisions of State Standard specifications §86-1.02B, “Conduit and Accessories”.

B. Conduit to be installed underground shall be the rigid steel or rigid non-metallic type, Schedule 40 or 80 HDPE, unless otherwise specified. Schedule 80 HDPE shall be used if conduit is to be installed under roadways or by the directional boring method. Detector termination conduits may be the rigid non-metallic type.

C. The conduit in a foundation, in a structure, under railroad tracks, and between a foundation and the nearest pull box shall be the rigid steel type. For lighting, the conduit run between a foundation and the nearest pull box shall be the rigid metal type.

D. Conduit shall have a solid No. 10 conductor tracer wire installed in all empty conduit and conduit with interconnect cables, as shown on plans. Tracer wire shall be grounded and bonded.

2.04 CONDUCTOR AND CABLES

A. Conductor and cables shall conform to the provisions of State Standard specifications §86-1.02F, “Conductors and Cables”.

B. Splices shall be insulated by "Method B”, or, at the Contractor's option, splices of conductors shall be insulated with heat-shrink tubing of the appropriate size after thoroughly painting the spliced conductors with electrical insulating coating.

2.05 FIBER OPTIC CABLE SYSTEM

A. Fiber optic cable system shall conform to the provisions of State Standard specifications §87-19, “Fiber Optic Cable Systems”. Fiber optic cable system components include:

1. Fiber optic cables

2. Fiber optic splice enclosures
3. Fiber distribution units
4. Fiber optic markers
5. Patch cords
6. Fiber optic connectors and couplers
7. Warning tape

B. Cable installed in runs between intersections shall be minimum 144-strand, single mode fiber count, unless otherwise noted on the plans.

C. Cable installed in runs between splice closures and termination equipment shall be minimum 12-strand, single mode fiber count, unless otherwise noted on the plans.

2.06 FIBER OPTIC EDGE SWITCH

A. The edge switch shall be environmentally hardened and intended for industrial applications and shall meet or exceed the NEMA TS2 environmental requirements. The switch must include:

1. A minimum of four (4) 1000BASE, SFP ports (transmit and receive) capable of transmitting Ethernet data at 1000 Mb/s over single-mode fiber, full duplex. Maximum distance for transmission shall be 120km (SFP dependent). Switch shall be provided with four SFP modules.
2. A minimum of eight (8) autosensing 100BASE-TX / 10BASE-T RJ45 ports capable of transmitting Ethernet data at 10 or 100 Mb/s, full duplex.
3. Single-mode fiber connector type shall be SC.
4. 100BASE-TX / 10BASE-T RJ45 ports to be assigned as follows:
    i. Port 1 – Traffic Signal Controller
    ii. Port 2 – PTZ CCTV Camera
    iii. Port 3 – Video Detection
    iv. Port 4 – Preemption
    v. Port 5 – Accessible Pedestrian Signal

vi. Port 6 – Spare

vii. Port 7 – Spare

viii. Port 8 – Spare

5. Field hardened power supply.
6. Switch ports shall comply with the following standards:
    i. IEEE 802.3 10Base-T
    ii. IEEE 802.3u 100Base-TX
    iii. IEEE 802.3u 100Base-FX
    iv. IEEE 802.3ab 1000Base-T
    v. IEEE 802.3z 1000Base-SX and 1000Base-LX
    vi. IEEE 802.1D Rapid Spanning Tree Protocol
    vii. IEEE 802.3af PoE
    viii. IEEE 802.1P priority queuing
    ix. IEEE 802.Q VLAN and GVRP
    x. IEEE 802.3X flow control
    xi. IEEE 802.1x Port_based Network Access Control
7. Minimum MTBF of 8 years (Bellcore Method).
8. Operating temperature = -40 to +75 degrees Celsius.
9. Relative humidity = 10% - 90%, non-condensing.
10. IP Multicast Filtering through IGMP Snooping.
11. Support remote reset and remote management.
12. Support remote turn on/off of 10/100 Base-T ports.
13. Inter-VLAN IP (Internet Protocol) routing for full layer 3 routing between VLANs.
14. Non-Blocking.

15. Management Console Port.

2.07 CONTROLLER

A. Traffic Signal Controllers shall be Model 2070L.

B. Controllers shall be compliant with Advanced Transportation Controller (ATC) standards and Caltrans Transportation Electrical Equipment Specification (TEES).

C. The controller shall be equipped with the following modules:

1. 2070-1C CPU Module.
2. 2070-2E Field I/O Module for 332 cabinets.
3. 8x40 Front Panel LCD Display and dual keyboard panel.
4. 2070-41 10A Power Supply Module.
5. 2070-7A Dual Serial Port Card, RS-232.
6. Linux, open architecture operating system.

