CITYWIDE COMMUNICATIONS SYSTEM MASTER PLAN

APRIL 2024

DRAFT FINAL

City of Temecula

Acknowledgements

City of Temecula

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APPENDICIES

List of Acronyms

AB ..... Assembly Bill

ACS ..... American Community Survey

ALPR ..... Automated License Plate Recognition

APS ..... Accessible Pedestrian Signal

ATC ..... Advance Traffic Controller

ATMS ..... Advanced Traffic Management Systems

ATTAIN ..... Advanced Transportation Technologies and Innovation

ATTIMD ..... Advanced Transportation Technologies and Innovative Mobility Development

AV ..... Audio/Visual

BBS ..... Battery Back-Up System

BEAD ..... Broadband Equity, Access, and Deployment

BIL ..... Bipartisan Infrastructure Law (BIL)

bps ..... Bits per Second

Caltrans ..... California Department of Transportation

CA MUTCD ..... California Manual on Uniform Traffic Control Devices

CASF ..... California Advanced Services Funds

CCSMP ..... Citywide Communication System Master Plan

CCTV ..... Closed-Circuit Television

CDT ..... California department of Technology

CFD ..... Community Facility Districts

CIP ..... Capital Improvement Program

CISA ..... Cybersecurity and Infrastructure Security Agency

CMS ..... Changeable Message Sign

CMU ..... Conflict Monitor Unit

Comm ..... Communications

CPUC ..... California Public Utilities Commission

CV ..... Connected Vehicle

C-V2X ..... Cellular Vehicle-To-Everything

C2X ..... Cellular-To-Everything

DIF ..... Development Impact Fees

DLA ..... Division of Local Assistance

EVPE ..... Emergency Vehicle Preemption

FCC ..... Federal Communications Commission

FDU ..... Fiber Distribution Unit

FHWA ..... Federal Highway Administration

FiOs ..... Fiber Optic Service

FOC ..... Fiber Optic Cable

FSP ..... Freight Signal Priority

FY ..... Fiscal Year

GB ..... Gigabyte

GHG ..... Greenhouse Gas Emissions

GIS ..... Geographic Information Systems

HOT ..... High-Occupancy Tolling

HOV ..... High Occupancy Vehicle

HSIP ..... Highway Safety Improvement Program

I ..... Interstate

ICM ..... Integrated Corridor Management

ID ..... Identification

IIJA ..... Infrastructure, Investment and Jobs Act

IMS ..... Intersection Management System

IP ..... Internet Protocol

IPP ..... Implementation Phasing and Prioritization Plan

IT ..... Information Technologies

ITS ..... Intelligent Transportation System

ITSS ..... Information Technology and Support Services

ISP ..... Internet Service Provider

LED ..... Light Emitting Diode

LF ..... Linear Foot

LPI ..... Leading Pedestrian Interval

LRSM ..... Local Roadway Safety Manual

LRSP ..... Local Roadway Safety Plan

MB ..... Megabyte

Mbps ..... Megabits per second

MFA ..... Multifactor Authentication

MHz ..... Megahertz

MPO ..... Multi-Fiber Push On

MRC ..... Margarita Recreation Center

NITA ..... National Telecommunications and Information Administration

No ..... Number

NOFO ..... Notice of Funding Opportunity

OCR ..... Optical Character Recognition

PD ..... Police Department

POTS ..... Plain Old Telephone Service

PVC ..... Polyvinyl Chloride

PW ..... Public Works

QLMP ..... Quality of Life Master Plan

RCTC ..... Riverside County Transportation Commission

RMC ..... Rigid Metallic Conduit

RS ..... Recommended Standard

SB ..... Senate Bill

SFP ..... Small Form Factor Pluggable

SHS ..... State Highway System

SIC ..... Signal Interconnect Cable

SMART ..... Strengthening Mobility and Revolutionizing Transportation

SMFOC ..... Single-Mode Fiber Optic Cable

SOPs ..... Standard Operating Procedures

SPMs..... Signal Performance Measures

SR ..... State Route

SS4A .....Safe Street and Road for All

TBMP ..... Trails and Bikeways Master Plan

TCP ..... Transmission Control Protocol

TOC..... Traffic Operations Center

TSP.....Transit Signal Priority

TUMF..... Transportation Uniform Mitigation Fee

TVE2 ..... Temecula Valley Entrepreneus Exchange

USDOT ..... United States Department of Transportation

VPN..... Virtual Private Network

VLAN ..... Virtual Local Area Network

V2X ..... Vehicle-to-Everything

WRCOG .....Western Riverside Council of Governments

Executive Summary

The City of Temecula has taken a proactive approach to implement a state-of-the-art fiber optic communications system though the development of a Citywide Communications System Master Plan (CCSMP). The CCSMP presents a comprehensive strategy to leverage existing fiber optic and Intelligent Transportation Systems (ITS) infrastructure and deploy modern infrastructure, laying the foundation for secure, high-speed, reliable, and future-proof communication networks. This plan aims to revolutionize connectivity, support economic growth, enhance public services, and improve quality of life for residents.

The communication system will connect traffic signal infrastructure throughout the City to ITS elements that provide the technology for effective system management, operation, and maintenance. An intelligent traffic system promotes increased roadway safety for all modes of travel, shorter commute times, more reliable travel, a healthier environment, and economic and sustainable growth which are all key ingredients for using ITS infrastructure to maintain a high quality of life for residents. The wide geographical network involved with traffic signal communication systems provides the opportunity to extend Smart City applications across City departments and services. These include connecting to emergency services (police and fire), building facilities such as libraries, community centers, maintenance yards, parks, recreation centers, etc. The CCSMP addresses these opportunities and demonstrates the wide area network topology of connected infrastructure and fiber management and allocation for various uses.

The CCSMP purpose is to guide the City's investment and implementation in fiber optic communications and ITS technology. The CCSMP is critical in ensuring the City's current and future communication system needs and objectives are realized through this growth.

Need

The City of Temecula has a population of 110,003[1] and encompasses 37.3 square miles in southwestern Riverside County, California. The City operates and maintains 132 signaled intersections and 395 paved lane miles of public roads. Temecula's transportation system has developed concurrently with the City's physical expansion. Western Riverside County and the City of Temecula have grown rapidly over the past twenty years, with high levels of population growth projected to continue.

The City's current communications network technology was built to legacy standards that do not have the capacity to support the growing data demands of the community. Advancements in the digital world have accelerated in recent years, spurred by technology improvements, automation, and the rise in e-commerce, remote work, and online learning. This has put pressure on the City of Temecula to modernize existing assets and utilize technology to streamline government processes and improve City services for residents and businesses.

[1] United States Census Bureau, 2020

The City of Temecula has a dedicated Traffic Operations Center (TOC). Most of the City's traffic signals were connected to the TOC through a hybrid mix of copper twisted pair copper, fiber, and wireless systems. Although the City has made a great effort to install communications to 88% of the 132 existing traffic signals over the last 20 years, only 35% are communicating back to the TOC through fiber infrastructure. The copper wire analog network and serial wireless radios systems were considered state-of-the-art and performed reliably at the time they were installed. However, by today's standards, the system technology is outdated, difficult to maintain, and can no longer service the current traffic management system information demands such as real-time video monitoring devices and data gathering applications.

The City's Public Works and Information Technology and Support Services (ITSS) departments are responsible for planning, building, operating, managing, and maintaining the City's communications system network. Needs identified by both departments are summarized below:

- Expansion of the communication system throughout the City.
- Pursue available funding opportunities to expand the City's communication system.
- Prioritize implementation of fiber infrastructure at City facilities to replace third-party leased network lines within the next three to five years.
- Develop a formal planning framework to identify and implement communication projects strategically and leverage projects between both departments.
- Develop standard operating procedures (SOPs) for maintaining the communication system, implementing new communication projects, documenting completed projects, communication security protocols, and standard specifications.
- Develop a centralized location for communication related documents between ITSS and Public Works departments.
- Interactive live citywide map showing existing and planned communication infrastructure readily available to both departments.
- Separate communication system networks and equipment between ITSS and Public Works.

Purpose, Goals and Objectives

The purpose of the Temecula CCSMP is to strategically guide the replacement and expansion of the existing obsolete communications system to provide a citywide network that is capable of meeting municipal operational needs, supporting future growth and advanced technologies, while ensuring resiliency, efficiency, and equity. The plan represents a significant opportunity for the City of Temecula to advance the citywide communication system and supporting elements to the technological forefront. The CCSMP will open doors to opportunities including access to grant funding, coordination with various projects and developments, cost savings, providing a future proof platform, and advancing Smart City and Qualify of Life initiatives. The CCSMP provides a framework for strategically achieving the following goals and objectives:

- Evaluate the existing communications system to identify deficiencies.

- Identify current and future system needs based on resolutions for existing system deficiencies and stakeholder feedback.
- Leverage existing conduit and fiber infrastructure to advance the availability, affordability, and reliability of communications for municipal and community services.
- Identify near-term and future planned improvement projects that may be leveraged to bridge communication system gaps and enable expansion of City services.
- Evaluate current off-the-shelf technology trends and related applications that the City may choose to implement to ensure the future communication system will be capable of supporting.
- Identify key recommendations for designing, implementing, and maintaining an efficient citywide communications network based on reliability, scalability, redundancy, and compatibility.
- Develop a plan for phased communications system implementation and prioritization.
- Meet the Temecula Quality of Life Master Plan 2040 goals of establishing a broadband master plan and completing fiber optic connections to City facilities.

Key Recommendations

Key communications systems and ITS element recommendations identified in the Master Plan are summarized below:

- Leverage the existing fiber optic backbone to establish communication to remaining traffic signals and facilities with no communication infrastructure.
- A redundant fiber optic ring network configuration is recommended for Public Works and ITSS Departments.
- The City's core network layer will consist of a backbone fiber ring made up of primary and secondary rings. Provide the following fiber optic deployments in existing and new conduit installations:
    - Primary rings should be a minimum 288-strand single-mode fiber optic cable.
    - Secondary rings should be a minimum 144-strand single-mode fiber optic cable.
    - Linear branch connections should be a minimum 72-strand single-mode fiber optic cable.
- Communication hubs will provide access between the fiber backbone ring and network equipment at traffic signal cabinets and ITSS facilities.
    - Each hub shall be connected to a minimum of two other hubs.
    - Each hub shall provide communications backhaul to City Hall.
- City traffic signals and ITSS facilities are recommended to be organized into separate network groups with each group connected to a minimum of two communication hubs. The use of communication hubs and network groups provides two levels of redundancy:
    - Devices can communicate with separate hubs if a communication link within the network group fails.
    - If a communication hub fails, each network group can communicate with the second or third hub.
- The traffic signal and ITSS facilities network systems will utilize the same fiber backbone and communication hub network layout and will backhaul to City Hall's Data Center/ Server Room.

- The traffic signal and ITSS facilities network systems will be segregated. Each department will have their own dedicated fiber count and layer 3 switch within the Data Center/ Server Room.
- The recommended fiber strand allocation for the 288-strand primary fiber optic ring is as follows:
    - Public Work Department (144 strands of fiber).
        - 36 strands of fiber allocated to the redundant ring network configuration.
        - 108 strands of dark fiber.
    - ITSS Department (144 strands of fiber)
        - 64 strands of fiber allocated to the home-run fiber network configuration.
        - 36 strands of fiber allocated to the redundant ring network configuration.
        - 44 strands of dark fiber.
- Dark fiber strands for each department can be utilized for future network expansion, communication needs, or may be leased out.
- Install splice closures to facilitate fiber optic breakout cables to traffic signal cabinets and ITSS facilities. All splicing and splice enclosures shall be underground vaults.

Implementation Phasing and Prioritization

Existing investments in communication infrastructure, underground systems, and communication cabinet infrastructure will continue to be utilized. Obsolete legacy network equipment will be decommissioned and replaced with new modern communication technologies. Implementation of CCSMP recommendations are divided into three phases over a ten-year period which includes immediate, near-term, and full citywide buildout. The timeframe for each phase of implementation is based on available funding and could be accelerated as additional funds are made available.

Phase 1: Immediate Upgrades (Years 1-3)

Phase 1 improvements provide the City with expanded connectivity to traffic signals along major and secondary arterials. Additionally, improvements will bridge communication gaps and make progress towards the backbone fiber optic rings topology. Phase 1 of the implementation plan includes:

- Upgrade fiber distribution units (FDUs) and install splice closures at seven existing communication hubs to accommodate the recommended upsized fiber optic cable. Communication hub upgrades at Rancho California Road and Jefferson Avenue/Old Town Front Street will be prioritized.
- Leverage existing underground and communication cabinet infrastructure to install new fiber optic communication media. Locations that require fiber breakout cables and/or communication equipment at traffic signal cabinets will be prioritized next. These are locations along corridors with existing fiber optic infrastructure that are currently not connected to the fiber optic network.
- Segments with copper wire media will be upgraded next by utilizing the existing conduit to pull in new fiber. Pull box spacing and conduit sweeps will be upgraded to current fiber optic standards.
- Install wireless radios and communication equipment at remaining remote locations to establish communications back to City Hall.

Phase 2: Near-Term Upgrades (Years 4-6)

Phase 2 of the implementation plan includes:

- Prioritize upgrading existing fiber optic infrastructure along Rancho California Road, Temecula Parkway, and Winchester Road.
    - This includes upsizing fiber optic cable (FOC) size, proper fiber allocation, and new splice closures.
    - Fiber optic infrastructure upgrades at these three corridors are critical as they constitute the majority of the City's primary backbone fiber optic ring.
- Fiber distribution units and splice closures at the remaining two existing communication hubs along Winchester Road and Temecula Parkway will be upgraded to accommodate the recommended upsized fiber optic cable.
- Three new communication hubs on Rancho California Road/Butterfield Stage Road, Temecula Parkway/Margarita Road-Redhawk Parkway, and Temecula Parkway/Butterfield Stage Road will be included in Phase 2.

Phase 3: Citywide Buildout (Years 7-10)

Buildout of the Citywide communication system network will be completed in Phase 3.

- Remaining segments with a low fiber strand count will be upgraded.
- New conduit and fiber will be installed along remaining gaps.
- New communication hubs will be installed at Butterfield Stage Road/Nicolas Road and at Old Town Front Street/Santiago Road-First Street/
- Remaining ITSS facilities will be connected to the fiber optic communication system network.

Order of Magnitude Costs

Phase	Implementation Years	Cost
1	1 through 3	$3,896,800
2	4 through 6	$3,579,520
3	7 through 10	$14,587,904
	Grand Total:	**$22,064,224**

The order of magnitude cost estimate for the Citywide Communication System Master Plan is $22,064,904.

1 Introduction

As technology advances, municipalities have been embracing the use of communications network infrastructure to connect and coordinate between critical City services. The City of Temecula has invested in a network of fiber optic cables, copper interconnect, wireless radios, and cellular modems to provide communications for essential municipal services including governance, public safety, transportation, recreation, commerce, and education. The City has sought to balance immediate and long-range needs as the existing communications systems have become obsolete and inhibit staff's ability to effectively and efficiently manage vital municipal systems.

The Temecula Citywide Communications System Master Plan (CCSMP) establishes a robust strategy for establishing the infrastructure, connectivity, and bandwidth necessary to effectively operate and manage the Temecula Public Works and Information Technology and Support Services (ITSS) systems and enable new possibilities for Smart City technology solutions. The CCSMP is a central element of the City's planning framework for establishing a proactive approach to establishing a future-proof platform that supports growth and enables to the City to deploy future technologies that will benefit municipal operations, residents, businesses, and other community stakeholders for years to come.

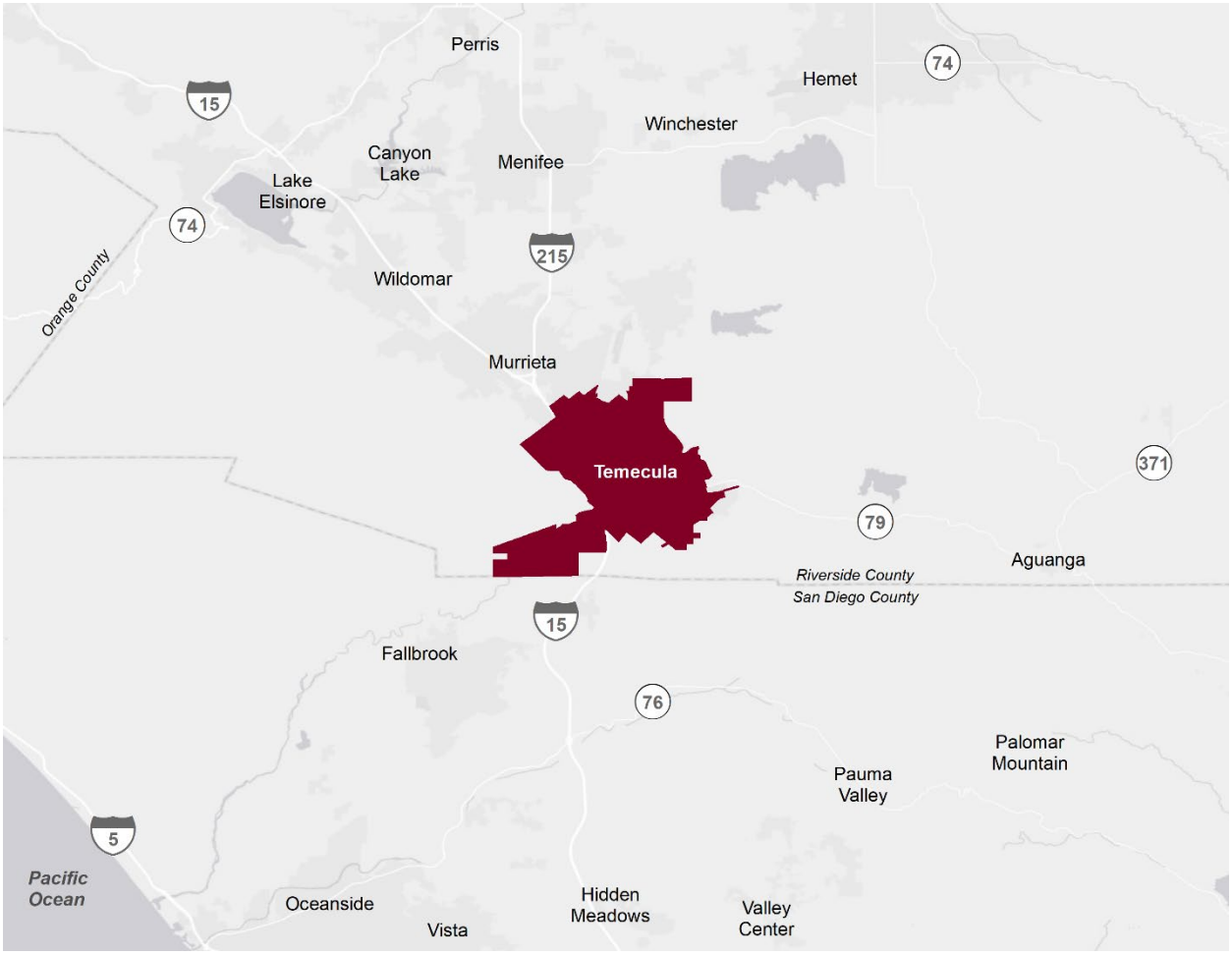
1.1 City Setting

The City of Temecula has a population of 110,003[2] and encompasses 37.3 square miles in southwestern Riverside County, California. As illustrated in ***Figure 1-1***, Temecula is bounded by the City of Murrieta, unincorporated Riverside County, unincorporated San Diego County, and Pechanga Band of Luiseño Mission Indians lands. Temecula operates and maintains 132 signaled intersections and 395 paved lane miles of public roads. The City is traversed north-south by Interstate 15 (I-15) in the western area of the City and California State Route 79 (SR-79) / Temecula Parkway in the southern area of the City.

Temecula's transportation system has developed concurrently with the City's physical expansion. Western Riverside County and the City of Temecula have grown rapidly over the past twenty years, with high levels of population growth projected to continue. For context, the City of Temecula's recently adopted Quality of Life Master Plan (QLMP) 2040 anticipates that private development will add more than 4,000 housing units and 12,000 residents by 2028.

[2] United States Census Bureau, 2020

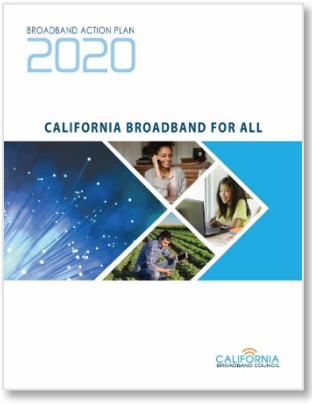
Figure 1-1: Vicinity Map



1.2 Regional, State, and National Plans and Architectures

1.2.1 California Broadband for All Action Plan

The Broadband for All program was established in 2020 to improve digital connectivity and equity across the State of California. Broadband has become essential for accessing vital services and opportunities and the State has commited to enhancing connectivity, access, adoption, and training. The program includes establishment of the California Broadband For All Action Plan, Middle-Mile Broadband Initiative, and programs for Last-Mile Infrastructure and Adoption.



The California Broadband for All Action Plan is an overarching plan established by the California Department of Technology's Office of Broadband and Digital Literacy to address the digital divide and promote equity. The plan identifies long-term goals, actions, and key parties for ensuring all Californians have: high-performance broadband available at

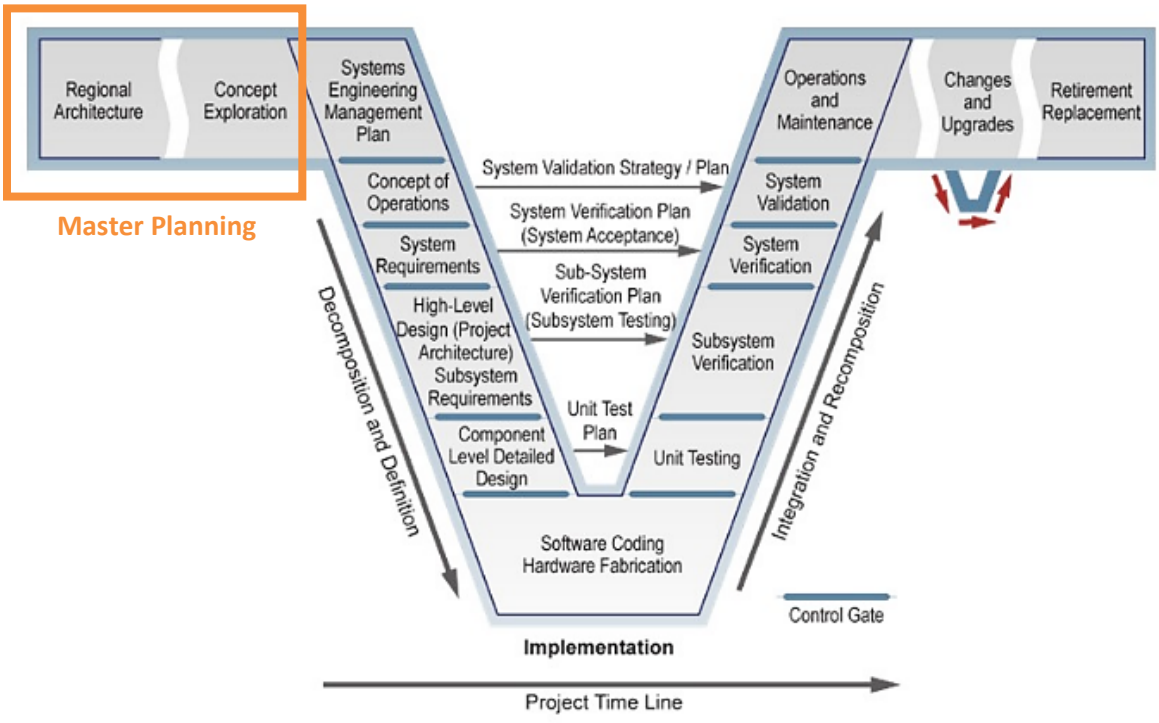
home, schools, libraries, and businesses; access to affordable broadband and necessary devices; and access to training and support to enable digital inclusion.

Development of the CCSMP will be consistent with California Broadband for All Action Plan goals, objectives, and actions for:

- Meet broadband definition standards across Federal Communications Commission (FCC) and State grant-funded broadband programs.
- Meet broadband speed targets to be eligible for infrastructure subsidies and grants.
- Modernize existing systems to support broadband deployment and ongoing maintenance.
- Promote connectivity to "unserved" and "underserved" areas.
- Establish standards for backhaul resilience and reliability.
- Evaluate broadband at service levels for greater accuracy and granularity.
- Meet the State's "Dig Smart" policy to install conduit as part of any appropriate and feasible transportation project on strategic corridors.
- Identify opportunities to partner with Federal, State, local, and tribal governments, and active philanthropy organizations to leverage funding opportunities.
- Partner with governments and broadband providers to enhance permitting processes at all levels.

1.2.2 Federal Highway Administration (FHWA) Systems Engineering for ITS Handbook

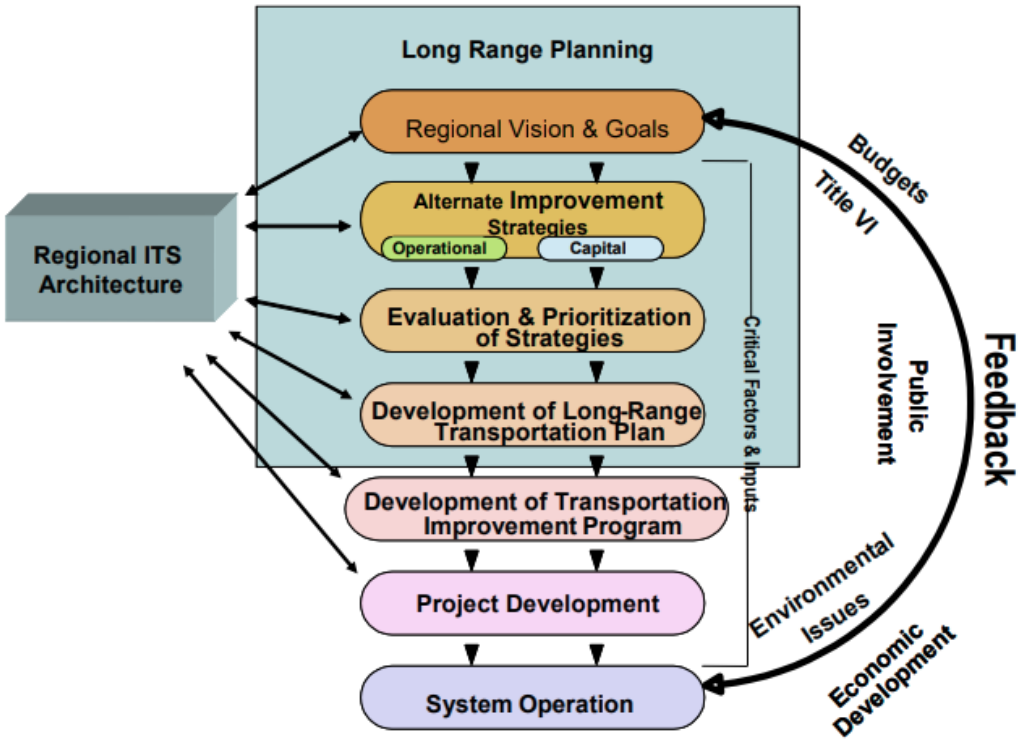
Development of the CCSMP will be consistent with regional, state, and national Systems Engineering plans and architectures. The Federal Highway Administration (FHWA)'s Systems Engineering for Intelligent



Transportation Systems (ITS) Handbook includes the "V" diagram standard. Following the processes reduces risk, controls cost and schedule, improves quality, and results in systems that meet user needs. The CCSMP includes the earliest planning stage of the systems engineering process and presents high-level concepts, architecture, and initial needs identification. The CCSMP provides the framework for capital improvement programming, prioritization, and budgeting for future identified projects through subsequent parts of the systems engineering process.

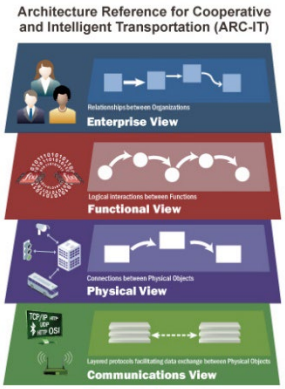
1.2.3 Southern California Regional ITS Architecture

The Southern California Association of Governments (SCAG) Southern California Intelligent Transportation Systems (ITS) Architecture, which was recently updated in 2019, provides a planning framework for ensuring that ITS technologies for managing transportation systems are deployed in a coordinated fashion. The Regional ITS Architecture seeks to address ITS projects and deployments that require connectivity and information exchange across the six-county SCAG region, which includes the City of Temecula. The SCAG ITS Architecture and Transportation Planning process illustrates the interrelation between the ITS Architecture and key steps in the transportation planning process. The CCSMP includes the components of the long-range planning process and considerations for ITS throughout identification of vision and goals, alternate improvement strategies, evaluation and prioritization of strategies, and development of the long-range master plan.



1.2.4 National ITS Architecture

The National ITS Architecture provides a definitive and consistent framework for the planning and deployment of ITS. It is comprised of four primary layers: enterprise, functional, physical, and communications.



The CCSMP addresses the communication view of the National ITS Architecture, which provides a framework for implementing information flow between physical objects. The communications view incorporates best practices for applications, data exchange, facilities, access, management, and security. The City relies on the communications system to support operation and management for multiple Temecula Public Works and Information Technology and Support Services (ITSS) systems.

1.3 Master Plan Mission and Goals

The primary mission of the Temecula CCSMP is to strategically guide the replacement and expansion of the existing obsolete communications system to provide a citywide network that is capable of meeting municipal operational needs, supporting future growth and advanced technologies, while ensuring resiliency, efficiency, and equity. Reliable high-speed broadband communications have become an essential utility for effectively operating, managing, and maintaining traditional City systems and has recently been utilized for more efficient, versatile, and innovative possibilities for public safety, recreation, governance, education, and business. The City of Temecula strives to realize the full potential of broadband and technology innovations to better serve our community.

The CCSMP provides a framework for strategically achieving the following goals and objectives:

- Evaluate the existing communications system to identify deficiencies.
- Identify current and future system needs based on resolutions for existing system deficiencies and stakeholder feedback.
- Leverage existing conduit and fiber infrastructure to advance the availability, affordability, and reliability of communications for municipal and community services.
- Identify near-term and future planned improvement projects that may be leveraged to bridge communication system gaps and enable expansion of City services.
- Evaluate current off-the-shelf technology trends and related applications that the City may choose to implement to ensure the future communication system will be capable of supporting.
- Identify key recommendations for designing, implementing, and maintaining an efficient citywide communications network based on reliability, scalability, redundancy, and compatibility.
- Develop a plan for phased communications system implementation and prioritization.
- Meet the Temecula Quality of Life Master Plan 2040 goals of establishing a broadband master plan and completing fiber optic connections to City facilities.

1.4 Report Organization

The Temecula CCSMP is organized as a compilation of six reports, which are described below:

- **Existing Conditions Assessment** – Detailed assessment of the existing communication system infrastructure for connected devices and facilities. Includes geographic information system (GIS) communication topology map and communication network architecture schematic.
- **Needs Assessment** – Detailed assessment of citywide communication system needs based on stakeholder input from the Temecula Information Technology and Support Services (ITSS) and Public Works Departments, deficiencies identified from the existing conditions assessment, and City initiatives and goals.
- **Capital Improvements** – Overview of research conducted for documentation from the Temecula Public Works Traffic Engineering Division, ITSS Department, and Capital Improvement Program (CIP) to identify future projects that may be leveraged to improve the communication system. Includes capital improvements topology map.
- **Technology Trends** – Overview of current industry technology trends and off-the-shelf technologies and applications that Cities are utilizing their communications systems to support for creating interconnected, sustainable, community-centric environments that can evolve and adapt to meet community needs. Includes smart mobility, smart infrastructure, community engagement, and cybersecurity.
- **Recommendations** – Detailed recommendations for establishing and maintaining a citywide communications network that will be capable of servicing Temecula's current and future needs for facilitating real-time data exchange between City Hall and connected facilities, buildings, and end-user devices. Includes network analysis and recommendations for communication system topology, network standards, infrastructure and equipment standards, and roles and responsibilities for ongoing operation, maintenance, and improvement.
- **Implementation Phasing and Prioritization Plan (IPP)** – Detailed plan for implementation phasing and prioritization of improvements to the citywide communications network based on the CCSMP network analysis finding and improvement recommendations. Includes strategic deployment plan, order of magnitude cost estimates, and identification of funding sources.

2 Existing Conditions Assessment

This chapter provides a detailed assessment of Temecula's communication system and represents the first step in the process to develop the Citywide Communications System Master Plan (CCSMP). The CCSMP will provide the strategic approach to implement a state-of-the-art fiber optic communication system that meets current and future transportation, mobility, and smart city needs.

The City has done an excellent job of building the communication systems over the years. The first copper interconnect systems were connected to traffic signals and implemented more than twenty years ago. The City has a dedicated Traffic Operations Center (TOC) for management and control of systems including traffic signals, Closed-Circuit Television (CCTV) cameras, and streetlights. Most traffic signals are connected to the TOC through a hybrid mix of copper twisted pair and recently implemented fiber systems. The first fiber systems were implemented to connect CCTV cameras at key intersections throughout the City. A majority of streetlights communicate via wireless and cellular nodes to a cloud based LightGrid central management system that can be accessed at the TOC. However, the citywide communication systems are dated and built to historical standards, much of which communicate on legacy serial devices.

The highest cost fiber optic communications system component is underground conduit, which is the greatest capital value in the communication system investments made over the years. The City roadway network is nearly built-out and communication conduit and cable were built on primary arterials in conjunction with the Capital Improvement Program (CIP) and private development projects.

This section provides an overview of the existing communication system infrastructure including connected devices and facilities. The existing conditions will be illustrated on a geographic information system (GIS) communication topology map and communication network architecture schematic. The purpose is to assess the potential for the existing network of communication infrastructure and connected devices throughout the City to add value to future Master Plan investments, especially for the installation of fiber optic cable in underground conduit.

2.1 Partnership

Public Works Traffic Engineering and Information Technology and Support Services are the primary communication system users. The two departments have partnered to operate, manage, maintain, and develop the communication system. The following section describes the departments roles, responsibilities, and uses for the system.

2.1.1 Public Works Traffic Engineering

The Public Works Department is responsible for development and maintenance of City streets, sidewalks, traffic systems, bike lanes, parks, buildings, trails, and drainage facilities; professional engineering oversight of public and private improvement projects; and implementation of erosion/sediment controls and storm water quality measures. The Public Works Department consists of four divisions: Capital Improvement, Land Development, Maintenance, and Traffic Engineering.

The Traffic Engineering Division is responsible for day-to-day traffic operations, safety issues, and future transportation needs, including:

- Collect and analyze traffic volume data
- Establish future traffic signal priorities
- Maintain traffic devices inventories
- Monitor traffic and implement changes from the TOC
- Monitor, maintain, and adjust traffic signal timing
- Perform speed surveys
- Respond to citizens' requests for traffic control devices
- Review accident reports
- Review traffic control plans for construction zones
- Review traffic signal, signing, and striping plans
- Review private development plans for traffic impacts and mitigation measures
- Technical support of the Public Traffic/Safety Commission

The Traffic Engineering Division uses the communication system to:

- Operate and manage signalized intersections from the TOC
- Collect traffic data from connected devices
- Monitor traffic conditions, system performance, and health
- Respond to traffic events including construction, incidents, and special events
- Provide CCTV camera streams to the TOC

2.1.2 Information Technology and Support Services (ITSS)

The Information Technology (IT) Department is responsible for planning, developing, implementing, supporting the technology systems and networks and use of media services to increase community involvement throughout the City. The IT Department consists of six divisions:

- Enterprise Application Services (EAS)
- Geographic Information Systems (GIS)
- Media Services
- Network Infrastructure
- Tech Support
- Support Services

The IT department uses the fiber optic communication system to:

- Connect to City facilities including City Hall, Facility Operations Center (FOC), Temecula Fire Department Stations, Grace Mellman Community Library, and Ronald H. Roberts Temecula Public Library
- Facilitate tech support services
- Provide CCTV camera streams to desktop computers at City Hall

- Remotely control speakers in the Old Town area
- Provide the public with data from the City's smart parking facilities at the Old Town parking garage, the Second Street parking lot, and the Sixth Street parking lot

2.1.3 Roles and Activities

The Public Works Traffic Engineering Division is responsible for maintaining the fiber optic communication system and edge devices for traffic signals and streetlights throughout the City. Public Works initially troubleshoots offline signals and devices. If further support is needed, on-call contractors are utilized to maintain the fiber communications including controllers, CCTV cameras, fiber optic cable, splicing, and terminations. City Staff technicians are utilized as needed to maintain streetlights and troubleshoot communication issues related to LightGrid.

The IT Department is responsible for maintaining the fiber optic communication system for City facilities including City Hall, Facility Operations Center (FOC), Temecula Fire Department Stations, and libraries. For City traffic signals, the department provides configuration and maintenance of the network switches, routers, and CCTV cameras. On-call consultants are utilized for support, including one consultant primarily focused on network security.

Both departments participate in new projects that improve the fiber optic communication system. Public Works leads projects that involve new development and public right-of-way improvements including traffic signals. The IT department leads projects that involve City facility tie-ins or network security. Regardless of which department leads each new project, Public Works is responsible for the design of infrastructure improvements, such as conduit, fiber, and establishing communications back to the network backbone. IT is responsible for developing the internet protocol (IP) schema, procuring and configuring network equipment, and security.

A summary of the communication system roles and responsibilities is provided in **Table 2-1**.

