SAN MARCOS

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MANUAL FOR TRAFFIC SIGNAL DESIGNS & INSTALLATIONS

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APPROVED BY:

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City Traffic Engineer

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This manual establishes uniform procedures for the design preparation of traffic signal plans and installation in the City of San Marcos. It is not intended as a textbook or as a substitute for solid working knowledge, experience and judgment of the principles of traffic signal design, but rather as a guideline to uniformity and to provide the designer and installer with sufficient information to prepare the desired plans with a minimum of uncertainty.

Deviations from these specifications shall be requested from the City Engineer for approval prior to commencement of work.

NOTE: Revisions to these guidelines shall be noted in the revision log below. The Engineer of Work should check with the Transportation Engineering Section of the City of San Marcos to confirm the copy in use is updated with the latest revisions.

REVISION LOG

REVISION DATE	CHANGES
06/26/17	New - Manual for Traffic Signal Designs and Installations

1.0 GENERAL TRAFFIC SIGNAL DESIGN REQUIREMENTS

The Engineer-of-Work preparing to design traffic signal plans shall utilize this traffic signal manual and the following:

1) Utilize the latest edition of Caltrans Standard Plans, Specifications (Section 86), and Special Provisions.

2) Utilize the latest edition of California Manual on Uniform Traffic Control Devices (CAMUTCD) recommended design practices.

3) Utilize the 2015 "Greenbook" Standard Specifications for Public Works Construction, Part 7, Street Lighting and Traffic Signal Systems.

4) At the onset of work, discuss design concepts with the City's Project Engineer. Upon preparation of base plans and preliminary design, meet with the City's Project Engineer to review and "redline" the design concept.

5) The Engineer-of-Work shall verify all existing traffic signal and related traffic improvements as to current state of repair and conformance to current standards, for re-use, replacement, salvage, and/or disposal.

1.1 Utility Research/Field Checks

1) Coordinate with San Diego Gas and Electric (SDG&E) and City Public Works staff for the service point(s) and show the service points on the plans.

2) The Engineer shall be responsible for locating proposed traffic signal poles to reduce potential underground and overhead utility conflicts. Send the plans to all utility companies (SDGE, AT&T, Cox Communications, Vallecitos Water District, Rincon Water District, and Vista Irrigation District) for utility location and conflict review.

3) A utility mark-out shall be conducted prior to completion of the plans in order to identify potential conflicts with existing substructures. Utility mark-outs shall be conducted using a temporary paint that can be removed by power wash.

4) In areas of critical location and at the direction of the City Engineer, potholing shall be conducted to determine potential conflicts. A record of the potholing showing depth, width, location, and unusual obstructions in the potholes shall be provided with the plans after potholing.

5) Field verification or ground survey of existing roadway lane widths, conflicting trees, and existing roadway striping and signage shall be performed prior to preparation of new traffic signal design and striping plans.

1.2 Submittals

Submittals shall include the following:

1) The first plan-check submittal shall be at least 90% complete. Plans not conforming to the standards herein will be returned to the design engineer for correction without further review.

2) Title sheet with general notes. The title sheet shall also include a note identifying the revision date of the City of San Marcos Traffic Signal Manual for Traffic Signal Designs and Installations.

3) Civil, signing and striping, and traffic control plans. (If applicable).

4) Provide three (3) full size bound sets of check prints and one full size Adobe PDF file for each submittal.

5) The City of San Marcos requires all final approved traffic signal plans to be prepared on 24-inch x 36-inch Mylar sheets with a ½ inch margin on all sides except the left side, which shall be 1½ inches, and waterproof ink in order to ensure legible reduced prints.

6) Provide files of plans in both AutoCAD and Adobe PDF format on CDROM disk(s)/or flash drive(s) to the City Engineer upon completion of final design.

7) The Engineer-of-Work shall be a Civil Engineer with current California registration and shall sign and seal the finalized Plans.