D. Controller firmware shall be compatible with the C/CAG Smart Corridors KITS transportation management system. Compatible controller firmware includes Fourth Dimension Traffic (D4), Econolite EOS (pending), Intelight MaxTimeLACO 4E, and Caltrans TSCP.

2.08 TRAFFIC SIGNAL CONTROLLER CABINET

A. The controller cabinet shall be a new fully wired Type 332L aluminum cabinet. The cabinet shall conform to State Standard Specifications and Standard Plans, and the latest Caltrans Transportation Electrical Equipment Specification (TEES). The cabinet assembly shall be wired with the following items as well as all auxiliary equipment required to control the system shown in the plans:

1. (2) Corbin Door Locks.
2. (1) Fan Panel/Light Mod Assembly.
3. (1) 16 Position Detector Test Panel.
4. (1) Fiber Optic Termination Panel.
5. (1) PDA#2L w/ Model 206L Power Supply.
6. (1) Output File w/nylon card guides.

7. (2) Input Files.
8. (8) dual-channel detector cards.
9. (1) Auxiliary Output File.
10. (1) Model 2010 Conflict Monitor w/Red Monitoring, EDI.
11. (13) Model 200 Load switches.
12. (2) Model 204 Flashers.
13. (3) Model 242 DC Isolators.
14. (5) Model 430 Flash Transfer Relays.

B. All cabinet wiring shall be incorporated into one schematic drawing. Each cabinet shall be provided with three schematic drawings. Drawings shall indicate the intersection name and phasing. Operational/repair manuals for each component and plug-in shall be provided with each cabinet.

C. Controller cabinet shall be painted gray/green, mural, or to match the pole. Cabinets painted with mural to be coordinated with the City of San Carlos Department of Parks and Recreation.

D. Each controller assembly shall be tested by an independent testing lab not associated with the cabinet manufacturer. The controller cabinet shall be tested as a complete unit (including all plug-ins provided and the traffic signal controller) under a continuous signal load for a minimum of 72 hours. The MMU supplied shall be programmed per the signal design and operation of the signalized intersection for which the cabinet assembly is designated. Each cabinet assembly shall be delivered with a signed certification by the testing lab with a checklist detailing the results of the test performed on the controller assembly. If the Contractor's work will affect existing interconnect and communications, the Contractor shall notify the Engineer two (2) working days prior to performing any interconnect work. Upon interrupting any existing interconnect or communications, communications shall be reestablished within three (3) working days. If the contractor fails to reestablish interconnect and communications within three (3) working days, the City at its sole option may perform the necessary work, interim, or permanent at the Contractor's expense.

E. Each controller assembly shall be dropped off at the City of San Carlos Corporation Yard at 1000 Branston Road for testing and programming, for a

minimum of 14 days. A seven-day advance notice shall be given to the City prior to drop-off.

2.09 SERVICE

A. Service enclosure cabinet shall conform to the provisions of State Standard specifications §86-1.02P(2), "Service Equipment Enclosures" and §86-1.02Q(4), "Battery Backup System Cabinets", and Caltrans TEES Chapter 4, "Specifications for Battery Back-Up Systems".

B. New service cabinet shall be type III-BF with Tesco 27-22BBS, or equal, attached. Continuous welding of exterior seams in service equipment enclosures is not required. Cabinet shall be fabricated from aluminum. The service cabinet and battery backup unit shall be the same color.

C. Service enclosure cabinet assembly shall provide a minimum two hours of full run-time operation, per Caltrans TEES Chapter 4, §4.2.2 Run-Time.

D. Service enclosure cabinet assembly shall include all wiring, circuit breakers, batteries, inverter/charger unit, and accessories/appurtenances for a complete and functioning system.

2.10 SIGNAL HEAD

A. Vehicle and bicycle signal heads shall conform to the provisions of State Standard specifications §86-1.02R, "Signal Heads".

B. All vehicle signal indications shall be LED. Type SV-l-T mountings with 5 sections and SV-2-TD mountings shall be bolted to the standard through the upper pipe fitting in a manner similar to the terminal compartment.

C. Housings and backplates shall be painted flat black. Mounting struts, elbows, and terminal compartments shall be painted signal green.

2.11 PEDESTRIAN SIGNALS

A. Pedestrian signal heads shall conform with State Standard specifications §86-1.02S, "Pedestrian Signal Heads".

B. Housings and backplates shall be painted flat black. Mounting struts, elbows, and terminal compartments shall be painted signal green.

C. Pedestrian signals shall be countdown type showing the remaining flashing don't walk time.

2.12 SIGNAL STANDARDS AND POLES

A. Traffic signal standards and poles shall conform to the provisions of State Standard specifications §86-1.02J, "Standards, Poles, Pedestals, and Posts".