Table 2-1: Communications System Roles and Responsibilities

Activity	Department	Description
Fiber Sharing	Public Works	Citywide communications routed through traffic signal network switches and dedicated traffic fiber strands
	IT Department	Dedicated IT fiber strands for communications to City Hall, Temecula Fire Department Stations, and Libraries
Network Management	Public Works	Traffic signal fiber, controllers, and edge devices
	IT Department	Network switches, routers, CCTV cameras, and security
System Maintenance	Public Works	Traffic signal fiber, controllers, and edge devices with on-call contractor support
	IT Department	Network switches, routers, CCTV cameras, and network security with on-call consultant support

Activity	Department	Description
Capital Improvement	Public Works	Design for infrastructure improvements (conduit, fiber, etc.) and connections to communications backbone
	IT Department	Develop IP schema and procure / configure network equipment during implementation

2.2 Legacy Communication Systems

The City's communication system was built over several decades with continued improvement and expansion through today. The initial builds were state-of-the-art at the time but are now dated and incapable of supporting modern ITS technologies and smart city applications. Much of the legacy systems have recently been replaced with modern network technology. The legacy systems consist of a copper wire based analog multi-drop network, serial digital wireless radios, and analog fiber optic lines network. The existing legacy systems are described in the following subsections.

2.2.1 Copper Wire Analog Network

The City's original traffic signal interconnect cable (SIC) system was 19-gauge 12-pair twisted copper cables. This network replicated the Plain Old Telephone Service (POTS) communication networks. The twisted pair is daisy chained from intersection to intersection and connected to multi-drop modems. The modems are configured as master or remote and run serial 1,200 bits per second (bps). This network communicates status, synchronizes clocks, and provides slow data transmission to legacy controllers via RS-232 Communication Protocol. In the early 2000's the City began installing fiber infrastructure on primary arterials to connect CCTV camera feeds back to City Hall. Over the last year, the City began interconnecting traffic signals along primary arterials utilizing the existing fiber infrastructure that was installed for CCTV cameras. The remaining copper wire network is located on minor arterials and collector streets and is bridged to the fiber network through media converters. The remaining copper wire interconnect locations are listed on **Table 2-2**.

Table 2-2: Copper Wire Interconnect Locations

ID	Intersection	Media	Protocol
6	Butterfield Stage Rd & Pauba Rd	Copper	TCP/IP
7	Butterfield Stage Rd & Royal Crest Pl-Rothenberg Dr	Copper	RS-232
8	Butterfield Stage Rd & Crowne Hill Dr	Copper	TCP/IP
9	Butterfield Stage Rd & De Portola Rd	Copper	TCP/IP
11	Butterfield Stage Rd & Wolf Store Rd	Copper	TCP/IP
13	Butterfield Stage Rd & Nighthawk Pass	Copper	TCP/IP
14	Campanula Way & Camino Del Sol	Copper	TCP/IP
15	Campanula Way East & De Portola Rd	Copper	RS-232
16	Date St & Lakeview Rd	Copper	TCP/IP
17	Date St & Kingwood Rd	Copper	RS-232
18	Dear Hollow Rd & Peach Tree Ln-Via La Colorada	Copper	RS-232

ID	Intersection	Media	Protocol
19	Deer Hollow Rd & Peppercorn Dr-Jon William Way-Anza Rd	Copper	TCP/IP
23	Jefferson Ave & Overland Dr	Copper	TCP/IP
24	Jefferson Ave & Via Montezuma	Copper	TCP/IP
25	Jefferson Ave & Del Rio Rd	Copper	TCP/IP
26	Margarita Rd & Date St	Copper	RS-232
27	Margarita Rd & Rustic Glen Dr-Harveston School	Copper	RS-232
28	Margarita Rd & Harveston Way	Copper	RS-232
29	Margarita Rd & Winco Dwy	Copper	TCP/IP
30	Margarita Rd & Verdes Ln	Copper	RS-232
31	Margarita Rd & North General Kearny Rd	Copper	TCP/IP
32	Margarita Rd & Overland Dr	Copper	RS-232
33	Margarita Rd & Solana Ridge-Abbot	Copper	RS-232
34	Margarita Rd & Solana Way	Copper	TCP/IP
35	Margarita Rd & Stonewood	Copper	RS-232
36	Margarita Rd & Moraga Rd	Copper	RS-232
37	Margarita Rd & Avenida Barca	Copper	RS-232
38	Margarita Rd & La Serena Way	Copper	TCP/IP
39	Margarita Rd & Yukon Rd-Honors Dr	Copper	TCP/IP
41	Margarita Rd & Pauba Rd	Copper	TCP/IP
42	Margarita Rd & Santiago Rd	Copper	TCP/IP
43	Margarita Rd & Pio Pico Rd	Copper	TCP/IP
48	Meadows Pkwy & Pauba Rd	Copper	RS-232
49	Meadows Pkwy & McCabe Dr-Sunny Meadows Dr	Copper	RS-232
50	Meadows Pkwy & Leena Way	Copper	RS-232
51	Meadows Pkwy & De Portola Rd	Copper	RS-232
52	Meadows Pkwy & Campanula Way	Copper	RS-232
53	Nicolas Rd & Rancho Temecula Town Ctr	Copper	TCP/IP
54	Nicolas Rd & North General Kearny Rd	Copper	TCP/IP
55	Vail Ranch Pkwy & Nighthawk Pass	Copper	TCP/IP
59	Overland Dr & Nicole Lane-Promenade Way	Copper	RS-232
60	Pauba Rd & Calle Ventura/Fire Station 84	Copper	TCP/IP
63	Pechanga Pkwy & Rainbow Canyon Rd	Copper	TCP/IP
64	Pechanga Pkwy & Muirfield Dr	Copper	RS-232
65	Pechanga Pkwy & Loma Linda Rd	Copper	TCP/IP
66	Pechanga Pkwy & Wolf Creek Dr North	Copper	RS-232
67	Pechanga Pkwy & Wolf Valley Rd-Via Eduardo	Copper	TCP/IP
68	Pechanga Pkwy & Pechange Casino Dr North	Copper	TCP/IP
69	Pechanga Pkwy & Pechanga Casino Dr South	Copper	RS-232
70	Pechanga Pkwy & Pechanga Resort Dr-Minimart	Copper	TCP/IP
71	Pechanga Pkwy & Wolf Creek Dr South	Copper	RS-232
72	Pechanga Pkwy & Deer Hollow Way	Copper	TCP/IP
116	Wolf Valley Rd & Wolf Creek North-South	Copper	RS-232
122	Ynez Rd & Promenade Mall Ring North	Copper	RS-232
123	Ynez Rd & Promenade Mall Ring South	Copper	RS-232

ID	Intersection	Media	Protocol
124	Ynez Rd & Overland Dr	Copper	TCP/IP
125	Ynez Rd & Motor Car Pkwy	Copper	RS-232
126	Ynez Rd & Solana Way	Copper	RS-232
127	Ynez Rd & Ynez Court-DLR Dr	Copper	RS-232
128	Ynez Rd & Town Center-Tower Plaza North	Copper	TCP/IP
129	Ynez Rd & Town Center-Tower Plaza South	Copper	TCP/IP
130	Ynez Rd & Tierra Vista Rd	Copper	TCP/IP
131	Ynez Rd & Rancho Vista Rd	Copper	TCP/IP
132	Ynez Rd & Pauba Rd	Copper	TCP/IP
133	Ynez Rd & Santiago Rd	Copper	TCP/IP

2.2.2 Serial Wireless Radios

Serial wireless radios were installed at six traffic signal locations along Butterfield Stage Road and Redhawk Parkway over 10 years ago. The traffic signal locations along these corridors are in remote areas of the City and radios were installed as a cost saving alternative to installation of underground interconnect infrastructure. The serial wireless radios are 900 megahertz (MHz) low bandwidth data rates and, like the copper wire analog network, they communicate status, synchronize clocks, and provide slow data transmission to legacy controllers. Existing serial wireless radios are experiencing communications issues resulting in offline status. Radios have outlasted their lifecycle and are due for replacement. The serial wireless radio locations are listed on **Table 2-3**.

Table 2-3: Serial Wireless Locations

ID	Intersection
11	Butterfield Stage Rd & Wolf Store Rd
12	Butterfield Stage Rd & Welton Way-Channel St
13	Butterfield Stage Rd & Nighthawk Pass
88	Redhawk Pkwy & Via Rio Temecula-Wolf Store Rd
89	Redhawk Pkwy & Overland Trail-Paseo Parallon
90	Redhawk Plwy & Vail Ranch Pkwy

2.2.3 Analog Fiber Optic Network

In the early 2000's the City began to install fiber optic cable along on primary arterials including Jefferson Avenue, Pechanga Parkway, Temecula Parkway, Ynez Road, Rancho California Road, and Winchester Road. Existing conduit with SIC interconnect was utilized to pull in the new fiber. Analog CCTV cameras were connected point-to-point on a single fiber strand. The data for CCTV control was connected to an RS-400 series data interface, the video was connected to a coaxial interface, and the encoded signal transmitted over the single fiber to the TOC where it was decoded and displayed. Existing traffic signal controllers and cabinet equipment were not connected to the fiber network. Video transmission technology was upgraded to Transmission Control Protocol/Internet Protocol (TCP/IP) in 2018 and 2022.

2.3 Current Fiber Optic System

The City has recently implemented upgrades to the fiber optic system and leveraged existing fiber optic cable to connect to building facilities, traffic signals, and remote systems for surveillance and parking. This section describes the recent upgrades, underground infrastructure, fiber optic cable, and above ground infrastructure.

2.3.1 Recent System Upgrade

Through Highway Safety Improvement Program (HSIP) Cycle 9 grant funding, the City recently upgraded the fiber optic system and communication equipment along Temecula Parkway, Rancho California Road, and Winchester Road. New 24-strand single mode fiber optic trunk cable (SMFOC) was installed along Rancho California Road and Winchester Road in a mix of polyvinyl chloride (PVC) and rigid metallic conduit (RMC) to bridge gaps in the existing fiber system. New 12-strand fiber breakout cables were installed to connect to traffic signal cabinets to allow network devices, such as the ethernet switches, traffic signal controllers, and IP conflict monitors, to communicate with the TOC. The conduit for the new 24-strand fiber trunk segments is summarized in **Table 2-4** below.

Table 2-4: Recent System Upgrade

Corridor	Segment	Conduit
Rancho California Rd	Business Park Drive to Diaz Road	Existing 2” and 3” PVC
	Margarita Road to Meadows Parkway	New 3” PVC
	Meadows Parkway to Butterfield Stage Road	Existing 2” RMC
Winchester Rd	Diaz Road to Jefferson Avenue	Existing 2” and 3” RMC

Additional improvements are summarized below:

- Existing pull boxes with splice closures upgraded to new #6.
- New 1U fiber distribution units (FDUs) for new 12-strand fiber break out cables.
- New ethernet switches.
- New advanced transportation controller (ATC) FLeX controllers with Omni-ex software.
- New 2010 ECLip conflict monitors.
- New CCTV cameras.

2.3.2 Underground Infrastructure

The underground communication infrastructure consists of conduit, pull boxes and splice closures. These system components facilitate installation of fiber optic cable in the ground. Older builds were constructed to SIC standards and newer builds to fiber optic standards. The following subsections describe the underground system components.

Conduit

Communication conduit utilized for both copper and fiber interconnect are a mix of polyvinyl chloride (PVC) and rigid metallic conduit (RMC), with conduit diameters ranging from 2-inch to 3-inch. The conduit built to outdated SIC standards has 90-degree sweeps into pull boxes with the conduit ends spaced close to the pull box lid. The narrow sweeps and tight spacing in the pull box are not ideal for fiber optic cable.

The more recent conduit was designed to current fiber optic standards with 45-degree sweeps into pull boxes and 16-inches minimum clearance around conduit ends. The communication conduit attributes are listed on **Table 2-5**.

Table 2-5: Existing Communication Conduit

ID	Corridor	Segment	Conduit Type	Conduit Size	Cable Media
1	Winchester Rd	Diaz Rd to Jefferson Ave	RMC	2"	24-Strand SMFOC
2		Jefferson Ave to Ynez Rd	RMC	1.5"	24-Strand SMFOC
3		Ynez Rd to Roripaugh Rd	RMC	3"	24-Strand SMFOC
4		Roripaugh Rd to Nicolas Rd	RMC	2"	24-Strand SMFOC
5	Rancho California Rd	Diaz Rd to Town Center	RMC	3"	24-Strand SMFOC
6		Town Center to Margarita Rd	RMC	2"	24-Strand SMFOC
7		Margarita Rd to Meadows Pkwy	PVC	3"	24-Strand SMFOC
8		Meadows Pkwy to Butterfield Stage Rd	RMC	2"	24-Strand SMFOC
10	Temecula Pkwy	Bedford Ct to La Paz St	PVC/RMC	3"/2"	24-Strand SMFOC
11		La Paz St to Butterfield Stage Rd	RMC	2"	24-Strand SMFOC
12	Margarita Rd	Rancho California Rd to Pio Pico Rd	PVC	3"	24-Strand SMFOC
13		Pio Pico Rd to Dartolo Rd	RMC	2"	24-Strand SMFOC
14		Dartolo Rd to Temecula Pkwy	RMC	2"	36-Strand SMFOC
15	Rancho Way	Business Park Dr to Diaz Rd	PVC	2"	12-Strand SMFOC
16	Business Park Dr	Rancho Way to Diaz Rd	PVC	2"	24-Strand SMFOC

Pull Boxes

Communication pull boxes are placed along conduit runs to facilitate pulling cable. The pull boxes are utilized for both copper and fiber interconnect and are typically Caltrans standard size number five (No. 5) concrete pull boxes with 200-feet spacing. The more recent pull boxes located on Rancho California Road from Margarita Road to Meadows Parkway were designed to current fiber optic standards and are Caltrans standard size number six (No. 6) with 600-feet spacing.

Splice Closures

Splice closures provide protection where fiber optic cable is opened to connect two cables together, typically in proximity of a traffic signal cabinet or a building. The splice closure is in a pull box where the trunk cable is spliced to a branch, or breakout, cable which enters the facility. Splice closures are typically housed in size number 6 pull boxes both with and without extensions. Vaults are not currently used for fiber optic splice closures.

2.3.3 Cable and Above Ground Infrastructure

Cable and above ground infrastructure consists of fiber optic cable, splice cabinets, and communication cabinets. Above ground infrastructure are the system components where splicing and connection to devices occur. The following subsections describe the cable and above ground system components.

Fiber Optic Cable

Existing fiber optic cable is single mode comprised of 24-strand SMFOC between traffic signal intersections on Jefferson Avenue, Rancho California Road, Temecula Parkway, Margarita Road, Winchester Road, and Ynez Road. There is also 48-strand SMFOC on Butterfield Stage Road between Ave Lestonnac and Murrieta Hot Springs which is spliced with the 24-strand trunk cable on Rancho California Road. The fiber optic cable is spliced to a smaller 6 or 12-strand breakout cable that enters traffic signal cabinets and building facilities such as fire stations, libraries, parks, and other City facilities. There are a few remaining segments within the City with fiber optic cable that connects CCTV cameras but bypasses traffic signal cabinets. Additionally, there is existing 2-inch PVC conduit with 24-strand SMFOC on Ynez Road/La Paz Street between Temecula Parkway and Rancho California Road owned by the City. The conduit and fiber were installed in the early 2000s by a telecommunications company as part of a regional fiber project. There were no fiber breakout cables installed to traffic signal cabinets along the corridor.

Table 2-6 summarizes the existing fiber corridors, fiber strands, and total traffic signals and CCTV cameras connected to the fiber system.

Table 2-6: Existing Fiber Optic Corridors

Corridor	Segment	Fiber Cable	Connected Traffic Signals	Connected CCTVs
Butterfield Stage Rd	Ave Lestonnac to Murrieta Hot Springs	48-strand SFMOC	5	4
Business Park Dr/Rancho Way	Rancho California Rd to Rancho Way	24-strand SMFOC	0	1
Jefferson Ave	Rancho California Rd to Winchester Rd	24-strand SMFOC	0	1
Jefferson Ave	Winchester Rd to Sanborn Ave	6-strand SMFOC	0	0
Margarita Rd	Temecula Pkwy to De Portola Rd	36-strand SMFOC	2	1
Margarita Rd	De Portola Rd to Rancho Vista Rd	24-strand SMFOC	0	0
Margarita Rd	Rancho Vista Rd to Rancho California Rd	24-strand SMFOC	1	1
Margarita Rd	North General Kearny Rd to Winchester Rd	24-strand SMFOC	0	1
Old Town Front St	Frist St/Santiago Rd to Rancho California Rd	72-strand SMFOC	1	0

Corridor	Segment	Fiber Cable	Connected Traffic Signals	Connected CCTVs
Rancho California Rd	Business Park Dr-Ridge Park Dr to Butterfield Stage Rd	24-strand SMFOC	15	10
Ring Rd	Promenade Mall N to Promenade Mall E	24-strand SMFOC	1	3
Temecula Pkwy	Bedford Ct to Butterfield Stage Rd	24-strand SMFOC	12	8
Pechanga Pkwy	Deer Hollow Way to Temecula Pkwy	24-strand SMFOC	0	3
Winchester Rd	Diaz Rd to Nicolas Rd	24-strand SMFOC	9	7
Ynez Rd/La Paz St	Temecula Pkwy to Rancho California Rd	24-strand SMFOC	0	0
Ynez Rd	Overland Dr to Winchester Rd	24-strand SMFOC	0	1
Ynez Rd	Equity Dr to Temecula Center Dr-Waverly Ln	24-strand SMFOC	3	1

Connected equipment at traffic signals includes controllers, Ethernet switches, and conflict monitor units (CMUs). All fiber trunk cables are routed to the communication cabinet at Rancho California Road and Jefferson Avenue-Old Town Front Street which is then routed to the City's TOC.

Splice Cabinet

A standalone fiber optic splice cabinet is located at the Rancho California Rd and Diaz Rd/Vincent Moraga Dr intersection. The cabinet is a Type 334 which is a modified Type 332 standard traffic signal cabinet stripped of the signal assemblies. The cabinet only contains a splice housing with splice trays and does not contain patch panels or communication devices.

Cross Connect Communication Cabinet

Type 334 cross connect communication cabinets house fiber termination equipment, including distribution units with splice trays and patch panels, and IT network switch gear connected to CCTV cameras. Existing fiber optic trunk cables enter the cross connect cabinet and are fully terminated on the patch panels. This allows fiber strands to be interconnected or cross connected to facilitate communication between various network devices. Cross connect communication cabinets that house multiple fiber trunk cables are located at the following ten intersections:

- Rancho California Road and Jefferson Avenue-Old Town Front Street
- Rancho California Rd and Ynez Rd
- Rancho California Rd and Margarita Rd (shared traffic signal cabinet)
- Temecula Pkwy and Pechanga Pkwy

- Winchester Rd and Jefferson Avenue
- Winchester Rd and Ynez Rd
- Winchester Rd and Margarita Rd
- Winchester Rd and Nicolas Rd
- Ynez Rd and Overland Dr

There are three additional communication cabinets that house distribution units with splice trays and patch panels at Jefferson Ave/Overland Rd, Rancho Way/Diaz Rd, and Temecula Pkwy/Bedford Ct. A single fiber trunk cable is terminated in these cabinets and doesn't provide interconnection or cross connection to another fiber trunk cable.

2.4 Network Devices

The communication system connects to a variety of network devices that are managed by the Public Works and IT departments. This section describes the ITS and IT connected devices.

2.4.1 ITS Elements

The Public Works Traffic Engineering Department uses the communications system to connect to devices at signalized intersections. Connected devices are monitored, managed, and controlled from the TOC. Devices at traffic signals include advanced transportation controller (ATC) traffic signal controllers, conflict monitor units (CMU), emergency vehicle preemption (EVPE) discriminator modules, battery backup systems (BBS), and accessible pedestrian signal (APS) pushbutton systems. CCTV cameras provide video to the TMC to monitor traffic conditions and respond to events. City staff monitor system health, operation, and performance via the connected devices. ITS network device elements include:

- Axis Q6135-LE CCTV (PTZ) cameras (latest)
- Axis brand CCTV cameras (older)
- Aruba 2930M communication cabinet switches
- Cisco IE-4000-4S8P4G-E traffic signal cabinet switches (HSIP project limits)

The Traffic Engineering Department also maintains school zone flashers and radar speed feedback signs. School zone flashers currently do not have any communications back to the TOC. Schedules for school zone flashers have to be physically downloaded at each sign via a USB. Older radar speed feedback signs have no communications back to the TOC. Newer radar feedback signs are Traffic Logix and communicate to Traffic Logix's web-based cloud server via cellular communications. The cloud server allows for real time monitoring and data analytics.

2.4.2 IT Facilities

The IT department utilizes the citywide communications system to connect to the City's CCTV camera network, speakers in the Old Town area, and smart parking facilities. The City utilizes Open Space Smart Parking by Logix at three public parking facilities in the Old Town area, which include the Old Town Parking Garage, 2nd Street Parking Lot, and the 6th Street Parking Lot. The Open Space server at each parking lot communicates to Logix's cloud server via cellular communications and reports real-time data.

Table 2-7: Existing ITSS Facilities

Name	Address	Network	Data Rate
Civic Center	41000 Main St	City Fiber	1GB
Civic Center Traffic Control Center	41000 Main St	City Fiber	1GB
Field Operations Center	43230 Business Park Dr	City Fiber	1GB
Old Town Parking Structure	28690 Mercedes St	City Fiber	1GB
Temecula Duck Pond	28250 Ynez Rd	City Fiber	1GB
Temecula Library	30600 Pauba Rd	City Fiber	1GB
Temecula Park & Ride	30100 Temecula Pkwy	City Fiber	1GB
Temecula Valley Entrepreneurs Exchange (Tve2)	43200 Business Park Dr	City Fiber	1GB
Pd Old Town Station	28690 Mercedes St #B	City Fiber	1GB
Fire Station 84	30650 Pauba Road	City Fiber	1GB
Community Recreation Center	30875 Rancho Vista Rd	E-Lines	500MB EPLAN
Help Center	28816 Pujol St	E-Lines	100MB EPLAN
Margarita Community Park	29119 Margarita Rd	E-Lines	500MB EPLAN
Mary Phillips Senior Center	41845 6th St	E-Lines	100MB EPLAN
Old Town 6th Street Restroom	41952 6th St	E-Lines	100MB EPLAN
Patricia H. Birdsall Sports Park	32380 Deer Hollow Way	E-Lines	500MB EPLAN
Ronald Reagan Sports Park	30875 Rancho Vista Rd	E-Lines	500MB EPLAN
Rotary Park	28816 Pujol St	E-Lines	100MB EPLAN
Sam Hicks Monument Park	41970 Moreno Rd	E-Lines	100MB EPLAN
Temecula History Museum	28314 Mercedes St	E-Lines	100MB EPLAN
Temecula Skate Park	42569 Margarita Rd	E-Lines	500MB EPLAN
Pd Mall Storefront	40820 Winchester Rd	E-Lines	100MB EPLAN
Pd Southwest Station	30755 Auld Rd	E-Lines	100MB EPLAN
Old Town Community Theater	42051 Main St	VPN Sec - FiOs	1GB
Pennypickle's Workshop	42081 Main St	VPN Sec - FiOs	1GB

2.5 Central Systems

The City's central systems are housed in City Hall and include the City Data Center/Server Room, the Genetec Security Surveillance System, the Traffic Operations Center/Data Room, and the Transparity Intersection Management System (IMS).

2.5.1 IT Data Center

Citywide fiber optic communication data is delivered to the City Hall Data Center/Server Room via a 72-strand fiber optic trunk cable routed from the communication hub at Rancho California Road and Jefferson Avenue-Old Town Front Street. The fiber optic trunk cable is routed to City Hall via Old Town Front Street and Mercedes Street and enters the facility through conduit. The fiber optic trunk cable bypasses the TOC and is landed on communication racks utilizing multi-fiber push on (MPO) connectors in IT's Server Room.

The City CCTV camera system is managed by the Genetec Security Surveillance System. The Genetec software displays video on the TOC video wall and on desktop computers which provide City staff the ability to view CCTV camera footage on geo-localized maps and review automated video analytics.

2.5.2 Traffic Operations Center/ Data Room

City Hall was built with a TOC and supporting data room back in 2008. The TOC was upgraded in 2018 to include a new state-of-the-art video wall and new traffic servers. The Traffic Engineering Department is currently utilizing Transparity IMS traffic management software to monitor the health of signals, update signal timing when necessary, and manage event logs. Additionally, the Traffic Engineering Department monitors and manages streetlights, radar feedback signs, and smart parking through web-based cloud servers.

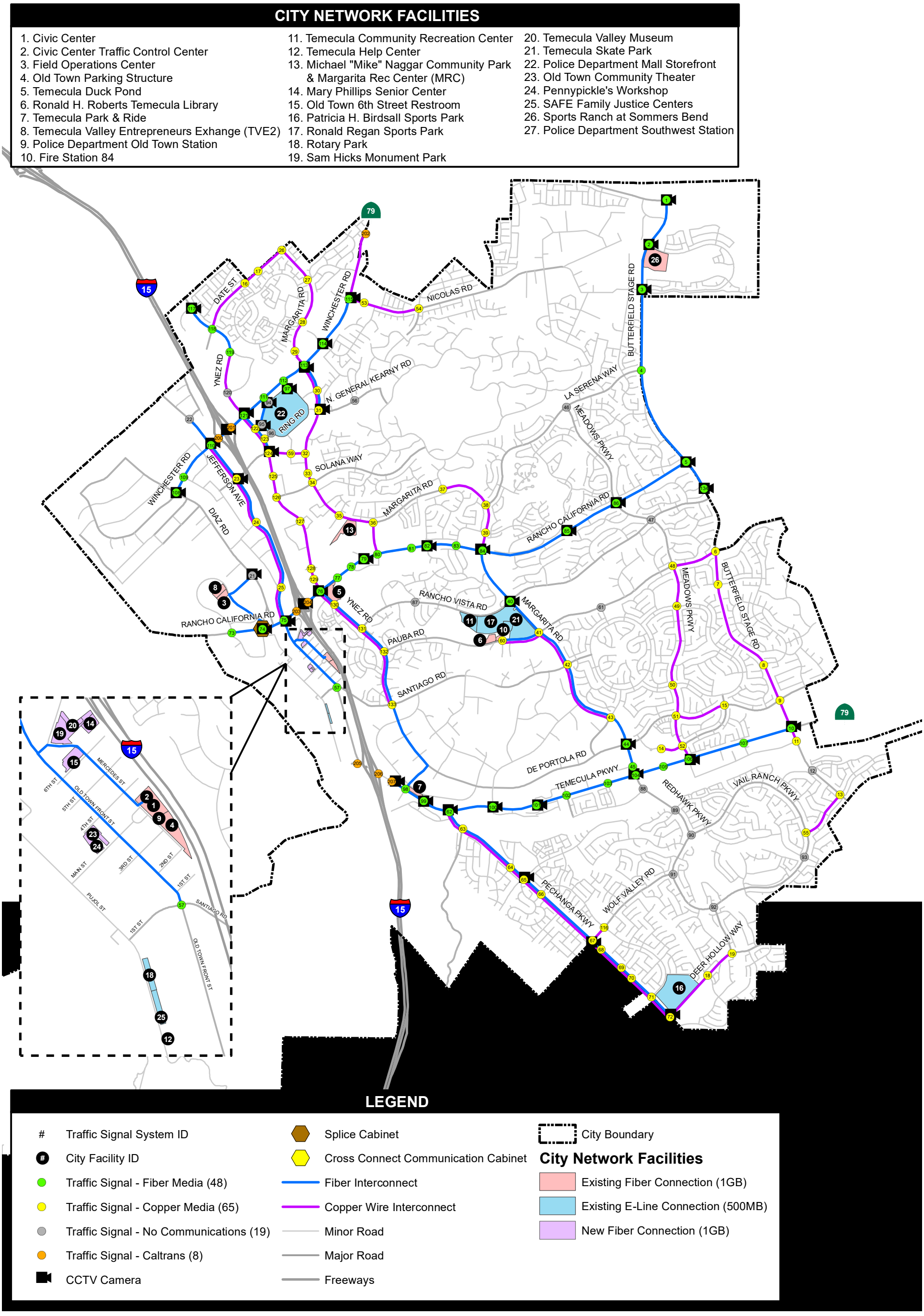
2.6 Communication System Topology Map

The fiber optic communication system covers 16 miles of roadway, including 10 miles on primary arterials, and connects 48 signalized intersections. A map of the communication system topology is provided in **Figure 2-1**. A general overview of the fiber optic network follows:

- The fiber optic communication network is homed at the City Hall server room. The network largely consists of 24-strand SMFOC trunk/feeder cabling along City's primary arterials with 12-strand or 6-strand SMFOC distribution/branch cables to City facilities and traffic signals. Intermediate cross-connect/communication hub cabinets are located at major roadway junctions.
- A 72-strand SMFOC backbone extends out from the City Hall server room to the network main cross-connect (MC)/communication hub located at Rancho California Road and Jefferson Avenue-Old Town Front Street. The MC/communication hub is an above ground Type 334 cabinet with two fiber distribution units (FDU) and two fiber ethernet switches. One FDU distributes fiber optic cabling routed to City Hall and the other distributes incoming fiber from the field/rest of the network.
- From the MC/communication hub at Rancho California Road and Jefferson Avenue-Old Town Front Street, a 24-strand SMFOC trunk cable routes north along Jefferson Avenue and another 24-strand SMFOC routes east along Rancho California Road. Additionally, another 24-strand SMFOC routes west along Rancho California Road and then north along Diaz Road to Rancho Way.
- The northbound Jefferson Avenue trunk cable extends to an intermediate cross-connect (IC) communication hub at Jefferson Avenue and Winchester Road. A 24-strand SMFOC routes along Winchester Road from Diaz Road to Nicolas Road with IC communication hubs located at Winchester Road/Ynez Road and Winchester Road/Margarita Road
- The northbound Jefferson Avenue trunk cable provides communications to CCTV cameras along the following corridor limits:
    - Jefferson Avenue between Rancho California Road to Sanborn Avenue
    - Winchester Road between Diaz Road and Nicolas Road
    - Margarita Road between N. General Kearny Road and Winchester Road
    - Ring Road between Promenade Mall North and Promenade Mall West

- The eastbound Rancho California Road 24-strand trunk cable backhauls communications for the following fiber segments:
    - Rancho California Road between Jefferson Avenue/Old Town Front Street and Ynez Road (24-strand SMFOC)
    - Rancho California Road between Ynez Road and Margarita Road (24-strand SMFOC)
    - Rancho California Road between Margarita Road and Butterfield Stage Road (24-strand SMFOC)
    - Butterfield Stage Road between Rancho California Road and Murrieta Hot Springs (combination of 48-strand and 24-strand SMFOC)
    - Margarita Road between Rancho California Road and Temecula Parkway (24-strand SMFOC)
    - Temecula Parkway between Bedford Court and Butterfield Stage Road (24-strand SMFOC)
- The westbound Rancho California Road 24-strand trunk cable backhauls communications for the following fiber segments:
    - Rancho California Road between Jefferson Avenue/Old Town Front Street to Business Park Drive/Ridge Park Dr.
    - Diaz Road between Rancho California Road to Rancho Way.

Figure 2-1: Existing Communication System Topology Map



2.7 System Architecture Schematic

The fiber system architecture is comprised of a combination of "bus" and "collapsed ring" network topology. The bus network topology is linear, and two fiber strands are used to connect every node or network switch/routing device in series with an end point. The bus line is not fault tolerant and a single break will cause downstream communication failure. The collapsed ring topology eliminates a single point of failure by using four fibers rather than two. Each network device is connected to two fibers and a device on each side, and a second pair of fibers connects at the end. In the case of a fiber break, communication will continue to flow. The collapsed ring provides redundancy in the absence of a geographical ring. An overview of the network defined by corridor segments follows:

- **Winchester Road: Diaz Road to Nicolas Road** – Collapsed ring network topology from Diaz Road
- **Jefferson Avenue: Rancho California Road to Sanborn Avenue** – Bus network topology branching out from Rancho California Road and Jefferson Avenue MC. Collapsed ring topology achievable by fiber cabling patching at cross-connect cabinets.
- **Ring Road** – Bus network topology branching from Winchester Road and Ynez Road. Collapsed ring topology achievable by fiber cabling patching at cross-connect cabinets.
- **Rancho California Road** – Multiple collapsed rings linearly down the corridor consisting of two to five signals per ring segment by fiber patching at cross-connect cabinets.
- **Margarita Road** – Bus topology branching out from Rancho California Road and Margarita Road. Geographical or collapsed ring topology achievable by fiber patching at Temecula Parkway and Margarita Road.
- **Temecula Parkway** – Multiple logical rings linearly down the corridor consisting of two to five signals per ring segment. Geographical ring topology achievable (Rancho California Road, Margarita Road, Temecula Parkway, and Ynez Road) by fiber patching at cross-connect cabinets.
- **Pechanga Parkway** – Bus ring topology branching from Temecula Parkway.

The existing system architecture schematic may be found in **Appendix A**.

3 Needs Assessment

This chapter provides a detailed assessment of the City of Temecula's communication system needs. It represents the second step in the master plan process, following the existing conditions assessment report, in the development of the Citywide Communications System Master Plan (CCSMP).

The existing communications network technology was built to legacy standards that do not have the capacity to support the growing data demands of the community and enable the Temecula Public Works and Information Technology and Support Services (ITSS) Departments to effectively support them. Advancements in the digital world have accelerated in recent years, spurred by technology improvements, automation, and the rise in e-commerce, remote work, and online learning. This has put pressure on the City of Temecula to modernize existing assets and utilize technology to streamline government processes and improve City services for residents and businesses. The purpose of this needs assessment report is to synthesize detailed analysis of the City's existing communication network and the systems management and operation relationship between the Temecula Public Works and ITSS Departments into a consolidated report that identifies a framework to address and resolve system needs.

3.1 Stakeholder Outreach

Outreach was conducted to the City Departments that are responsible for planning, building, operating, managing, and maintaining the City's communications system network. These are the Public Works and Information Technology and Support Services (ITSS) Departments. The objective of stakeholder outreach is to engage the PW and ITSS staff to gather input and understand their needs and concerns, determine strengths and vulnerabilities within the existing infrastructure, determine capabilities and resources, what processes work well and what could be improved, identify potential issues and risks, and generate support for the CCSMP within City departments.

Stakeholder input was gathered through in-person meetings, an online questionnaire in early 2023, and documentation review and comment. Discussions included the following topics:

- Goals and priorities.
- Current process and procedures on project delivery, system maintenance, and funding.
- Roles and responsibilities of each department.
- Technical considerations including subsystems, required tools, and future technology implementation.

Information and feedback from the discussions revealed a variety of current and future system needs and opportunities and are summarized in the following subsections.

3.1.1 Information Technology and Support Services Department

The Temecula Information Technology and Support Services Department (ITSS) Department is comprised of six divisions, including four that have responsibilities related to the citywide communications system:

1. **Infrastructure:** Division responsible for citywide surveillance systems, security systems, telecommunications system, and network and system administration.

2. **Tech Support:** Division responsible for Help Desk responses, computer support, inventory management, and technology support for Public Safety and City libraries.
3. **Enterprise Application Services:** Division responsible for creating and maintaining catalog of enterprise systems, report annual updates, application support, report development, and end user training.
4. **Geographic Information Systems:** Division responsible for mapping and database administration for the citywide communications network.

The City's ITSS department is responsible for improvements, maintenance, acceptance and testing, inspection, and purchasing surveillance and network equipment for both inside plant and outside plant. The ITSS department is also responsible for hardware and software system deployment and support for all the City's network infrastructure equipment. The ITSS department uses the communication system to connect to City-owned facilities (City Network), surveillance cameras, and public Wi-Fi throughout Old Town and Temecula's Public Library. There are defined equipment standards (i.e. cameras, cabling, power, etc.) and security standards for network devices in place. Funding for communication improvements is obtained through the City's annual operating budget, Capital Improvement Program (CIP), and by leveraging funds from other departments such as Public Works and the Police Department to deploy equipment. Current department goals related to the City's communication system include:

1. Network Security
2. Citywide connectivity and reach.
3. Owned versus leased infrastructure.
4. Improved network speeds.

3.1.2 Public Works Department

The Temecula Public Works Department is comprised of four divisions, including three which have responsibility for the citywide communications system:

1. **Capital Improvement Program:** Division responsible for administration of the City's 5-year Capital Improvement Program (CIP), which includes communications infrastructure improvements on CIP Circulation and Infrastructure projects.
2. **Traffic Engineering:** Division responsible for day-to-day operation and maintenance of the traffic signal communications network and fiber communication infrastructure along City roadways.
3. **Public Works Maintenance:** Division responsible for communications system maintenance.

The traffic engineering division is responsible for improvements, maintenance, acceptance and testing, inspection, and purchasing communications equipment for field elements (outside plant). They are also responsible for maintaining the central systems at the Traffic Operations Center (TOC). The communication system is utilized for traffic signal management and operations, data collection from connected devices, monitoring traffic conditions from the TOC through closed circuit television (CCTV) camera feeds, and monitoring system performance and health. Funding for communication improvements is through the City's annual operating budget, CIP, and Federal, State, and Regional grant programs. Current department goals for the City's communications system include:

1. Connectivity to traffic signal infrastructure

2. Smart management of the traffic system
3. Response times
4. System health
5. Data analysis and performance

3.1.3 ITSS and Public Works Communication System Needs

Communication system needs for both the City's ITSS and Public Work departments were identified based on input provided during meetings and on questionnaires. Summaries are provided on **Figure 3-1** which illustrates the issues associated with the current communication system and **Figure 3-2** which illustrates resolutions desired to address the communications system issues.