2.0 TRAFFIC SIGNAL DESIGN PLAN

1) Traffic signal plans shall include new and existing curb and gutter, right-of-way, maintenance easements showing all existing utilities, all traffic signal interconnect cable, and City boundary lines. All widths shall be clearly labeled and dimensioned to the centerline.

2) All traffic signal plans shall be prepared using latest release of AutoCAD.

2.1 Drafting Requirements

The City of San Marcos requires the traffic signal plans to be drafted as follows:

1) Traffic Signal Design Plans shall conform to the styles (notes, leaders, and symbols) presented in CAMUTCD Figure 4D-108(CA) Typical Traffic Signal Installation.

2) Traffic Signal Design Plans topographic lines and symbols shall conform to Caltrans Standard Plan A10B and equipment symbols and abbreviations shall conform to Caltrans Standard Plans ES-1A and ES-1B.

3) Prepare plans on standard "D" sheet size with the current City of San Marcos title block and sheet style. An electronic CADD file of the current City title block may be obtained from the City's Engineering Department.

4) Computer aided drafting or "Leroy" Lettering with a minimum text height of one-tenth inch (0.10").

5) Plans shall be drawn in the U.S. Customary System at a 1" = 20' scale. Metric shall not be used.

6) North shall always be oriented up or to the right on all plans. The north arrow shall be located in the upper right hand corner.

7) The major arterial shall always be horizontal on the plans.

8) Squares shall be used to designate construction notes.

9) For as-builts, inverted triangles and clouding shall be used to indicate plan revisions.

10) The hierarchy of screening is as follows: proposed design highest, then existing conditions, and utilities should be screened back to appear lightest. Topographic survey line work shall be cleaned up and only appropriate conditions shown (i.e. clean up vegetation, and convert symbols to standard styles).

11) Generally, signing and striping modifications shall be provided on separate plan sheets unless modifications are minor and can be neatly presented on the traffic signal plan.

12) The design plan shall include standard traffic signal construction notes. Refer to Section 2.4.6.

13) The nearest practical SDG&E service vault shall be shown on plan.

2.2 Phase Requirements

1) Traffic signal phase two (2) should be on the major street (the street with the higher classification or higher volume of traffic) in the northbound or the eastbound direction. If the arterials are apparently of equal importance, the City's Engineering Division shall designate the major arterial.

2) Left turn signal phasing should be considered on a case by case basis. At new intersections left turn phasing should be installed along any street classified as Major or above, but not automatically on minor streets. At new intersections, use projected volumes in determining the installation of left turn phasing on the minor street.

3) Protected Permissive Phasing (PPLT) is not allowed.

4) Split phasing should be considered for special circumstances with geometric conditions such as optional lanes or offset intersections. Care must be given to crosswalk placement.

5) Right turn overlaps should be considered where there is a dedicated right turn lane, there is a high number of right turn traffic, and the volume of right turn and corresponding left turn traffic is similar. Care must be given to conflicting U-turns.

6) Every signalized intersection should have pedestrian crossings on each approach with a marked pedestrian crosswalk, pedestrian phase, and curb ramps shall be constructed on all corners with truncated domes (dimensions compliant to the latest ADA requirement, and color and type as approved by the City Engineer).

   Exceptions to the guidelines listed above shall require approval by the City Project Engineer.

2.3 Schedules and Run Numbers

2.3.1 Pole Schedule

1) All plans shall contain a pole schedule and shall conform to CAMUTCD Table 4D-105 (CA) Pole and Equipment Schedule.

2) Poles shall be identified by lettering which corresponds to the pole schedule. The pole closest to the controller cabinet is pole “A” and continue lettering the poles clockwise around the intersection.

2.3.2 Conduit and Conductor Schedule

1) All plans shall contain a conduit and conductor schedule and shall conform to CAMUTCD Table 4D-106 (CA) Conductor and Conduit Schedule.

2) Conduit runs shall be identified by numbering and shall start at the farthest conduit crossing from the controller corner and increase toward the home run pullbox. The home run conduits shall have the highest identification numbers.

2.3.3 Detector Schedule

1) Group each set of loops, with a maximum of four loops to a set.