2.13 PEDESTRIAN PUSH BUTTON

A. Pedestrian push button shall conform to the provisions of State Standard specifications §86-1.02U, "Push Button Assemblies".

B. Pedestrian push buttons shall be the APS type and may be 2-wire or 4-wire.

C. Pedestrian push button shall have touchless activation, LED indication, and audible speaker on push button body to indicate activation of push button.

D. Audible messages shall be programmable to automatically adjust to ambient noise levels.

E. Button housing shall be painted yellow.

2.14 DETECTION

A. The video detection system (VDS) shall be Iteris Vantage Next system with Vantage Vector detection sensors.

B. The video detection system shall be a complete functioning system with color cameras, all necessary processors, all necessary video and power cables, mounting brackets, extension hardware, software, programing, lightning and surge protection as recommended by the manufacturer, 17" rack mounted video monitor at each controller cabinet and extension modules capable of processing the number of detection sensors and detection zones as shown on the plans.

C. The VDS will be deployed at locations where site conditions and roadway geometry vary. The VDS system may also be deployed at locations where existing cabinets or equipment exist. Existing site configurations will dictate the availability of cabinet space and VDS usage.

D. Video detection shall utilize two different sensors of different technologies, video imaging and radar, to detect and track vehicles at distances over 600 feet.

E. Video detection zones shall be programmed via an embedded application displayed on a video monitor. The menu shall facilitate placement of detection zones and setting of zone parameters or to configure system parameters. A separate computer shall not be required for programming detection zones or to view system operation. All programming function shall occur on live video images and radar blips, no snapshots or still images are allowed.

F. Video detection shall be at least 98% accurate in good weather conditions, with slight degradation possible under adverse weather conditions (e.g., rain, snow, or fog) which reduce visibility. Detection accuracy is dependent upon

site geometry, sensor placement, camera image quality and detection zone location, and these accuracy levels do not include allowances for occlusion or poor video due to sensor location or quality.

G. If shown on the plans, loop detection shall conform to the provisions of State Standard specifications §87-1.03V, "Detectors". Detector loops shall be type A or D, as shown on the plans. Loop wire shall be Type 1. Detector cable shall be Type B.

2.15 LIGHTING

A. Lighting shall conform to the provisions of State Standard specifications §86-1.02K, "Luminaires" and §87-2, "Lighting Systems".

B. Light fixtures shall be capable of operating with 120V, 208V or 240V input. Light fixtures shall be on the State Authorized Materials List. See plans for wattage and lumen output requirements for streetlights.

C. The light fixture shall be dimmable and compatible with smart lighting control systems.

D. Photoelectric Control – Luminaires shall be provided with a 7-pin photoelectric control receptacle compliant with NEMA standard ANSI C136.41-2013 120-277V twist-lock connector. Unit shall be Ripley Tru-Filter model 6390TF-60 Hz or approved equal. Required features include:

1. Contactors shall be the mechanical armature type.
2. Nominal voltage range of 105V to 305V.
3. Infrared filtering silicon phototransistor.
4. Surge protection of 320 Jules MOV at 10,000-amp surge current.
5. Power consumption of 0.5W at 120V.
6. Time delay off (Instant on) of 3 to 5 seconds.
7. Operating lighting levels: turn-on 1.5 fc +/– 0.25, turn-off by 2.25 fc.
8. Temperature rating of 125 °C.
9. Photoelectric control shall conform with State Standard Specifications §86-6.11, "Photoelectric Controls".

2.16 PEDESTRIAN HYBRID BEACON SYSTEM

A. Pedestrian Hybrid Beacon (PHB) system components shall conform to the provisions of State Standard specifications §87-8, "Pedestrian Hybrid Beacon Systems".

2.17 SPEED FEEDBACK SIGN

A. Speed feedback sign shall conform to the provisions of State Standard specifications §87-14, "Radar Speed Feedback Sign Systems".

B. Data made available to the City shall include average vehicle count, total vehicle count, average speed, average number of speed violations, total number of speed violations, minimum and maximum speed, and 85th Percentile speed.

C. Data shall be provided to the City in CSV, Microsoft Excel, or Adobe Acrobat PDF formats.

2.18 RECTANGULAR RAPID-FLASHING BEACON

A. Rectangular Rapid Flashing Beacon (RRFB) assembly work consists of furnishing and installing the following:

1. RRFB Light Bars.
2. RRFB Assembly Pole and Foundation.
3. RRFB Controller and Enclosure.
4. Solar Panel and Battery Enclosure.
5. Pedestrian Push Button.
6. RRFB Assembly Pedestrian Signage.