Figure 3-1: Current Communication System Issues

1. Limitations (Reach or Capacity)
2. Downtime or Reliability
3. Upkeep (Operations & Maintenance)
4. Funding
5. Age of Assets
6. Lack of Strategic Plan
7. Security
8. Human Resources (Qualified Staff)
9. Records

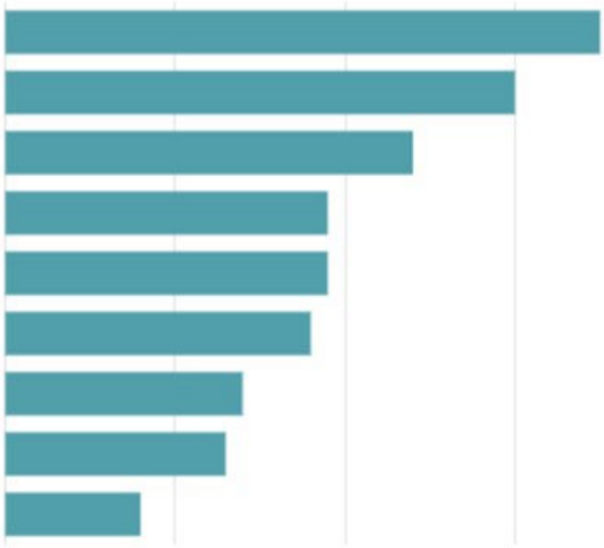
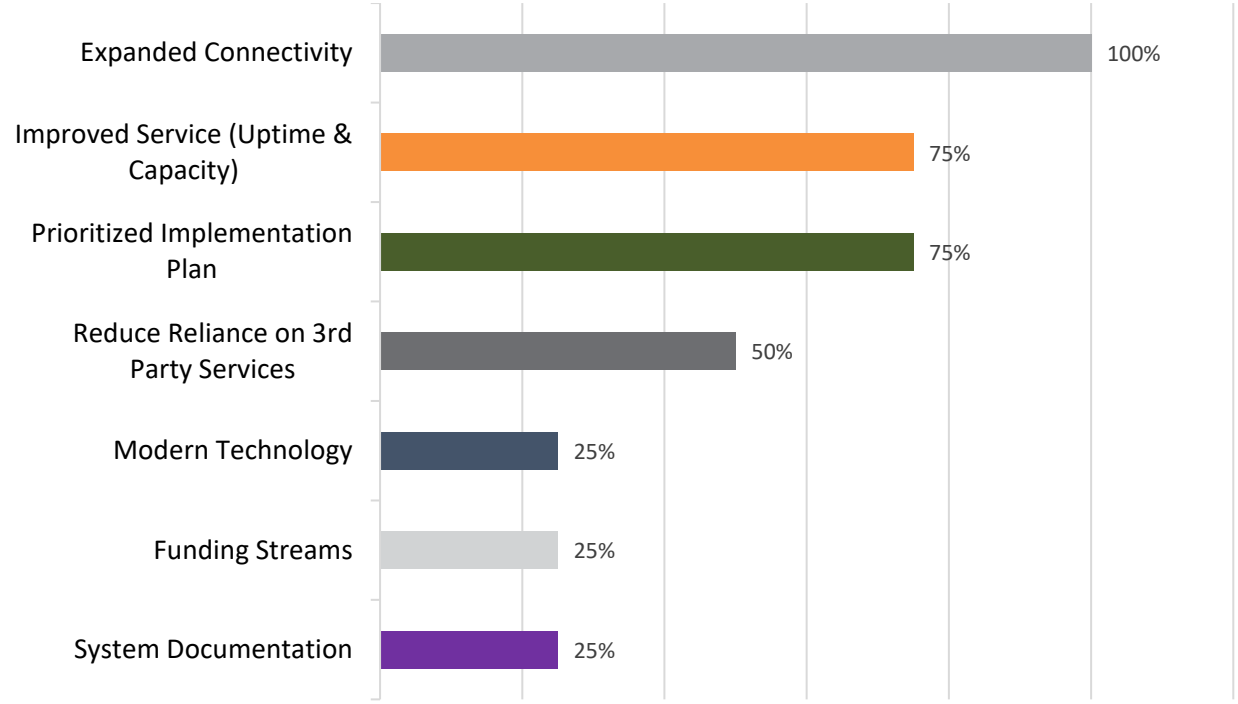


Figure 3-2: Communication System Resolutions

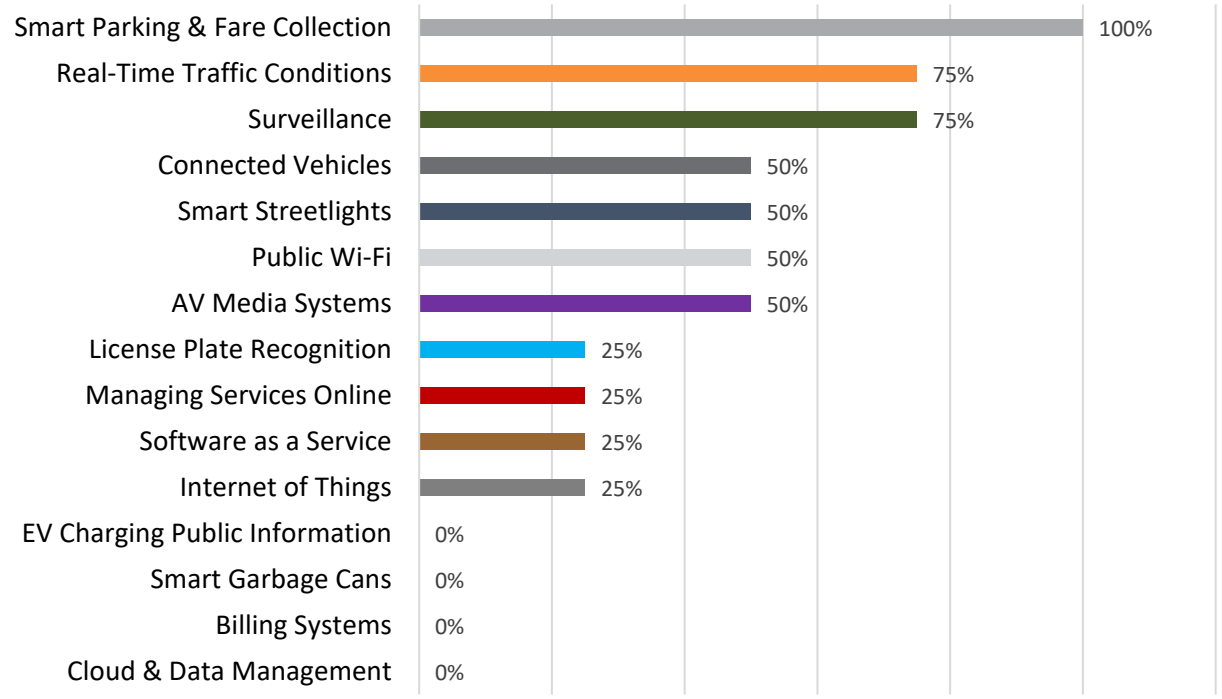


Needs identified by both ITSS and Public Works departments are summarized below:

- Expansion of the communication system throughout the City.
- Pursue available funding opportunities to expand the City's communication system.
- Prioritize implementation of fiber infrastructure at City facilities to replace third-party leased network lines within the next three to five years.
- Develop a formal planning framework to identify and implement communication projects strategically and leverage projects between both departments.
- Develop standard operating procedures (SOPs) for maintaining the communication system, implementing new communication projects, documenting completed projects, communication security protocols, and standard specifications.
- Develop a centralized location for communication related documents between ITSS and Public Works departments.
- Interactive live citywide map showing existing and planned communication infrastructure readily available to both departments.
- Separate communication system networks and equipment between ITSS and Public Works.

Input was solicited from both departments for desired Intelligent Transportation Systems (ITS) and Smart City applications. **Figure 3-3** illustrates the needs identified.

Figure 3-3: ITS and Smart City Applications



3.2 Communication System Deficiency Identification

Deficiency identification is a critical step in the master planning process to prioritize immediate, near-term, and future communication system needs. Communication system deficiencies have been identified for communication gaps, obsolete and malfunctioning equipment, dated standards, central systems, field elements, and leased facilities.

3.2.1 Gaps

Communication system gap deficiencies were identified through analysis of the Existing Communication System Topology GIS Map. Although the City has made a great effort to install communications to 88% of the 132 existing traffic signals over the last 20 years, only 35% are communicating back to the TOC through fiber infrastructure. There are 10 traffic signals identified that are located in more remote areas of the City that lack communication infrastructure and are listed in **Table 3-1** below.

Table 3-1: Communication System Gaps Locations

ID	Intersection
46	Meadows Pkwy & La Serena Way
47	Meadows Pkwy & Rancho Vista Rd
56	North General Kearny Rd & Camino Campos Verdes
61	Pauba Rd & Via Rami/Linfield Way
87	Rancho Vista Rd & Mira Loma Dr
91	Redhawk Pkwy & Wolf Valley Rd
92	Redhawk Pkwy & Peppercorn Dr

ID	Intersection
93	Redhawk Pkwy & El Chimisal Rd-Tehachapi Pass
96	Ring Rd & Promenade Mall S
120	Ynez Rd & County Center Dr

Three traffic signals with fiber infrastructure on Ynez Road are not communicating back to the TOC due to a gap on Ynez Road between Equity Drive and Winchester Road. The following three signals on Ynez Road contain 24-strand SMFOC with 12-strand SMFO break out cables.

- Ynez Rd and Waverly Ln/Temecula Center Dr
- Ynez Rd and Date St
- Ynez Rd and Equity Dr

There are 18 traffic signals with communication gaps due to missing fiber break out cables and equipment. These are locations where fiber was installed along the corridor for CCTV cameras, but fiber break-out cables were not installed to nearby traffic signal cabinets. There is existing twisted copper cable at 14 out of the 18 traffic signals with missing fiber break out cables. Copper communication infrastructure is obsolete and can no longer provide reliable communications back to the TOC. Signals with missing communication links are summarized in **Table 3-2**.

Table 3-2: Missing Fiber Communication Breakout Locations

ID	Intersection
21	Diaz Rd & Rancho Way
22	Jefferson Ave & Sanborn Ave
23	Jefferson Ave & Overland Dr
24	Jefferson Ave & Via Montezuma
25	Jefferson Ave & Del Rio Rd
30	Margarita Rd & Verdes Ln
31	Margarita Rd & North General Kearny Rd
41	Margarita Rd & Pauba Rd
42	Margarita Rd & Santiago Rd
43	Margarita Rd & Pio Pico Rd
60	Pauba Rd & Calle Ventura/Fire Station 84
63	Pechanga Pkwy & Rainbow Canyon Rd
64	Pechanga Pkwy & Muirfield Dr
70	Pechanga Pkwy & Pechanga Resort Dr-Minimart
71	Pechanga Pkwy & Wolf Creek Dr South
72	Pechanga Pkwy & Deer Hollow Way
94	Ring Rd & Promande Mall W
95	Ring Rd & Promenade Mall N

Additionally, there are five traffic signals on Pechanga Parkway with 12-strand SMFO breakout cables pulled and coiled in the controller cabinet but lack communication equipment and fiber termination. **Table 3-3** lists locations with missing communication equipment.

Table 3-3: Missing Communication Equipment Locations

ID	Intersection
65	Pechanga Pkwy & Loma Linda Rd
66	Pechanga Pkwy & Wolf Creek Dr North
67	Pechanga Pkwy & Wolf Valley Rd-Via Eduardo
68	Pechanga Pkwy & Pechanga Casino Dr North
69	Pechanga Pkwy & Pechanga Casino Dr South

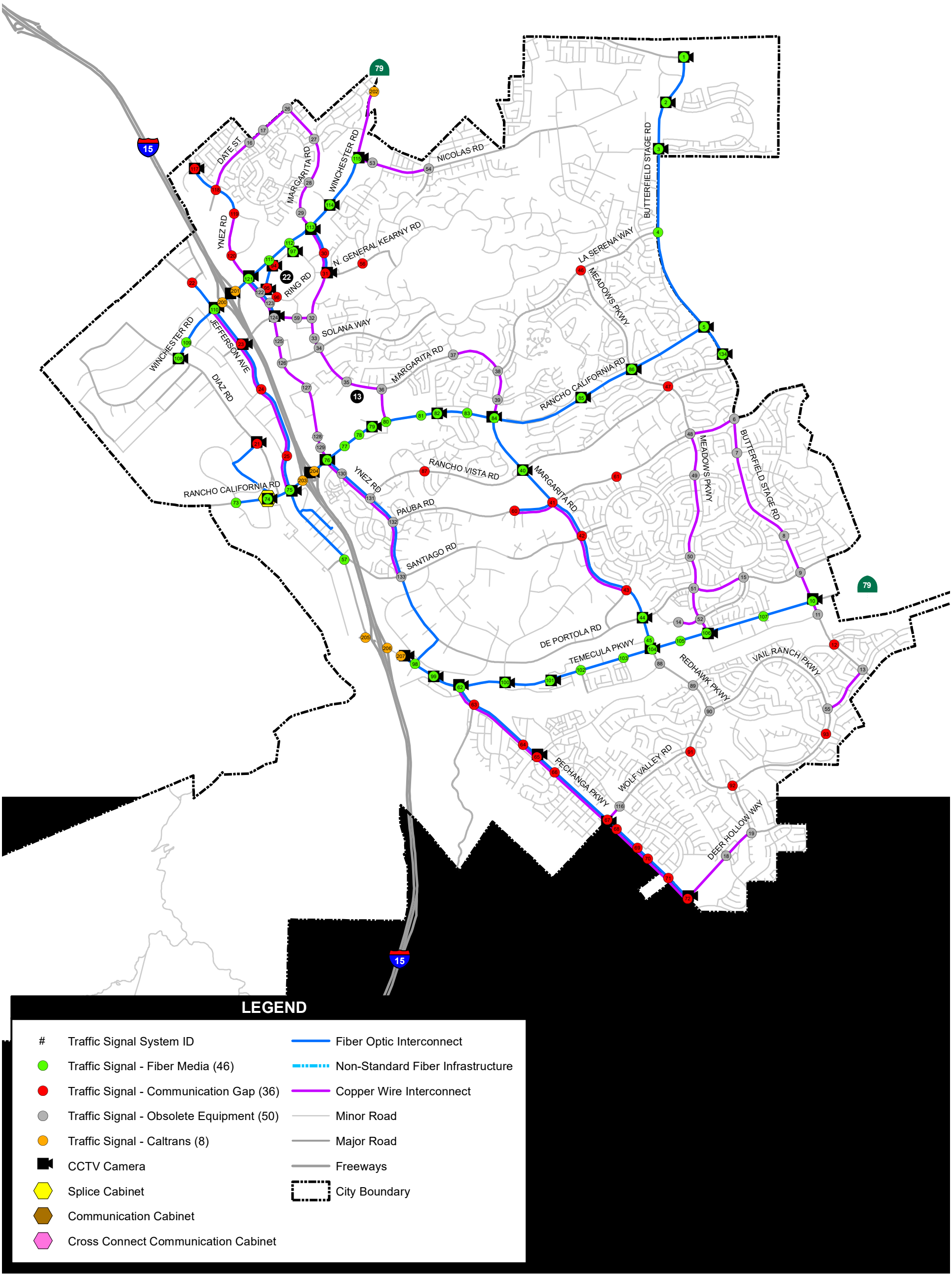
3.2.2 Obsolete Equipment

Obsolete equipment are unable to support modern device communication protocols and high bandwidth needs of current ITS applications. Traffic signals with existing copper wire and serial wireless radio infrastructure systems can no longer be accessed remotely from the TOC. At the time the systems were installed, they were considered state-of-the-art and performed reliably. However, by today's standards, the system technology is outdated, difficult to maintain, and can no longer service the current traffic management system information demands such as real-time video monitoring devices and data gathering applications. The City's copper wire and wireless radio networks are serial and have low bandwidth capability. There are currently 50 traffic signals with obsolete communication network equipment.

There are 36 traffic signals with communication gaps and 50 traffic signals with obsolete equipment accounting for a total of 86 traffic signals with no communications back to the TOC. Offline traffic signals cannot be monitored remotely from the TOC and City staff must be dispatched to verify operations and timing in the field. This is an inefficient use of City time and resources.

Locations with communication system gaps and obsolete equipment are illustrated in **Figure 3-4** on the following page.

Figure 3-4: Communication System Gaps & Obsolete Equipment



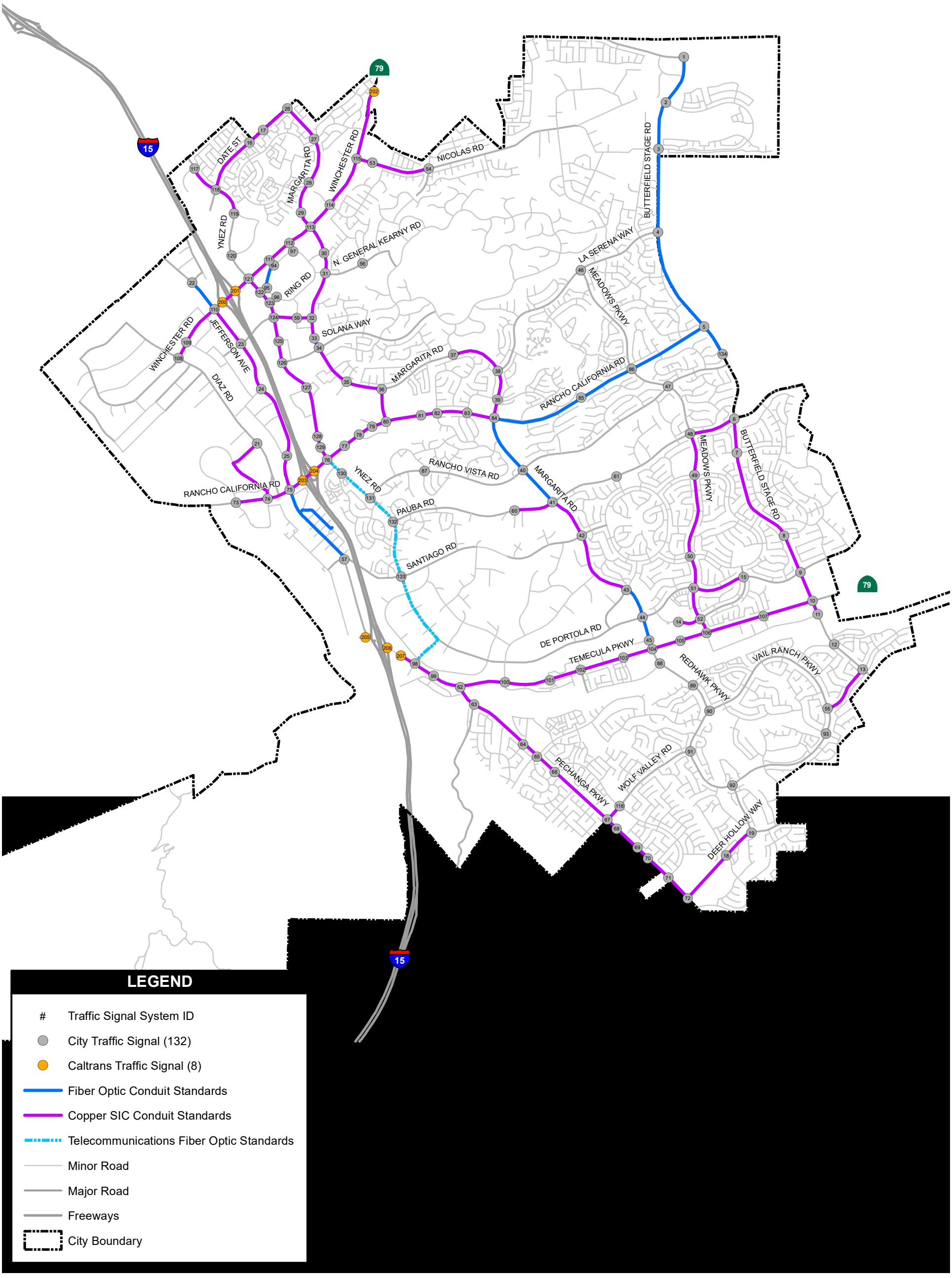
3.2.3 Dated Standards

The City's communications conduit system was built over several decades and most of it was built to historical copper wire signal interconnect cable (SIC) standards. These standards include shorter pull box spacing at intervals (approximately 200 feet), Caltrans standard number 3 and number 5 pull box sizes, 90-degree conduit sweeps at communication pull boxes, and segments with rigid metal conduit (RMC). Copper cable can be bent in tighter angles and coiled very tightly inside smaller pull boxes. Fiber optic cable is capable of transmitting data over much longer distances. Communication pull boxes may be spaced out at longer intervals (approximately 1,000 feet). Existing number 3 and number 5 pull boxes provide insufficient room for fiber slack and conduit sweeps need to be upgraded to 45-degrees to accommodate the wider bend radius of fiber optic cable.

The City's current primary fiber ring is comprised of 24-strand and 48-strand SMFOC which limits future expansion and communication system reliability between traffic signals and City facilities. Additionally, there are currently no standards in place for fiber segregation and allocation.

Figure 3-5 on the following page depicts the City's communications conduit systems built to either copper SIC standards or fiber standards.

Figure 3-5: Citywide Communications Conduit Standards



3.2.4 Central Systems

Central system communication deficiencies at the City's TOC were identified and are listed below.

- Public Works and IT's fiber network are not currently separated.
- Low quality CCTV camera video feeds are experienced at the TOC, which may be a result obsolete computer equipment with insufficient data processing.

3.2.5 Field Elements

The City uses multiple ITS systems and Smart City applications to manage traffic operations, real-time monitoring, surveillance, and data collection throughout Temecula. Systems include connected devices at traffic signal cabinets, CCTV and surveillance cameras, streetlight monitoring systems, school zone flashers, radar speed feedback signs, data collection software, and smart parking applications. Each system has been reviewed and deficiencies identified and listed below.

- The existing legacy 332 traffic signal cabinets and equipment are aging. The City is installing Advanced Traffic Control (352i ATC) technology cabinets at new traffic signals and at locations in need of replacement. 352i ATC cabinets support modern ITS applications including adaptive operations and performance measures. New 352i ATC cabinets may be installed on existing 332 cabinet foundations.
- There are 54 type 170 controllers throughout the City, which are outdated, no longer supported by the manufacturer, and do not provide modern communication protocols or functionality required to perform advanced traffic operations. The City is anticipating replacing the remaining type 170 controllers with ATC FLeX controllers by the end of 2025.
- 68% of conflict monitor units (CMUs) throughout the City are a combination of type 210 and 2010 ECL, which are not capable of providing intersection status and logs back to the TOC. Locations that are upgraded to new 352i ATC cabinets include integrated CMUs with auxiliary display units.
- Tomar Electronics emergency vehicle preemption (EVPE) equipment is infrared-based, relies on line-of-sight, and is susceptible to illegal emitters. EVPE equipment models include 2000, 3000, and 4000 series. The 2000 and 3000 model series are only capable of serial communications.
- 89% of the City's traffic signals have battery back-up (BBS) systems which include Alpha, Dimensions, and Marathon model brands. 50% of BBS systems are Dimensions and are outdated. They are typically installed within the traffic signal cabinet and do not provide communication protocols.
- Cleanliness of CCTV cameras can create low quality video feeds back at the TOC.
- There are traffic signals throughout the City that have existing CCTV cameras and four fixed cameras for police department surveillance. Multiple video feeds can place a large load on the existing communication system and affect overall bandwidth capacity.
- Older school zone flashers do not have communications back to the TOC. Schedules for each school zone flashers must be physically uploaded and downloaded by City staff in the field.
- Older radar speed feedback signs do not have communications back to the TOC. Data for each speed feedback sign must be physically uploaded and downloaded in the field.

- Smart parking applications currently communicate through a third-party owned cellular network.

3.2.6 Leased Facilities

There are currently seven City facilities and two police department facilities on third-party leased network lines. Existing network data rates for leased lines range between 100 MB to 1 GB. Third-party leased network lines were a feasible and fast solution to establish communications to City facilities at the time they were installed. The leased network communication lines are costly, reliant on the third-party owner for communication repairs, and have limited communications capabilities. This creates an unsustainable model for future expansion and data demands. **Table 3-4** below summarizes the existing facilities on leased lines, network, and connection data rates.

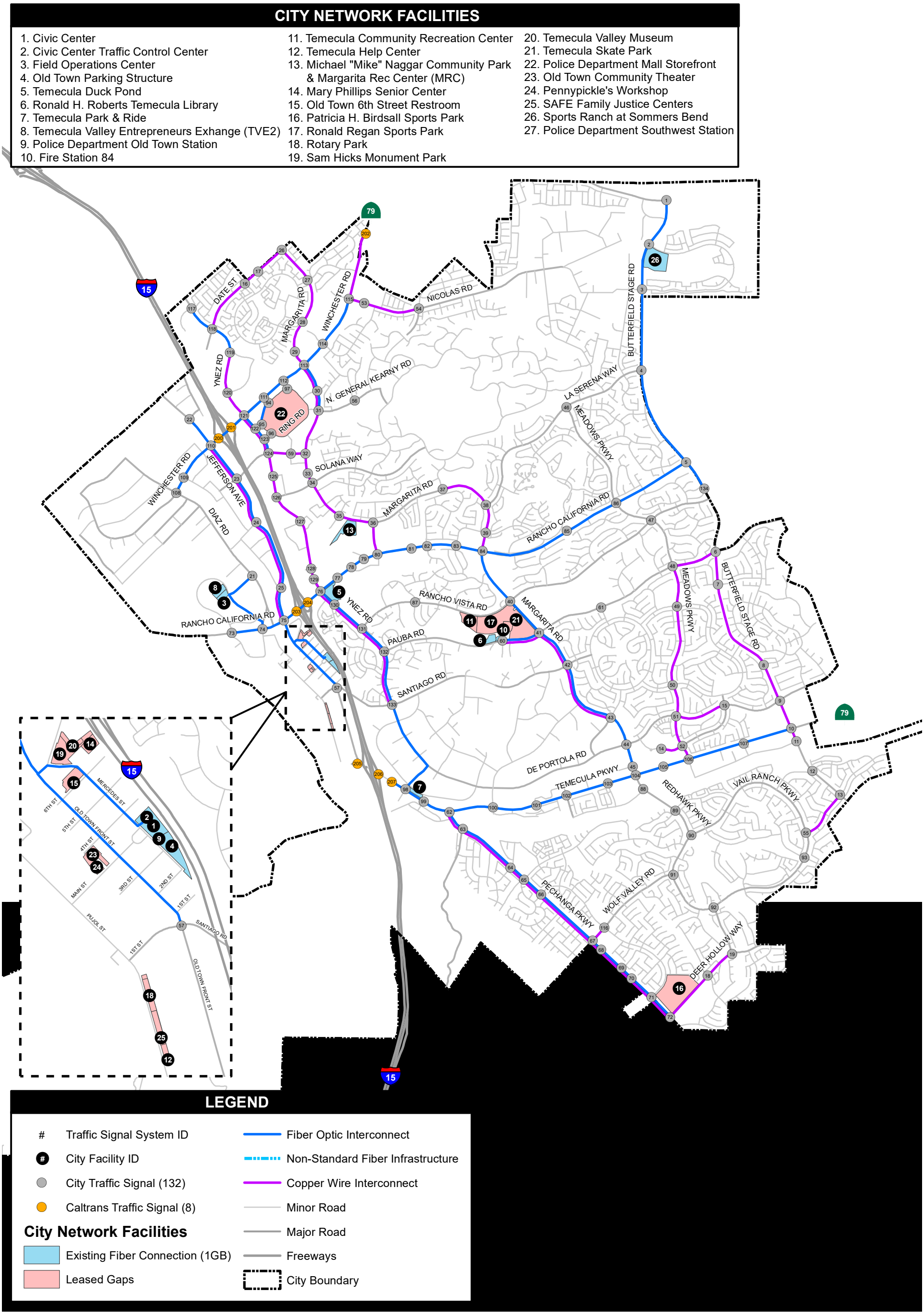
Table 3-4: Existing Facilities on Leased Network Lines

ID	Name	Type	Existing Network	Connection Rate
11	Temecula Community Recreation Center	City Facility	E-Lines	500MB EPLAN
12	Temecula Help Center	City Facility	E-Lines	100MB EPLAN
16	Patricia H. Birdsall Sports Park	City Facility	E-Lines	500MB EPLAN
17	Ronald Reagan Sports Park	City Facility	E-Lines	500MB EPLAN
18	Rotary Park	City Facility	E-Lines	100MB EPLAN
21	Temecula Skate Park	City Facility	E-Lines	500MB EPLAN
22	Police Department Mall Storefront	Police Department	E-Lines	100MB EPLAN
24	Pennypickle's Workshop	City Facility	VPN Sec – FiOs	1GB
27	Police Department Southwest Station	Police Department	E-Lines	100MB EPLAN

The City's ITSS department plans to install fiber infrastructure and equipment at all City facilities, including the Mall Storefront Police Department substation which is currently on a leased network line. The City contracts with the Riverside County Sheriff's Office for police services. The Southwest Station is in Murrieta and serves as Temecula's main police department station. The leased network line at the Southwest Station is expected to remain.

Figure 3-6 presents City facilities with current 1 GB fiber connections and third-party leased network lines.

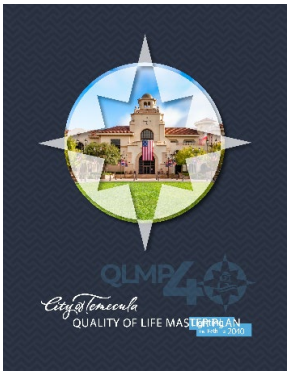
Figure 3-6: City Facilities Communications Topology



3.3 City Initiatives

This section summarizes City plans, programs, and initiatives that were evaluated to identify strategic objectives, goals, and needs relative to the transportation and communication systems. The needs established within City initiative documents will inform development of communication system improvements and recommendations identified in the master plan.

3.3.1 Quality of Life Master Plan



Temecula's Quality of Life Master Plan (QLMP) 2040 was adopted by City Council in November 2015 and serves as a living document that reflects the vision and long-term goals of the City. The QLMP provides a proactive approach to identify specific community needs, goals, and improvements. Seven core values are identified in the QLMP that contribute to the City's overall quality of life:

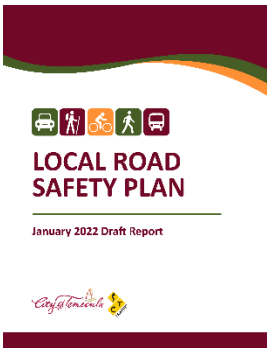
1. Healthy and Livable City
2. Economic Prosperity
3. A Safe and Prepared City
4. A Sustainable City
5. Transportation, Mobility, and Connectivity
6. Accountable and Responsible Government
7. Equity

Table 3-5 below summarizes goals and objectives identified in the QLMP that are connected to the communication system, the responsible department, and the system/subsystems that will help attain the goals and objectives.

Table 3-5: QLMP Goals and Objectives

Goals/Objectives	Department	System/Subsystem
Evolving technology and increased internet access changing transportation systems and service delivery	ITSS/ PW-Traffic	Communication System
Maintain a five minute or less response time for fire protection	PW-Traffic	Emergency Vehicle Preemption Systems
Maintain and improve roadway network so that flow of traffic is efficient	PW-Traffic	Traffic Signal and Communication System
Maintain the City's high level of air quality possible in Temecula	PW-Traffic	Traffic Signal and Communication System
Build out the City's fiber optic network to provide public broadband access and manage City facilities and equipment	ITSS	Communication System
Install Smart City technology to increase efficiency of service deliver	ITSS/ PW-Traffic	Communication System

3.3.2 Local Roadway Safety Plan



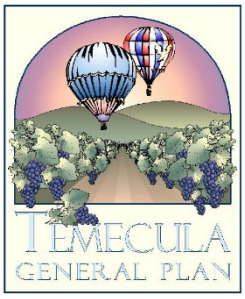
The Temecula Local Roadway Safety Plan (LRSP) was adopted by City Council on April 2022. The LRSP provides a framework to systematically identify and analyze roadway safety problems and recommend prioritized safety improvements through collisions analysis and collaborative stakeholder input. The document includes a prioritized list of issues, risk, actions, and improvements that can be used to reduce fatalities and serious injuries on Temecula roadways. Four priority projects were identified through evaluation of Temecula's roadway needs, crash data analysis, and roadway network screening.

1. **Citywide Pedestrian Countdown Signal Heads Upgrades** – Upgrade 54 signalized intersections with pedestrian countdown heads, APS push buttons, and new controllers.
2. **Citywide Traffic Signal Hardware Upgrades** – Upgrade 127 signalized intersections with new LED safety lighting and LED internally illuminated signs.
3. **Citywide Dynamic Variable Speed Warning Systems** – Install dynamic speed warning signs at 8 roadway segments throughout the City with relatively sharp curves.
4. **Citywide Signal Timing and Communication Upgrades** – Traffic operation and communication upgrades at 89 signalized intersections. Upgrades include, installation of network switches, fiber optic cable, and Ethernet wireless radio communications.

The citywide pedestrian countdown signal heads upgrades project and a combination of the citywide traffic signal hardware and signal timing and communication system upgrades projects mentioned above were selected for award through the HSIP Cycle 11 grant program in 2023.

3.3.3 General Plan

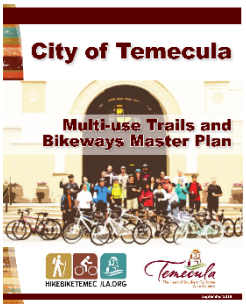
The City's General Plan is a blueprint providing long-term policy guidance for the community's physical, economic, social, and environmental changes. The General Plan was first created in 1993, updated in 2005, and is expected to be updated within the next two years. In the upcoming update, the City plans to adopt a new Circulation Element which will provide an opportunity to identify ways to better manage traffic through the City. General Plan goals and policies relative to the Circulation Element are summarized below.



- **Policy 1.2 –** Pursue trip reduction and transportation systems management measures to reduce and limit congestion at intersections and along streets within the City.
- **Policy 1.3 –** Actively monitor the capacity of principal intersections throughout the City.
- **Policy 2.1 –** Actively pursue the construction of system improvements outside the City's jurisdiction in cooperation with Caltrans, City of Murrieta, Riverside County, the Pechanga Band, and local developers.
- **Policy 2.3 –** Actively pursue improvements to current freeway interchanges within the City.
- **Policy 3.1 –** Require proper spacing and interconnect traffic signals where feasible to maximize the smooth progression of traffic flow and to minimize delay and stop-and-go conditions.

Additionally, the Growth Management/Public Facilities Element includes **Policy 9.3** to encourage installation of new technological infrastructure throughout the City including broadband, fiber optics, wireless, and other developing technologies.

3.3.4 Multi-use Trails and Bikeway Master Plan



In 2016, the City completed a comprehensive update to the 2002 Multi-use Trails and Bikeways Master Plan (TBMP). The document evaluates previous and new proposed trails and on-street bicycle facilities using conventional field techniques, geographic information systems (GIS) analysis, and public input to guide Temecula's future trail and bicycle facility implementation.

The TBMP identifies a need for continuous multi-modal measurement through technology to measure variables like pedestrian density and sidewalk level-of-service, as well as monitoring roadway usage, vehicle speeds, and bicycle counts. The goal is to support projects and studies through real-time counts on specific streets or urban locations.

4 Capital Improvements

Information for future projects that may be leveraged to improve the communication system throughout Temecula was researched in documentation provided by the City's Public Works Traffic Engineering Division, ITSS Department, and through the Capital Improvement Program (CIP). The Temecula CIP serves as a 5-year planning tool that aligns revenue and funding source projections with capital projects for City departments based on projected development activity, fees, and grant opportunities. The current fiscal years 2023-2027 (FY23-27) CIP includes circulation projects, infrastructure projects, parks, and recreation projects. These improvements provide the opportunity to bridge communication system gaps and enable expansion of City services including public Wi-Fi and other Smart City applications.

4.1 Future Project Improvements Summary

Research of City documentation and CIP provided information on new communication systems, new roadways, planned roadway widenings, new traffic signals, and new City facilities. Future projects provide an opportunity to install communication infrastructure and connect existing traffic signals that are offline or have no communication to them. Related future improvements identified are summarized in the following subsections below and are organized into tables that include project's name, description, City department executing the project, and source from where project information was obtained.

4.1.1 Communications System

The City plans to construct several new communication system paths in the near future. Improvements are summarized in **Table 4-1** below. A few of the future communications system projects identified are strategically paired with new roadway improvements.

Table 4-1: Future Communication Systems

ID	Project Name/Description	Department	Source
1	**Ynez Rd Fiber:** New fiber on Ynez Rd from Equity Dr to Winchester Rd. New fiber breakouts at Ynez Rd/County Center Dr	Public Works-Traffic	City Documentation
2	**Diaz Rd Expansion:** Widen Diaz Rd into 4-lane divided major arterial between Cherry St and Rancho California Rd. New fiber and conduit to be installed on Diaz Rd between Winchester Rd to Rancho California Rd	Public Works-Traffic	City Documentation/ FY23-27 CIP
3	**Murrieta Creek Bridge at Overland Dr/Overland Dr Widening:** New conduit and fiber on Overland Dr from Diaz Rd to Jefferson Ave	Public Works-Traffic	City Documentation
4	**Traffic Signal Enhancement Program:** Upgrade existing traffic signal equipment at various signalized intersections citywide including replacement of traffic signal controllers, battery back-up systems, light emitting diode (LED) traffic signal indications, traffic signal controller cabinets, service cabinets, safety street lighting, signal communication equipment, fiber optic cable, conduit, service conductors, and detector cable	Public Works-Traffic	FY23-27 CIP

ID	Project Name/Description	Department	Source
5	**HSIP Cycle 11 Citywide Pedestrian Countdown Signal Heads:** Install pedestrian countdown signal heads and upgrade traffic signal controllers for operation at 54 intersections throughout the City.	Public Works-Traffic	HSIP Cycle 11 Approved Project List
6	**HSIP Cycle 11 Citywide Traffic Signal Hardware, Signal Timing, and Communications Upgrades:** Upgrade traffic signal hardware including LED safety lighting, vehicle signal heads, retro-reflective backplates, signal wiring, and traffic signal cabinets at 127 intersections throughout the City. Install fiber communications and equipment at five signalized intersections on Butterfield Stage Rd and 15 signalized intersections on Ynez Rd. Install wireless communications and equipment at 11 signalized intersections located remote areas within the City. Update signal timing at intersections with fiber and wireless communication upgrades.	Public Works-Traffic	HSIP Cycle 11 Approved Project List
7	**Citywide Surveillance Cameras:** Install citywide camera surveillance systems to support public safety, traffic management, and asset protection for Sam Hicks Park, History Museum, Senior Center, 6th Street Restroom, Old Town Theatre, Children's Museum	ITSS	FY23-27 CIP/IT Citywide Network Master Plan Map

4.1.2 Roadway Projects

Future roadway projects researched from the City's CIP include roadway widening, construction of medians, curb, gutter, sidewalk, and storm drain improvements. Projects researched are summarized in **Table 4-2** below.