2) Advance loops are separated into one set for each approach lane.

3) Front loops shall be grouped by lane.

4) A bicycle lane loop is not grouped with any other loops.

5) Left-turn lane loops are grouped together by lane. At the beginning of the left turn lane a single advance left turn lane loop shall be grouped separately.

6) Right-turn lane loops are grouped together by lane.

7) Sneak-by loops are not grouped together with any other loops.

8) Each set of loops is assigned to a separate detector channel. Advance loops and bicycle loops need to be assigned to a channel which permits assignment of unique carry values through the 2070 LX controller software. Right-turn-only and sneak-by loops need to be assigned to a channel which permits assignment of delay values through the 2070 LX controller software.

9) Loop sets are numbered beginning with the advance loops for phase two. Continue numbering towards the intersection, working from the curb out. Continue clockwise around the intersection. All detector loop cables to be labeled for each lane assignment, in cabinet with permanent type P – touch labeling or equal.

2.4 Plan Notes

The following notes shall appear on the traffic signal plan TITLE SHEET (not the design sheet).

2.4.1 Declaration of Responsible Charge

"I hereby declare that I am the engineer of work for this project and that I have exercised responsible charge over the design of this project as defined in Section 6703 of the Business and Professions Code, and the design is consistent with current standards. I understand that the check of project drawings and specifications by the City of San Marcos is confined to a review only and does not relieve me as Engineer-of-Work of my responsibilities or project design."

Include signature and dateline for endorsement by the engineer of work. The name, CA registration number and expiration date of the Engineer-of-Work shall be printed below the line.

2.4.2 Work To Be Done

The improvements consist of work to be done according to the project plans and specifications and the latest editions of:

1) City of San Marcos Manual for Traffic Signal Designs & Installations, latest version.

2) Caltrans Standard Specifications and Standard Plans, latest version.

3) California Manual on Uniform Traffic Control Devices (CAMUTCD), latest version.

4) Standard Specifications for Public Works Construction (Green Book), including supplements thereto (for non-traffic signal related work), latest version.

5) San Diego Area Regional Standard Drawings, latest version.

6) Vallecitos Water District Standard Specifications for Construction of Water and Sewer Facilities, latest version.

2.4.3 Traffic Signal General Notes

The following notes shall appear on the traffic signal plan TITLE SHEET (not the design sheet).

1) The location of all existing underground utilities is approximate. The CONTRACTOR shall determine the location and depth of all utilities including those not shown on these plans. Verification of the location and depth of underground utilities and digging for foundations shall be done by hand excavation methods until clear of all underground facilities. All underground utilities shall be protected during construction and expense of repair or replacement of utilities damaged during construction shall be borne by the CONTRACTOR.

2) The CONTRACTOR shall obtain all necessary permits and notify all utilities, agencies, and the City of San Marcos (760) 752-7550 at least 48 hours in advance of construction.

   Before excavating, the CONTRACTOR shall verify locations of underground facilities of the following utilities by contacting the Underground Service Alert at 1-800-277-2600:

   - AT&T
   - Pacific Bell
   - San Diego Gas & Electric
   - Vallecitos Water District
   - Cox Communications

   Utility mark-outs shall be conducted using a temporary paint that can be removed by power wash, if necessary. Add to the plans “the contractor shall remove all mark out paint upon completion of the work”.

3) All property corner monuments shall be undisturbed by construction or improvements. Disturbed monuments shall be reset or replaced by a licensed land surveyor or registered civil engineer authorized to set monuments.

4) Pole, detector and equipment locations are approximate. The City of San Marcos' Engineering Department Inspectors / Traffic Signal Lighting Supervisor shall field verify and approve the exact equipment locations prior to installation.

5) The CONTRACTOR shall provide all necessary traffic control devices during traffic signal installation. A traffic control plan, including the layout of construction warning and detour signs, working hours, and construction schedule shall be submitted to the Engineering Department for approval a minimum of (14) calendar days prior to the commencement of construction. Traffic control shall be implemented before any work is started.