B. RRFB assembly shall the comply with the latest version of the California Manual on Uniform Traffic Control Devices (MUTCD), in accordance with manufacturers recommendations, and in conformance with designs and details shown on the plans and these special provisions.

C. Rectangular Rapid Flashing Beacon (RRFB) shall comply with FHWA Interim Approval for Optional Use of Pedestrian-Activated Rectangular Rapid-Flashing Beacons at Uncontrolled Marked Crosswalks (IA-21), dated March 21, 2018. The assembly shall be pedestrian push button activated.

D. The RRFB housing shall contain two primary light bars mounted in compliance with MUTCD requirements. The housing shall have side emitting pedestrian confirmation lights. The LEDs used shall be rated for a minimum 15-year life.

The RRFB shall meet SAE J595 class 1 intensity and SAE J578 chromaticity.

E. The RRFB housing shall be made of powder-coated aluminum with a minimum thickness of 0.125" and shall provide a mounting mechanism allowing for directional rotation of the primary light bars toward oncoming traffic at curves and corners.

F. The controller shall auto-adjust RRFB brightness based on ambient light levels and dim during night operations.

G. Flash duration shall be field-configurable to one second increments, programming is responsibility of the contractor.

H. RRFB bars mounted on a pole shall be able to be independently aimed to optimize performance in each direction.

I. RRFB Controller Enclosure (if required by the manufacturer) shall be a NEMA 3R enclosure with a dead front panel and a hasp with a 7/16-inch hole for a padlock. The enclosure shall be powder coated, hot-dip galvanized, or factory-applied rust resistant prime coat and finish coat.

J. RRFB Solar Panel Assemblies shall be rated for a minimum of 300, 20 second activations per day, year-round operations.

K. RRFB Standards And Posts as shown on the plans, and the installation thereof, shall conform to the provisions in Section 86-1.02J, "Standards, Poles, Pedestals and Posts," of the State Standard Specifications and these Special Provisions. Foundations shall conform to Section 86-2.03, "Foundations", and Section 87-1.03E (3), "Concrete Pads, Foundations, and Pedestals" of the Standard Specifications.

PART 3 – EXECUTION

3.01 FOUNDATIONS

A. Construction of foundations shall conform to the provisions in §87-1.03E (3), "Concrete Pads, Foundations, and Pedestals" of the State Standard Specifications and these Special Provisions.

3.02 PULL BOXES

A. Pull boxes shall conform to the provisions of State Standard specifications §87-1.03C, "Installation of Pull Boxes".

B. After conductors have been installed, the ends of conduits terminating in pull boxes, and in service and controller cabinets shall be sealed with an approved type of sealing compound.

3.03 CONDUIT

A. Conduit shall conform to the provisions of State Standard specifications §87-1.03B, "Conduit Installation". Conduit installation by trenching method shall conform to the City of San Carlos Standard Detail No. 18.

3.04 CONDUCTOR AND CABLES

A. Conductor and cables shall conform to the provisions of State Standard specifications §87-1.03F, "Conductors and Cables Installations".

3.05 FIBER OPTIC CABLE SYSTEM

A. Fiber optic cable system installation and testing shall conform to the provisions of State Standard specifications §87-19, "Fiber Optic Cable Systems" and §87-18, "Interconnection Conduit and Cable".

3.06 FIBER OPTIC EDGE SWITCH

A. Switch shall be installed in the controller cabinet at each signalized intersection along existing public-agency owned fiber.

B. Prior to installation, the Contractor shall coordinate programming and configuration of each switch with the City.

3.07 CONTROLLER

A. The Contractor shall provide a signal technician, qualified to work on the controller unit and employed by the controller unit manufacturer or approved representative, present at the time the equipment is turned on to provide controller integration support and programming. City technician, or City designated representative, shall be present at the time the equipment is turned on.

B. Contractor shall notify the Engineer two weeks before controller is to be delivered to an independent testing facility and obtain a copy of the timing sheet.

C. New timing shall be input prior to 7-day burn-in testing. Test results shall include a description of the test procedures and summary of findings.

3.08 TRAFFIC SIGNAL CONTROLLER CABINET

A. Cabinet shall conform to the provisions of State Standard specifications §87-1.03Q, "Cabinets" and Caltrans TEES.

3.09 SIGNAL HEAD

A. Vehicle and bicycle signal heads shall conform to the provisions of State Standard specifications §87-1.03R, "Signal Heads".

3.10 PEDESTRIAN SIGNAL

A. Pedestrian signal heads shall conform with State Standard specifications §87-1.03S, "Pedestrian Signal Heads".

3.11 SIGNAL STANDARDS AND POLES

A. Traffic signal standards and poles shall conform to the provisions of State Standard specifications §87-1.03J, "Standards, Poles, Pedestals, and Posts".