Table 4-2: Future Roadway Projects

ID	Project Name/Description	Department	Source
1	**Nicolas Rd Extension:** Extend Nicolas Rd from the Roripaugh Ranch Phase II westerly boundary to Calle Girasol/Liefer Rd. New communication conduit on Nicolas Rd from Joseph Rd to Butterfield Stage Rd	Public Works-Traffic	City Documentation/ FY23-27 CIP
2	**Ynez Road Improvements - Phase I:** Widen Ynez Rd from Rancho Vista Rd to Tierra Vista Rd to 2-lanes and complete missing segments of curb and gutter, sidewalk, and landscaped medians	Public Works	City Documentation/ FY23-27 CIP
3	**Butterfield Stage Rd Storm Drain Improvements:** Widen east side of Butterfield Stage Road north of Temecula Pkwy; storm drain will be on east side of Butterfield Stage Rd from south of De Portola Rd to south of Wolf Store Rd	Public Works	FY23-27 CIP
4	**Cherry St Extension and Murrieta Creek Low Flow Crossing:** Extend Cherry St from Adams Ave to Diaz Rd	Public Works	FY23-27 CIP
5	**French Valley Interchange Phase II:** Construct 2-lane northbound collector/ distributor road system from north of	Public Works	FY23-27 CIP

ID	Project Name/Description	Department	Source
	the Winchester Road interchange on-ramps to north of the I-15/I-215 junction with connectors to I-15 and I-215		
6	**French Valley Interchange Phase III:** Construct French Valley Pkwy interchange and southbound collector/ distributor road system	Public Works	FY23-27 CIP
7	**I-15 Congestion Relief:** Construct single auxiliary lane on northbound I-15 connecting the Temecula Pkwy on-ramp to the Rancho California Rd on-ramp	Public Works	FY23-27 CIP
8	**Motor Cark Pkwy Improvements:** Improve roadway on Motor Car Pkwy, Ynez Rd, Margarita Rd, and Solana Wy	Public Works	FY23-27 CIP
9	**Rancho California Rd Median:** Construct missing raised medians on Rancho California Rd between Humber Dr and Butterfield Stage Rd; construct missing street improvements such as median curbs, curb and gutter, sidewalks, and landscape and irrigation on the north side of Rancho California Rd between Riesling Ct and Promenade Chardonnay Hills	Public Works	FY23-27 CIP
10	**Ynez Rd Improvements - Phase II:** Widen Ynez Rd from Rancho Vista Rd to La Paz St to 2-lanes in each direction and complete missing segments of curb and gutter, sidewalk, landscaped medians, streetlights; traffic signal modification at Santiago Rd; Phase 2A between Rancho Vista Rd and Santiago Rd; Phase 2B between Santiago Rd and La Paz St	Public Works	FY23-27 CIP
11	**La Paz St Widening:** Ynez Rd to Temecula Pkwy	Public Works	FY23-27 CIP
12	**Pauba Rd Improvements:** East of Margarita Rd to the north side	Public Works	FY23-27 CIP
13	**Rainbow Canyon Rd Widening:** Pechanga Pkwy to City Limit	Public Works	FY23-27 CIP
14	**Rancho Wy Extension:** Diaz Rd to Margarita Rd	Public Works	FY23-27 CIP
15	Pedestrian and Bicycle Bridge Overcrossing into Old Town	Public Works	FY23-27 CIP

4.1.3 Traffic Signals

There are future traffic signals planned throughout the City. The City is currently determining final locations. Traffic signals will need to be connected to the City's future communication system built out. Future traffic signals will be entered into the City's Transparity database and will be assigned a logical system ID following construction. Turn on dates and full traffic signal equipment inventory will be tabulated into the City's existing signal inventory database.

4.1.4 City Facilities

Five new City facilities were identified in the City's CIP and are listed in **Table 4-3**.

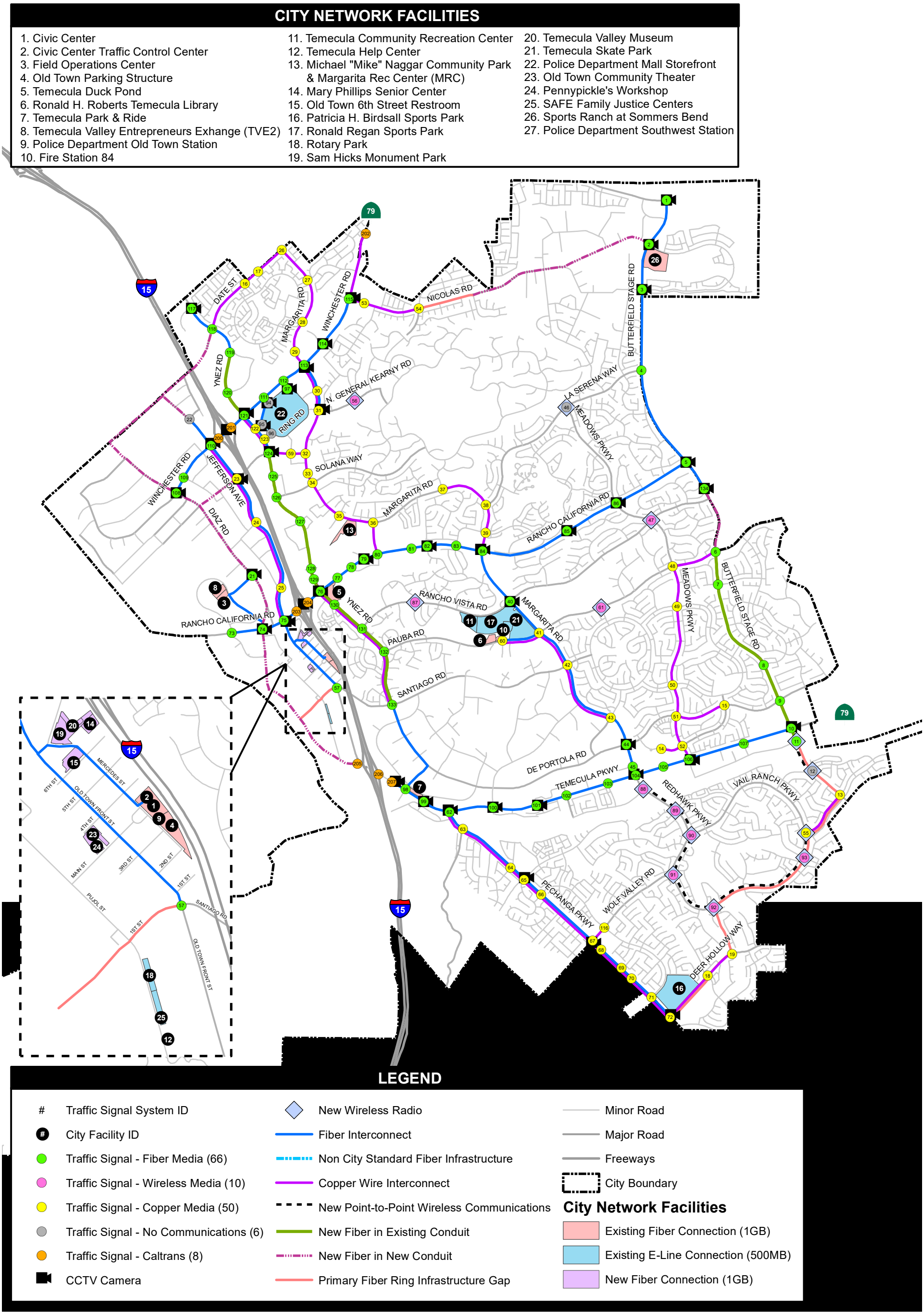
Table 4-3: Future City Facilities

ID	Project Name/Description	Department	Source
1	Old Town Gymnasium	Public Works	FY23-27 CIP
2	Southside Branch Library	Public Works	FY23-27 CIP
3	Southside Recreation Center	Public Works	FY23-27 CIP
4	Ronald Reagan Sports Park	Public Works	FY23-27 CIP
5	Vail Ranch Park Site D	Public Works	FY23-27 CIP

Public Works and IT departments will determine during the design phase whether each new facility will be interconnected to the existing communication system.

Figure 4-1 on the next page illustrates the planned future communication infrastructure that was summarized in this chapter. A dynamic layer was created to highlight missing communication conduit segments required to complete a primary fiber backbone ring within the City. The recommended primary fiber backbone ring is discussed in further detail in the Communication Network Recommendations chapter.

Figure 4-1: Capital Improvements Topology



5 Technology Trends

This chapter discusses current industry technology trends that are transforming cities into interconnected, sustainable, and community-centric environments. As technology continues to advance, Cities will continue to evolve and adapt to meet the needs of their residents while striving for a more sustainable and livable future. The purpose of this report is to identify current off-the-shelf technology trends and related applications to ensure that the City's future communication system can support the various applications. Technology trends are summarized in the following sections.

5.1 Smart Mobility

Smart mobility leverages technology to enable various forms of transportation to function in a more efficient, resilient, and sustainable ways. This includes the use of Intelligent Transportation Systems (ITS) to alleviate congestion, improve public transportation, and enhance mobility. The various applications available merge and interrelate. Smart mobility applications and strategies are summarized in the subsections below.

5.1.1 Advanced Traffic Management Systems

Advanced Traffic Management Systems (ATMS) are central system platforms that integrate connected devices including controllers, detection, and communications into one application. ATMS provides an interface and access for operations and management of the traffic signal system. Standard ATMS applications provide various modes of traffic signal operations and enable collection of high-resolution (Hi-Res) data, which improves roadway safety and increases effective capacity of local roads. Additional ATMS modules may include the following:

1. **Adaptive Signal Timing:** applications that provide traffic operations that dynamically adjust timing to accommodate variable traffic demands. It requires a combination of robust vehicle detection, traffic signal communication systems, and advanced control software. The vehicle detection configuration requirements vary by vendor, but most advanced adaptive systems require a level of detection beyond typical standards for actuated operation.
2. **Signal Performance Measures (SPMs):** applications that automatically convert Hi-Res controller data into actionable performance measures utilizing a collection of data analytics tools. Integration into a ATMS software provides the ability to utilize traffic signal controller logs and real-time traffic data from the vehicle detection system to provide analytical reports including controller events list, phase split monitoring, phase arrivals, phase idle times, Purdue Coordination Diagrams (PCD), preemption logs, turning movement counts, and peak hour logs.
3. **Asset Management Tools:** applications that are specially designed to meet the needs of traffic engineering, operations, and maintenance staff. Applications are capable of consolidating system-

wide information into a central database by tracking various traffic signal infrastructure assets and conditions, inventory, and maintenance records by location.

4. **Platform Integration Modules:** applications that can integrate ITS equipment and applications including detectors, connected equipment at signal controller cabinets, variable message signs, CCTV cameras, counting stations, parking garages, air quality sensors, and connected vehicle technology.

The City of Temecula uses Transparity Intersection Management System (IMS) to manage intersection status and timing data. This is a good start and an ideal companion to a larger traffic management system.

5.1.2 Integrated Corridor Management

Multijurisdictional transportation corridors are often independently operated which can result in underutilized capacity throughout the entire transportation network. According to the USDOT, Integrated Corridor Management (ICM) can efficiently and proactively manage the movement of people and goods in major transportation corridors through collaboration, leveraging ITS technologies, innovative multimodal and multijurisdictional strategies that optimize existing infrastructure to help manage and reduce congestion. ICM strategies can provide travelers with relevant information on transportation alternatives, which encourages redistribution of trips to less congested routes, modes, or times of day. This can be achieved by implementing a smart multijurisdictional transportation system that combines road sensors, transit management strategies, video, and traveler information to reduce congestion. The system can deliver information to commuters through a variety of mediums such as Internet websites, mobile applications, and changeable message signs. This enables traffic management managers to adjust traffic signal and ramp meters to direct travelers to high-occupancy vehicle (HOV) lanes, high-occupancy tolling (HOT) lanes, bus rapid transit systems, and other options.

Temecula is a regional roadway transportation hub at the confluence of I-15, I-215, and SR-79 in southern Riverside County. Traffic congestion during peak hour periods on the state highway system (SHS) greatly impacts Temecula's major east-west arterials. There is a lack of effective traffic management systems between various governing jurisdictions including San Diego County, Riverside County, California Department of Transportation (Caltrans), City of Temecula, and City of Murrieta. This results in reduced system efficiency, limited proactive management and operation, and significant loss of transportation access.

5.1.3 Connected Vehicle Technology

According to the USDOT, connected vehicle (CV) technologies consist of equipment, applications, or systems that use vehicle-to-everything (V2X) communications to address safety, system efficiency, and mobility on roadways. The CV concept uses data from short-range communication broadcasts and peer-to-peer exchanges to sense other travelers including vehicles, bicyclists, pedestrians, wheelchairs, motorcycles, buses, and trucks.

CV strategies include Transit Signal Priority (TSP) and Freight Signal Priority (FSP). Both strategies modify traffic signal timing and/or phasing to provide priority to applicable vehicles at traffic signals along a corridor to improve reliability, travel time, and reduce delay and greenhouse gas emissions (GHG). The

Federal Communications Commission (FCC) has recently introduced a new standard to V2X communications referred as cellular-to-everything (C2X). C2X technology allows vehicles to exchange information with other vehicles, infrastructure components, and other roadway users through cellular vehicle-to-everything (C-V2X) technology. C2X technology can enhance road safety and improve traffic efficiency by exchanging real-time information including traffic conditions, road hazards, or upcoming traffic signals. Vehicles can make informed decisions to optimize their routes and prevent collisions. Standards and regulations governing C2X communication are being established to ensure interoperability and compatibility among different manufacturers and infrastructure providers.

5.1.4 Smart Parking Systems

Smart parking applications utilize sensors, data analytics, mobile applications, and communication system to provide real-time information about parking availability and optimize parking operations. Smart parking solutions can be implemented in various environments including street parking, parking lots, garages, and shopping malls. Key features and benefits of smart parking include:

- Real-time parking availability
- Parking guidance and navigation
- Reservation and pre-booking
- Payment and ticketless systems
- Analytics and data insights
- Enforcement and security

The City has made great progress in implementing smart parking facilities at Old Town Parking Garage, 2nd Street Parking Lot, and 6th Street Parking Lot.

5.2 Smart Infrastructure

Smart infrastructure refers to the integration of advanced technologies, connectivity, and data-driven solutions into various components of urban infrastructure systems. The following subsections discuss a few trends related to smart infrastructure.

5.2.1 Changeable Message Signs

Changeable Message Signs (CMS) are defined by the California Department of Transportation (Caltrans) and the California Manual on Uniform Traffic Control Devices (CA MUTCD) as a traffic control device that can display one or more alternative messages. CMS systems provide real-time traffic information to motorists including expected delays, travel time estimates, diversion routes, and lane closures during incidents, special events, and work zone traffic control. CMS systems may be integrated with the communication system to provide real-time information.

5.2.2 Automatic License Plate Recognition

Automatic License Plate Recognition (ALPR) systems that utilize optical character recognition (OCR) and image processing techniques to automatically read and recognize license plate numbers on vehicles, compare the plate number acquired to one more database of vehicles of interest to law enforcement

known as “hot lists”, and alert law enforcement officers when a vehicle of interest has been observed. ALPR systems typically consist of cameras, software algorithms, and databases to capture, analyze, and store license plate data.

5.2.3 Smart Street Lights

Street lighting contributes to the safety and security of road traffic by providing an enhanced visual environment allowing accurate and comfortable visibility during hours of darkness. Intelligent lighting controls and energy management systems can enable light fixtures to operate autonomously using various prediction algorithms based on astrological calendar, photocontrols or motion detectors. Implementing intelligent street lighting with a central management system via wireless and wired networks rounds out a portfolio of capabilities that save energy and improve quality of lighting. Smart street light poles include various sensors and devices including:

- Wi-Fi access points
- Video and AV media systems
- Smart grid lighting
- Dynamic banner signs
- Environmental sensors
- Emergency call stations
- Charging pile for electric vehicles

The City currently has a GE LightGrid central management system that provides communication access to most street lights throughout the City.

5.3 Community Engagement

Community engagement plays a vital role in the development and success of a Smart City. City officials can better understand the needs, challenges of residents, businesses, and other stakeholders. Community engagement may be established by (1) establishing proper communication and information sharing and (2) providing digital platforms and applications.

It is important to establish open and transparent channels of communication to inform the community about Smart City projects, initiatives, and their potential benefits. This may be achieved through various communication channels including websites, social media platforms, newsletters, and community meetings to share updates, seek feedback, and address concerns. Digital platforms and mobile applications can enable residents to access information, services, and participate in Smart City initiatives. These platforms can facilitate two-way communication, reporting issues, accessing public services, and engaging in civic activities.

The City’s QLMP lists a strategic objective to develop a web-based dashboard to help communicate with Temecula residents and track progress over time. The active involvement of residents and stakeholders can lead to a more sustainable and citizen-centric Smart City development.

5.4 Cybersecurity

As digital infrastructure and interconnected systems become more prevalent, it's essential to implement robust cybersecurity measures to protect against potential threats and vulnerabilities. The US Cybersecurity and Infrastructure Security Agency (CISA) outlines best practices and recommendations that Smart Cities may take to prevent any potential threats. Best practices and recommendations include secure planning and design, proactive supply chain risk management, and operational resilience. Relevant recommendations are summarized below:

- **Enforce Multifactor Authentication:** Secure remote access applications and enforce multifactor authentication (MFA) on local and remote accounts and devices where possible to harden the infrastructure that enables access to networks and systems.
- **Implement Zero Trust Architecture:** Creates a more secure network environment that requires authentication and authorization for each new connection with a layered, defense-in-depth approach to security.
- **Securely Manage Smart City Assets:** Secure Smart City assets against theft and unauthorized physical changes. Consider implementing physical and logical security controls to protect sensors and monitors against manipulation, theft, vandalism, and environmental threats.
- **Managed Service Providers and Cloud Service Providers:** Consider setting clear security requirements for managed service providers and other vendors supporting Smart City technology implementation and operations. Ensure organization security standards are included in contractual agreements.
- **Backup Systems and Data:** Consider creating, maintaining, and testing backups for IT system records and for manual operational capabilities for the physical systems integrated in a Smart City network.

The Temecula ITSS department is responsible for researching, developing, implementing, and supporting effective and innovative uses of cybersecurity technologies. Cybersecurity is an ongoing process that requires continuous evaluation, improvement, and collaboration to address emerging threats and maintain a secure Smart City environment. Prioritizing cybersecurity can protect critical infrastructure, sensitive data, and privacy of residents while enabling the benefits of digital transformation.

6 Recommendations

This chapter of the Citywide Communications System Master Plan (CCSMP) presents key recommendations for establishing and maintaining an efficient communications network capable of servicing the City's current and future needs.

The City's communication system network connects various facilities, buildings, and network devices including traffic signal equipment and surveillance cameras. Its primary purpose is to facilitate real-time data exchange between network devices and the City's central hub (City Hall). The following key qualities were considered for the development of recommendations outlined in this chapter:

- **Security:** The communication system network shall be built with security as the essential component.
- **Reliability:** The communication system network shall ensure continuous communications to City's network devices.
- **Scalability:** The communication system network shall accommodate future growth and technological advancements.
- **Redundancy:** The communication system network shall be built in to ensure system resilience in case of failures.
- **Compatibility:** The communication system network shall support various communication protocols and be compatible with existing and future equipment.

The recommendations outlined in this chapter provide a framework for designing and implementing a communications network that provides these qualities and meets the needs identified in the previous Needs Assessment chapter.

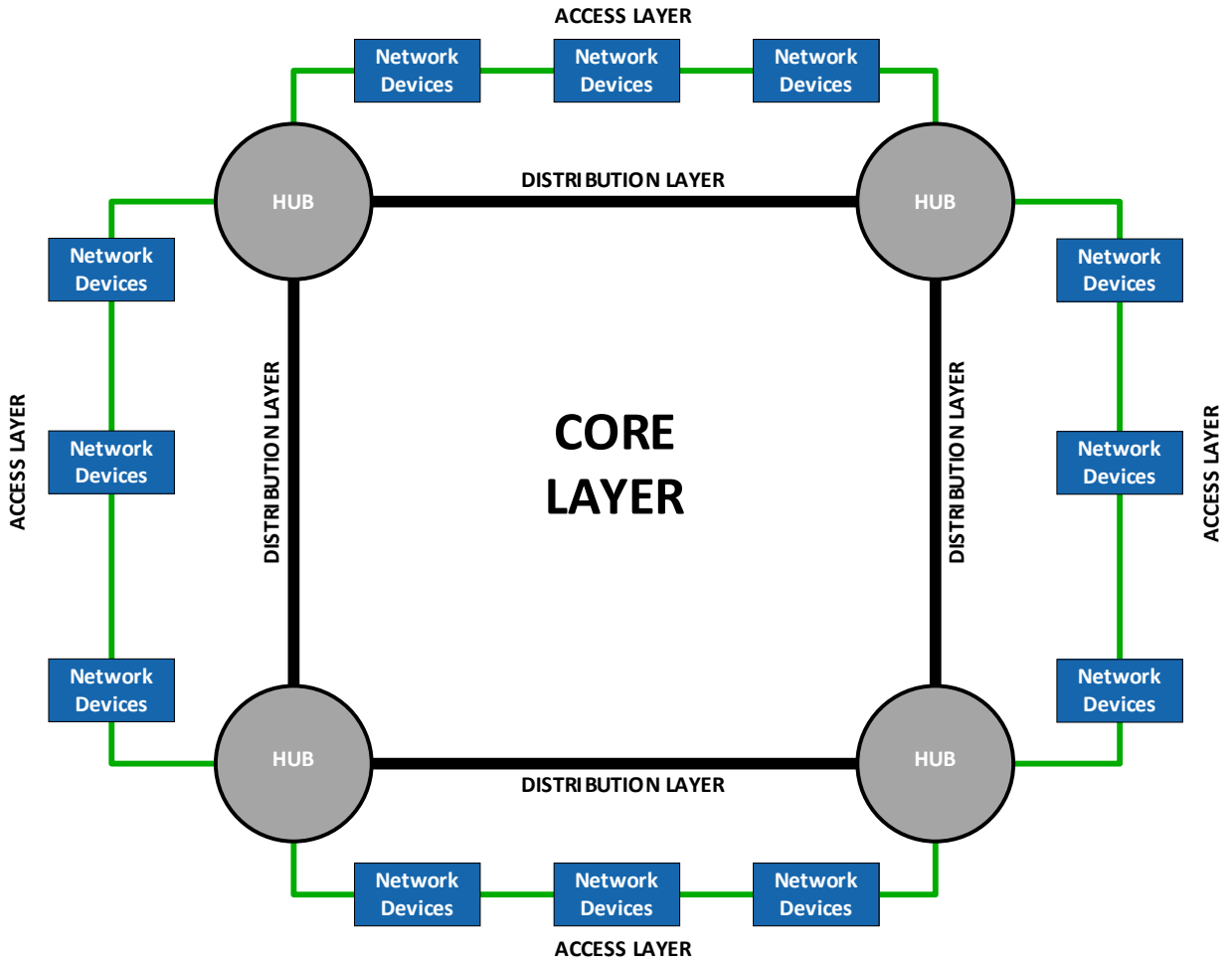
6.1 Communication System Topology

Temecula's future citywide communication system will link all system elements creating one ubiquitous network on which all devices will communicate. The Public Works Traffic Engineering and ITSS Departments are responsible for the City's communication system and have identified the need to expand the existing system to connect to all City owned facilities. The citywide communication system will be composed of the following network layers:

- **Core –** Central layer that provides high-speed connection between various distribution layer devices and serves at the backbone of the network.
- **Distribution –** Layer that connects the access layer to the core layer.
- **Access –** Layer that provides connection to network devices. The access layer acts as a subring of network devices.

Figure 6-1 provides a high-level schematic illustration of a communication network system composed of a core, distribution, and access layer.

Figure 6-1: Communication System Network Architecture Example



This section identifies the topology that will provide a reliable, redundant, and future-proof communication network that meets the City's Transportation and IT System needs. The following subsections discuss recommendations related to the City's backbone fiber ring, communication hubs, and system network groups.

6.1.1 Core Layer

The City's core network layer will consist of a backbone fiber ring made up of primary and secondary rings located on major roadways. A fiber optic ring design increases flexibility and resilience by minimizing risks from an equipment failure or fiber cut. The City's major roadway network includes principal, major, and secondary arterials:

- **Principal** arterials act as the main thoroughfares by providing access to major activity centers and to the regional freeway system. These include Rancho California Road, Temecula Parkway, Winchester Road, and Pechanga Parkway.
- **Major** arterials complement the principal system by providing a medium capacity backbone system. These include Butterfield Stage Rd, Jefferson Ave, Margarita Rd, Nicolas Rd, and Ynez Rd.

- **Secondary** arterials carry traffic between local streets and principal or major arterials. These include Date Street, Deer Hollow Way, Meadows Pkwy, Redhawk Pkwy, and Vail Ranch Pkwy.

The primary fiber optic ring routes along the City's outermost perimeter and principal/major arterials. This provides the City with the widest reach possible which maximizes service area with connections to most of the City's traffic signals, facilities, and key areas. The existing communication system was built ad-hoc without a specific topology approach. There are planned capital improvement projects that will install fiber optic communication infrastructure along Butterfield Stage Road, Diaz Road, and Nicolas Road. These improvements will bridge gaps and make progress toward the primary fiber optic ring. It is recommended to install new fiber optic interconnect and conduit at the remaining gaps to establish a ring at the outermost perimeter of the City. **Table 6-1** lists the remaining roadway gaps.

Table 6-1: Primary Rings Gaps

Roadway	Start	End
Old Town Front St	Santiago Rd/First St	Temecula Parkway
Temecula Pkwy	Old Town Front St	Bedford Ct
Deer Hollow Way	Pechanga Pkwy	Peppercorn Dr
Peppercorn Dr	Deer Hollow Way	Redhawk Pkwy
Redhawk Pkwy/ Vail Ranch Rd	Peppercorn Dr	Nighthawk Pass
Nighthawk Pass	Vail Ranch Rd	Butterfield Stage Rd
Butterfield Stage Rd	Nighthawk Pass	Wolf Store Rd
Nicolas Rd	Via Lobo Rd	North General Kearny Rd

Secondary fiber optic rings are routed through the City's major and secondary arterials and will provide connections to traffic signals and facilities along Redhawk Parkway, Vail Ranch Parkway, Meadows Parkway, Date Street, Ynez Road (north of Winchester Road), and Margarita Road (north of Winchester Road). Linear branches from the primary and/or secondary rings will connect remaining traffic signals and facilities located in remote areas of the City. The following recommendations are provided for fiber optic deployments in existing and new conduit installations:

- Leverage the existing fiber optic backbone to establish communication to remaining traffic signals and facilities with no communication infrastructure.
- Primary rings should be a minimum 288-strand single-mode fiber optic cable.
- Secondary rings should be a minimum 144-strand single-mode fiber optic cable.
- Linear branch connections should be a minimum 72-strand single-mode fiber optic cable.

6.1.2 Distribution Layer

The distribution layer will consist of communication hubs strategically located throughout the City's core network. Communication hubs will provide access between the fiber backbone ring and network equipment at traffic signal cabinets and ITSS facilities. There are nine existing communication hubs located throughout the communication network on principal and major arterials. Five new communication hubs are recommended to establish redundancy with rings between hubs. New hubs will house layer 3 switches and fiber distribution units with splice trays and patch panels. Existing hubs will be upgraded to

accommodate the recommended upsized fiber backbone ring. **Table 6-2** below lists the existing and recommended communication hub locations.

Table 6-2: Communication Network Hub Locations

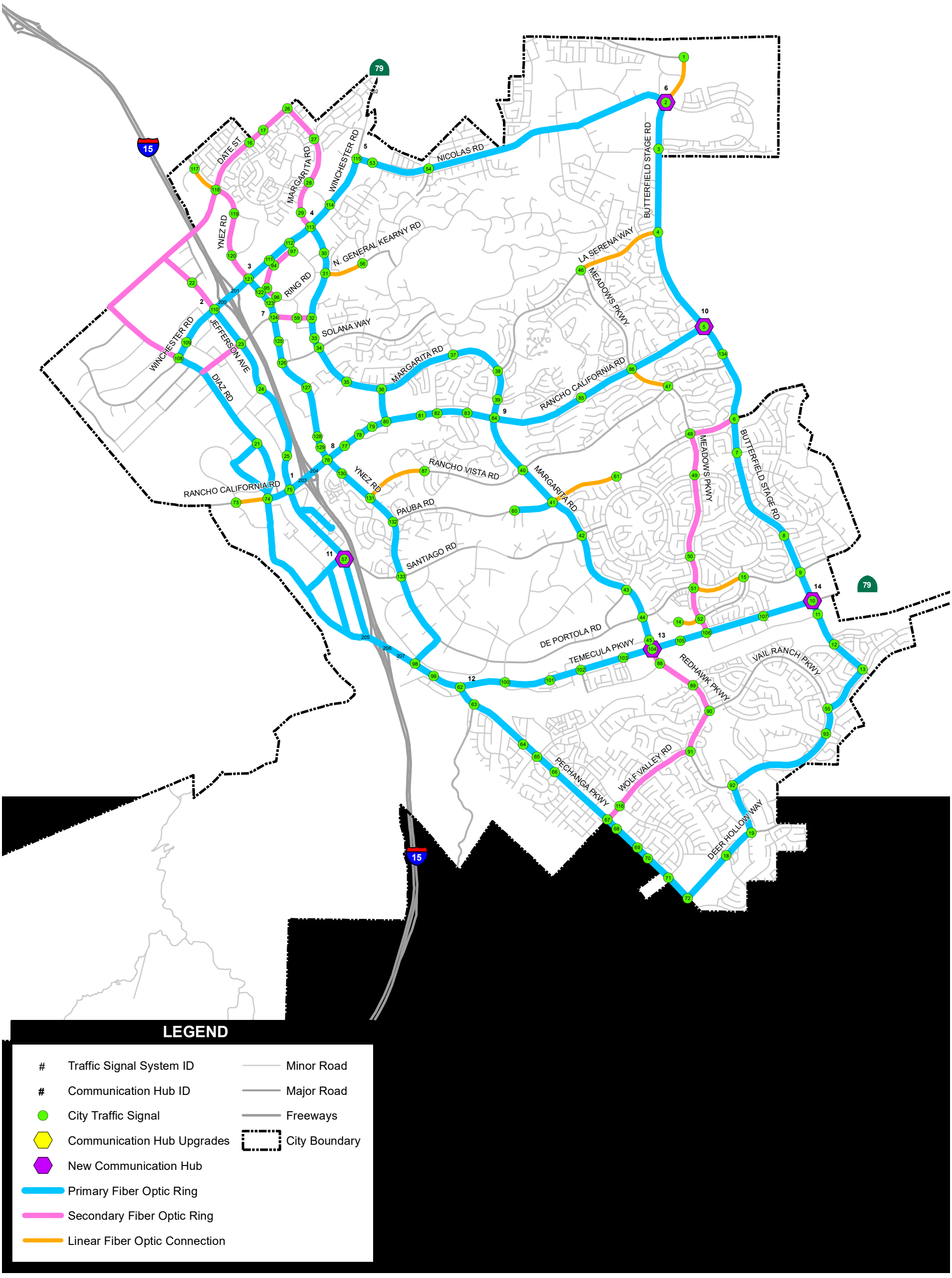
ID	Location	Status
1	Rancho California Rd & Jefferson Ave/Old Town Front St	Existing
2	Winchester Rd & Jefferson Ave	Existing
3	Ynez Rd & Winchester Rd	Existing
4	Winchester Rd & Margarita Rd	Existing
5	Winchester Rd & Nicolas Rd	Existing
6	Butterfield Stage Rd & Nicolas Rd	Recommended
7	Ynez Rd & Overland Dr	Existing
8	Rancho California Rd & Ynez Rd	Existing
9	Rancho California Rd & Margarita Rd	Existing
10	Butterfield Stage Rd & Rancho California Rd	Recommended
11	Old Town Front St & Santiago Rd/First St	Recommended
12	Pechanga Pkwy & Temecula Pkwy	Existing
13	Temecula Pkwy & Margarita Rd/Redhawk Pkwy	Recommended
14	Butterfield Stage Rd & Temecula Pkwy	Recommended

The following lists recommendations for existing and new communication hubs:

- Provide a Layer 3 switch at each hub for the traffic signal network.
- Provide a Layer 3 switch at each hub for the ITSS network.
- Each hub shall be connected to a minimum of two other hubs.
- Each hub shall provide communications backhaul to City Hall.

Figure 6-2 on the following page depicts the built-out backbone fiber rings, hub upgrades, and recommended hubs.

Figure 6-2: Backbone Fiber Optic Rings and Hubs Topology



6.1.3 Access Layer

The access layer consists of connected Internet Protocol (IP) devices at traffic signal controller cabinets and ITSS facilities. City traffic signals and ITSS facilities are recommended to be organized into separate network groups with each group connected to a minimum of two communication hubs. The use of communication hubs and network groups provides two levels of redundancy: (1) Devices can communicate with separate hubs if a communication link within the network group fails and (2) If a communication hub fails, each network group can communicate with the second or third hub.

The traffic signal system network is organized into 13 groups ranging between 5 and 16 signals per group. Each traffic signal network group is connected to a minimum of two hubs and some groups are connected to three hubs. Each hub will backhaul traffic signal data to the City's Traffic Operation Center (TOC). **Table 6-3** summarizes the traffic signal system network groups by total number of signals in each group, corridors, segment limits, and recommended hub connectivity and **Figure 6-3** illustrates the traffic signal network groups topology.