6) All traffic signal conduit and fittings (after the electric meter pedestal) shall be minimum

three inch (3") Schedule 80 PVC. Street crossings shall be four inches (4") minimum, encased in a minimum of twelve inches (12") of 56-C-3250 psi concrete (8" minimum concrete cover to top of pipe). All conduits shall be buried with a minimum of thirty inches (30") of total cover from the top of pipe to finished grade. All conduits shall be sealed upon completion. Street crossings by bore method shall be approved by the City Engineer. All directional bored raceways shall be HDPE typical.

7) All signal conductors, communication cables and other associated wiring shall be labeled (with the Brother P-touch waterproof labels or City approved equal) in the cabinet with associated assignments (lane, phases, channel numbers and communication functions).

8) Curb ramps shall be installed at all curb returns per Title 24, Part 2, State Chapter 71, Site Development Requirements for Handicapped Accessibility, Section 7103, Curb Ramps of the California Building Code, and shall include truncated domes (type and color as directed by the Engineer).

9) All trench excavation and backfill in the public right-of-way shall conform to the requirements of the City of San Marcos' Excavation Ordinance. Minimum 95% compaction is required in all on-site fill areas within ultimate Right-of-Way.

10) A new slurry coat or overlay shall be applied a minimum of 20 feet either side of patch work resulting from excavation work (trenching and potholing) on new streets (slurry coated within last three years) or street with clean and uniform pavement. The determination of existing pavement condition shall be made by the Engineering Division Inspector.

11) The CONTRACTOR shall be responsible for service coordination with SDG&E. The CONTRACTOR shall apply for a new service meter and obtain an SDG&E service order. The City shall provide building addresses for the new service meters.

12) Existing traffic signal facilities, signals and communications shall remain operational until new facilities are cutover or connected or as long as approved by the project inspector. The CONTRACTOR shall be responsible for installation, maintenance and removal of any temporary wiring necessary to maintain signal operational during construction.

13) Luminaires shall conform to the latest City of San Marcos Street Lighting Standards with GE Evolve™ LED Roadway Scalable Cobrahead fixtures for safety lighting.

14) The CONTRACTOR shall be responsible for the installation, relocation or replacement of all striping and signing as required by the City Traffic Engineer. All signs and traffic striping shall conform to the California Manual on Uniform Traffic Control Devices (CAMUTCD) and City of San Marcos Signing and Striping Standards.

15) An "AS-BUILT" drawing shall be submitted for all public improvements prior to the acceptance of said improvements.

16) These plans have been examined by the City of San Marcos Engineering Division to ensure compliance with general engineering standards and the City's design standards and specifications. The Engineer-of-Work shall bear the sole responsibility of the mathematical data and accuracy of design shown hereon.

17) Traffic signal construction shall not commence until all materials including poles, mast arms and controller are on-hand unless otherwise approved by the project inspector.

18) The CONTRACTOR shall be responsible for the installation, relocation or replacement of all traffic loop detectors as required by the Traffic Engineer within 48 hours of direction, or install temporary video detection until loop detector work is completed. Existing traffic signal detector loops damaged during construction shall be replaced within 48 hours of date and time damaged or temporary video detection shall be installed until the damaged loops are replaced. The CONTRACTOR shall furnish and install temporary video detection cameras, detection cards, and other equipment as necessary for full operation. Approval is required by the City's Traffic Signal Supervisor prior to operation. The CONTRACTOR shall repair asphalt paving and apply slurry seal coat after installation of loops.

19) When performing a traffic signal modification work, the CONTRACTOR shall be responsible for ensuring continued operation of the traffic signal throughout the project. If any damages occur, the CONTRACTOR shall respond within 3 hours and restore the operation within 48 hours.

2.4.4 Traffic Signing Notes

Where traffic signing work is required, the City of San Marcos Traffic Signing & Striping Notes shall appear on the traffic signal plan (**refer to the City Traffic Signing & Striping Notes**) TITLE SHEET (not the design sheets).