B. Signal poles shall be painted brown, unless otherwise directed by the City.

3.12 PEDESTRIAN PUSH BUTTON

A. Pedestrian push button shall conform to the provisions of State Standard specifications §87-1.03U, "Push Button Assemblies".

B. Forms for programming APS verbal announcements shall be provided by the Contractor as part of the materials submittal. Forms will be completed by the City. Contractor shall obtain programming sheets from the Engineer prior to installation, and have the vendor record the audible messages.

C. Contractor shall arrange to have a representative of the manufacturer present on two separate days for button installation. The first day shall be for installation of devices and setting of volume controls. The second day, if required, shall be to adjust volume controls in response to input from adjacent residents.

3.13 DETECTION

A. The contractor shall program and configure the detection zones as shown on the plans. Installation of the VDS shall be by a factory-authorized representative or a minimum IMSA-Level II Certified Traffic Signal Technician.

B. Loop detection shall conform to the provisions of State Standard specifications §87-1.03V, “Detectors”.

1. The Contractor shall test each detector loop as they are installed. Acceptable testing results for each individual loop pair shall be 124 micro-henries inductance and infinite meg-ohms to ground. Values of the test results for loop inductance shall vary no more than ±5 percent (± 6 micro-henries). No loop wiring is to be connected to a DLC until tested and approved by SVP traffic personnel. Any detector loop that fails to meet acceptable testing results shall be replaced immediately at no additional cost to the City.

2. Contractor shall conduct the tests in the presence of the inspector or shall document the test results in writing. Loops that fail to meet requirements shall be repaired by the contractor at no additional cost to the City.

3.14 LIGHTING

A. The functional test for each lighting system shall consist of not less than 14 days. If unsatisfactory performance of the system develops, the conditions shall be corrected, and the test shall be repeated until the 14 days of continuous, satisfactory operation is obtained.

3.15 PEDESTRIAN HYBRID BEACON SYSTEM

A. Pedestrian Hybrid Beacon (PHB) System shall conform to the provisions of State Standard specifications §87-8, “Pedestrian Hybrid Beacon Systems”.

3.16 SPEED FEEDBACK SIGN

A. Speed feedback sign shall conform to the provisions of State Standard specifications §87-14, “Radar Speed Feedback Sign Systems”.

3.17 RECTANGULAR RAPID-FLASHING BEACON

A. Rectangular rapid-flashing beacon shall conform to the provisions of State Standard specifications §87-7, “Flashing Beacon Systems”.