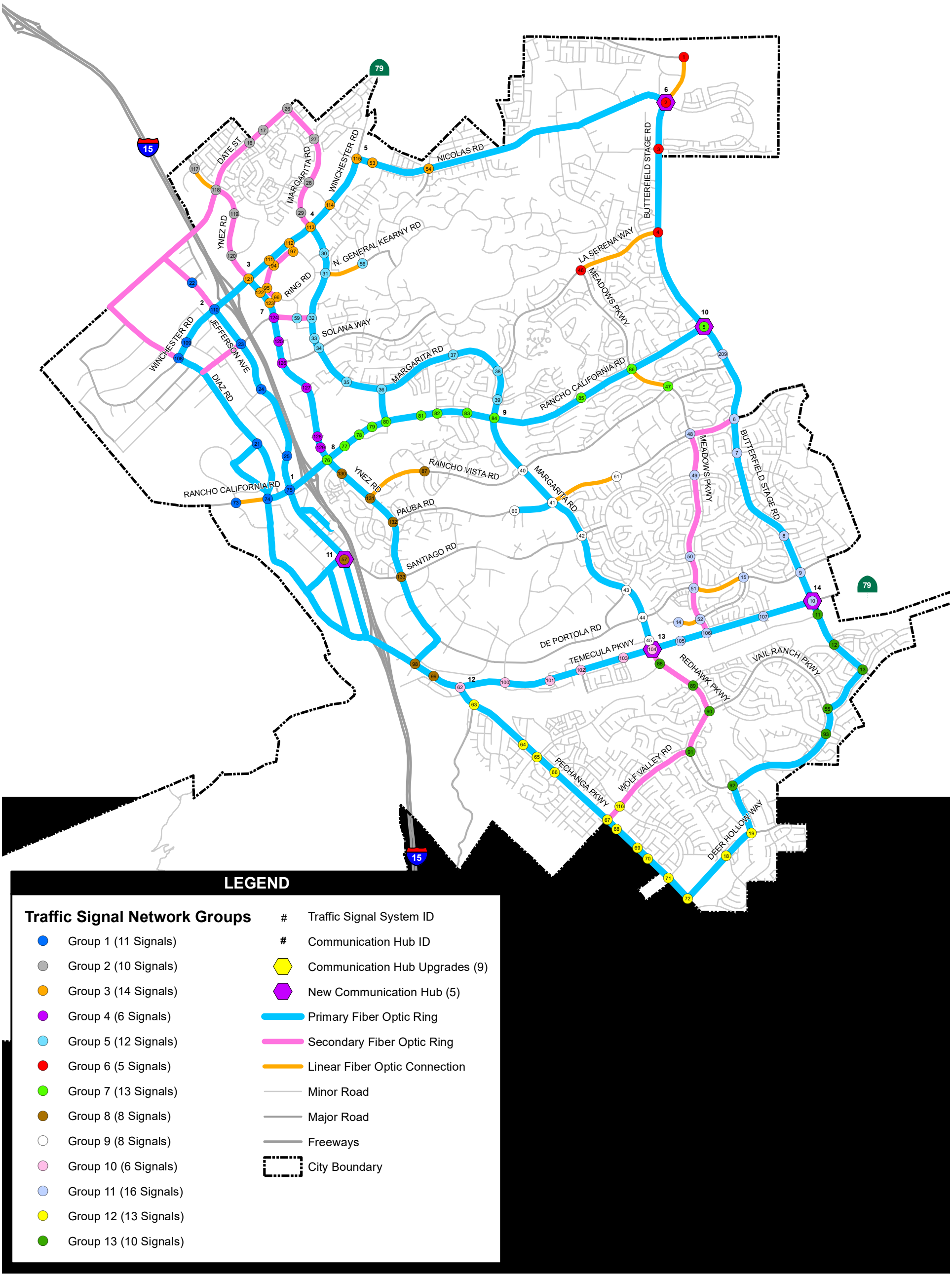
Table 6-3: Traffic Signal System Network Groups

Group No.	Total Signals	Corridor	Segment (signals along segment)	Hub Connectivity
1	11	Diaz Rd	Winchester Rd to Rancho California Rd	1. Rancho California Rd & Jefferson/ Old Town Front St 2. Winchester Rd & Jefferson Ave
		Jefferson Ave	Sanborn Ave to Rancho California Rd/Old Town Front St	
		Winchester Rd	Diaz Rd to Jefferson Ave	
		Rancho California Rd	Business Park Dr/Ridge Park Dr to Jefferson Ave/ Old Town Front St	
2	10	Ynez Rd	Waverly Ln/Temecula Center to Winchester Rd	3. Ynez Rd & Winchester Rd 4. Winchester Rd & Margarita Rd
		Margarita Rd	Date St to Winchester Rd	
		Date St	Ynez Rd to Margarita Rd	
3	14	Ynez Rd	Winchester Rd to Promenade Mall/Palm Plaza South	3. Ynez Rd & Winchester Rd 4. Winchester Rd & Margarita Rd 5. Winchester Rd & Nicolas Rd 7. Ynez Rd & Overland Dr
		Winchester Rd	Ynez Rd to Margarita Rd	
		Ring Rd	Promenade Mall South to Promenade Mall East	
4	6	Ynez Rd	Overland Dr to Town Plaza South	7. Ynez Rd & Overland Dr 8. Rancho California Rd & Ynez Rd
5	12	Margarita Rd	Verdes Ln to Yukon Rd/Honors Dr	4. Winchester Rd & Margarita Rd
		N General Kearny Rd	Margarita Rd to Camino Campos Verdes	

Group No.	Total Signals	Corridor	Segment (signals along segment)	Hub Connectivity
		Overland Dr	Promenade Way/Nicole Ln to Margarita Rd	9. Rancho California Rd & Margarita Rd
6	5	Butterfield Stage Rd	Murrieta Hot Springs Rd to La Serena Way	6. Butterfield Stage Rd & Nicolas Rd 10. Rancho California Rd & Butterfield Stage Rd
		La Serena Way	Meadows Pkwy to Butterfield Stage Rd	
7	13	Rancho California Rd	Ynez Rd to Butterfield Stage Rd	8. Rancho California Rd & Ynez Rd 9. Rancho California Rd & Margarita Rd 10. Butterfield Stage Rd & Rancho California Rd
		Meadows Pkwy	Rancho California Rd to Rancho Vista Rd	
8	8	Ynez Rd	Tierra Vista Rd to Temecula Pkwy	8. Rancho California Rd & Ynez Rd 11. Old Town Front St & Santiago Rd/First St 12. Pechanga Pkwy & Temecula Pkwy
		Rancho Vista Rd	Ynez Rd to Mira Loma Dr	
		Temecula Pkwy	Ynez Rd to Wabash Ln	
		Old Town Front St	Signal at Old Town Front St & Santiago Rd/First St	
9	8	Margarita Rd	Rancho Vista Rd to Dartolo Rd	9. Rancho California Rd & Margarita Rd 13. Temecula Pkwy & Margarita Rd/Redhawk Pkwy
		Pauba Rd	Calle Ventura/Fire State 84 to Via Rami/Linfield Way	
10	6	Temecula Pkwy	Pechanga Pkwy to Margarita Rd	12. Pechanga Pkwy & Temecula Pkwy 13. Temecula Pkwy & Margarita Rd/Redhawk Pkwy
11	16	Meadows Pkwy	Pauba Rd to Temecula Pkwy	10. Butterfield Stage Rd & Rancho California Rd 14. Butterfield Stage Rd & Temecula Pkwy
		Butterfield Stage Rd	Ave Lestonnac to Temecula Pkwy	
		De Portola Rd	Meadows Pkwy to Campanula Way E	
		Campanula Way	Camino Del Sol to Meadows Pkwy	
		Temecula Pkwy	Camino Del Sol to Butterfield Stage Rd	
12	13	Pechanga Pkwy	Rainbow Canyon Rd to Deer Hollow Way	12. Pechanga Pkwy & Temecula Pkwy 13. Temecula Pkwy & Margarita Rd/Redhawk Pkwy
		Wolf Valley Rd	Pechanga Pkwy to Wolf Creek Dr N/S	
		Deer Hollow Way	Pechanga Pkwy to Peppercorn Dr	
13	10	Redhawk Pkwy	Via Rio Temecula/Wolf Store Rd to El Chimisal Rd/Tehachapi Pass	13. Temecula Pkwy & Margarita Rd/Redhawk Pkwy
		Nighthawk Pass	Vail Ranch Pkwy to Butterfield Stage Rd	

Group No.	Total Signals	Corridor	Segment (signals along segment)	Hub Connectivity
		Butterfield Stage Rd	Wolf Store Rd to Nighthawk Pass	14. Butterfield Stage Rd & Temecula Pkwy

Figure 6-3: Traffic Signal System Network Groups Topology



The City's ITSS facility system network is organized into eight groups based on geographic location. Most of the connected ITSS facilities are in the Old Town District and at the center of the City near Margarita Road/Ranch Vista Road and Margarita Road/Pauba Road. The ITSS facility system network groups are also recommended to connect to a minimum of two communication hubs. **Table 6-4** summarizes the facility system network groups by total number of facilities in each group, facility ID, facility name, and recommended hub connectivity.

Table 6-4: ITSS Facilities System Network Groups

Group No.	Total Facilities	Facility ID	Name	Hub Connectivity
1	8	4	Old Town Parking Structure	1. Rancho California Rd & Jefferson/ Old Town Front St 11. Old Town Front St & Santiago Rd/First St
		9	Police Department Old Town Station	
		14	Mary Phillips Senior Center	
		15	Old Town 6th Street Restroom	
		19	Sam Hicks Monument Park	
		20	Temecula Valley Museum	
		23	Old Town Community Theater	
		24	Pennypickle's Workshop	
2	2	3	Field Operations Center	1. Rancho California Rd & Jefferson/ Old Town Front St 2. Winchester Rd & Jefferson Ave
		8	Temecula Valley Entrepreneurs Exchange (TVE2)	
3	1	22	Police Department Mall Storefront	3. Ynez Rd & Winchester Rd 4. Winchester Rd & Margarita Rd 7. Ynez Rd & Overland Dr
4	1	13	Michael "Mike" Naggar Community Park & Margarita Rec Center (MRC)	4. Winchester Rd & Margarita Rd 9. Rancho California Rd & Margarita Rd
5	1	26	Sports Ranch At Sommers Bend	6. Butterfield Stage Rd & Nicolas Rd 10. Rancho California Rd & Butterfield Stage Rd
6	5	5	Temecula Duck Pond	8. Rancho California Rd & Ynez Rd 11. Old Town Front St & Santiago Rd/First St 12. Pechanga Pkwy & Temecula Pkwy
		7	Temecula Park & Ride	
		12	Temecula Help Center	
		18	Rotary Park	
		25	Safe Family Justice Centers	
7	5	6	Ronald H. Roberts Temecula Library	9. Rancho California Rd & Margarita Rd 13. Temecula Pkwy & Margarita Rd/Redhawk Pkwy
		10	Fire Station 84	
		11	Temecula Community Recreation Center	
		17	Ronald Reagan Sports Park	
		21	Temecula Skate Park	

Group No.	Total Facilities	Facility ID	Name	Hub Connectivity
8	1	16	Patricia H. Birdsall Sports Park	12. Pechanga Pkwy & Temecula Pkwy 13. Temecula Pkwy & Margarita Rd/Redhawk Pkwy 14. Butterfield Stage Rd & Temecula Pkwy

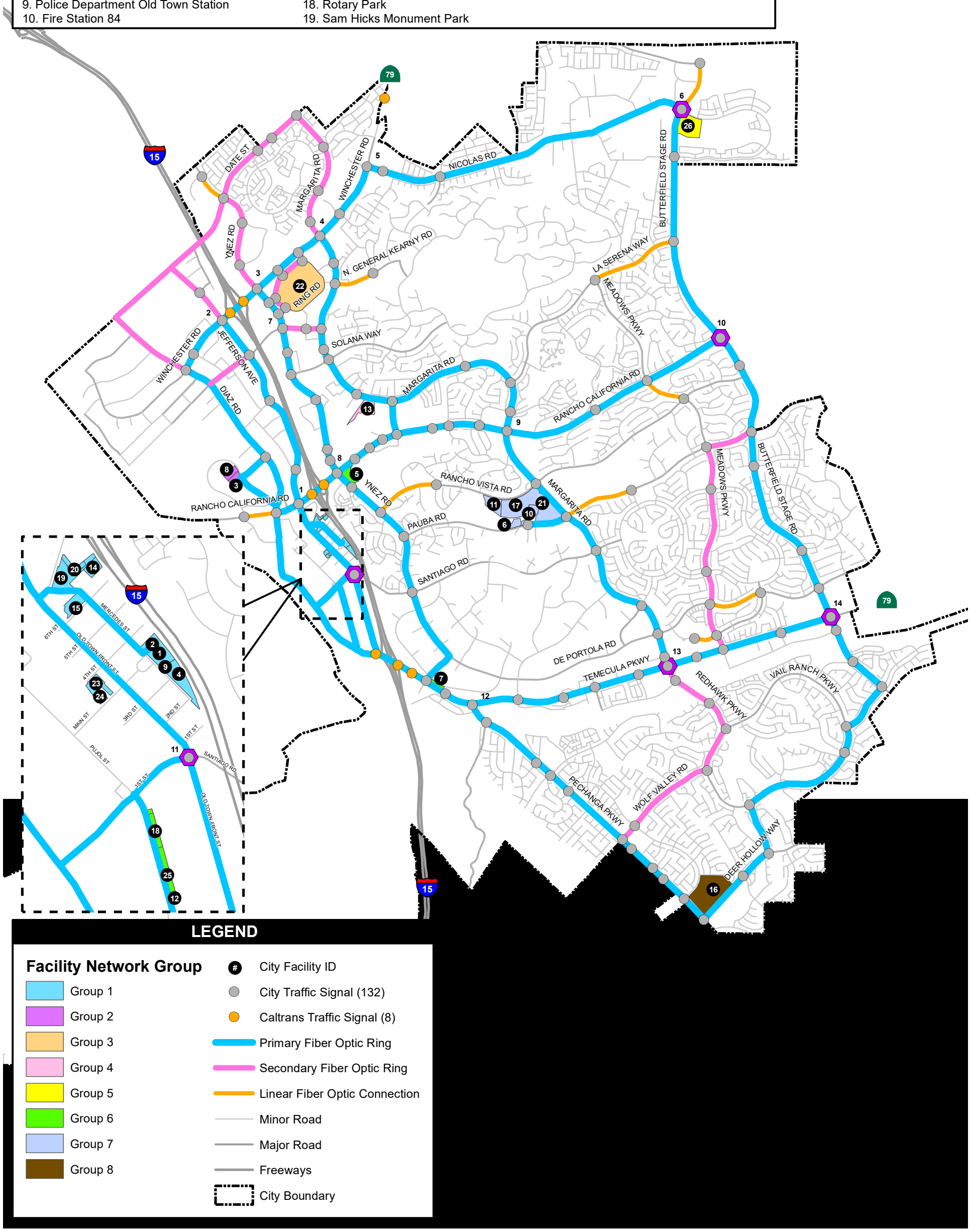
The City's Civic Center Building (Facility ID 1), Traffic Operations Center (Facility ID 2), and PD Southwest Station (Facility ID 27) were not included in the facility system network groups listed above.

Figure 6-4 depicts the ITSS facility system network groups topology.

Figure 6-4: ITSS Facilities System Network Goups Topology

CITY NETWORK FACILITIES

1. Civic Center
2. Civic Center Traffic Control Center
3. Field Operations Center
4. Old Town Parking Structure
5. Temecula Duck Pond
6. Ronald H. Roberts Temecula Library
7. Temecula Park & Ride
8. Temecula Valley Entrepreneurs Exhange (TVE2)
9. Police Department Old Town Station
10. Fire Station 84
11. Temecula Community Recreation Center
12. Temecula Help Center
13. Michael "Mike" Naggar Community Park & Margarita Rec Center (MRC)
14. Mary Phillips Senior Center
15. Old Town 6th Street Restroom
16. Patricia H. Birdsall Sports Park
17. Ronald Regan Sports Park
18. Rotary Park
19. Sam Hicks Monument Park
20. Temecula Valley Museum
21. Temecula Skate Park
22. Police Department Mall Storefront
23. Old Town Community Theater
24. Pennypickle's Workshop
25. SAFE Family Justice Centers
26. Sports Ranch at Sommers Bend
27. Police Department Southwest Station



6.1.4 Network Architecture

The City of Temecula resembles a geographic grid based on the layout of east/west and north/south arterials. These arterials are the physical routes for the fiber optic communication system topology. The recommended network architecture presented in this subsection is designed to provide as much failover connectivity as possible.

City Hall is located west of Interstate 15 (I-15) and acts as the central hub for the communication system network. The central hub (City Hall) has multiple connections to hubs located on the west and east side of the I-15. Winchester Road, Rancho California Road, and Temecula Parkway serve as the three main routes across the I-15 and provide failover connectivity in the event a communication fault occurs along either one of the three routes. Each communication hub is connected to a minimum of two hubs. There are instances on the eastern side of the City where hubs are connected to three or even four other hubs. Device subrings are created between hubs and resemble the traffic signal and facility system network groups presented in the previous subsection. Like communication hubs, device subrings are connected to a minimum of two hubs. Some device subrings are connected to three or four hubs depending on where they're located within the network. The network architecture layout matches the topology of the City, provides a high-level of redundancy, and provides connectivity to all network devices that ultimately require a network connection.

Figure 6-5 and **Figure 6-6** on the following pages illustrate the recommended traffic signal and ITSS facilities system network architectures, respectively. The traffic signal and ITSS facilities network systems will utilize the same fiber backbone and communication hub network layout. Device subrings between hubs are shown relative to the geographic location of traffic signals and ITSS facilities. Ethernet switch symbols represent the first and last breakouts within each device subring. The conforming continuation symbol represents the total breakouts between the first and last breakout. Although the traffic signal and ITSS facilities network systems will be backhauled to City Hall's Data Center/ Server Room, both network systems are recommended to be separate. Each department will have their own dedicated fiber count and layer 3 switch within the Data Center/ Server Room.

Figure 6-5 : Traffic Signal Network Architecture

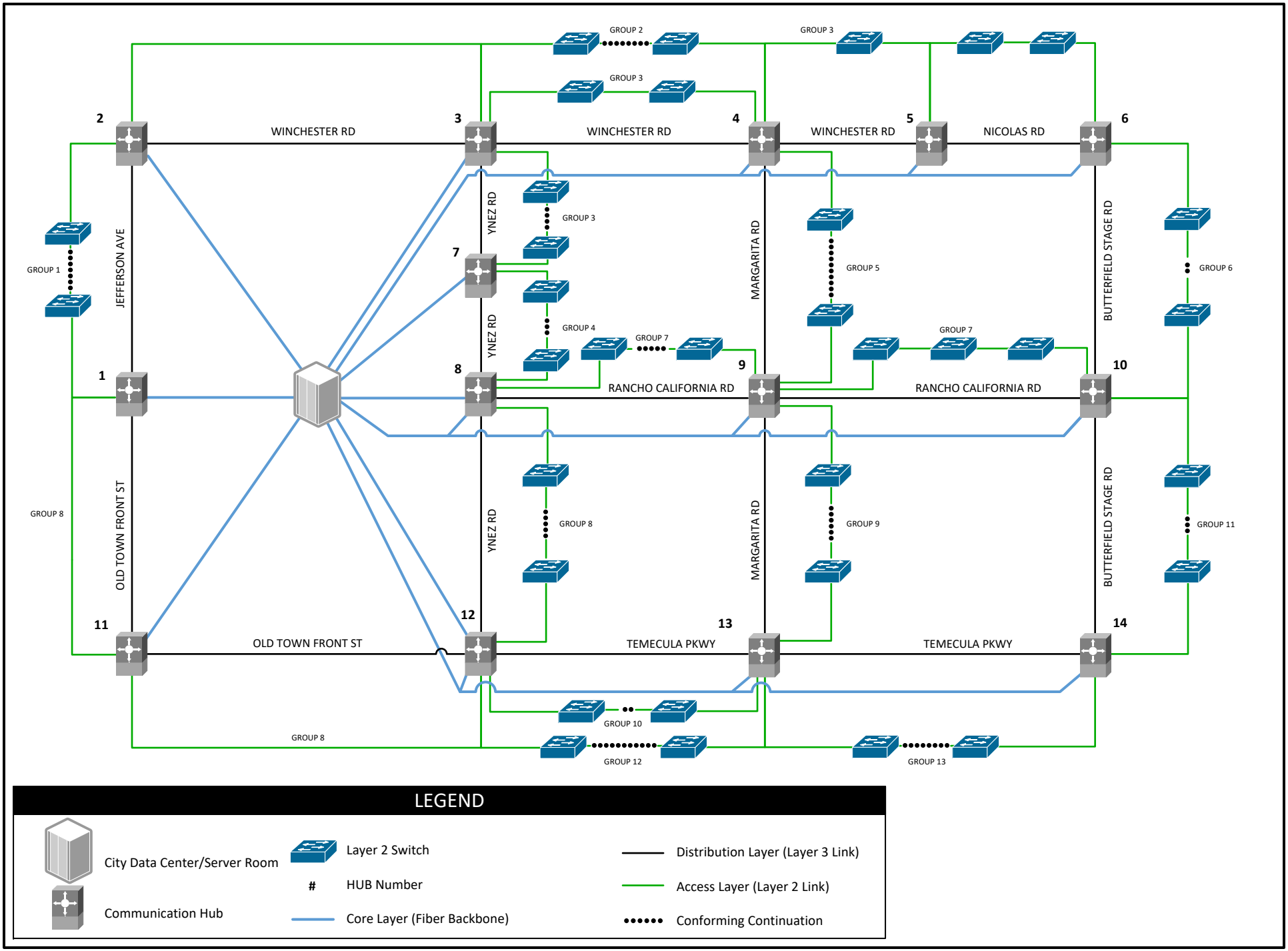
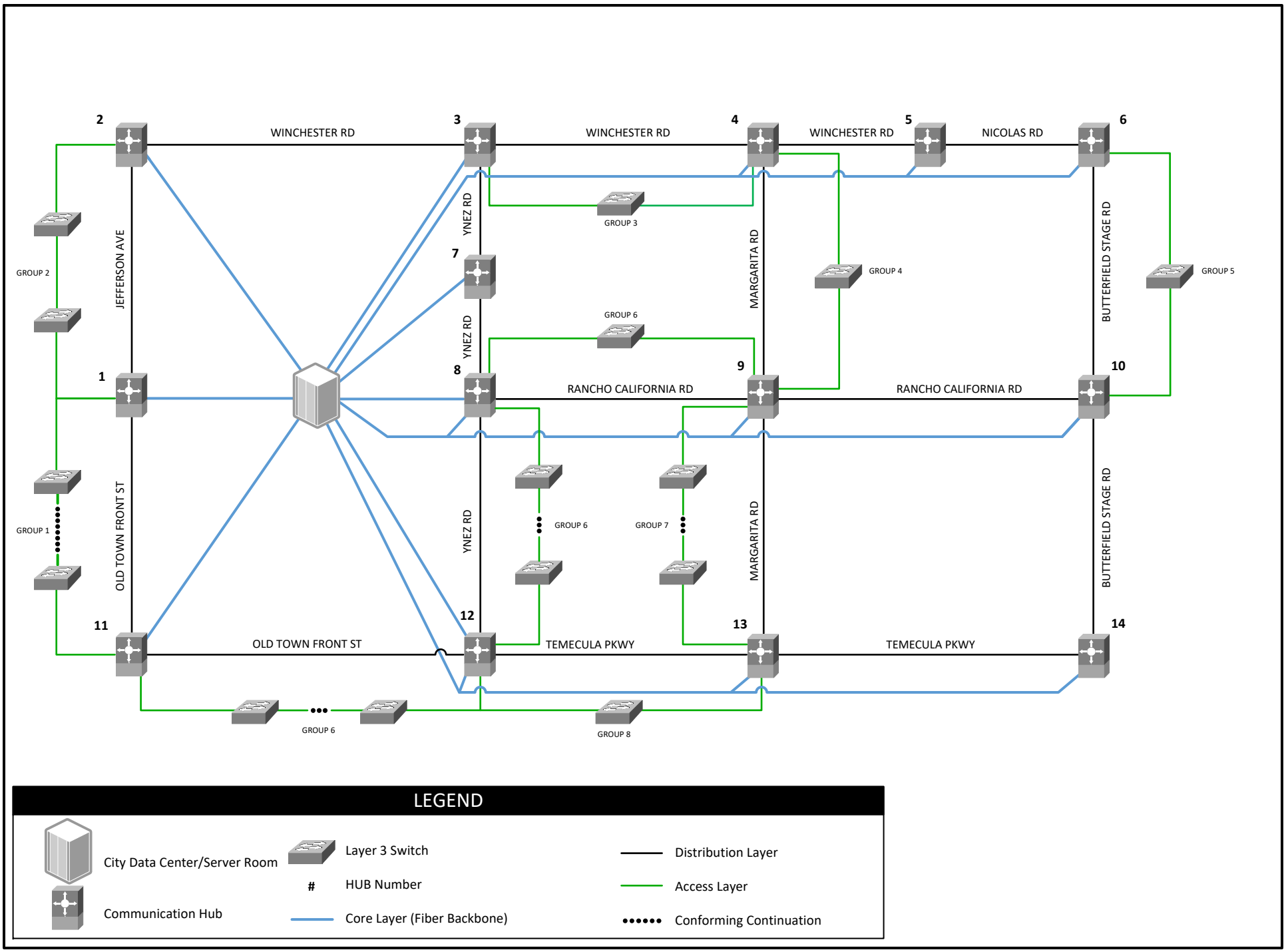


Figure 6-6 : ITSS Facilities Network Architecture Example



The City's ITSS Department will implement a combination of the recommended redundant ring network presented earlier in this section and a home-run fiber network. Home-run fiber connections to all existing and future facilities within the City will be prioritized first. This network configuration only consists of the core and access layer. Home-run fiber connections include individual fiber optic pairs between the City's Data Center/ Server Room to a Layer 3 switch at a City facility. In this configuration, there are no intermediate connections, splices, or branching off to other devices along the path of the cable. This configuration offers advantages including reduced signal loss, minimized interference, and easier troubleshooting but also utilizes more fiber optic cable strands compared to the redundant ring network layout. **Figure 6-7** below presents a high-level typical schematic diagram illustrating a home-run fiber connection between the City's Data Center/ Server room and a facility. Connected equipment at facilities include surveillance cameras, Wi-Fi, and work stations for ITSS staff.

Figure 6-7: ITSS Fiber Home-Run Network Architecture Example

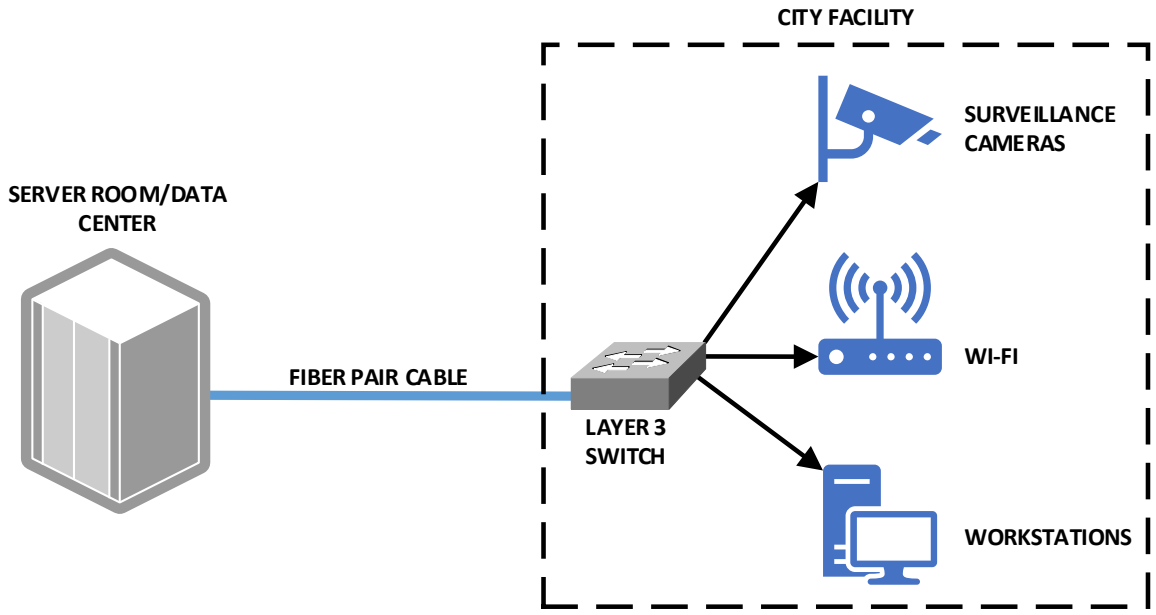


Table 6-5 lists existing and future facilities that will receive home-run fiber connections.

Table 6-5:ITSS Facilities with Home-Run Fiber Connections

Facility	Facility Status
Civic Center Traffic Control Center	Existing
Field Operations Center	Existing
Fire Station 84 (Near the Library)	Existing
Altair Recreation Center	Future
Jefferson Soccer Field	Future
Harveston Boat House	Existing
Harveston Lake Park	Existing
Jefferson Recreation Center	Existing
Margarita Recreation Center	Existing
Mary Phillips Senior Center	Existing

Facility	Facility Status
Michael "Mike" Naggar Community Park	Existing
Old Town 6th Street Restroom	Existing
Old Town Community Theater	Existing
Old Town Parking Structure	Existing
Temecula Park & Ride	Existing
Patricia Birdsall Sports Park	Existing
Pennypickle's Workshop	Existing
Police Department Mall Storefront	Existing
Police Department Old Town Station	Existing
Police Department Southwest Station	Existing
Ronald Reagan Sports Park	Existing
Ronald Roberts Temecula Public Library	Existing
Rotary Park	Existing
SAFE Family Justice Center	Existing
Sam Hicks Monument Park	Existing
Sommers Bend	Existing
Community Recreation Center	Existing
Temecula Duck Pond	Existing
Temecula Help Center	Existing
Temecula Skate Park	Existing
Temecula Valley Museum	Existing
Temecula Valley Entrepreneurs Exchange (TVE2)	Existing
Total:	**32**

6.2 Network Analysis

Network analysis of the fully built out communication system was performed to compare future data demands with the theoretical bandwidth capacity. The purpose of the network analysis is to assess the overall data requirements necessary for the various network devices to communicate to City Hall utilizing the recommended communication system topology routing and network groups. It is crucial to ensure that the recommended communication system can service the City's current and future needs.

The analysis conducted in this section will assist in identifying proper network configurations needed for network devices to efficiently communicate data within the system topology without constraint and ensure enough headroom remains to service future data demands. The following sections analyze data demands and summarize bandwidth calculation results for both the traffic signal and ITSS facilities network systems.

6.2.1 Traffic Signal System Bandwidth Calculations

The traffic signal system is comprised of various devices that place data demands on the City's communication system network. Research was performed to identify data demands for equipment utilized in this analysis. **Table 6-6** lists equipment, provides a short description of equipment functionality, and lists data demands for each equipment in megabits per second (Mbps).

Table 6-6: Traffic Signal System Devices and Data Demands

Equipment	Data Demand (Mbps)
Controller Software – Adaptive Operations	0.1
Controller Software – Signal Performance Measures	0.1
Controller Software – Travel Time Synchronization	0.01
APS Pedestrian Push Button	0.01
Conflict Monitor Unit	0.01
Ethernet Switch	0.1
Emergency Vehicle Preemption Discriminator	0.1
Battery Back-Up System Invertor	0.01
Wireless Radio	0.1
CCTV Camera	8
Video Detection*	16
Sum:	**24.54**

**Four cameras per signal*

Data demands for traffic signal devices place minimal data demands on the communication system network whereas video feed devices for monitoring or vehicle detection place a much higher demand. Bandwidth calculations were performed for each traffic signal system network group identified in **Section 6.1.3**. A full data demand scenario was evaluated for each group by assuming a demand of 24.54 Mbps for each signal. Additionally, a factor of safety was applied by accounting for potential future traffic signals per network group on a case-by-case basis. **Appendix C** contains the bandwidth calculations conducted for each traffic signal network group. Each network group is broken up into subgroups based on two segment types: (1) trunk segment or (2) branch segment. A trunk segment contains traffic signals along a particular roadway connected to a hub. Branch segments are connected to a trunk segment at one end and to the link extent at the other end. The data demands of all subgroups are aggregated to determine the demand of the entire traffic signal network group. **Table 6-7** below summarizes aggregated data demands per traffic signal network groups.

Table 6-7: Traffic Signal System Network Groups Data Demand

Traffic Signal Network Group	Total Demand (Mbps)
Group 1	368.1
Group 2	245.4
Group 3	392.64
Group 4	147.24
Group 5	294.48
Group 6	220.86
Group 7	368.1
Group 8	294.48
Group 9	245.4
Group 10	171.78
Group 11	441.72
Group 12	343.56
Group 13	343.56

Aggregated data demand at each communication hub per traffic signal network group serviced is summarized in **Table 6-8** below.

Table 6-8: Aggregated Data Demands at Hubs for Traffic Signal System Network

Hub ID	Hub Location	TS Group	TS Group Demand (Mbps)	Total Demand at Hub (Mbps)
1	Rancho California Rd & Jefferson Ave/Old Town Front St	Group 1	368.1	368.1
2	Winchester Rd & Jefferson Ave	Group 1	368.1	368.1
3	Ynez Rd & Winchester Rd	Group 2	245.4	638.04
		Group 3	392.64	
4	Winchester Rd & Margarita Rd	Group 2	245.4	932.52
		Group 3	392.64	
		Group 5	294.48	
5	Winchester Rd & Nicolas Rd	Group 3	392.64	392.64
6	Butterfield Stage Rd & Nicolas Rd	Group 6	220.86	220.86
7	Ynez Rd & Overland Dr	Group 3	392.64	539.88
		Group 4	147.24	
8	Rancho California Rd & Ynez Rd	Group 4	147.24	809.82
		Group 7	368.1	
		Group 8	294.48	
9	Rancho California Rd & Margarita Rd	Group 5	294.48	907.98
		Group 7	368.1	
		Group 9	245.4	
10	Butterfield Stage Rd & Rancho California Rd	Group 6	220.86	1030.68
		Group 7	368.1	
		Group 11	441.72	
11	Old Town Front St & Santiago Rd/First St	Group 8	294.48	294.48
12	Pechanga Pkwy & Temecula Pkwy	Group 8	294.48	809.82
		Group 10	171.78	
		Group 12	343.56	
13	Temecula Pkwy & Margarita Rd/Redhawk Pkwy	Group 9	245.4	1104.3
		Group 10	171.78	
		Group 12	343.56	
		Group 13	343.56	
14	Butterfield Stage Rd & Temecula Pkwy	Group 11	441.72	1128.84
		Group 12	343.56	
		Group 13	343.56	

6.2.2 ITSS Facilities Bandwidth Calculations

The ITSS department utilizes the communication system to access audio/visual (AV) systems installed throughout the City's facility campuses. Bandwidth calculations were performed for each ITSS facilities system network group identified in **Section 6.1.3**. A full demand scenario was evaluated for each network

group by utilizing the total number of surveillance cameras at each facility campus provided by the ITSS department. The data demand for one surveillance camera is equivalent to approximately 10 Mbps. **Table 6-9** summarizes the City's ITSS facilities by network group, total number of surveillance cameras at each facility campus, total data demand by facility campus, and aggregated data demand by network group.

Table 6-9: ITSS Facilities System Network Groups Data Demand

ID	Name	Network Group	Surveillance Cameras	Facility Demand (Mbps)	Network Group Demand (Mbps)
1	Civic Center	1	72	720	2020
4	Old Town Parking Structure		43	430	
9	Police Department Old Town Station		0	0	
14	Mary Phillips Senior Center		25	250	
15	Old Town 6th Street Restroom		6	60	
19	Sam Hicks Monument Park		5	50	
20	Temecula Valley Museum		24	240	
23	Old Town Community Theater		24	240	
24	Pennypickle's Workshop		3	30	
3	Field Operations Center	2	15	150	290
8	Temecula Valley Entrepreneurs Exchange (TVE2)		14	140	
22	Police Department Mall Storefront	3	0	0	0
13	Michael "Mike" Naggar Community Park & Margarita Rec Center (MRC)	4	23	230	230
26	Sports Ranch at Sommers Bend	5	26	260	260
5	Temecula Duck Pond	6	7	70	150
7	Temecula Park & Ride		8	80	
12	Temecula Help Center		0	0	
18	Rotary Park		0	0	
25	Safe Family Justice Centers		0	0	
6	Ronald H. Roberts Temecula Library	7	33	330	1090
10	Fire Station 84		0	0	
11	Temecula Community Recreation Center		47	470	
17	Ronald Reagan Sports Park		19	190	
21	Temecula Skate Park		10	100	
16	Patricia H. Birdsall Sports Park	8	19	190	190

Table 6-9 above may also be utilized to determine the total bandwidth needs per facility for the home-run fiber connection network configuration. Aggregated data demand at each communication hub per facility network group serviced is summarized in **Table 6-10** below.

Table 6-10: Aggregated Data Demands for ITSS Facilities System Network

Hub ID	Hub Location	Facility Group	Facility Group Demand (Mbps)	Total Demand at Hub (Mbps)
1	Rancho California Rd & Jefferson Ave/Old Town Front St	Group 1	2020	2310
		Group 2	290	
2	Winchester Rd & Jefferson Ave	Group 2	290	290
3	Ynez Rd & Winchester Rd	Group 3	0	0
4	Winchester Rd & Margarita Rd	Group 3	0	230
		Group 4	230	
5	Winchester Rd & Nicolas Rd	None		
6	Butterfield Stage Rd & Nicolas Rd	Group 5	260	260
7	Ynez Rd & Overland Dr	Group 3	0	0
8	Rancho California Rd & Ynez Rd	Group 6	150	150
9	Rancho California Rd & Margarita Rd	Group 4	230	1320
		Group 7	1090	
10	Butterfield Stage Rd & Rancho California Rd	Group 5	260	260
11	Old Town Front St & Santiago Rd/First St	Group 1	2020	2170
		Group 6	150	
12	Pechanga Pkwy & Temecula Pkwy	Group 6	150	340
		Group 8	190	
13	Temecula Pkwy & Margarita Rd/Redhawk Pkwy	Group 7	1090	1280
		Group 8	190	
14	Butterfield Stage Rd & Temecula Pkwy	Group 8	190	190

6.3 Network Standards

The Communications System Master Plan conceives a reliable and future-proof network based on the communications connection needs, topology, and network analysis. The following sections present recommendations for network standardization.

6.3.1 Communications Protocol Standardization

Modern communications systems utilize Ethernet protocol to continuously connect devices with each other and the internet. There is no longer a need to have separate data and voice networks. Ethernet/IP protocols are standard for the City's communication network devices. The City's legacy serial and analog communication systems will be upgraded to support modern ITS technologies and smart city applications. City investments in existing point-to-multipoint wireless and cellular communications will be utilized on an as-needed basis, including system redundancy.

6.3.2 Network Configuration

Proper network configuration is essential for a network to operate efficiently, securely, and reliably. The use of Virtual Local Area Networks (VLANs) and subnets can efficiently route data within the communication system topology and minimize broadcast storms. VLANS are utilized to isolate network

traffic and increase the number of available IP addresses within a network by using multiple subnets (sub-networks). Benefits to VLAN configuration include:

- Offer large network scalability
- Prevent crosstalk between devices
- Allow for easier monitoring and identification of network traffic
- Maintain organization within a network

Ports on switches can be designated for a specific VLAN which provides uniformity throughout the network. The City has recently developed a Citywide IP Scheme for the traffic signal network system which includes VLANs for different traffic signal equipment. It is recommended to continue utilizing this approach to maintain proper organization.

Police Department surveillance cameras at signalized intersections are maintained by the ITSS department. These cameras will be connected to the Public Works Traffic Engineering Department's switch located at the respective traffic signal controller cabinet. It is recommended that the Traffic Engineering Department assigns a dedicated port for all Police Department surveillance cameras. This will ensure that surveillance cameras are separate from the traffic signal network system.