2.4.5 Traffic Striping Notes

Where traffic striping work is required, the City of San Marcos Traffic Signing & Striping Notes shall appear on the traffic signal plan (**refer to the City Traffic Signing & Striping Notes**) TITLE SHEET (not the design sheet).

2.4.6 Traffic Signal Construction Notes

The following notes shall appear on the traffic signal plan design sheet(s) and shall be amended and/or augmented as required.

1) Furnish and Install model 2070 LX controller unit with McCain Omni eX firmware in a model 352i ATC cabinet with an LED internal light front and back (AVA Technology Part # US2324 or City approved equal), front and back door switches, and rack mounted document drawer located under the controller. Cabinet shall be wired for red monitor and full eight (8)-phase capability including the necessary accessories to provide phasing shown on these plans. Install foundation per Standard Plan ES-3C. Cabinet assembly shall be equipped with RENO model 1101 SS loop detector cards, model 2212-HV-MC conflict monitor, model 2220-MC ADU, a 10.4" flat screen monitor (to be installed only at CCTV locations), Ethernet video remote access card (if video detection is used), fiber patch panel, Ethernet switch, and powerstrip. Any deviation from the specified equipment shall be approved by the City Engineer.

2) Install one, three inch (1-3") (minimum size) DB electrical service conduit and pullrope from the service point to the meter pedestal with thirty inches (30") minimum cover per SDG&E requirements.

3) Furnish and Install Type III-C service per SDG&E requirements and cabinet and foundation as specified by Caltrans Standard Plan ES-2C and ES-2E. Service shall

have separate main disconnect circuit breakers for metered and unmetered sections, plug in type breakers, and 42,000 AIC rating.

4) Furnish and Install a Clary BBS or equivalent system as approved by the City Engineer in a separate UPS cabinet. System shall be Ethernet compatible.

5) Furnish and Install one Opticom model No. 721 (or equivalent as approved by the City Engineer) emergency vehicle pre-emption detector assembly (including mounting hardware, cable, and detector card) for each direction. Furnish and install Opticom Model No. 764 phase selectors in controller cabinet. System shall be Ethernet compatible.

6) Furnish and Install Single Face Reflectorized Street Name Sign (RSNS). All nuts, bolts, washers and fasteners shall be stainless steel. See Pole Schedule for street name(s).

7) Pedestrian signals shall be countdown type and push buttons shall be 2” ADA audible type per the City of San Marcos "Traffic Signal Designs and Installations” manual. Fasteners for Pedestrian Push Button (PPB) sign plate shall be installed with anti-seize compound.

8) New loop detection layout shall be performed after City approved “turkey-tracking” of proposed crosswalks and STOP bar limits.

9) Contractor shall deliver approved salvaged equipment shown on the plans to the San Marcos Public Works Yard at 201 Mata Way. San Marcos, CA 92069. Contact the City's Traffic Signal Supervisor at (760) 752-7550 ext.3334 forty eight hours in advance. Obtain a receipt for all salvaged equipment.

3.0 Design, Installation, and Equipment Requirements

The following sections provide further specifications about special traffic signal design, equipment and installation requirements as required by the City of San Marcos.

3.1 Poles and Mast Arms

3.1.1 Poles

1) Standards shall be placed on opposite sides of the pedestrian ramp (see ES-4C of the 2015 State of California Standard Plans for the typical location of signal standard placement). All traffic signal plans shall indicate required traffic signal pole locations as referenced from BCR, ECR, and curb face.

2) All poles must meet the wind load specified in the latest revision of the State of California Standard Plans.

3) No poles or pull boxes are allowed within the limits of pedestrian ramps including the ramp slopes.

4) Pole anchor bolts shall be cut and finished one-half inch (1/2") above the nut. Base plate bolt covers shall be installed for all standards.

5) Where modifications will leave holes in existing poles, the holes shall be repaired pursuant to State of California Standard Specifications, Section 86-2.04.

3.1.2 Mast Arms

1) Mast arms shall be provided for all approaches unless otherwise approved by the City Engineer.

2) All traffic signal mast arms shall present a uniform and level appearance when complete.