APPENDIX C – DETAILED COST ESTIMATE

APPENDIX C: DETAILED COST ESTIMATE

Project No.	Item	Quantity	Unit Cost	Total Cost (2023)	Capital Cost (Hardware)	Capital Cost (Software)	Soft Costs (Design and Oversight)	Total Cost
1-1	PROCURE AND INSTALL CONTROLLER WITH KITS COMPATIBLE FIRMWARE FOR INDUSTRIAL/BRANSTEN			$ 9,000.00	$ 7,500.00	$ 1,000.00	$ 500.00	$ 9,000.00
	PROCURE AND INSTALL KITS COMPATIBLE CONTROLLER	1	$ 7,500.00	$ 7,500.00				
	KITS COMPATIBLE FIRMWARE	1	$ 1,000.00	$ 1,000.00				
	CONTROLLER PROGRAMMING	1	$ 500.00	$ 500.00				
1-2	PROCURE AND INSTALL 10 TRAFFIC SIGNAL CONTROLLERS WITH KITS COMPATIBLE FIRMWARE			$ 506,000.00	$ 75,000.00	$ 10,000.00	$ 5,000.00	$ 90,000.00
	PROCURE AND INSTALL KITS COMPATIBLE CONTROLLER	10	$ 7,500.00	$ 75,000.00				
	KITS COMPATIBLE FIRMWARE	10	$ 1,000.00	$ 10,000.00				
	CONTROLLER PROGRAMMING	10	$ 500.00	$ 5,000.00				
1-4	PROCURE AND INSTALL CONTROLLER BATTERY BACK-UP SYSTEMS			$ 208,000.00	$ 160,000.00		$ 48,000.00	$ 208,000.00
	UPGRADE EXISTING BATTERY BACK-UP SYSTEM	10	$ 2,000.00	$ 20,000.00				
	FURNISH AND INSTALL NEW BATTERY BACK-UP SYSTEM	14	$ 10,000.00	$ 140,000.00				
	DESIGN	1	$ 48,000.00	$ 48,000.00				
4-1	UPGRADE 75 PEDESTRIAN HEADS TO COUNTDOWN TIMERS			$ 209,625.00	$ 161,300.00	$ -	$ 48,400.00	$ 209,700.00
	REMOVE AND SALVAGE EXISTING SIGNAL INDICATION	75	$ 200.00	$ 15,000.00				
	FURNISH AND INSTALL PEDESTRIAN SIGNAL INDICATION (COUNTDOWN)	75	$ 1,200.00	$ 90,000.00				
	MISC. CABLING	75	$ 750.00	$ 56,250.00				
	DESIGN	1	$ 48,375.00	$ 48,375.00				
4-2	UPGRADE 148 PEDESTRIAN PUSHBUTTONS TO ACCESSIBLE PEDESTRIAN SIGNALS (APS)			$ 481,000.00	$ 370,000.00	$ -	$ 111,000.00	$ 481,000.00
	REMOVE EXISTING PEDESTRIAN PUSH BUTTON ASSEMBLY	148	$ 250.00	$ 37,000.00				
	FURNISH AND INSTALL ACCESSIBLE PEDESTRIAN SIGNAL (APS) ASSEMBLY WITH SIGN	148	$ 1,500.00	$ 222,000.00				
	MISC. CABLING	148	$ 750.00	$ 111,000.00				
	DESIGN	1	$ 111,000.00	$ 111,000.00				
4-3	PILOT BIKE DETECTION AT ONE INTERSECTION			$ 89,125.00	$ 68,200.00	$ -	$ 21,000.00	$ 89,200.00
	FURNISH AND INSTALL BICYCLE DETECTED SIGNAL INDICATOR SYSTEM (2 INDICATORS, CONTROLLER UNIT)	1	$ 4,000.00	$ 4,000.00				
	FURNISH AND INSTALL VIDEO DETECTION SYSTEM PER INTERSECTION	1	$ 40,000.00	$ 40,000.00				
	FURNISH AND INSTALL 3" CONDUIT	75	$ 125.00	$ 9,375.00				
	FURNISH AND INSTALL NO. 6E PULLBOX	4	$ 3,500.00	$ 14,000.00				
	MISC. CABLING	1	$ 750.00	$ 750.00				
	DESIGN	1	$ 21,000.00	$ 21,000.00				
4-4	DEPLOY BIKE DETECTION AT 23 INTERSECTIONS			$ 2,051,600.00	$ 1,436,200.00	$ -	$ 615,500.00	$ 2,051,700.00
	PILOT BIKE DETECTION AT ONE INTERSECTION	23	$ 89,200.00	$ 2,051,600.00				
5-1	DEVELOP A FUNDING STRATEGY DOCUMENT			$ 25,000.00			$ 25,000.00	$ 25,000.00
	RESEARCH	30	$ 250.00	$ 7,500.00				
	DRAFT	40	$ 250.00	$ 10,000.00				
	REVIEW + FINAL	30	$ 250.00	$ 7,500.00				
5-2	DEVELOP A STAFFING PLAN			$ 17,500.00			$ 17,500.00	$ 17,500.00
	DRAFT	40	$ 250.00	$ 10,000.00				
	REVIEW + FINAL	30	$ 250.00	$ 7,500.00				
6-1	FORMALIZE MAINTENANCE AND OPERATIONS RESPONSIBILITIES AND BUDGETS			$ 32,500.00			$ 32,500.00	$ 32,500.00
	DRAFT	100	$ 250.00	$ 25,000.00				
	REVIEW + FINAL	30	$ 250.00	$ 7,500.00				