6.3.3 Fiber Allocation and Splicing

Fiber allocation and splicing are critical steps in the design, installation, and maintenance of the City's fiber optic communication system. This ensures that resources are utilized efficiently, connections are reliable, and ensures the network can service the changing demands and conditions. The City currently has no fiber allocation and splicing procedures in place. The following fiber allocation recommendations for the City's communication system buildout are provided below:

- Core Layer
    - Dedicated fiber pair per hub to establish communications back to City's central hub (City Hall)
    - A total of 28 strands of fiber are required for 14 hubs (28 strands)
- Distribution Layer
    - Dedicated fiber pair for hub-to-hub communications (2 strands)
    - Additional fiber pair for redundant communications (2 strands)
- Access Layer
    - Dedicated fiber pair for network device communications (2 strands)
    - Additional fiber pair for redundant communications (2 strands)

The Traffic Engineering and ITSS Departments will require a total of 36 strands of fiber each to accommodate the recommended redundant ring network configuration. The City's primary fiber optic ring is recommended to be comprised of 288-strands of fiber. The Traffic Engineering and ITSS Departments will each have 144-strands of fiber for their desired communication network system configuration. The recommended fiber strand allocation for the 288-strand fiber optic cable is summarized below:

- Public Works Department (144 strands of fiber)
    - 36 strands of fiber allocated to the redundant ring network configuration
    - 108 strands of dark fiber
- ITSS Department (144 strands of fiber)
    - 64 strands of fiber allocated to the home-run fiber network configuration
    - 36 strands of fiber allocated to the redundant ring network configuration
    - 44 strands of dark fiber

Remaining dark fiber strands for each department can be utilized for future network expansion, communication needs, or may be leased out.

Splicing recommendations for the City's communication system buildout are listed below:

- Install splice closures to facilitate fiber optic breakout cables.
- All splicing and splice enclosures shall be in underground vaults.
- Install splice closures capable of housing a minimum of 288 splices on primary rings, 144 splices on secondary rings, 72 splices on linear branch connections.
- 12-strand or 24-strand SMFO breakout cables to traffic signals and ITSS facility campuses.

6.4 Infrastructure and Equipment Standards

The Communications System Master Plan network architecture will link all system elements together to create a ubiquitous network on which all devices communicate. The following sections present the infrastructure and equipment standards recommended to achieve the future communication system concept.

6.4.1 Communications Infrastructure

The City's legacy communications infrastructure was built several decades ago and is comprised of copper wire signal interconnect cable (SIC) analog multi-drop network, serial digital wireless radios, and analog fiber optic lines network. The legacy communications system infrastructure is outdated and incapable of supporting modern ITS technologies and smart city applications. This does not include Temecula Parkway, Rancho California Road, and Winchester Road which were recently upgraded on the Highway Safety Improvement Program (HSIP) Cycle 9 grant project. Communications infrastructure recommendations are listed below:

- Utilize existing copper SIC conduit in good working condition to pull new fiber optic cable to resolve communications gaps and create a redundant network.
- Upgrade existing #3 and #5 copper SIC pull boxes with 90-degree sweeps and tight spacing to current fiber optic standards which includes #6 pull boxes and 45-degree conduit sweeps with a minimum 16-inches clearance around conduit ends.
- Utilize existing wireless radios for communications system redundancy and remote locations.
- New fiber should be single-mode fiber optic cable (SMFOC) with a minimum of:
    - Primary rings: 288-strand SMFOC
    - Secondary rings: 144-stand SMFOC

  - Linear branches: 72-strand SMFOC
  - Breakout cables for traffic signals and facilities: 12-strand or 24-strand SMFOC
- New communications conduit installations should be 3-inch Polyvinyl Chloride (PVC).
- New communications pull boxes placed along conduit runs should include Caltrans standard #6 pull box and 600 to 800-feet spacing.
- New fiber splice vaults installed near traffic signal cabinets with:
  - 3-inch PVC conduit installed to existing traffic signal cabinet.

Splice closures per recommendations in **Section 6.3.3**.

6.4.2 Traffic Signal Cabinet Assemblies and Equipment

The existing traffic signal cabinet assemblies and equipment components were primarily developed under legacy communication protocols that are unable to support modern devices with high bandwidth needs for current applications. Modern assemblies and equipment provide the ability to utilize multiple ITS systems and smart city applications to manage traffic operations with real-time monitoring, data collection, and analysis. Related equipment recommendations include:

- Replace legacy 332 traffic signal cabinets and equipment with Advanced Traffic Control (ATC) standard cabinets capable of installation on existing 332 cabinet foundations.
- Replace legacy 170 controllers with ATC controllers. The City is currently in the process of replacing the remaining 170 controllers with ATC FLeX controllers.
- Replace legacy type 210 and 2010 ECL conflict monitor units (CMUs) with equipment that is capable of internet protocol (IP) communications for remote monitoring.
- Replace legacy serial Tomar Electronics emergency vehicle preemption (EVPE) model ranges 2000 and 3000 series with EVP equipment that is capable of IP communications for remote monitoring and coding to prevent susceptibility to illegal emitters.
- Replace legacy Dimensions battery back-up (BBS) systems which are no longer manufactured and supported with BBS equipment that is capable of IP communications for remote monitoring.
- New traffic signal installations should include:
  - 350i/352i ATC cabinet
  - ATC FLeX controller
  - Layer 2 switch
  - 1U FDU for 12-stand fiber break out cables
  - 2010 ECLip CMU
  - 4000 series Tomar Electronics EVPE
  - Alpha FXM 1100 BBS

6.4.3 Communication Hub Assemblies and Equipment

Communication hubs are installed at strategic locations to complete a redundant and self-healing fiber optic communication rings topology throughout the City. As previously depicted in the fiber optic backbone rings and hubs topology map, there are nine existing communications hubs that are

recommended for upgrade and five new communications hubs that are identified for installation. Recommendations for communication hub field elements include:

- Layer 3 switch for the Public Works' traffic signal network.
- Layer 3 switch for the ITSS network.

6.4.4 Alternative Communications

The Temecula Traffic Engineering Division maintains school zone flashers and radar speed feedback signs that do not currently have communications back to the TOC. Schedules and data for each device must be physically uploaded and downloaded by City staff in the field. The Temecula ITSS Department maintains smart parking systems at the Old Town parking garage, Second Street parking lot, and Sixth Street parking lot that currently communicate through a third-party owned cellular network. Recommendations for alternative communications for these systems include:

- As existing school flashers and speed feedback signs require life cycle replacement, determine on a case-by-case basis if communications between the device and the TOC should be established by wireless radios, based on adjacent infrastructure, or replaced with newer cellular-capable models.
- Existing smart parking systems currently communicate through a third-party owned cellular network. It is recommended to transition smart parking systems into the City's fiber optic communication system.

Existing ITSS facility campuses on leased lines are recommended to be integrated into the City's fiber optic communication system. Additionally, new facilities with planned AV systems are recommended to be connected to the City's fiber optic communication system.

6.5 Roles and Responsibilities

The City of Temecula Information Technology and Support Services (ITSS) and Public Works Departments are responsible for City's communications system. To ensure the network needs of both departments are met and the roles and responsibilities for planning, building, operating, managing, and maintaining the communications system are defined, the following recommendations are made:

- ITSS Department maintains primary responsibility for the planning, improvement, maintenance, testing and acceptance, inspection, and purchasing of communications network equipment for City-owned buildings and facilities (inside plant). Additionally, ITSS maintains primary responsibility for planning, improvement, maintenance, testing and acceptance, and purchasing of network equipment for City traffic and communications cabinets as well as surveillance equipment (outside plant).
- Public Works Department and Traffic Engineering Division maintains primary responsibility for planning, improvement, maintenance, testing and acceptance, inspection, and purchasing of communications equipment for City traffic signals and field elements (outside plant).
- ITSS Department, Public Works Department, and Traffic Division should collaborate to develop:
    - Centralized location for communications system documentation.

- Standard Operating Procedures (SOPs) for maintaining ITSS and Public Works communication system networks, implementing new communications projects, documenting complete projects, developing communication security protocols, and defining standard specifications.
- Formal planning framework to ensure communications system improvements are identified, planned, and implemented strategically and improvement project opportunities can be leveraged between both departments.
- Pursuit of available funding opportunities to expand the citywide communications system, with a focus on prioritizing implementation of fiber infrastructure to City facilities with third-party leased network lines.
- Formal framework for regularly updating the Communications System Topology Map to reflect existing and planned communication infrastructure.

7 Implementation Phasing and Prioritization Plan (IPP)

This chapter provides the implementation phasing and prioritization plan (IPP) for Temecula's Citywide communications system based on network analysis findings and improvement recommendations. The implementation strategy is the Master Plan capstone. It establishes priorities, costs, schedule, and various funding sources to aid the City with the implementation phasing process.

This chapter provides a plan for implementing a state-of-the-art fiber optic communication network that will be capable of meeting the City of Temecula's existing and future needs. Migrating the existing dated communication systems to state-of-the-art requires a staged approach where critical deficiencies are addressed first, followed by strategic conversion of the remaining communication and ITS element infrastructure. Integration and interface with recent system improvements is also accounted for in the strategic deployment plan.

7.1 Strategic Deployment Plan

Existing investments in communication infrastructure, underground systems, and communication cabinet infrastructure will continue to be utilized. Obsolete legacy network equipment will be decommissioned and replaced with new modern communication technologies. Implementation of CCSMP Recommendations are divided into three phases over a ten-year period which includes immediate, near-term, and full citywide buildout. Each phase is presented in further detail in the following subsections.

7.1.1 Phase 1: Immediate Upgrades (Years 1-3)

Phase 1 of the implementation plan includes:

- Upgrade fiber distribution units (FDUs) and install splice closures at seven existing communication hubs to accommodate the recommended upsized fiber optic cable. Communication hub upgrades at Rancho California Road and Jefferson Avenue/Old Town Front Street will be prioritized.
- Leverage existing underground and communication cabinet infrastructure to install new fiber optic communication media. Locations that require fiber breakout cables and/or communication equipment at traffic signal cabinets will be prioritized next. These are locations along corridors with existing fiber optic infrastructure that are currently not connected to the fiber optic network.
- Segments with copper wire media will be upgraded next by utilizing the existing conduit to pull in new fiber. Pull box spacing and conduit sweeps will be upgraded to current fiber optic standards.
- Install wireless radios and communication equipment at remaining remote locations to establish communications back to City Hall.

These improvements provide the City with expanded connectivity to traffic signals along major and secondary arterials. Additionally, improvements will bridge communication gaps and make progress towards the backbone fiber optic rings topology presented in the Recommendations section. **Table 7-1** includes locations with communication hub upgrades, **Table 7-2** lists locations in need of fiber breakout

cables and/or communication equipment at traffic signal cabinets, and **Table 7-3** lists locations with existing copper wire media to be upgraded with fiber optic media.

Table 7-1: Project 1 Communication Hub Upgrades

ID	Location	Improvements
1	Rancho California Road & Jefferson Avenue/Old Town Front Street	FDUs & Splice Closures
3	Ynez Road & Winchester Road	FDUs & Splice Closures
4	Winchester Road & Margarita Road	FDUs & Splice Closures
5	Winchester Road & Nicolas Road	FDUs & Splice Closures
7	Ynez Road & Overland Drive	FDUs & Splice Closures
8	Rancho California Road & Ynez Road	FDUs & Splice Closures
9	Rancho California Road & Margarita Road	FDUs & Splice Closures

Table 7-2: Project 2 Traffic Signal Communication Upgrades

ID	Intersection	Improvements
21	Diaz Rd & Rancho Way	Fiber Breakout & Comm Equipment
22	Jefferson Ave & Sanborn Ave	Comm Equipment
23	Jefferson Ave & Overland Dr	Fiber Breakout & Comm Equipment
24	Jefferson Ave & Via Montezuma	Fiber Breakout & Comm Equipment
25	Jefferson Ave & Del Rio Rd	Fiber Breakout & Comm Equipment
30	Margarita Rd & Verdes Ln	Fiber Breakout & Comm Equipment
31	Margarita Rd & North General Kearny Rd	Fiber Breakout & Comm Equipment
41	Margarita Rd & Pauba Rd	Fiber Breakout & Comm Equipment
42	Margarita Rd & Santiago Rd	Fiber Breakout & Comm Equipment
43	Margarita Rd & Pio Pico Rd	Fiber Breakout & Comm Equipment
60	Pauba Rd & Calle Ventura/Fire Station 84	Fiber Breakout & Comm Equipment
63	Pechanga Pkwy & Rainbow Canyon Rd	Fiber Breakout & Comm Equipment
64	Pechanga Pkwy & Muirfield Dr	Fiber Breakout & Comm Equipment
65	Pechanga Pkwy & Loma Linda Rd	Comm Equipment
66	Pechanga Pkwy & Wolf Creek Dr North	Comm Equipment
67	Pechanga Pkwy & Wolf Valley Rd-Via Eduardo	Comm Equipment
68	Pechanga Pkwy & Pechanga Casino Dr North	Comm Equipment
69	Pechanga Pkwy & Pechanga Casino Dr South	Comm Equipment
70	Pechanga Pkwy & Pechanga Resort Dr-Minimart	Fiber Breakout & Comm Equipment
71	Pechanga Pkwy & Wolf Creek Dr South	Fiber Breakout & Comm Equipment
72	Pechanga Pkwy & Deer Hollow Way	Fiber Breakout
94	Ring Rd & Promande Mall W	Fiber Breakout & Comm Equipment
95	Ring Rd & Promenade Mall N	Fiber Breakout & Comm Equipment
96	Ring Rd & Promenade Mall S	Fiber Breakout & Comm Equipment
122	Ynez Rd & Promenade Mall/Palm Plaza N	Fiber Breakout & Comm Equipment
123	Ynez Rd & Promenade Mall/Palm Plaza S	Fiber Breakout & Comm Equipment

Table 7-3: Project 3 Fiber Optic Infrastructure Upgrades

Roadway	Segment	Total Signals	Improvements
Campanula Way	Camino Del Sol to Meadows Parkway	1	Fiber Trunk Cable, Fiber Breakout, & Comm Equipment
Date Street	Ynez Road to Margarita Road	3	Fiber Trunk Cable, Fiber Breakout, & Comm Equipment
Deer Hollow Way	Pechanga Parkway to Peppercorn Drive	2	Fiber Trunk Cable, Fiber Breakout, & Comm Equipment
De Portola Road	Meadows Parkway to Campanula Way E	1	Fiber Trunk Cable, Fiber Breakout, & Comm Equipment
Margarita Road	Moraga Road to N General Kearny Road	5	Fiber Trunk Cable, Fiber Breakout, & Comm Equipment
Margarita Road	Rancho California Road to Avenida Barca	3	Fiber Trunk Cable, Fiber Breakout, & Comm Equipment
Margarita Road	Winchester Road to Date Street	3	Fiber Trunk Cable, Fiber Breakout, & Comm Equipment
Meadows Parkway	Rancho California Road to Pauba Road	5	Fiber Trunk Cable, Fiber Breakout, & Comm Equipment
Moraga Road	Rancho California Road to Margarita Road	–	Fiber Trunk Cable
Nicolas Road	Winchester Road to N. General Kearny Road	2	Fiber Trunk Cable, Fiber Breakout, & Comm Equipment
Nighthawk Pass	Vail Ranch Parkway/Redhawk Parkway to Butterfield Stage Road	2	Fiber Trunk Cable, Fiber Breakout, & Comm Equipment
Overland Drive	Ynez Road to Margaria Road	1	Fiber Trunk Cable, Fiber Breakout, & Comm Equipment
Pauba Road	Meadows Parkway to Butterfield Stage Road	–	Fiber Trunk Cable
Wolf Valley Road	Pechanga Parkway to Peppercorn Drive	1	Fiber Trunk Cable, Fiber Breakout, & Comm Equipment

There are programmed CIP and development projects that will install fiber optic and wireless communication infrastructure within the next three years. These improvements complement phase 1 of the implementation plan. **Table 7-4** lists locations with planned fiber optic infrastructure and associated projects.

Table 7-4: Phase 1 CIP Fiber Optic Infrastructure Upgrades

Project	Roadway	From	Total Signals	Improvements
HSIP Cycle 11 Citywide Signal Timing	Butterfield Stage Road	Wolf Store Road to Avenida Lestonnac	5	Fiber Trunk Cable, Fiber Breakout, & Comm Equipment

Project	Roadway	From	Total Signals	Improvements
& Communication Upgrades	Ynez Road	Santiago Road to Overland Drive	10	Fiber Trunk Cable, Fiber Breakout, & Comm Equipment
Ynez Road Private Development	Ynez Road	Winchester Road to Equity Drive	1	Fiber Breakout & Comm Equipment
Nicolas Road Extension	Nicolas Road	Joseph Road to Butterfield Stage Road	–	Conduit

Additionally, the HSIP Cycle 11 project will install wireless communication infrastructure and communication cabinet equipment at 11 intersections and are listed in **Table 7-5** below. New radios and communication equipment will be installed at remaining remote locations and are included in **Table 7-6**.

Table 7-5: Phase 1 CIP Wireless Infrastructure Upgrades

ID	Location	Improvements
47	Meadows Parkway & Rancho Vista Road	Wireless Radios & Comm Equipment
56	North General Kearny Road & Camino Campos Verdes	Wireless Radios & Comm Equipment
61	Pauba Road & Via Rami/Linfield Way	Wireless Radios & Comm Equipment
87	Rancho Vista Road & Mira Loma Drive	Wireless Radios & Comm Equipment
88	Redhawk Parkway & Via Rio Temecula/Wolf Store Road	Wireless Radios & Comm Equipment
89	Redhawk Parkway & Overland Trail/Paseo Parallon	Wireless Radios & Comm Equipment
90	Redhawk Parkway & Vail Ranch Parkway	Wireless Radios & Comm Equipment
91	Redhawk Parkway & Wolf Valley Road	Wireless Radios & Comm Equipment
92	Redhawk Parkway & Peppercorn Drive	Wireless Radios & Comm Equipment
93	Redhawk Parkway & El Chimisal Road/Tehachapi Pass	Wireless Radios & Comm Equipment
55	Nighthawk Pass & Vail Ranch Parkway/Redhawk Parkway	Wireless Radios & Comm Equipment

Table 7-6: Project 4 Wireless Communications at Remote Locations

ID	Location	Improvements
11	Butterfield Stage Road & Wolf Store Road	Wireless Radio
12	Butterfield Stage Road & Welton Way/Channel Street	Wireless Radios & Comm Equipment
46	Meadows Parkway & La Serena Way	Wireless Radios & Comm Equipment

The Citywide Surveillance Cameras project is also programmed in the CIP and will provide fiber connections to six ITSS facilities within the next three years. **Table 7-7** below lists the facilities that will be connected to the fiber optic network.

Table 7-7: Phase 1 CIP Fiber Optic Infrastructure Implementation at ITSS Facilities

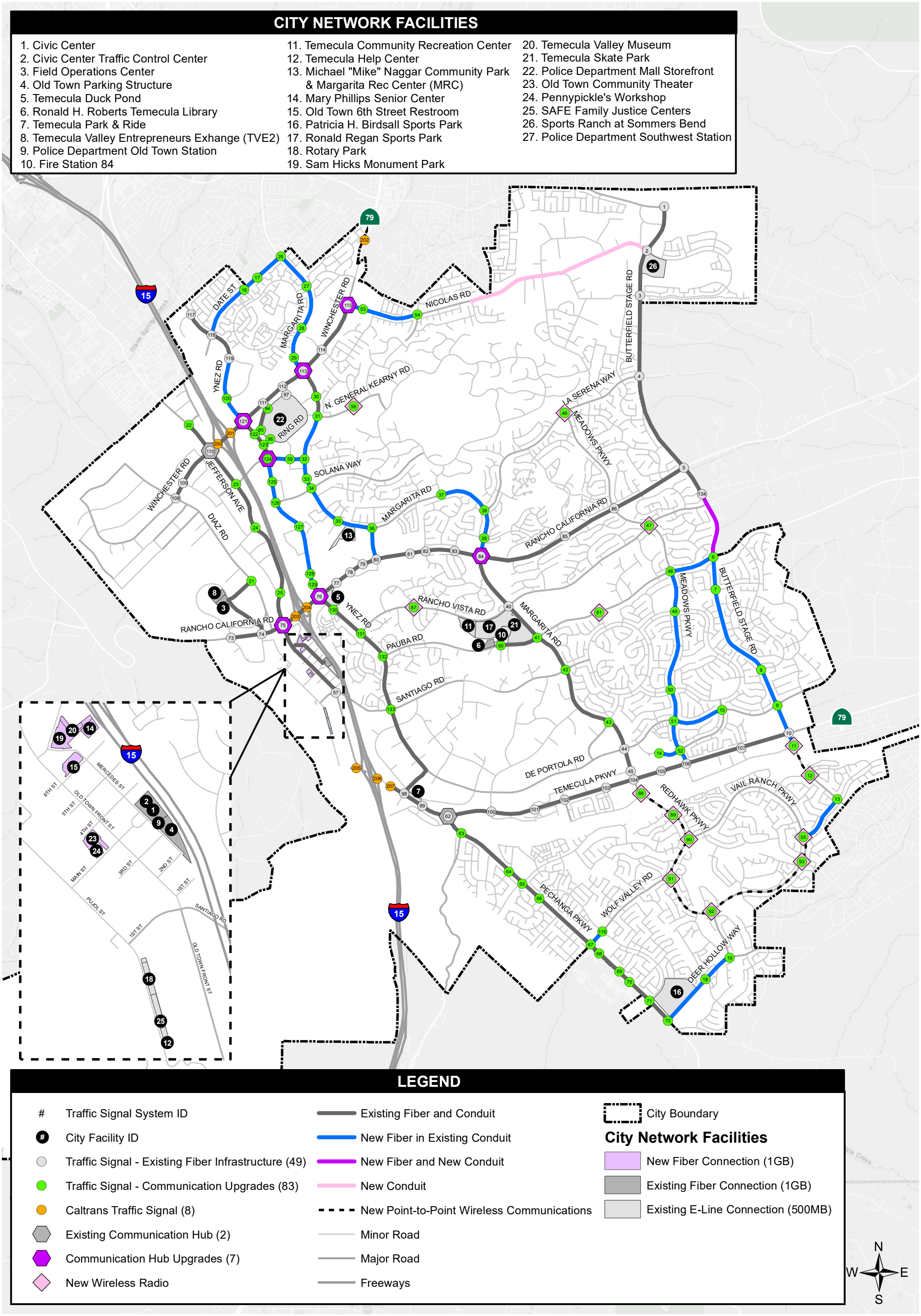
ID	Name	Address	Improvements
14	Mary Phillips Senior Center	41845 6th St	Surveillance Cameras, Fiber Breakout & Comm Equipment
15	Old Town 6th Street Restroom	41952 6th St	Surveillance Cameras, Fiber Breakout & Comm Equipment

ID	Name	Address	Improvements
19	Sam Hicks Monument Park	41970 Moreno Rd	Surveillance Cameras, Fiber Breakout & Comm Equipment
20	Temecula Valley Museum	28314 Mercedes St	Surveillance Cameras, Fiber Breakout & Comm Equipment
23	Old Town Community Theater	42051 Main St	Surveillance Cameras, Fiber Breakout & Comm Equipment
24	Pennypickle's Workshop	42081 Main St	Surveillance Cameras, Fiber Breakout & Comm Equipment

A total of 84 traffic signals and six ITSS facilities will have established communications back to City Hall via fiber with Phase 1.

Figure 7-1 on the following page depicts Phase 1 improvements.

Figure 7-1: Phase 1 Immediate Communication Upgrades Topology



7.1.2 Phase 1 Order of Magnitude Costs

Cost estimate quantities were obtained from the CCSMP GIS database and aerial imagery. Quantities for conduit were increased by 15% and fiber optic cable by 25% to account for any unforeseeable factors. Cost estimates include a construction contingency of 30%. An additional 30% was added to account for soft costs such as preliminary engineering and construction management. Unit price costs were increased by 7% for phase 2 and 3 to account for inflation. The Order of Magnitude Costs for Phase 1 are summarized in the following tables below.

Table 7-8: Project 1 Communication Hub Upgrades Costs

Item	Item Description	Quantity	Unit	Unit Price	Amount
1	Furnish & Install 4U FDU, Splice Cassette, and Cabinet Termination	6	EA	$15,000	**$90,000**
2	Furnish & Install Splice Closure	6	EA	$5,000	**$30,000**
3	Fiber Testing & Documentation	1	LS	$20,000	**$20,000**
				Sub Total:	**$140,000**
				Soft Costs (30%):	**$42,000**
				Construction Contingency (30%):	**$42,000**
				Grand Total:	**$224,000**

Table 7-9: Project 2 Traffic Signal Communication Upgrades Costs

Item	Item Description	Quantity	Unit	Unit Price	Amount
1	Furnish & Install Ethernet Layer 2 Ethernet Switch	25	EA	$8,500	**$212,500**
2	Furnish & Install 1U FDU, Splice Cassette, and Cabinet Termination.	25	EA	$3,500	**$87,500**
3	Furnish & Install 12-strand SMFO Breakout Cable	5,000	LF	$5	**$25,000**
4	Fiber Testing & Documentation	1	LS	$15,000	**$15,000**
				Sub Total:	**$340,000**
				Soft Costs (30%):	**$102,000**
				Construction Contingency (30%):	**$102,000**
				Grand Total:	**$544,000**

Table 7-10: Project 3 Fiber Optic Infrastructure Upgrades Costs

Item	Item Description	Quantity	Unit	Unit Price	Amount
1	Furnish & Install Ethernet Layer 2 Ethernet Switch	29	EA	$8,500	**$246,500**
2	Furnish & Install 1U FDU, Splice Cassette, and Cabinet Termination.	29	EA	$3,500	**$101,500**
3	Furnish & Install 288-strand SMFOC	32,000	LF	$6	**$192,000**
4	Furnish & Install 144-strand SMFOC	33,000	LF	$5	**$165,000**
5	Furnish & Install 72-strand SMFOC	6,000	LF	$5	**$30,000**
6	Furnish & Install 12-strand SMFO Breakout Cable	6,500	LF	$5	**$32,500**
7	Furnish & Install Splice Closure	29	EA	$5,000	**$285,000**

Item	Item Description	Quantity	Unit	Unit Price	Amount
8	Furnish & Install Communication Vault	29	EA	$13,000	**$377,000**
9	Remove & Salvage Existing Pull Box. Furnish & Install No. 6 Pull Box & 45-degree Conduit Sweeps	57	EA	$5,000	**$285,000**
10	RS Existing Pull Box and Connect Existing Conduit with New Continuous Conduit	57	EA	$5,000	**$285,000**
11	Fiber Testing & Documentation	1	LS	$30,000	**$30,000**
				Sub Total:	**$1,889,500**
				Soft Costs (30%):	**$566,850**
				Construction Contingency (30%):	**$566,850**
				Grand Total:	**$3,023,200**

Table 7-11: Project 4 Wireless Communications at Remote Locations Costs

Item	Item Description	Quantity	Unit	Unit Price	Amount
1	Furnish & Install Wireless Radio	3	EA	$8,000	**$24,000**
2	Furnish & Install Repeater	2	EA	$10,000	**$20,000**
3	Furnish & Install Ethernet Switch	2	EA	$8,500	**$17,000**
7	Wireless Testing and Documentation	1	LS	$5,000	**$5,000**
				Sub Total:	**$66,000**
				Soft Costs (30%):	**$19,800**
				Construction Contingency (30%):	**$19,800**
				Grand Total:	**$105,600**

7.1.3 Phase 2: Near-Term Upgrades (Years 4-6)

Phase 2 of the implementation plan includes:

- Prioritize upgrading existing fiber optic infrastructure along Rancho California Road, Temecula Parkway, and Winchester Road.
    - This includes upsizing fiber optic cable (FOC) size, proper fiber allocation, and new splice closures.
    - Fiber optic infrastructure upgrades at these three corridors are critical as they constitute the majority of the City's primary backbone fiber optic ring.
- Fiber distribution units and splice closures at the remaining two existing communication hubs along Winchester Road and Temecula Parkway will be upgraded to accommodate the recommended upsized fiber optic cable.
- Three new communication hubs on Rancho California Road/Butterfield Stage Road, Temecula Parkway/Margarita Road-Redhawk Parkway, and Temecula Parkway/Butterfield Stage Road will be included in Phase 2.

Programmed CIP projects that correlate to Phase 2 include Diaz Road Expansion, Murrieta Creek Bridge at Overland Drive/Overland Drive Widening, and Nicolas Road Extension. Project limits for the three programmed CIP projects are summarized in **Table 7-12** below.

Table 7-12: Phase 2 CIP Fiber Optic Infrastructure Implementation

Project	Roadway	Segment	Improvements
Diaz Road Expansion	Diaz Road	Winchester Road to Rancho California Road	Conduit & Fiber Trunk Cable
Murrieta Creek Bridge/Overland Drive Widening	Overland Drive	Diaz Road to Jefferson Avenue	Conduit & Fiber Trunk Cable
Nicolas Road Extension	Nicolas Road	Joseph Road to Butterfield Stage Road	Fiber Trunk Cable

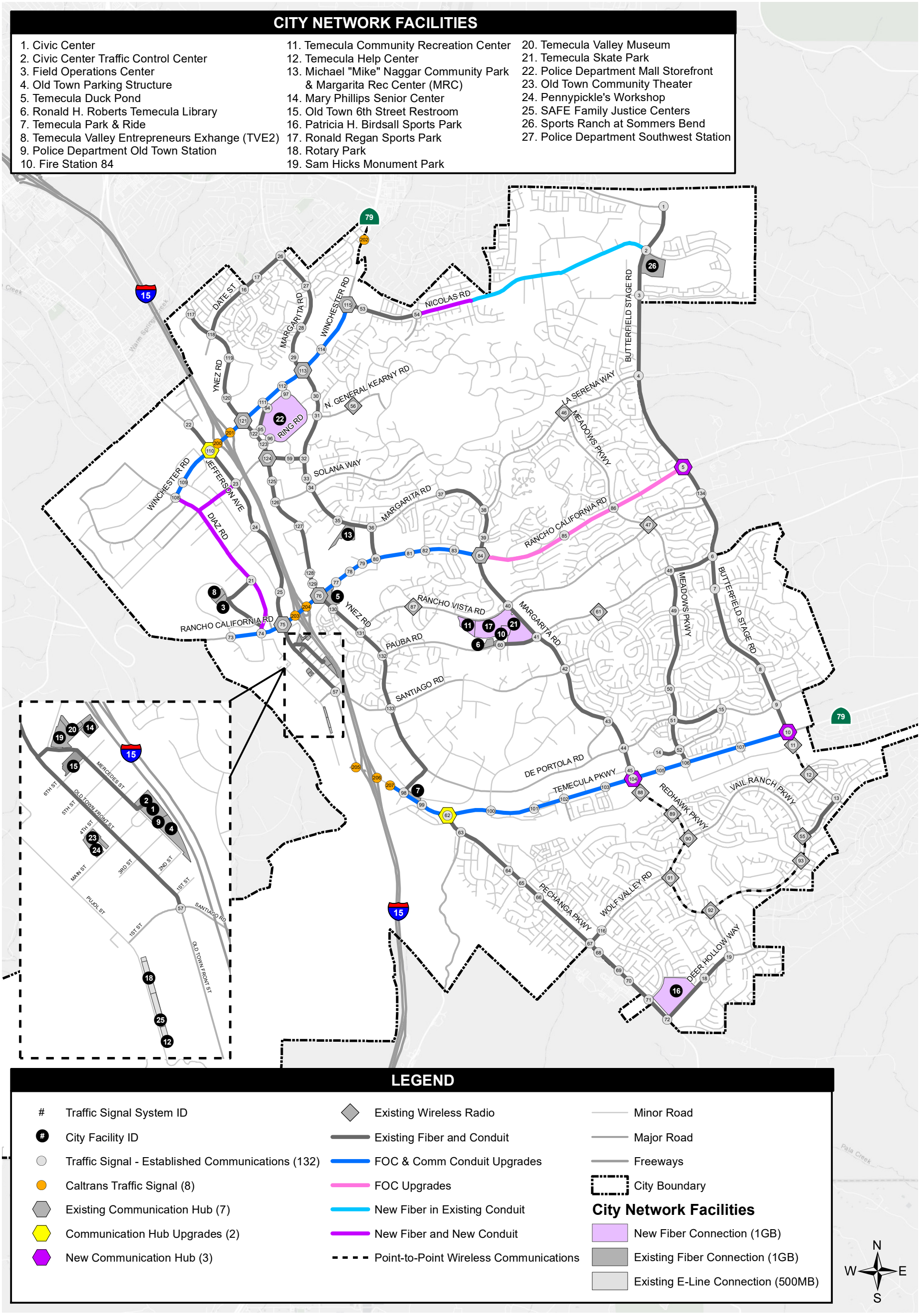
Five ITSS facilities will be connected to the fiber optic network in Phase 2. New conduit, pull boxes, and fiber breakout cables will be installed from the nearest adjacent signalized intersection with existing fiber infrastructure. **Table 7-13** lists the five ITSS facilities that will receive fiber connections.

Table 7-13: Phase 2 Fiber Optic Infrastructure Implementation at ITSS Facilities

ID	Name	Address	Improvements
11	Temecula Community Recreation Center	30875 Rancho Vista Rd	Fiber Breakout & Comm Equipment
16	Patricia H. Birdsall Sports Park	32380 Deer Hollow Way	Fiber Breakout & Comm Equipment
17	Ronald Reagan Sports Park	30875 Rancho Vista Rd	Fiber Breakout & Comm Equipment
21	Temecula Skate Park	42569 Margarita Rd	Fiber Breakout & Comm Equipment
22	Police Department Mall Storefront	40820 Winchester Rd	Fiber Breakout & Comm Equipment

A summary of Phase 2 improvements is illustrated in **Figure 7-2**.

Figure 7-2: Phase 2 Near-Term Communication Upgrades Topology



7.1.4 Phase 2 Order of Magnitude Costs

The Order of Magnitude Costs for Phase 2 are summarized below.

Table 7-14: Project 5 Communication Infrastructure Upgrades at Rancho California Rd, Temecula Pkwy, and Winchester Road Costs

Item	Item Description	Quantity	Unit	Unit Price	Amount
1	Furnish & Install 288-strand SMFOC	73,000	LF	$6.50	**$474,500**
2	Furnish & Install 144-strand SMFOC	2,000	LF	$5.40	**$10,800**
3	Furnish & Install Communication Vault	36	EA	$14,000	**$504,000**
4	Furnish & Install Splice Closure	36	EA	$5,400	**$194,400**
5	Fiber Testing & Documentation	1	LS	$30,000	**$30,000**
				Sub Total:	**$1,213,700**
				Soft Costs (30%):	**$364,110**
				Construction Contingency (30%):	**$364,110**
				Grand Total:	**$1,941,920**

Table 7-15: Project 6 Communication Hub Upgrades Costs

Item	Item Description	Quantity	Unit	Unit Price	Amount
1	Furnish & Install 4U FDU, Splice Cassette, and Cabinet Termination	2	EA	$16,100	**$32,000**
2	Furnish & Install New Communication Hub	3	EA	$50,000	**$150,000**
3	Fiber Testing & Documentation	1	LS	$20,000	**$20,000**
				Sub Total:	**$202,000**
				Soft Costs (30%):	**$60,600**
				Construction Contingency (30%):	**$60,600**
				Grand Total:	**$323,200**

Table 7-16: Project 7 Fiber Optic Infrastructure at ITSS Facilities Costs

Item	Item Description	Quantity	Unit	Unit Price	Amount
1	Furnish & Install 3" PVC Conduit	8,000	LF	$70	**$560,000**
2	Furnish & Install 12-strand SMFO Breakout Cable	8,500	LF	$5.40	**$45,900**
3	Furnish & Install No. 6 Pull Box & 45-degree Conduit Sweeps	14	EA	$5,400	**$75,600**
4	Fiber Termination at City Facility & Equipment	5	EA	$25,000	**$125,000**
5	Fiber Testing & Documentation	1	LS	$15,000	**$15,000**
				Sub Total:	**$821,500**
				Soft Costs (30%):	**$246,450**
				Construction Contingency (30%):	**$246,450**
				Grand Total:	**$1,314,400**

7.1.5 Phase 3: Citywide Buildout (Years 7-10)

Buildout of the Citywide communication system network will be completed in Phase 3.

- Remaining segments with a low fiber strand count will be upgraded. **Table 7-17** lists remaining roadway segments and proposed fiber strand count.
- New conduit and fiber will be installed along remaining gaps. **Table 7-18** lists roadway segments with proposed conduit and fiber strand count.
- New communication hubs will be installed at Butterfield Stage Road/Nicolas Road and at Old Town Front Street/Santiago Road-First Street/
- Remaining ITSS facilities will be connected to the fiber optic communication system network. **Table 7-19** below lists segments that will receive fiber optic infrastructure upgrades and installations during Phase 3.