3) If fully-protected left turn phasing is provided, the mast arm shall be long enough to align the left-turn signal head as close as possible to the center of the left-turn lane where there is one left-turn lane, or to the lane line between the left-turn lanes if there are two left-turn lanes.

4) Avoid signal standards in center medians (use only on very wide streets where signal mast arms are not long enough to reach to left-turn lanes).

5) Street light mast arms shall be 15 feet long.

3.2 Pull Boxes

1) All pullboxes (box, lid, extension) shall be concrete and size No. 6 unless otherwise indicated. Pullbox covers shall be stamped "Traffic Signal".

2) The approved manufacture is Christy and the approved models are as follows:

Table 3.1 Pull Boxes Product Numbers

Size	Part Number
#5 Box	C30B-N30 Box
#5 Box Lid	C30R03-N30R Lid
#6 Box	C36B-N36 Box
#6 Box Lid	C36R03-N36R Lid
#6 Box Fiberlyte Lid	FL36T86-FL36T Lid

3) Pull box lids shall not be bolted down.

4) Pull boxes shall not be placed: In raised or painted medians (unless approved by City Engineer), in paved shoulder, in traveled way, in driveways, within one foot of a sidewalk access ramp or flares. Pull boxes shall be located beyond the door opening paths of traffic signal controller cabinets and service cabinets.

5) When retrofitting pedestrian ramps and relocating existing boxes is cost prohibitive, existing pull boxes must be replaced with traffic-rated models and non-skid steel lids and re-installed flush with the concrete surface.

6) Pull boxes shall be spaced at intervals of 200 feet or less.

7) A No. 5 pull box may be used for advance loops.

8) Electrical power pull box shall be No. 5 and shall be placed no more than 20 feet from the service cabinet.

9) Where the sump of an existing pullbox is disturbed by the CONTRACTOR's operations, the sump shall be reconstructed and, if the sump was grouted, the old grout shall be removed and replaced with new grout.

10) The tops of pull boxes installed in the sidewalk area shall be flush with the surrounding grade or the top of the adjacent curb.

3.3 Conduit

1) All traffic signal conduit street crossings or any conduit located within the roadway traveled way (including driveways) shall be schedule 80 rigid PVC and 560-C-3250 psi concrete encased with a minimum of 12" cover. Exceptions to this requirement shall be determined by the City Engineer.

2) Concrete encasement for traffic signal conduit located behind the curb is not required.

3) All conduits shall be three inches (3") minimum. All street crossing conduits shall be four inches (4") minimum, including potential future street crossings and interconnect crossings. All legs of the intersection shall have a conduit crossing installed (one spare with pull rope). Signal interconnect conduits shall be three inches (3") minimum. All conduits shall contain "detectable mule tape" pull rope per State of California Standard Specifications 86-2.05C and a No.8 THWN stranded insulated green trace wire.

4) As much as practical, conduit shall be laid out perpendicular to the curb line of the street crossing under the center of the crosswalk.

5) Conduit fill shall not exceed the NEC maximum of 40% for conduits with three or more conductors. For traffic signal modifications, max percent conduit fill shall be approved by the City Engineer.

6) Install a minimum of three, three-inch (3-3") conduits from controller cabinet base to the adjacent home run pull box with signal cable in one conduit and the balance of conductors in the other. Install signal cable in the first conduit, and interconnect conductors in the second and the balance of conductors in the third.

7) All conduits entering pull boxes, vaults and cabinets shall be protected with duct seal. No open holes are allowed.

3.4 Conductors and Wiring

1) #14 gauge/3 conductor and #14 gauge/12 conductor per Caltrans-Standard Specification 86-2.08 shall be continuous from the signal cabinet to the terminal block on the signal standard it services. No splicing of signal cable shall be permitted unless otherwise directed by the City Engineer.

2) The signal cables shall be labeled in each pull box per State of California Standard Specifications Section 86-2.08D and at the signal cabinet, indicating the cable/wire type and signal standard to which it is connected.