7-1	CONNECT INDUSTRIAL/COMMERCIAL, INDUSTRIAL/E. SAN CARLOS, AND OLD COUNTY/HOWARD TO EXISTING C/CAG SMART CORRIDOR FIBER TRUNKLINE			$ 154,297.00	$ 118,700.00	$ -	$ 35,700.00	$ 154,400.00
	FURNISH AND INSTALL 3" CONDUIT	270	$ 125.00	$ 33,750.00				
	FURNISH AND INSTALL 12-STRAND SMFO CABLE	324	$ 10.00	$ 3,240.00				
	FURNISH AND INSTALL NO. 6E PULLBOX	14	$ 3,500.00	$ 49,000.00				
	FURNISH AND INSTALL FIBER OPTIC SPLICE VAULT	3	$ 3,200.00	$ 9,600.00				
	FURNISH AND INSTALL SPLICE CLOSURE	3	$ 2,500.00	$ 7,500.00				
	FURNISH AND INSTALL 12-PORT FIBER TERMINATION PANEL AND PATCH CORDS	3	$ 1,200.00	$ 3,600.00				
	MAKE AND TEST FIBER SPLICINGS AND TERMINATIONS	48	$ 250.00	$ 12,000.00				
	DESIGN	1	$ 35,607.00	$ 35,607.00				
7-2	USE EXISTING COPPER INTERCONNECT FOR ETHERNET CONNECTIONS FOR NEAR TERM IMPLEMENTATION			$ 65,000.00	$ 50,000.00		$ 15,000.00	$ 65,000.00
	HARDWARE	5	$ 10,000.00	$ 50,000.00				
	DESIGN	1	$ 15,000.00	$ 15,000.00				
7-3	REPLACE COPPER INTERCONNECT WITH FIBER AT SIX INTERSECTIONS			$ 748,020.00	$ 575,400.00	$ -	$ 172,700.00	$ 748,100.00
	FURNISH AND INSTALL 3" CONDUIT	2800	$ 125.00	$ 350,000.00				
	FURNISH AND INSTALL 288-STRAND SMFO CABLE	3360	$ 18.00	$ 60,480.00				
	FURNISH AND INSTALL 12-STRAND SMFO CABLE	672	$ 10.00	$ 6,720.00				
	FURNISH AND INSTALL NO. 6E PULLBOX	38	$ 3,500.00	$ 133,000.00				
	FURNISH AND INSTALL FIBER OPTIC SPLICE VAULT	0	$ 3,200.00	$ -				
	FURNISH AND INSTALL SPLICE CLOSURE	0	$ 2,500.00	$ -				
	FURNISH AND INSTALL 12-PORT FIBER TERMINATION PANEL AND PATCH CORDS	6	$ 1,200.00	$ 7,200.00				
	MAKE AND TEST FIBER SPLICINGS AND TERMINATIONS	72	$ 250.00	$ 18,000.00				
	DESIGN	1	$ 172,620.00	$ 172,620.00				
8-1	UPDATE SIGNAL TIMING COORDINATION IN 2026			$ 80,000.00	$ -	$ -	$ 80,000.00	$ 80,000.00
	COUNTS	1	$ 15,000.00	$ 15,000.00				
	SIGNAL TIMING PLAN UPDATES	1	$ 60,000.00	$ 60,000.00				
	CONTROLLER PROGRAMMING	10	$ 500.00	$ 5,000.00				
9-1	INSTALL CELLULAR/WIRELESS COMMUNICATIONS AT THREE, REMOTE INTERSECTIONS.			$ 17,550.00	$ 13,500.00	$ -	$ 4,100.00	$ 17,600.00
	WIRELESS MODEM	3	$ 2,250.00	$ 6,750.00				
	ANTENNA	3	$ 750.00	$ 2,250.00				
	MISC. CABLING	3	$ 750.00	$ 2,250.00				
	START-UP COST	3	$ 750.00	$ 2,250.00				
	DESIGN	1	$ 4,050.00	$ 4,050.00				
9-2	INSTALL CELLULAR/WIRELESS COMMUNICATIONS AT THREE, REMOTE INTERSECTIONS			$ 17,550.00	$ 13,500.00	$ -	$ 4,100.00	$ 17,600.00
	WIRELESS MODEM	3	$ 2,250.00	$ 6,750.00				
	ANTENNA	3	$ 750.00	$ 2,250.00				
	MISC. CABLING	3	$ 750.00	$ 2,250.00				
	START-UP COST	3	$ 750.00	$ 2,250.00				
	DESIGN	1	$ 4,050.00	$ 4,050.00				
9-3	INSTALL FIBER ALONG SAN CARLOS AVE BETWEEN DEVONSHIRE BLVD AND ALAMEDA, AND CONNECT THREE INTERSECTIONS			$ 571,155.00	$ 439,400.00	$ -	$ 131,900.00	$ 571,300.00
	FURNISH AND INSTALL 3" CONDUIT	2250	$ 125.00	$ 281,250.00				
	FURNISH AND INSTALL 288-STRAND SMFO CABLE	1800	$ 18.00	$ 32,400.00				
	FURNISH AND INSTALL 12-STRAND SMFO CABLE	900	$ 10.00	$ 9,000.00				
	FURNISH AND INSTALL NO. 6E PULLBOX	24	$ 3,500.00	$ 84,000.00				
	FURNISH AND INSTALL FIBER OPTIC SPLICE VAULT	3	$ 3,200.00	$ 9,600.00				
	FURNISH AND INSTALL SPLICE CLOSURE	3	$ 2,500.00	$ 7,500.00				
	FURNISH AND INSTALL 12-PORT FIBER TERMINATION PANEL AND PATCH CORDS	3	$ 1,200.00	$ 3,600.00				
	MAKE AND TEST FIBER SPLICINGS AND TERMINATIONS	48	$ 250.00	$ 12,000.00				
	DESIGN	1	$ 131,805.00	$ 131,805.00				