Table 7-17: Phase 3 Fiber Optic Cable Upgrades

ID	Roadway	Segment	Proposed Fiber Strands
1	Business Park Dr/Diaz Rd	Rancho California Rd to Rancho Way	288-strand SMFOC
2	Jefferson Ave	Rancho California Rd to Winchester Rd	288-strand SMFOC
3	Margarita Rd	Pio Pico Rd to Pauba Rd	288-strand SMFOC
4		Winchester Rd to N General Kearny Rd	288-strand SMFOC
5	Pauba Rd	Calle Ventura/Fire Station 84 to Margarita Rd	288-strand SMFOC
6	Pechanga Pkwy	Deer Hollow Way to Temecula Pkwy	288-strand SMFOC
7	Promenade Mall N	Ynez Rd to Ring Rd	144-strand SMFOC
8	Promenade Mall W	Winchester Rd to Ring Rd	144-strand SMFOC
9	Rancho Way	Business Park Dr to Diaz Rd	288-strand SMFOC
10	Ring Rd	Promenade Mall N to Promenade Mall W	144-strand SMFOC
11	Ynez Rd	Date St to Equity Dr	72-strand SMFOC
12		Overland Dr to Winchester Rd	288-strand SMFOC
13		Waverly Ln/Temecula Center Dr to Date St	144-strand SMFOC

Table 7-18: Phase 3 New Fiber Optic Cable and Conduit along Gaps

ID	Roadway	Segment	Proposed Fiber Strands
1	Butterfield Stage Rd	Nighthawk Pass to Wolf Store Rd	288-strand SMFOC
2	First St	Western Bypass to Old Town Front St	288-strand SMFOC
3	La Serena Way	Meadows Pkwy to Butterfield Stage Rd	72-strand SMFOC
4	Margarita Rd	Moraga Rd to Avenida Barca	288-strand SMFOC
8	Meadows Pkwy	Rancho Vista Rd to Rancho California Rd	72-strand SMFOC
6	N General Kearny Rd	Margarita Rd to Camino Campo Verdes	72-strand SMFOC
7	Old Town Front St	Santiago Rd/First St to Temecula Pkwy	288-strand SMFOC
8	Pauba Rd	Margarita Rd to Via Rami/Linfield Way	72-strand SMFOC
9	Peppercorn Dr	Deer Hollow Way to Redhawk Pkwy	288-strand SMFOC
10	Promenade Mall S	Ynez Rd to Ring Rd	144-strand SMFOC
11	Pujol St	First St to Western Bypass	72-strand SMFOC
12	Rancho Vista Rd	Ynez Rd to Mira Loma Dr	72-strand SMFOC

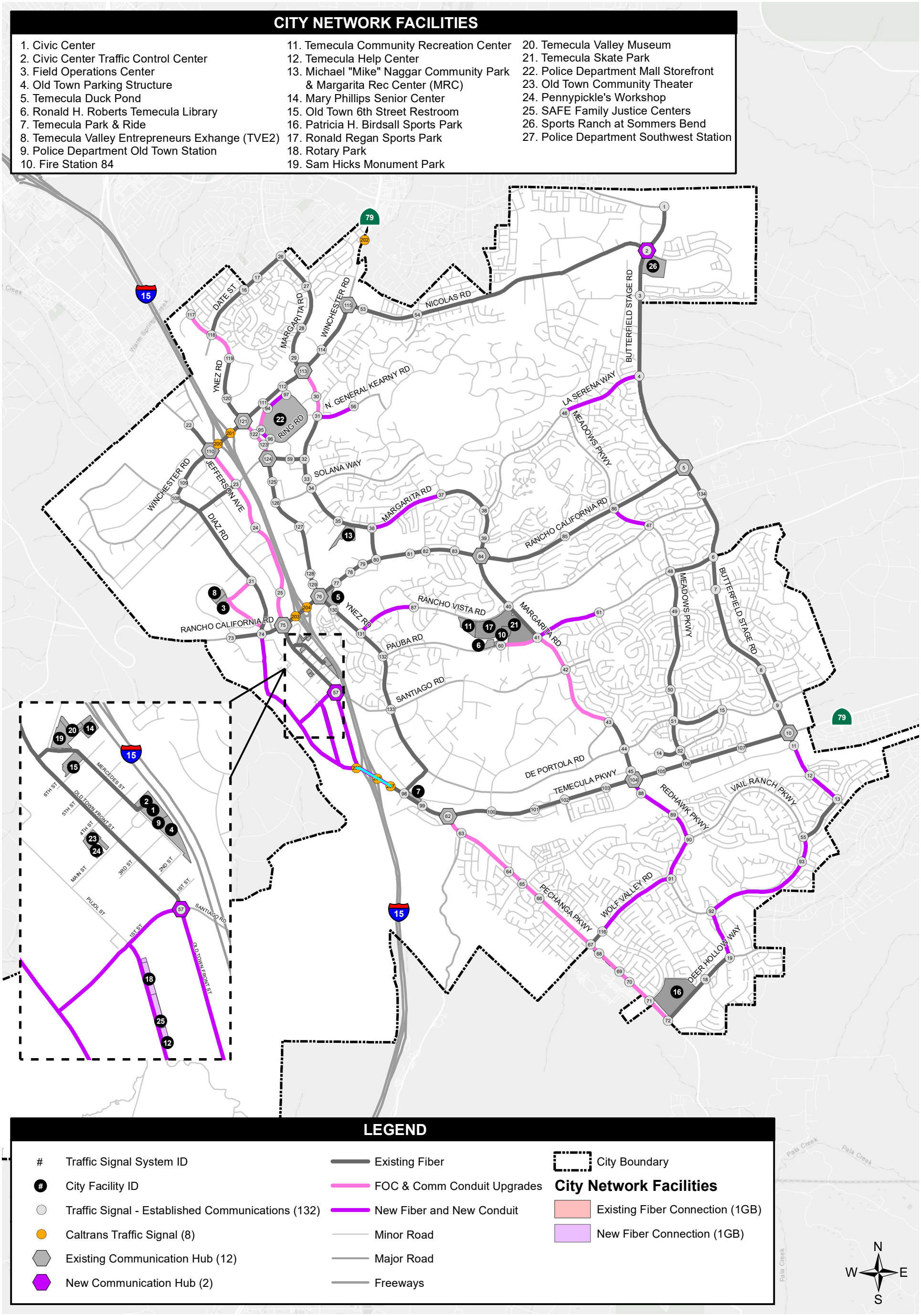
ID	Roadway	Segment	Proposed Fiber Strands
13	Redhawk Pkwy	Peppercorn Dr to Nighthawk Pass	288-strand SMFOC
14	Redhawk Pkwy	Wolf Valley Rd to Temecula Pkwy	144-strand SMFOC
15	Ring Rd	Promenade Mall W to Promenade Mall E	144-strand SMFOC
16	Ring Rd	Promenade Mall S to Promenade Mall N	144-strand SMFOC
17	Temecula Pkwy	Old Town Front St/Western Bypass to Bedford Ct	288-strand SMFOC
18	Western Bypass	Rancho California Rd to Temecula Pkwy	288-strand SMFOC
19	Wolf Valley Rd	Wolf Creek Dr N/S to Redhawk Pkwy	144-strand SMFOC

Table 7-19: Phase 3 Fiber Optic Infrastructure Implementation at ITSS Facilities

ID	Name	Address	Improvements
12	Temecula Help Center	28922 Pujol St	Fiber Breakout & Comm Equipment
18	Rotary Park	28816 Pujol St	Fiber Breakout & Comm Equipment
25	SAFE Family Justice Centers	28910 Pujol St	Fiber Breakout & Comm Equipment

Citywide buildout is illustrated in **Figure 7-3** on the following page.

Figure 7-3: Phase 3 Citywide Buildout Topology



7.1.6 Phase 3 Order of Magnitude Costs

The Order of Magnitude Costs for Phase 3 are summarized below.

Table 7-20: Project 8 Fiber Optic Cable and Communication Conduit Upgrades Costs

Item	Item Description	Quantity	Unit	Unit Price	Amount
1	Furnish & Install 288-strand SMFOC	50,000	LF	$6.90	**$345,000**
2	Furnish & Install 144-strand SMFOC	5,000	LF	$5.70	**$28,500**
3	Furnish & Install Communication Vault	14	EA	$14,900	**$208,600**
4	Furnish & Install Splice Closure	14	EA	$5,700	**$79,800**
5	Remove & Salvage Existing Pull Box. Furnish & Install No. 6 Pull Box & 45-degree Conduit Sweeps	70	EA	$5,700	**$399,000**
6	RS Existing Pull Box and Connect Existing Conduit with New Continuous Conduit	70	EA	$5,700	**$399,000**
7	Fiber Testing & Documentation	1	LS	$20,000	**$15,000**
				Sub Total:	**$1,479,900**
				Soft Costs (30%):	**$443,970**
				Construction Contingency (30%):	**$443,970**
				Grand Total:	**$2,367,840**

Table 7-21: Project 9 New Fiber Optic Cable and Conduit along Gaps Costs

Item	Item Description	Quantity	Unit	Unit Price	Amount
1	Furnish & Install Ethernet Switch	13	EA	$9,700	**$126,100**
2	Furnish & Install 1U FDU, Splice Cassette, and Cabinet Termination	13	EA	$4,000	**$52,000**
3	Furnish & Install 288-strand SMFOC	44,000	LF	$6.90	**$303,600**
4	Furnish & Install 144-strand SMFOC	16,000	LF	$5.70	**$91,200**
5	Furnish & Install 72-strand SMFOC	17,500	LF	$5.70	**$99,750**
6	Furnish & Install 12-strand SMFO Breakout Cable	2,500	LF	$5.70	**$14,250**
7	Furnish & Install 3" PVC Conduit	70,000	LF	$80	**$5,600,000**
8	Furnish & Install Communication Vault	13	EA	$14,900	**$193,700**
9	Furnish & Install No. 6 Pull Box & 45-degree Conduit Sweeps	100	EA	$5,700	**$570,400**
10	Fiber Testing & Documentation	1	LS	$20,000	**$20,000**
				Sub Total:	**$7070,600**
				Soft Costs (30%):	**$2,121,180**
				Construction Contingency (30%):	**$2,121,180**
				Grand Total:	**$11,312,960**

Table 7-22: Project 10 New Communication Hubs Costs

Item	Item Description	Quantity	Unit	Unit Price	Amount
1	Furnish & Install New Communication Hub	2	EA	$57,000	**$114,000**
2	Fiber Testing & Documentation	1	LS	$15,000	**$15,000**
				Sub Total:	**$129,000**
				Soft Costs (30%):	**$38,700**
				Construction Contingency (30%):	**$38,700**
				Grand Total:	**$206,400**

Table 7-23: Project 11 Fiber Optic Infrastructure at ITSS Facilities Costs

Item	Item Description	Quantity	Unit	Unit Price	Amount
1	Furnish & Install 3" PVC Conduit	3,500	LF	$80	**$280,000**
2	Furnish & Install 12-strand SMFO Breakout Cable	3,200	LF	$5.70	**$18,240**
3	Furnish & Install No. 6 Pull Box & 45-degree Conduit Sweeps	6	EA	$5,700	**$34,200**
4	Fiber Termination at City Facility & Equipment	3	EA	$28,500	**$85,500**
5	Fiber Testing & Documentation	1	LS	$20,000	**$20,000**
				Sub Total:	**$437,940**
				Soft Costs (30%):	**$131,382**
				Construction Contingency (30%):	**$131,382**
				Grand Total:	**$700,704**

7.2 Order of Magnitude Costs

The following tables provide a summary of costs for the communications system master plan deployment and are organized by phase. CIP projects mentioned in the previous section are not accounted for in the order of magnitude costs below.

Table 7-24: Phase 1 Deployment Costs

Project #	Description	Total
1	Communication Hub Upgrades	$224,000
2	Traffic Signal Communication Upgrades	$544,000
3	Fiber Optic Infrastructure Upgrades	$3,023,200
4	Wireless Communications at Remote Locations	$105,600
	Grand Total:	**$3,896,800**

Table 7-25: Phase 2 Deployment Costs

Project #	Description	Total
5	Communication Infrastructure Upgrades at Rancho California Road, Temecula Parkway, and Winchester Road	$1,941,920
6	Communication Hub Upgrades	$323,200
7	Fiber Optic Infrastructure at ITSS Facilities	$1,314,400
	Grand Total:	**$3,579,520**

Table 7-26: Phase 3 Deployment Costs

Project #	Description	Total
8	Fiber Optic Cable and Communication Conduit Upgrades	$2,367,840
9	New Fiber Optic Cable and Conduit along Gaps	$11,312,960
10	New Communication Hubs	$206,400
11	Fiber Optic Infrastructure at ITSS Facilities	$700,704
	Grand Total:	**$14,587,904**

Table 7-27: Deployment Costs by Phase

Phase	Implementation Years	Cost
1	1 through 3	$3,896,800
2	4 through 6	$3,579,520
3	7 through 10	$14,587,904
	Grand Total:	**$22,064,224**

The order of magnitude cost estimate for the Citywide Communication System Master Plan is $22,064,904.

7.3 Funding Sources

The Temecula Public Works and ITSS Departments have utilized a variety of funding sources to plan, build, operate, and maintain the citywide communications systems. Potential funding sources for the CCSMP IPP are identified in the following sections including general funds, capital improvement program (CIP) funds, special revenue fee-based funds, and State and Federal grant funding opportunities. It is recommended that local funding from the City's Annual Operating Budget and Capital Improvement Program (CIP) be allocated and /or reassigned for the improvements identified in the CCSMP. Pursuit of outside grant funding opportunities is also recommended to supplement local funds and accelerate full CCSMP deployment.

7.3.1 Local General Funds and Capital Improvement Program

The City of Temecula's Annual Operating Budget is a financial plan for meeting the goals, programs, policies, and service priorities that the City is committed to providing its citizens. The City's General Fund is a general operating fund that accounts for all resources that are not legally restricted to expenditure for specific purposes, which are designated as special revenue funds.

The City of Temecula's Capital Improvement Program (CIP) is a comprehensive five-year program that identifies individual capital improvement projects and funding sources. Capital project types include circulation, housing, infrastructure, parks and recreation, and Community Facility Districts (CFD). CIP funding sources include City funds, Federal, State, and Local Grants, CFD Funds, Successor Agency Funds, and Special Revenue funds. The City of Temecula's adopted fiscal year (FY) 2024-2028 CIP includes $606,075,009 in funding for capital improvements citywide.

Table 7-28: FY2024-2028 CIP Forecasted Revenue

FY22/23 Amended	FY23/24 Adopted	FY24/25 Projected	FY25/26 Projected	FY26/27 Projected	FY27/28 Projected	Total
$248,927,279	$38,365,005	$21,586,848	$32,729,552	$9,141,417	$9,872,272	$606,075,009

7.3.2 Development Impact Fees

The City of Temecula collects one-time Development Impact Fees (DIF) based on residential and commercial land use and size to mitigate the impact of new development on the community. Funding is used for capital improvements, including transportation infrastructure improvements to maintain existing levels of services throughout the City.

7.3.3 Transportation Uniform Mitigation Fee (TUMF)

The City of Temecula is a Member Jurisdiction of the Western Riverside Council of Governments (WRCOG). Member jurisdictions participate in a Transportation Uniform Mitigation Fee (TUMF) program, which collects fees for new residential, commercial, and industrial development to provide improvements for local and regional traffic systems and ensure new development pays its fair share for the increased traffic created. Fees are based on the land use type and size of the proposed development. WRCOG administers and allocates funds based on Riverside County Transportation Commission (RCTC) jurisdiction groupings, referred to as TUMF Zones, which the City of Temecula receives based on the current TUMF Administration Plan. Fees are used for planning, engineering, right-of-way acquisition, and construction for eligible TUMF facilities and acquisition of open space.

7.3.4 Gas Tax

Voters approved Senate Bill 1, known as the Road Repair and Accountability Act, which collects taxes based on fuel and annual vehicle registration fees to fund transportation improvements. Local governments receive a portion of the funding from the Road Maintenance and Rehabilitation Account. Funding in Temecula is used to account for revenues apportioned under the Streets and Highways Code of the State of California.

7.3.5 Grants

State and Federal grant funding opportunities that the City of Temecula can pursue to supplement local funding sources for the deployment of the CCSMP Implementation Phasing and Prioritization Plan are presented in this subsection.

7.3.6 California Advanced Services Fund (CASF) Rural and Urban Broadband Consortia

California Senate Bill (SB) 156, SB4, and Assembly Bill (AB) 164, and AB 14 were signed by the Governor in 2021 to authorize the California Public Utilities Commission (CPUC) to collect up to $150 million per year until December 31, 2032 for use by the California Advanced Services Fund (CASF) program, which distributes the Rural and Urban Regional Broadband Consortia Account. Funding is provided to eligible

consortiums to facilitate deployment of broadband infrastructure and services. Based on the 2023 CASF Active Consortia Regions, the City of Temecula falls within the Inland Empire Regional Broadband Consortium. This consortium covers San Bernardino and Riverside Counties with representatives from organizations including, but not limited to, local and regional government, public safety, education, healthcare, libraries, parks and recreation, workforce and community-based organizations, tourism, agriculture, and air pollution control or air quality management districts. Eligible funding activities achieve the following objectives:

1. Collaborating with the CPUC to engage regional consortia, local officials, internet service providers (ISPs), stakeholders, and consumers regarding priority areas and cost-effective strategies
2. Identifying CASF infrastructure projects or broadband deployment projects where providers can expand and improve their infrastructure and service offerings to achieve the goal of reaching 98% broadband deployment in each consortia region
3. Applicant assistance for broadband deployment project development/grant application processes
4. Conducting activities that will lead to CASF infrastructure projects or broadband deployment projects, including but not limited to:
    a. Project permitting
    b. Engagement and technical assistance for local government officials and communities
    c. Inventory of public assets (e.g. rights-of-way, publicly owned towers, public utility poles, equipment housing, publicly owned property, etc.), aggregating demand, and identification and updates of priority areas
5. Assisting the CPUC to in publicizing requests for wireline testing volunteers
6. Assisting the CPUC to promote broadband deployment in California through federal funding and other programs including Middle-Mile, Broadband Loan Loss Reserve, and Local Agency Technical Assistance under SB 156 and AB 164

Grant cycles occur annually with application openings in June and due by July. Approximately $10 million in funding is available each cycle.

7.3.7 California Advanced Services Fund (CASF) Broadband Infrastructure Grant Account

California Senate Bill (SB) 156, SB4, and Assembly Bill (AB) 164, and AB 14 were signed by the Governor in 2021 to authorize the California Public Utilities Commission (CPUC) to collect up to $150 million per year until December 31, 2032 for use by the California Advanced Services Fund (CASF) program, which distributes Broadband Infrastructure Grant Account. Funding is provided to local agencies, public entities, and wireless carries for building and deploying broadband networks in underserved or unserved locations, identified on the California Broadband Map as having no fixed facility-based broadband providers with service at speeds of at least 25 Mpbs download and 3 Mbps upload. Eligible projects are within an unserved (no internet connectivity) or underserved (internet speeds at or below 10 Mbps download and 1 Mbps upload) areas and can provide broadband service speeds of at least 100 Mbps download and 20 Mbps upload. Grant funding can also be used to subsidize middle-mile and last-mile infrastructure to expand the State's broadband network, with open access / interconnection points provided wherever

technically feasible at nondiscriminatory, reasonable, and equal terms. This can include, but is not limited to, lease of dark fiber, local transmission services, transport, and dedicated internet access services to other CASF-funded grant recipients. The maximum grant amount is $25 million. Funding varies between 60% for baseline eligible projects to 100% based on specific program criteria. Additional 30% funding is given for areas with US Census Bureau American Community Survey (ACS) or Department of Housing and Community Development's designation for low-income. Additional 10% funding increments are given for:

1. Meeting 3 of the 6 following characteristics:
    a. Rugged or difficult terrain including mountains, desert, and national / state forest
    b. Unincorporated community
    c. More than 10 miles from the nearest hospital
    d. More than 10 miles to the nearest state of federal highway
    e. US Census Bureau designation of rural census block
    f. CPUC Fire-Threat Map designation of extreme or elevated fire threat area
2. Existing outside plant infrastructure, including poles and conduit, that may be upgraded for broadband deployment.
3. Making a significant contribution to the program goal, including areas within broadband consortium regions that do not have broadband internet service at speeds of 25 Mps download / 3 Mps upload to 98% of households.
4. Low-income areas that offer State / Federal-subsidized service or low-cost broadband plans

Grant cycles occur annually with application openings in November / December and due by April of the following year.

7.3.8 California Public Utilities Commission (CPUC) Broadband Equity, Access, and Deployment (BEAD) Program

The Broadband Equity, Access, and Deployment (BEAD) program is a federal funding program authorized by the Infrastructure, Investment and Jobs Act (IIJA), also known as the Bipartisan Infrastructure Law (BIL), that is implemented nationally by the National Telecommunications and Information Administration (NTIA). BEAD funding for the State of California is administered through the California Public Utilities Commission (CPUC), which recently submitted a draft Five-Year Action Plan to NTIA. Following approval and adoption, the CPUC will be able to begin selecting subgrantees based on competitive sub-grant awards, by mid-2024 at the earliest, to carry out broadband deployment activities for:

1. Unserved service projects (i.e. no internet access or under 25 Mps download / 3 Mbps upload)
2. Underserved service projects (i.e. under 100 Mps download /20 Mbps upload)
3. Community anchor institution projects (i.e. 1 Gps download/1 Gps upload for schools, library, health clinic / center, hospital, higher education, public housing organization, or community support organization)
4. Broadband data collection, mapping, and planning
5. Installing internet and Wi-Fi infrastructure or providing reduced-cost broadband within multi-family residential buildings

6. Broadband adoption programs
7. Other activities determined by NTIA

Approximately $4 billion in funding is anticipated to be available from a combination of national BEAD and State Legislature allocations.

7.3.9 California Department of Technology (CDT) Digital Equity Act

The Digital Equity Act program is a federal funding program authorized by the IIJA / BIL and implemented nationally by the NTIA that establishes three grant programs that promote digital equity and inclusion.

1. **State Digital Equity Planning Grant Program:** Formal grant program for States, Territories, and Tribal governments to develop digital equity plans. California has received over $4 million in funding and sub-grants for local and regional stakeholders are anticipated.
2. **Digital Equity Capacity Building Grant Program:** Formula grant program for States, Territories, and Tribal governments to implement digital capacity projects. This program is actively being developed by NTIA and approximately $1.44 billion in funding is anticipated to be available.
3. **Digital Equity Competitive Grant Program:** Annual 5-year competitive grant program to implement digital equity projects. This program is actively being developed by NTIA and approximately $1.25 billion in funding is anticipated to be available.

Digital Equity Act funding for the State of California is administered through the California Department of Technology (CDT), which is actively developing the State Digital Equity Plan (SDEP). The Broadband for All Action Plan will focus on the following goals to meet the State's vision of establishing 98% high-speed internet access and 90% statewide adoption:

1. Access to high-speed internet at homes, schools and libraries
2. Access to affordable internet services and devices
3. Access to digital skills and training

7.3.10 Caltrans Highway Safety Improvement Program (HSIP)

The Highway Safety Improvement Program (HSIP) is a federal funding program authorized by the IIJA / BIL to provide States with funding to achieve significant reduction in fatalities and serious injuries on all public roads. The California Department of Transportation (Caltrans) Division of Local Assistance (DLA) administers California's local agency share of HSIP funds. Projects must be identified on the basis of eligible safety countermeasures, crash experience, and benefit-cost ratio analyses. Based on the 2022 Local Roadway Safety Manual (LRSM) v1.6, there are three countermeasures that would be eligible for deploying traffic signal technology upgrades that support CCSMP implementation:

1. S3 Improve Signal Timing (Coordination, Phases, Red, Yellow, or Operation)
2. S5 Install Emergency Vehicle Pre-Emption Systems
3. S21PB: Modify Signal Phasing to Implement a Leading Pedestrian Interval (LPI)

Grant cycles occur every two years, with call-for-projects announced in May and applications due in September. Cycle 12 is anticipated to be announced in Spring 2024. Available funding typically ranges between $180 million and $240 million, with agencies limited to $10 million in total funding each cycle.

7.3.11 US Department of Transportation (USDOT) Safe Streets and Roads for All (SS4A)

Safe Streets and Roads for All (SS4A) is a federal funding program authorized by the IIJA / BIL to provide regional, local, and Triabal funding to prevent roadway deaths and serious injuries. Implementation grants carry out specific projects and strategies identified in eligible existing Action Plans that address roadway safety. Implementation grant projects can utilize innovative technologies and strategies to reduce serious deaths and injuries. Eligible commercially available technologies include, but are not limited to:

1. Intelligent Transportation Systems
2. Vehicle-to-Infrastructure (C2X) communications
3. Adaptive signal timing
4. Variable speed limits

Grant cycles occur annually until 2026 with notice of funding opportunity (NOFO) announced in April and applications due in July. FY24 is anticipated to be announced in Spring 2024. Approximately $1 billion in funding is available, with implementation grant awards ranging from $2.5 million to $25 million.

7.3.12 USDOT Strengthening Mobility and Revolutionizing Transportation (SMART)

The Strengthening Mobility and Revolutionizing Transportation (SMART) grant program is a federal funding program authorized by the IIJA / BIL to provide public sector agencies with funding to plan, prototype, and implement advanced smart community technologies and systems in order to improve transportation efficiency and safety. Eligible projects demonstrate at least one technology category:

1. Coordinated automation
2. Connected vehicles
3. Sensors
4. Systems integration
5. Delivery / logistics
6. Innovative aviation
7. Smart grid
8. Traffic signals

Grant cycles occur annually until 2026 with notice of funding opportunity (NOFO) announced in August and applications due in October. FY24 funding is anticipated to be announced in Fall of 2024. Approximately $100 million in funding is available, with implementation grant awards ranging from $250,000 to $15 million.

7.3.13 Federal Highway Administration (FHWA) Advanced Transportation Technologies and Innovation (ATTAIN)

The IIJA / BIL amended the Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) program to be renamed Advanced Transportation Technologies and Innovative Mobility Development (ATTIMD). The Federal Highway Administration (FHWA) implements and refers to the ATTIMD program as Advanced Transportation Technology and Innovation (ATTAIN), which is a federal

funding program that provides competitive grants to deploy, install, and operate advanced transportation technologies to improve safety, mobility, efficiency, system performance, intermodal connectivity, and infrastructure return on investment. Eligible advanced transportation and congestion management technologies include:

1. Advanced transportation technologies to improve emergency evacuation and responses by Federal, State, and local authorities
2. Integrated corridor management systems
3. Advanced parking reservation or variable pricing systems
4. Electronic pricing, toll collection, and payment systems
5. Technology that enhances high occupancy vehicle toll lanes, cordon pricing, or congestion pricing
6. Integration of transportation service payment systems
7. Advanced mobility access and on-demand transportation service technologies, such as dynamic ridesharing and other shared-use mobility applications and information systems to support human services for elderly and disabled individuals
8. Retrofitting dedicated short-range communications (DSRC) technology to cellular vehicle-to-everything (C-V2X) technology
9. Advanced transportation technologies

Grant cycles occur annually until 2026 with notice of funding opportunity (NOFO) announced in September and applications due in November. FY24 is anticipated to be announced in Fall 2024. Approximately $60 million in funding is available, with implementation grant awards ranging from $2.5 million to $25 million.

Table 7-29 on the following page summarizes grant funding programs by agency, program, and eligible activities.

Table 7-29: Grant Funding Programs

Agency	Grant Program	Eligible Activities
California Public Utilities Commission (CPUC)	California Advanced Services Fund (CASF) Rural and Urban Regional Broadband Consortia	Projects for broadband infrastructure and service deployment that support program objectives for: - Collaboration with CPUC, regional consortia, local officials, ISPs, stakeholders, and consumers on priority areas and cost-effective strategies - Identifying CASF infrastructure projects and broadband service deployment projects - Applicant assistance for broadband deployment project development and grant processes - Activities that lead to CASF infrastructure projects or broadband deployment projects, including project permitting, engagement / technical assistance, inventory of public assets - Wireline testing volunteers - Promoting broadband deployment through federal / other funding programs
California Public Utilities Commission (CPUC)	CASF Broadband Infrastructure Grant Account	Projects for broadband infrastructure and service deployment that support underserved areas (below 10/1 Mbps) or unserved areas that can provide broadband service speeds of at least 100/20 Mbps. Includes middle-mile and last-mile infrastructure if reasonable open access / interconnection points are provided to other CASF-funded grant recipients.
National Telecommunications and Information Administration (NTIA) & California Public Utilities Commission (CPUC)	Broadband Equity, Access, and Deployment (BEAD) Program	Projects that support the California BEAD 5-Year Action Plan's Implementation Plan for: - Unserved areas (below 25/3 Mbps) / high-cost locations in the State - Underserved areas (below 100/20 Mps) - Community anchor institutions (1/1 Gps) - Broadband data collection, mapping, and planning - Installing internet and Wi-Fi infrastructure or providing reduced-cost broadband within multi-family residential buildings - Broadband adoption programs
National Telecommunications and Information Administration (NTIA) & California Department of Technology (CDT)	Digital Equity Act	Projects that support the forthcoming California State Digital Equity Plan and implement digital equity and inclusion. The Broadband for All Plan will focus on: - Access to high-speed internet at homes, schools, and libraries - Access to affordable internet services and devices - Access to digital skills and training

Agency	Grant Program	Eligible Activities
California Department of Transportation (Caltrans)	Highway Safety Improvement Program (HSIP)	Projects that have up to 3 safety countermeasures (CMs) from the Local Roadway Safety Manual. CMs that may be used for technology upgrades include: - S3: Improve signal timing (coordination, phases, red, yellow, or operation) - S5: Install emergency vehicle pre-emption systems - S21PB: Modify signal phasing to implement a Leading Pedestrian Interval (LPI)
US Department of Transportation (USDOT) Office of the Secretary	Safe Streets and Roads for All (SS4A)	Projects included in an eligible Action Plan that use innovative technologies and strategies to reduce deaths and serious injuries and provide a nexus for roadway safety. Eligible commercially available technology examples include, but are not limited to: - Intelligent transportation systems - Vehicle-to-Infrastructure (V2X) communications - Adaptive signal timing - Variable speed limits
US Department of Transportation (USDOT) Office of the Assistant Secretary for Research and Technology (OST-R)	Strengthening Mobility and Revolutionizing Transportation (SMART)	Projects that demonstrate at least 1 technology area: - Coordinated Automation - Connected Vehicles - Intelligent, Sensor-Based Infrastructure - Systems Integration - Commerce Delivery and Logistics - Innovative Aviation Technology - Smart Grid - Smart Technology Traffic Signals
Federal Highway Administration (FHWA)	Advanced Transportation Technologies and Innovation (ATTAIN)	Advanced transportation & congestion management technologies including: - Emergency evacuation and response technologies - Integrated corridor management systems - Advanced parking reservation or variable pricing systems - Electronic pricing, toll collection, and payment systems - High occupancy vehicle toll lanes, cordon pricing, and congestion pricing - Advanced mobility access and on-demand transportation service technologies including dynamic ridesharing, shared-use mobility applications, and human services information systems for elderly and disabled individuals - Retrofitting DSRC technology to C-V2X - Advanced transportation technologies

APPENDIX A

EXISTING SYSTEM ARCHITECTURE SCHEMATIC

Temecula
The Heart of Southern California
Wine Country

Existing System Architecture Schematic

JEFFERSON AVE & SANBORN AVE — TS CABINET — ES

MARGARITA RD & WINCO DWY — TS CABINET — SM

- MARGARITA RD & HARVESTON WAY
- MARGARITA RD & RUSTIC GLEN DR / HARVESTON SCHOOL RD

MARGARITA RD & DATE ST — TS CABINET — SM

- DATE ST & KINGWOOD RD
- DATE ST & LAKEVIEW RD / BLACKSTONE RD

DATE ST & YNEZ RD — TS CABINET — ES, CFMC

DATE ST & WAVERLY LN — TS CABINET — ES

DATE ST & EQUITY DR — TS CABINET — ES

WINCHESTER RD & JEFFERSON AVE — COMM CABINET — IC, ES

TO RANCHO CALIFORNIA RD & JEFFERSON AVE TS CABINET

WINCHESTER RD & DIAZ RD — TS CABINET — ES

WINCHESTER RD & ENTERPRISE CIR — TS CABINET — ES

WINCHESTER RD & JEFFERSON AVE — TS CABINET — ES

WINCHESTER RD & YNEZ RD — COMM CABINET — IC, ES

WINCHESTER RD & YNEZ RD — TS CABINET — ES

WINCHESTER RD & PROMENADE MALL W — TS CABINET — ES

WINCHESTER RD & PROMENADE MALL E — TS CABINET — ES

WINCHESTER RD & MARGARITA RD — COMM CABINET — IC, ES

WINCHESTER RD & MARGARITA RD — TS CABINET — ES

WINCHESTER RD & RORIPAUGH RD — TS CABINET — ES

WINCHESTER RD & NICOLAS RD — COMM CABINET — IC, ES

WINCHESTER RD & NICOLAS RD — TS CABINET — CFMC, ES

WINCHESTER RD & WINCHESTER CREEK AVE - WILLOWS AVE — TS CABINET — SM

NICOLAS RD RORIPAUGH RD — TS CABINET — SM

NICOLAS RD N GENERAL KEARNY RD — TS CABINET — SM

RING RD & PROMENADE MALL E — TS CABINET — ES

MARGARITA RD & N GENERAL KEARNY RD — TS CABINET — ES

JEFFERSON AVE & OVERLAND DR — COMM CABINET — ES

YNEZ RD & OVERLAND DR — COMM CABINET — IC, ES

RING RD & PROMENADE MALL N — TS CABINET — ES

RING RD & PROMENADE MALL W — TS CABINET — ES

YNEZ RD & TOWN CENTER S - TOWER PLAZA S — TS CABINET — SM

- YNEZ RD & TOWN CENTER N - TOWER PLAZA N
- YNEZ RD & DLR DR
- YNEZ RD & YNEZ CT
- YNEZ RD & MOTOR CAR PKWY

YNEZ RD & OVERLAND DR — TS CABINET — SM

OVERLAND DR & PROMENADE WAY - NICOLE LN — TS CABINET — SM

OVERLAND DR & MARGARITA RD — TS CABINET — SM

MARGARITA RD & SOLANA RIDGE — TS CABINET — SM

MARGARITA RD & SOLANA WAY — TS CABINET — SM

MARGARITA RD & STONEWOOD RD — TS CABINET — SM

MARGARITA RD & MORAGA RD — TS CABINET — SM

RANCHO CALIFORNIA RD & VINCENT MORAGA DR / DIAZ RD — SPLICE CABINET

RANCHO CALIFORNIA RD & VINCENT MORAGA DR / DIAZ RD — TS CABINET — ES

RANCHO CALIFORNIA RD & BUSINESS PARK DR / RIDGE PARK DR — TS CABINET — ES

FIELD OPERATIONS CENTER

RANCHO WAY & DIAZ RD — COMM CABINET — ES

RANCHO WAY & DIAZ RD — TS CABINET — ES

MARGARITA RD & YUKON RD - HONORS DR — TS CABINET — SM

MARGARITA RD & LA SERENA WAY — TS CABINET — SM

MARGARITA RD & AVENIDA BARCA — TS CABINET — SM

RANCHO CALIFORNIA RD & JEFFERSON AVE — COMM CABINET — CFMC, CFMC, CFMC, MC, ES, ES, CFMC

* ROUTED THROUGH MC

RANCHO CALIFORNIA RD & JEFFERSON AVE — TS CABINET — ES

RANCHO CALIFORNIA RD & YNEZ RD — COMM CABINET — IC, ES

RANCHO CALIFORNIA RD & YNEZ RD — TS CABINET — ES

RANCHO CALIFORNIA RD & HOPE WAY / TOWN CENTER — TS CABINET — ES

RANCHO CALIFORNIA RD & VIA LAS COLINAS — TS CABINET — ES

RANCHO CALIFORNIA RD & LYNDIE RD — TS CABINET — ES

RANCHO CALIFORNIA RD & MORAGA RD — TS CABINET — ES

RANCHO CALIFORNIA RD & RENDEVOUZ RD / PORTOFINO — TS CABINET — ES

RANCHO CALIFORNIA RD & COSMIC DR / HUMBER DR — TS CABINET — ES

RANCHO CALIFORNIA RD & YUKON RD / ASTEROID WAY — TS CABINET — IC, ES

RANCHO CALIFORNIA RD & MARGARITA RD — TS CABINET — CFMC, IC, ES

RANCHO CALIFORNIA RD & MEADOWS PKWY — TS CABINET — ES

RANCHO CALIFORNIA RD & TEE DR — TS CABINET — ES

RANCHO CALIFORNIA RD & BUTTERFIELD STAGE RD — TS CABINET — ES

BUTTERFIELD STAGE RD & AVENIDA LESTONNAC — TS CABINET — ES

BUTTERFIELD STAGE RD & LA SERENA WAY — TS CABINET — ES

BUTTERFIELD STAGE RD & CALLE CHAPOS — TS CABINET — ES

BUTTERFIELD STAGE RD & NICOLAS RD — TS CABINET — ES

BUTTERFIELD STAGE RD & MURRIETA HOT SPRINGS RD — TS CABINET — ES

* ROUTED THROUGH:
- RANCHO CALIFORNIA RD & YNEZ RD IC
- TEMECULA PKWY & PECHANGA PKWY IC

ROUTED THROUGH RANCHO CALIFORNIA RD & YNEZ RD IC *

TO WINCHESTER RD/ NICOLAS RD TS CABINET

YNEZ RD & TIERRA VISTA RD — TS CABINET — SM

- YNEZ RD & RANCHO VISTA RD
- YNEZ RD & PAUBA RD

YNEZ RD & SANTIAGO RD — TS CABINET — SM

* TO TMC ROUTED THROUGH:
- RANCHO CALIFORNIA RD & JEFFERSON AVE MC
- RANCHO CALIFORNIA RD & YNEZ RD IC
- RANCHO CALIFORNIA RD & YUKON RD IC
- RANCHO CALIFORNIA RD & MARGARITA RD IC

RONALD H. ROBERTS TEMECULA PUBLIC LIBRARY (30600 PAUBA RD)

SOMMERS BEND SPORTS PARK

6TH ST PARKING LOT PUBLIC RESTROOMS

IT SERVER ROOM

OLD TOWN FRONT ST & 1ST ST - SANTIAGO RD

MARGARITA RD & RANCHO VISTA RD — TS CABINET — ES

MARGARITA RD & PAUBA RD — TS CABINET — IC

MARGARITA RD & SANTIAGO RD — TS CABINET — IC

MARGARITA RD & DE PORTOLA RD — TS CABINET — ES

MARGARITA RD & DARTOLO RD — TS CABINET — ES

TEMECULA PKWY & BEDFORD CT — COMM CABINET — ES

TEMECULA PKWY & LA PAZ RD — TS CABINET — ES

TEMECULA PKWY & WABASH LN — TS CABINET — ES

TEMECULA PKWY & PECHANGA PKWY — COMM CABINET — IC, ES, CFMC

TEMECULA PKWY & PECHANGA PKWY — TS CABINET — ES

TEMECULA PKWY & JEDEDIAH SMITH RD — TS CABINET — ES

TEMECULA PKWY & RANCHO COMMUNITY CENTER — TS CABINET — ES

TEMECULA PKWY & RANCHO PUEBLA / AVENIDA DE MISIONES — TS CABINET — ES

TEMECULA PKWY & COUNTRY GLEN WAY — TS CABINET — ES

TEMECULA PKWY & MARGARITA RD — TS CABINET — ES

TEMECULA PKWY & CAMINO DEL SOL — TS CABINET — ES

TEMECULA PKWY & MEADOWS PKWY/ APIS RD — TS CABINET — ES

TEMECULA PKWY & MAHLON VAIL RD — TS CABINET — ES

TEMECULA PKWY & BUTTERFIELD STAGE RD — TS CABINET — CFMC, ES

- BUTTERFIELD STAGE RD & DE PORTOLA RD
- BUTTERFIELD STAGE RD & PAUBA RD
- MEADOWS PKWY & PAUBA RD

MEADOWS PKWY & DE PORTOLA RD — TS CABINET — SM

DE PORTOLA RD & CAMPANULA WAY — TS CABINET — SM

MEADOWS PKWY & CAMPANULA WAY — TS CABINET — SM

CAMPANULA WAY & CAMINO DEL SOL — TS CABINET — SM

JEFFERSON AVE & VIA MONTEZUMA — TS CABINET — ES

JEFFERSON AVE & OVERLAND DR — TS CABINET — ES

JEFFERSON AVE& SANBORN AVE — TS CABINET — ES

PECHANGA PKWY & RAINBOW VALLEY BLVD — TS CABINET — SM

- PECHANGA PKWY & MUIRFIELD DR
- PECHANGA PKWY & LOMA LINDA RD
- PECHANGA PKWY & VIA CONSUELO - WOLF CREEK DR N

PECHANGA PKWY & WOLF VALLEY RD - VIA EDUARDO — TS CABINET — SM

- PECHANGA PKWY & N CASINO DR
- PECHANGA PKWY & CASINO DR
- PECHANGA PKWY & PECHANGA RESORT DR
- PECHANGA PKWY & GREAT OAK DR - WOLF CREEK DR S

PECHANGA PKWY & DEER HOLLOW WAY — TS CABINET — SM

DEER HOLLOW WAY & VIA LA COLORADA - PEACH TREE ST — TS CABINET — SM

DEER HOLLOW WAY & PEPPERCORN DR - JON WILLIAM WAY — TS CABINET — SM

WOLF VALLEY RD & WOLF CREEK DR N - WOLF CREEK DR S — TS CABINET — SM

BUTTERFIELD STAGE RD & NIGHTHAWK PASS — TS CABINET — SM

LEGEND:

- CITY FACILITY
- TRAFFIC SIGNAL CABINET
- COMMUNICATIONS CABINET
- SPLICE CABINET
- COMMUNICATION CABINET W/ CROSS-CONNECT
- ES — ETHERNET SWITCH
- CFMC — COPPER FIBER MEDIA CONVERTER
- SM — SERIAL MODEM
- MC — MAIN CROSS-CONNECT
- IC — INTERMEDIATE CROSS-CONNECT
- FIBER OPTIC MEDIA
- COPPER WIRE INTERCONNECT
- TS — TRAFFIC SIGNAL
- ●●● — CONTINUING MEDIA

Plotted By:Miguel Lomeli February 07, 2023 12:18:56pm R:\Shared With Me\STC Data\Projects\Temecula\22.0944_Fiber Optic Communication System - Citywide, PW22-03\07_Engineering\CADD\DLV\Temecula Network Architecture_BH2.dwg

APPENDIX B

COMMUNICATION SYSTEM DEFICIENCY IDENTIFICAITON – TRAFFIC SIGNAL LIST

Temecula
The Heart of Southern California
Wine Country

Traffic Signal System ID	Name	Communication System Deficiency
1	Butterfield Stage Rd & Murrieta Hot Springs Rd	None - Existing Fiber Media
2	Butterfield Stage Rd & Nicolas Rd	None - Existing Fiber Media
3	Butterfield Stage Rd & Calle Chapos	None - Existing Fiber Media
4	Butterfield Stage Rd & La Serena Way	None - Existing Fiber Media
5	Butterfield Stage Rd & Rancho California Rd	None - Existing Fiber Media
6	Butterfield Stage Rd & Pauba Rd	Obsolete Equipment
7	Butterfield Stage Rd & Royal Crest Pl/Rothenberg Dr	Obsolete Equipment
8	Butterfield Stage Rd & Crowne Hill Dr	Obsolete Equipment
9	Butterfield Stage Rd & De Portola Rd	Obsolete Equipment
10	Butterfield Stage Rd & Temecula Pkwy	None - Existing Fiber Media
11	Butterfield Stage Rd & Wolf Store Rd	Obsolete Equipment
12	Butterfield Stage Rd & Welton Way/Channel St	Obsolete Equipment
13	Butterfield Stage Rd & Nighthawk Pass	Obsolete Equipment
14	Campanula Way & Camino Del Sol	Obsolete Equipment
15	Campanula Way E & De Portola Rd	Obsolete Equipment
16	Date Street & Lakeview Road	Obsolete Equipment
17	Date & Kingwood	Obsolete Equipment
18	Deer Hollow Way & Peach Tree/Via La Coloarada	Obsolete Equipment
19	Deer Hollow Way & Peppercorn Dr	Obsolete Equipment
21	Diaz Rd & Rancho Way	Communication System Gap
22	Jefferson Ave & Sanborn Ave	Communication System Gap
23	Jefferson Ave & Overland Dr	Communication System Gap
24	Jefferson Ave & Via Montezuma	Communication System Gap
25	Jefferson Ave & Del Rio	Communication System Gap
26	Margarita Rd & Date St	Obsolete Equipment
27	Margarita Rd & Rustic Glen Dr/Harveston School Rd	Obsolete Equipment
28	Margarita Rd & Harveston Way	Obsolete Equipment
29	Margarita Rd & Winco-Ralphs Dwy	Obsolete Equipment
30	Margarita Rd & Verdes Ln	Communication System Gap
31	Margarita Rd & N.General Kearny Rd	Communication System Gap
32	Margarita Rd & Overland Dr	Obsolete Equipment
33	Margarita Rd & Abbott Vascular/Solana Ridge	Obsolete Equipment
34	Margarita Rd & Solana Way	Obsolete Equipment
35	Margarita Rd & Stonewood Rd	Obsolete Equipment
36	Margarita Rd. & Moraga Rd.	Obsolete Equipment
37	Margarita Rd & Avenida Barca	Obsolete Equipment
38	Margarita Rd & La Serena Way	Obsolete Equipment
39	Margarita Rd & Yukon Rd/Honors Dr	Obsolete Equipment
40	Margarita Rd & Rancho Vista Rd	None - Existing Fiber Media
41	Margarita Rd & Pauba Rd	Communication System Gap
42	Margarita Rd & Santiago Rd	Communication System Gap
43	Margarita Rd & Pio Pico Rd	Communication System Gap
44	Margarita Rd & De Portola Rd	None - Existing Fiber Media
45	Margarita Rd & Dartolo Rd	None - Existing Fiber Media
46	Meadows Pkwy & La Serena Way	Communication System Gap
47	Meadows Pkwy & Rancho Vista Rd	Communication System Gap
48	Meadows Pkwy & Pauba Rd	Obsolete Equipment

Traffic Signal System ID	Name	Communication System Deficiency
49	Meadows Pkwy & McCabe Dr/Sunny Meadows Dr	Obsolete Equipment
50	Meadows Pkwy & Leena Way	Obsolete Equipment
51	Meadows Pkwy & De Portola Rd	Obsolete Equipment
52	Meadows Pkwy & Campanula Way	Obsolete Equipment
53	Nicolas Rd & Rancho Temecula Town Center	Obsolete Equipment
54	Nicolas Rd & North General Kearny Rd	Obsolete Equipment
55	Nighthawk Pass & Vail Ranch /Redhawk	Obsolete Equipment
56	North General Kearny Rd & Camino Campos Verdes	Communication System Gap
57	Old Town Front St & Santiago Rd/First St	None - Existing Fiber Media
59	Overland Dr & Promenade Way/Nicole Ln	Obsolete Equipment
60	Pauba Rd & Calle Ventura/Fire Station 84	Communication System Gap
61	Pauba Rd & Via Rami/Linfield Way	Communication System Gap
62	Pechanga Pkwy & Temecula Pkwy	None - Existing Fiber Media
63	Pechanga Pkwy & Rainbow Canyon Rd	Communication System Gap
64	Pechanga Pkwy & Muirfield Dr	Communication System Gap
65	Pechanga Pkwy & Loma Linda Rd	Communication System Gap
66	Pechanga Pkwy & Wolf Creek Dr N	Communication System Gap
67	Pechanga Pkwy & Wolf Valley Rd/Via Eduardo	Communication System Gap
68	Pechanga Pkwy & Casino Dr North	Communication System Gap
69	Pechanga Pkwy & Casino Dr South	Communication System Gap
70	Pechanga Pkwy & Pechanga Resort Dr	Communication System Gap
71	Pechanga Pkwy & Wolf Creek Dr S/Great Oak Dr	Communication System Gap
72	Pechanga Pkwy & Deer Hollow Way	Communication System Gap
73	Rancho California Rd & Business Park Dr W/Ridge Park Dr	None - Existing Fiber Media
74	Rancho California Rd & Diaz Rd	None - Existing Fiber Media
75	Rancho California Rd & Jefferson Ave/Old Town Front	None - Existing Fiber Media
76	Rancho California Rd & Ynez Rd	None - Existing Fiber Media
77	Rancho California Rd & Town Center Dr/Hope Wy	None - Existing Fiber Media
78	Rancho California Rd & Via Las Colinas	None - Existing Fiber Media
79	Rancho California Rd & Lyndie Ln	None - Existing Fiber Media
80	Rancho California Rd & Moraga Rd	None - Existing Fiber Media
81	Rancho California Road & Portofino/Rendezvous Drive	None - Existing Fiber Media
82	Rancho California Rd & Cosmic Dr/Humber Dr	None - Existing Fiber Media
83	Rancho California Rd & Yukon Rd/Asteroid Way	None - Existing Fiber Media
84	Rancho California Rd & Margarita Rd	None - Existing Fiber Media
85	Rancho California & Tee Dr	None - Existing Fiber Media
86	Rancho California Rd & Meadows Pkwy	None - Existing Fiber Media
87	Rancho Vista Rd & Mira Loma Dr	Communication System Gap
88	Redhawk Pkwy & Via Rio Temecula/Wolf Store Rd	Obsolete Equipment
89	Redhawk Pkwy & Overland Tr/Paseo Parallon	Obsolete Equipment
90	Redhawk Pkwy & Vail Ranch Pkwy	Obsolete Equipment
91	Redhawk Pkwy & Wolf Valley Rd	Communication System Gap
92	Redhawk Pkwy & Peppercorn Dr	Communication System Gap
93	Redhawk Pkwy & El Chimisal Rd/Tehachapi Pass	Communication System Gap
94	Ring Rd & Promenade Mall W. (Winchester)	Communication System Gap
95	Ring Rd & Promenade Mall N. (Ynez)	Communication System Gap
96	Ring Rd & Promenade Mall S. (Ynez)	Communication System Gap
97	Ring Rd & Promenade Mall E	None - Existing Fiber Media

Traffic Signal System ID	Name	Communication System Deficiency
98	Temecula Pkwy & La Paz St	None - Existing Fiber Media
99	Temecula Pkwy & Wabash Ln	None - Existing Fiber Media
100	Temecula Pkwy & Jedediah Smith Rd	None - Existing Fiber Media
101	Temecula Pkwy & Kevin Pl/Rancho Community	None - Existing Fiber Media
102	Temecula Pkwy & Ave. De Missiones/Rancho Pueblo Rd	None - Existing Fiber Media
103	Temecula Pkwy & Country Glen Way	None - Existing Fiber Media
104	Temecula Pkwy & Margarita Rd/Redhawk Pkwy	None - Existing Fiber Media
105	Temecula Pkwy & Camino Del Sol	None - Existing Fiber Media
106	Temecula Pkwy & Meadows Pkwy/Apis Rd	None - Existing Fiber Media
107	Temecula Pkwy & Mahlon Vail Rd	None - Existing Fiber Media
108	Winchester Rd & Diaz Rd.	None - Existing Fiber Media
109	Winchester Rd & Enterprise Circle	None - Existing Fiber Media
110	Winchester Rd & Jefferson Ave	None - Existing Fiber Media
111	Winchester Rd & Promenade Mall W.	None - Existing Fiber Media
112	Winchester Rd & Promenade Mall E./Margarita Meadows	None - Existing Fiber Media
113	Winchester Rd & Margarita Rd	None - Existing Fiber Media
114	Winchester Rd & Roripaugh Rd	None - Existing Fiber Media
115	Winchester Rd & Nicolas Rd	None - Existing Fiber Media
116	Wolf Valley Rd & Wolf Creek Dr N/S	Obsolete Equipment
117	Ynez Rd & Waverly Ln/Temecula Center Dr	Communication System Gap
118	Ynez Rd & Date St	Communication System Gap
119	Ynez Rd & Equity Dr	Communication System Gap
120	Ynez Rd & County Center Dr	Communication System Gap
121	Ynez Rd & Winchester Rd	None - Existing Fiber Media
122	Ynez Rd & Promenade Mall/Palm Plaza N	Obsolete Equipment
123	Ynez Rd & Promenade Mall/Palm Plaza S	Obsolete Equipment
124	Ynez Rd & Overland Drive	Obsolete Equipment
125	Ynez Rd & Motor Car Pkwy	Obsolete Equipment
126	Ynez Rd & Solana Way	Obsolete Equipment
127	Ynez Rd & DLR Dr/Ynez Ct	Obsolete Equipment
128	Ynez Rd & Town Center/Tower Plaza N	Obsolete Equipment
129	Ynez Rd & Town Center/Tower Plaza S	Obsolete Equipment
130	Ynez Rd & Tierra Vista Road	Obsolete Equipment
131	Ynez Rd & Rancho Vista Rd	Obsolete Equipment
132	Ynez Rd & Pauba Road	Obsolete Equipment
133	Ynez Rd & Santiago Road	Obsolete Equipment
134	Butterfield Stage Rd & Lestonnac	None - Existing Fiber Media

APPENDIX C

TRAFFIC SIGNAL SYSTEM NETWORK BANDWIDTH CALCULATIONS

Temecula
The Heart of Southern California
Wine Country

Traffic Signal Network Group	Traffic Signal System ID	Intersection	Intersection Demand (Mbps)	Sub Group	Sub Group Demand (Mbps)	Aggregated Traffic Signal Network Group Demand (Mbps)
1	21	Diaz Rd & Rancho Way	24.54	1-T1		
1	73	Rancho California Rd & Business Park Dr W/Ridge Park Dr	24.54	1-T1		
1	74	Rancho California Rd & Diaz Rd	24.54	1-T1		
1	108	Winchester Rd & Diaz Rd.	24.54	1-T1	171.78	
1	109	Winchester Rd & Enterprise Circle	24.54	1-T1		
1	110	Winchester Rd & Jefferson Ave	24.54	1-T1		
1	22	Jefferson Ave & Sanborn Ave	24.54	1-T1-B1		
1	23	Jefferson Ave & Overland Dr	24.54	1-T2		**368.1**
1	24	Jefferson Ave & Via Montezuma	24.54	1-T2	98.16	
1	25	Jefferson Ave & Del Rio	24.54	1-T2		
1	75	Rancho California Rd & Jefferson Ave/Old Town Front	24.54	1-T2		
1	–	Reserved	24.54	1-F-T3		
1	–	Reserved	24.54	1-F-T3	98.16	
1	–	Reserved	24.54	1-F-T3		
1	–	Reserved	24.54	1-F-T3		
2	16	Date Street & Lakeview Road	24.54	2-T1		
2	17	Date & Kingwood	24.54	2-T1		
2	26	Margarita Rd & Date St	24.54	2-T1		
2	27	Margarita Rd & Rustic Glen Dr/Harveston School Rd	24.54	2-T1		
2	28	Margarita Rd & Harveston Way	24.54	2-T1	245.4	**245.4**
2	29	Margarita Rd & Winco-Ralphs Dwy	24.54	2-T1		
2	118	Ynez Rd & Date St	24.54	2-T1		
2	119	Ynez Rd & Equity Dr	24.54	2-T1		
2	120	Ynez Rd & County Center Dr	24.54	2-T1		
2	117	Ynez Rd & Waverly Ln/Temecula Center Dr	24.54	2-T1-B1		
3	121	Ynez Rd & Winchester Rd	24.54	3-T1		
3	122	Ynez Rd & Promenade Mall/Palm Plaza N	24.54	3-T1	73.62	
3	123	Ynez Rd & Promenade Mall/Palm Plaza S	24.54	3-T1		
3	111	Winchester Rd & Promenade Mall W.	24.54	3-T2	49.08	
3	112	Winchester Rd & Promenade Mall E./Margarita Meadows	24.54	3-T2		
3	113	Winchester Rd & Margarita Rd	24.54	3-T3	49.08	
3	114	Winchester Rd & Roripaugh Rd	24.54	3-T3		
3	53	Nicolas Rd & Rancho Temecula Town Center	24.54	3-T4		**392.64**
3	54	Nicolas Rd & North General Kearny Rd	24.54	3-T4	73.62	
3	115	Winchester Rd & Nicolas Rd	24.54	3-T4		
3	94	Ring Rd & Promenade Mall W. (Winchester)	24.54	3-T5		
3	95	Ring Rd & Promenade Mall N. (Ynez)	24.54	3-T5	98.16	
3	96	Ring Rd & Promenade Mall S. (Ynez)	24.54	3-T5		
3	97	Ring Rd & Promenade Mall E	24.54	3-T5		
3	–	Reserved	24.54	3-F-T6	49.08	
3	–	Reserved	24.54	3-F-T6		
4	124	Ynez Rd & Overland Drive	24.54	4-T1		
4	125	Ynez Rd & Motor Car Pkwy	24.54	4-T1		
4	126	Ynez Rd & Solana Way	24.54	4-T1	147.24	**147.24**
4	127	Ynez Rd & DLR Dr/Ynez Ct	24.54	4-T1		
4	128	Ynez Rd & Town Center/Tower Plaza N	24.54	4-T1		
4	129	Ynez Rd & Town Center/Tower Plaza S	24.54	4-T1		
5	30	Margarita Rd & Verdes Ln	24.54	5-T1		
5	31	Margarita Rd & N.General Kearny Rd	24.54	5-T1		
5	32	Margarita Rd & Overland Dr	24.54	5-T1		
5	33	Margarita Rd & Abbott Vascular/Solana Ridge	24.54	5-T1		
5	34	Margarita Rd & Solana Way	24.54	5-T1		
5	35	Margarita Rd & Stonewood Rd	24.54	5-T1	294.48	**294.48**
5	36	Margarita Rd. & Moraga Rd.	24.54	5-T1		
5	37	Margarita Rd & Avenida Barca	24.54	5-T1		
5	38	Margarita Rd & La Serena Way	24.54	5-T1		
5	39	Margarita Rd & Yukon Rd/Honors Dr	24.54	5-T1		
5	56	North General Kearny Rd & Camino Campos Verdes	24.54	5-T1-B1		
5	59	Overland Dr & Promenade Way/Nicole Ln	24.54	5-T1-B2		

Traffic Signal Network Group	Traffic Signal System ID	Intersection	Intersection Demand (Mbps)	Sub Group	Sub Group Demand (Mbps)	Aggregated Traffic Signal Network Group Demand (Mbps)
6	2	Butterfield Stage Rd & Nicolas Rd	24.54	6-T1		
6	3	Butterfield Stage Rd & Calle Chapos	24.54	6-T1		
6	4	Butterfield Stage Rd & La Serena Way	24.54	6-T1	122.7	
6	1	Butterfield Stage Rd & Murrieta Hot Springs Rd	24.54	6-T1-B1		
6	46	Meadows Pkwy & La Serena Way	24.54	6-T1-B1		**220.86**
6	–	Reserved	24.54	6-F-T2		
6	–	Reserved	24.54	6-F-T2	98.16	
6	–	Reserved	24.54	6-F-T2		
6	–	Reserved	24.54	6-F-T2		
7	5	Butterfield Stage Rd & Rancho California Rd	24.54	7-T1		
7	76	Rancho California Rd & Ynez Rd	24.54	7-T1		
7	77	Rancho California Rd & Town Center Dr/Hope Wy	24.54	7-T1		
7	78	Rancho California Rd & Via Las Colinas	24.54	7-T1		
7	79	Rancho California Rd & Lyndie Ln	24.54	7-T1		
7	80	Rancho California Rd & Moraga Rd	24.54	7-T1		
7	81	Rancho California Road & Portofino/Rendezvous Drive	24.54	7-T1	319.02	
7	82	Rancho California Rd & Cosmic Dr/Humber Dr	24.54	7-T1		**368.1**
7	83	Rancho California Rd & Yukon Rd/Asteroid Way	24.54	7-T1		
7	84	Rancho California Rd & Margarita Rd	24.54	7-T1		
7	85	Rancho California & Tee Dr	24.54	7-T1		
7	86	Rancho California Rd & Meadows Pkwy	24.54	7-T1		
7	47	Meadows Pkwy & Rancho Vista Rd	24.54	7-T1-B1		
7	–	Reserved	24.54	7-F-T2	49.08	
7	–	Reserved	24.54	7-F-T2		
8	57	Old Town Front St & Santiago Rd/First St	24.54	8-T1		
8	130	Ynez Rd & Tierra Vista Road	24.54	8-T2		
8	131	Ynez Rd & Rancho Vista Rd	24.54	8-T2	147.24	
8	132	Ynez Rd & Pauba Road	24.54	8-T2		
8	133	Ynez Rd & Santiago Road	24.54	8-T2		
8	87	Rancho Vista Rd & Mira Loma Dr	24.54	8-T2-B1		**294.48**
8	98	Temecula Pkwy & La Paz St	24.54	8-T3	49.08	
8	99	Temecula Pkwy & Wabash Ln	24.54	8-T3		
8	–	Reserved	24.54	8-F-T4		
8	–	Reserved	24.54	8-F-T4	98.16	
8	–	Reserved	24.54	8-F-T4		
8	–	Reserved	24.54	8-F-T4		
9	40	Margarita Rd & Rancho Vista Rd	24.54	9-T1		
9	41	Margarita Rd & Pauba Rd	24.54	9-T1		
9	42	Margarita Rd & Santiago Rd	24.54	9-T1		
9	43	Margarita Rd & Pio Pico Rd	24.54	9-T1	196.32	
9	44	Margarita Rd & De Portola Rd	24.54	9-T1		**245.4**
9	45	Margarita Rd & Dartolo Rd	24.54	9-T1		
9	60	Pauba Rd & Calle Ventura/Fire Station 84	24.54	9-T1-B1		
9	61	Pauba Rd & Via Rami/Linfield Way	24.54	9-T1-B2		
9	–	Reserved	24.54	9-F-T2	49.08	
9	–	Reserved	24.54	9-F-T3		
10	62	Pechanga Pkwy & Temecula Pkwy	24.54	10-T1		
10	100	Temecula Pkwy & Jedediah Smith Rd	24.54	10-T1		
10	101	Temecula Pkwy & Kevin Pl/Rancho Community	24.54	10-T1	147.24	
10	102	Temecula Pkwy & Ave. De Missiones/Rancho Pueblo Rd	24.54	10-T1		**171.78**
10	103	Temecula Pkwy & Country Glen Way	24.54	10-T1		
10	104	Temecula Pkwy & Margarita Rd/Redhawk Pkwy	24.54	10-T1		
10	–	Reserved	24.54	10-F-T2	24.54	

Traffic Signal Network Group	Traffic Signal System ID	Intersection	Intersection Demand (Mbps)	Sub Group	Sub Group Demand (Mbps)	Aggregated Traffic Signal Network Group Demand (Mbps)
11	6	Butterfield Stage Rd & Pauba Rd	24.54	11-T1	147.24	**441.72**
11	7	Butterfield Stage Rd & Royal Crest Pl/Rothenberg Dr	24.54	11-T1		
11	8	Butterfield Stage Rd & Crowne Hill Dr	24.54	11-T1		
11	9	Butterfield Stage Rd & De Portola Rd	24.54	11-T1		
11	10	Butterfield Stage Rd & Temecula Pkwy	24.54	11-T1		
11	209	Butterfield Stage Rd & Lestonnac	24.54	11-T1		
11	48	Meadows Pkwy & Pauba Rd	24.54	11-T2	171.78	
11	49	Meadows Pkwy & McCabe Dr/Sunny Meadows Dr	24.54	11-T2		
11	50	Meadows Pkwy & Leena Way	24.54	11-T2		
11	51	Meadows Pkwy & De Portola Rd	24.54	11-T2		
11	52	Meadows Pkwy & Campanula Way	24.54	11-T2		
11	14	Campanula Way & Camino Del Sol	24.54	11-T2-B1		
11	15	Campanula Way E & De Portola Rd	24.54	11-T2-B2		
11	105	Temecula Pkwy & Camino Del Sol	24.54	11-T3	73.62	
11	106	Temecula Pkwy & Meadows Pkwy/Apis Rd	24.54	11-T3		
11	107	Temecula Pkwy & Mahlon Vail Rd	24.54	11-T3		
11	–	Reserved	24.54	11-F-T4	49.08	
11	F4	Reserved	24.54	11-F-T4		
12	18	Deer Hollow Way & Peach Tree/Via La Coloarada	24.54	12-T1	49.08	**343.56**
12	19	Deer Hollow Way & Peppercorn Dr	24.54	12-T1		
12	63	Pechanga Pkwy & Rainbow Canyon Rd	24.54	12-T2	269.94	
12	64	Pechanga Pkwy & Muirfield Dr	24.54	12-T2		
12	65	Pechanga Pkwy & Loma Linda Rd	24.54	12-T2		
12	66	Pechanga Pkwy & Wolf Creek Dr N	24.54	12-T2		
12	67	Pechanga Pkwy & Wolf Valley Rd/Via Eduardo	24.54	12-T2		
12	68	Pechanga Pkwy & Casino Dr North	24.54	12-T2		
12	69	Pechanga Pkwy & Casino Dr South	24.54	12-T2		
12	70	Pechanga Pkwy & Pechanga Resort Dr	24.54	12-T2		
12	71	Pechanga Pkwy & Wolf Creek Dr S/Great Oak Dr	24.54	12-T2		
12	72	Pechanga Pkwy & Deer Hollow Way	24.54	12-T2		
12	116	Wolf Valley Rd & Wolf Creek Dr N/S	24.54	12-T2-B1		
12	–	Reserved	24.54	12-F-T3	24.54	
13	11	Butterfield Stage Rd & Wolf Store Rd	24.54	13-T1	73.62	**343.56**
13	12	Butterfield Stage Rd & Welton Way/Channel St	24.54	13-T1		
13	13	Butterfield Stage Rd & Nighthawk Pass	24.54	13-T1		
13	55	Nighthawk Pass & Vail Ranch /Redhawk	24.54	13-T2	49.08	
13	93	Redhawk Pkwy & El Chimisal Rd/Tehachapi Pass	24.54	13-T2		
13	88	Redhawk Pkwy & Via Rio Temecula/Wolf Store Rd	24.54	13-T3	122.7	
13	89	Redhawk Pkwy & Overland Tr/Paseo Parallon	24.54	13-T3		
13	90	Redhawk Pkwy & Vail Ranch Pkwy	24.54	13-T3		
13	91	Redhawk Pkwy & Wolf Valley Rd	24.54	13-T3		
13	92	Redhawk Pkwy & Peppercorn Dr	24.54	13-T3		
13	–	Reserved	24.54	13-F-T4	98.16	
13	–	Reserved	24.54	13-F-T4		
13	–	Reserved	24.54	13-F-T4		
13	–	Reserved	24.54	13-F-T4		

APPENDIX D

ORDER OF MAGNITUDE COST ESTIMATES

Temecula
The Heart of Southern California
Wine Country

PHASE 1 ORDER OF MAGNITUDE COST ESTIMATE

Item: 1
Description: Communication Hub Upgrades

Item #	Item Description	Quantity	Unit	Unit Price	Amount
1	Furnish & Install 4U FDU, Splice Cassette, and Cabinet Termination	6	EA	$15,000	**$90,000**
2	Furnish & Install Splice Closure	6	EA	$5,000	**$30,000**
3	Fiber Testing & Documentation	1	LS	$20,000	**$20,000**
				Sub Total:	**$140,000**
				Soft Costs (30%):	**$42,000**
				Construction Contingency (30%):	**$42,000**
				Grand Total:	**$224,000**

Item: 2
Description: Fiber Breakout Cables and Communication Equipment at Traffic Signal Cabinets

Item #	Item Description	Quantity	Unit	Unit Price	Amount
1	Furnish & Install Ethernet Switch	25	EA	$8,500	**$212,500**
2	Furnish & Install 1U FDU, Splice Cassette, and Cabinet Termination.	25	EA	$3,500	**$87,500**
3	Furnish & Install 12-strand SMFO Breakout Cable	5,000	LF	$5	**$25,000**
4	Fiber Testing & Documentation	1	LS	$15,000	**$15,000**
				Sub Total:	**$340,000**
				Soft Costs (30%):	**$102,000**
				Construction Contingency (30%):	**$102,000**
				Grand Total:	**$544,000**

Item: 3
Description: Installation of New Fiber Optic Infrastructure at Locations with Existing Copper Wire Interconnect and Communication Conduit Upgrades

Item #	Item Description	Quantity	Unit	Unit Price	Amount
1	Furnish & Install Ethernet Switch	29	EA	$8,500	**$246,500**
2	Furnish & Install 1U FDU, Splice Cassette, and Cabinet Termination.	29	EA	$3,500	**$101,500**
3	Furnish & Install 288-strand SMFOC	32,000	LF	$6	**$192,000**
4	Furnish & Install 144-strand SMFOC	33,000	LF	$5	**$165,000**
5	Furnish & Install 72-strand SMFOC	6,000	LF	$5	**$30,000**
6	Furnish & Install 12-strand SMFO Breakout Cable	6,500	LF	$5	**$32,500**
7	Furnish & Install Splice Closure	29	EA	$5,000	**$145,000**
8	Furnish & Install Communication Vault	29	EA	$13,000	**$377,000**
9	Remove & Salvage Existing Pull Box. Furnish & Install No. 6 Pull Box & 45-degree Conduit Sweeps	57	EA	$5,000	**$285,000**
10	RS Existing Pull Box and Connect Existing Conduit with New Continous Conduit	57	EA	$5,000	**$285,000**
11	Fiber Testing & Documentation	1	LS	$30,000	**$30,000**
				Sub Total:	**$1,889,500**
				Soft Costs (30%):	**$566,850**
				Construction Contingency (30%):	**$566,850**
				Grand Total:	**$3,023,200**

Item: 4

Description: Wireless Communication Upgrades at Remote Locations

Item #	Item Description	Quantity	Unit	Unit Price	Amount
1	Furnish & Install Wireless Radio	3	EA	$8,000	**$24,000**
2	Furnish & Install Repeater	2	EA	$10,000	**$20,000**
3	Furnish & Install Ethernet Switch	2	EA	$8,500	**$17,000**
4	Wireless Testing and Documentation	1	LS	$5,000	**$5,000**
				Sub Total:	**$66,000**
				Soft Costs (30%):	**$19,800**
				Construction Contingency (30%):	**$19,800**
				Grand Total:	**$105,600**

Phase 1 Grand Total:	**$3,896,800**

PHASE 2 ORDER OF MAGNITUDE COST ESTIMATE

Item: 5
Description: Fiber Optic Infrastructure Upgrades at Rancho California Road, Temecula Parkway, and Winchester Road

Item #	Item Description	Quantity	Unit	Unit Price	Amount
1	Furnish & Install 288-strand SMFOC	73,000	LF	$6.50	**$474,500**
2	Furnish & Install 72-strand SMFOC	2,000	LF	$5.40	**$10,800**
3	Furnish & Install Communication Vault	36	EA	$14,000	**$504,000**
4	Furnish & Install Splice Closure	36	EA	$5,400	**$194,400**
5	Fiber Testing & Documentation	1	LS	$30,000	**$30,000**
				Sub Total:	**$1,213,700**
				Soft Costs (30%):	**$364,110**
				Construction Contingency (30%):	**$364,110**
				Grand Total:	**$1,941,920**

Item: 6
Description: Communication Hub Upgrades

Item #	Item Description	Quantity	Unit	Unit Price	Amount
1	Furnish & Install 4U FDU, Splice Cassette, and Cabinet Termination	2	EA	$16,000	**$32,000**
2	Furnish & Install New Communication Hub	3	EA	$50,000	**$150,000**
3	Fiber Testing & Documentation	1	LS	$20,000	**$20,000**
				Sub Total:	**$202,000**
				Soft Costs (30%):	**$60,600**
				Construction Contingency (30%):	**$60,600**
				Grand Total:	**$323,200**

Item: 7
Description: Fiber Optic Infrastructure to ITSS Facilities

Item #	Item Description	Quantity	Unit	Unit Price	Amount
1	Furnish & Install 3" PVC Conduit	8,000	LF	$70	**$560,000**
2	Furnish & Install 12-strand SMFO Breakout Cable	8,500	LF	$5.40	**$45,900**
3	Furnish & Install No. 6 Pull Box & 45-degree Conduit Sweeps	14	EA	$5,400	**$75,600**
4	Fiber Termination at City Facility & Equipment	5	EA	$25,000	**$125,000**
5	Fiber Testing & Documentation	1	LS	$15,000	**$15,000**
				Sub Total:	**$821,500**
				Soft Costs (30%):	**$246,450**
				Construction Contingency (30%):	**$246,450**
				Grand Total:	**$1,314,400**

Phase 2 Grand Total:	**$3,579,520**

PHASE 3 ORDER OF MAGNITUDE COST ESTIMATE

Item: 8
Description: Fiber Optic Cable and Communication Conduit Upgrades

Item #	Item Description	Quantity	Unit	Unit Price	Amount
1	Furnish & Install 288-strand SMFOC	50,000	LF	$6.90	**$345,000**
2	Furnish & Install 144-strand SMFOC	5,000	LF	$5.70	**$28,500**
3	Furnish & Install Communication Vault	14	EA	$14,900	**$208,600**
4	Furnish & Install Splice Closure	14	EA	$5,700	**$79,800**
5	Remove & Salvage Existing Pull Box. Furnish & Install No. 6 Pull Box & 45-degree Conduit Sweeps	70	EA	$5,700	**$399,000**
6	RS Existing Pull Box and Connect Existing Conduit with New Continous Conduit	70	EA	$5,700	**$399,000**
7	Fiber Testing & Documentation	1	LS	$20,000	**$20,000**
				Sub Total:	**$1,479,900**
				Soft Costs (30%):	**$443,970**
				Construction Contingency (30%):	**$443,970**
				Grand Total:	**$2,367,840**

Item: 9
Description: New Fiber Optic Cable and Conduit along Gaps

Item #	Item Description	Quantity	Unit	Unit Price	Amount
1	Furnish & Install Ethernet Switch	13	EA	$9,700	**$126,100**
2	Furnish & Install 1U FDU, Splice Cassette, and Cabinet Termination.	13	EA	$4,000	**$52,000**
3	Furnish & Install 288-strand SMFOC	44,000	LF	$6.90	**$303,600**
4	Furnish & Install 144-strand SMFOC	16,000	LF	$5.70	**$91,200**
5	Furnish & Install 72-strand SMFOC	17,500	LF	$5.70	**$99,750**
6	Furnish & Install 12-strand SMFO Breakout Cable	2,500	LF	$5.70	**$14,250**
7	Furnish & Install 3" PVC Conduit	70,000	LF	$80	**$5,600,000**
8	Furnish & Install Communication Vault	13	EA	$14,900	**$193,700**
9	Furnish & Install No. 6 Pull Box & 45-degree Conduit Sweeps	100	EA	$5,700	**$570,000**
10	Fiber Testing & Documentation	1	LS	$20,000	**$20,000**
				Sub Total:	**$7,070,600**
				Soft Costs (30%):	**$2,121,180**
				Construction Contingency (30%):	**$2,121,180**
				Grand Total:	**$11,312,960**

Item: 10
Description: New Communication Hubs

Item #	Item Description	Quantity	Unit	Unit Price	Amount
1	Furnish & Install New Communication Hub	2	EA	$57,000	**$114,000**
2	Fiber Testing & Documentation	1	LS	$15,000	**$15,000**
				Sub Total:	**$129,000**
				Soft Costs (30%):	**$38,700**
				Construction Contingency (30%):	**$38,700**
				Grand Total:	**$206,400**

PHASE 3 ORDER OF MAGNITUDE COST ESTIMATE

Item: 11
Description: Fiber Optic Infrastructure to ITSS Facilities

Item #	Item Description	Quantity	Unit	Unit Price	Amount
1	Furnish & Install 3" PVC Conduit	3,500	LF	$80	**$280,000**
2	Furnish & Install 12-strand SMFO Breakout Cable	3,200	LF	$5.70	**$18,240**
3	Furnish & Install No. 6 Pull Box & 45-degree Conduit Sweeps	6	EA	$5,700	**$34,200**
4	Fiber Termination at City Facility & Equipment	3	EA	$28,500	**$85,500**
5	Fiber Testing & Documentation	1	LS	$20,000	**$20,000**
				Sub Total:	**$437,940**
				Soft Costs (30%):	**$131,382**
				Construction Contingency (30%):	**$131,382**
				Grand Total:	**$700,704**

Phase 3 Grand Total:	**$14,587,904**