9-4	CONNECT BRITTAN/LAUREL TO FIBER TRUNKLINE ALONG EL CAMINO REAL			$ 233,610.00	$ 179,700.00	$ -	$ 54,000.00	$ 233,700.00
	FURNISH AND INSTALL 3" CONDUIT	900	$ 125.00	$ 112,500.00				
	FURNISH AND INSTALL 288-STRAND SMFO CABLE	0	$ 18.00	$ -				
	FURNISH AND INSTALL 12-STRAND SMFO CABLE	1080	$ 10.00	$ 10,800.00				
	FURNISH AND INSTALL NO. 6E PULLBOX	13	$ 3,500.00	$ 45,500.00				
	FURNISH AND INSTALL FIBER OPTIC SPLICE VAULT	1	$ 3,200.00	$ 3,200.00				
	FURNISH AND INSTALL SPLICE CLOSURE	1	$ 2,500.00	$ 2,500.00				
	FURNISH AND INSTALL 12-PORT FIBER TERMINATION PANEL AND PATCH CORDS	1	$ 1,200.00	$ 1,200.00				
	MAKE AND TEST FIBER SPLICINGS AND TERMINATIONS	16	$ 250.00	$ 4,000.00				
	DESIGN	1	$ 53,910.00	$ 53,910.00				
9-5	CONNECT OLD COUNTY/E. SAN CARLOS TO FIBER ALONG HOLLY			$ 291,590.00	$ 224,300.00	$ -	$ 67,300.00	$ 291,600.00
	FURNISH AND INSTALL 3" CONDUIT	1200	$ 125.00	$ 150,000.00				
	FURNISH AND INSTALL 288-STRAND SMFO CABLE	0	$ 18.00	$ -				
	FURNISH AND INSTALL 12-STRAND SMFO CABLE	1440	$ 10.00	$ 14,400.00				
	FURNISH AND INSTALL NO. 6E PULLBOX	14	$ 3,500.00	$ 49,000.00				
	FURNISH AND INSTALL FIBER OPTIC SPLICE VAULT	1	$ 3,200.00	$ 3,200.00				
	FURNISH AND INSTALL SPLICE CLOSURE	1	$ 2,500.00	$ 2,500.00				
	FURNISH AND INSTALL 12-PORT FIBER TERMINATION PANEL AND PATCH CORDS	1	$ 1,200.00	$ 1,200.00				
	MAKE AND TEST FIBER SPLICINGS AND TERMINATIONS	16	$ 250.00	$ 4,000.00				
	DESIGN	1	$ 67,290.00	$ 67,290.00				
9-6	INTEGRATE INDUSTRIAL/COMMERCIAL AND INDUSTRIAL/E. SAN CARLOS INTO KITS			$ 3,000.00			$ 3,000.00	$ 3,000.00
	INTEGRATE INTERSECTION INTO KITS	2	$ 1,500.00	$ 3,000.00				
9-7	INTEGRATE HOLLY/LAUREL INTO KITS			$ 1,500.00			$ 1,500.00	$ 1,500.00
	INTEGRATE INTERSECTION INTO KITS	1	$ 1,500.00	$ 1,500.00				
9-8	INTEGRATE FIVE INTERSECTIONS INTO KITS			$ 7,500.00			$ 7,500.00	$ 7,500.00
	INTEGRATE INTERSECTION INTO KITS	5	$ 1,500.00	$ 7,500.00				
9-9	INTEGRATE THREE INTERSECTIONS INTO KITS			$ 4,500.00			$ 4,500.00	$ 4,500.00
	INTEGRATE INTERSECTION INTO KITS	3	$ 1,500.00	$ 4,500.00				
9-10	INTEGRATE FIVE INTERSECTIONS INTO KITS (AS THEY COME ONLINE)			$ 7,500.00			$ 7,500.00	$ 7,500.00
	INTEGRATION INTO KITS	5	$ 1,500.00	$ 7,500.00				
10-1	ESTABLISH A TRAFFIC OPERATORS CENTER			$ 105,000.00	$ 70,000.00		$ 30,000.00	$ 100,000.00
	PLANNING AND CONSTRUCTION	1	$ 70,000.00	$ 70,000.00				
	DESIGN	1	$ 30,000.00	$ 30,000.00				
10-2	PROCURE ADDITIONAL KITS WORKSTATION			$ -	$ 2,000.00	$ -	$ 3,000.00	$ 5,000.00
	PROCURE ADDITIONAL KITS WORKSTATION	1	$ 2,000.00	$ 2,000.00				
	INSTALL KITS WORKSTATION	1	$ 3,000.00	$ 3,000.00				