3) All traffic signal field conductors shall have a 5-foot coil of extra wire in each pull box to allow for servicing. The signal conductors shall be organized in a bundle to allow for easy identification of wires and cables.

4) Multi-conductor video cable shall be 6 conductor 2 elements: 18 AWG 5 conductors 7/26 bare copper, 20 AWG 1 conductor, solid bare copper (McCain part number KG-995P or approved equivalent).

5) Loop detector lead-in cable shall be Type B Caltrans Standard 16 AWG.

6) Loop detector wire shall be Type 2. All lead-in DLCs shall be labeled in cabinet with lane number and phase assignment.

7) Conductors for Safety Lighting (SL) shall be No. 10 THW as defined in State of California Standard Specifications Section 86-2.08B. The conductors shall be black and white.

8) The SL conductors may be spliced to branch the SL circuit as it progresses around the intersection.

9) Fused splice connectors shall be installed in the pole hand hole for each luminaire.

10) All field installed wiring shall be Megger-Ohm tested. The CONTRACTOR shall provide documentation showing results that the wiring has passed the test.

3.5 Detection

1) Inductive loop detection is required on all streets and approaches and shall not be substituted unless special conditions exist that preclude the installation of in-pavement detection.

2) The special conditions, for example, may include private driveways, decorative pavements, or bridge decks. In these instances video detection may be utilized and the video detection camera and processor shall be the Iteris system or approved equivalent. The video detection system shall be installed per manufacturer installation specifications. One spare camera shall be furnished for each new intersection constructed.

3) Loop detection shall be installed on all limit line, advance detection, left turn lanes, and bike lanes. Vehicle loops shall be circular Type E (6' diameter) installed per California Standard Plans ES-5.

4) Loops at the crosswalk or stop bar (limit line) shall be Modified Type "E" loops per City of San Diego Drawing SDE-104. Loops shall be installed 1-foot behind the limit line.

5) If an approach has advance detection, install two loops per lane spaced 10 feet apart starting at the crosswalk or stop bar.

6) Install four loops spaced 10 feet apart in advance of the crosswalk or limit line in left-turn lanes and for approach lanes without advance detection.

7) Right-turn only lanes will have 2 loops spaced 10 feet apart. Provide separate DLC to controller cabinet.

8) If there is no right-turn only lane, install one loop at the limit line, adjacent to the curb for sneak-by traffic.

9) All bicycle lane detector loops shall be Type Q.

10) Advance detection is required on all approaches with an 85th percentile speed or posted speed limit greater than 25 mph (if not available, use design speed). Install a single loop per lane with one DLC per loop. Setbacks from the limit line shall be per CAMUTCD Table 4D-101.

3.5.1 Speed and Count Detection

Single speed and count detection shall be installed on the departure side of the major street. The departure side system detection shall be one loop per lane grouped separately and located approximately 150 feet from the approach limit line. All speed and count detection cables and cards shall be labeled in the cabinet with lane number and phase assignment.

3.5.2 Bicycle Detection

1) If the approach has a bike lane, install a six-foot-long Type Q loop, 44 feet in advance of crosswalk or limit line in the bike lane (or where the bike lane drop transition occurs if further back).

2) On streets classified as local, residential or other minor streets with bike lanes, install a six-foot long Type Q loop at the limit line and at 44 feet in advance of the crosswalk/limit line.

3) Width of Type Q loop varies: 6" to 12" inside bike lane line and 6" to 12" outside gutter or other channelization line, providing a 3-foot wide to 4-foot wide loop.

4) For approaches equipped with Video Detection and has a bike lane, configure bike detection zones in Video Detection setup.

3.5.3 Loop Detection Installation

1) Loop detectors shall have 3 clockwise turns of loop wire for each detector.
2) Loop detector saw cut shall be a minimum of 3" deep for the detection zone loop detector wire.
3) The "home-run" part of the loop wire which is the segment from the 3 clockwise turns of the loop detection zone to the pulbox, shall be twisted clockwise with a minimum of 2 turns per foot.
4) The "home-run" saw cut shall be a minimum of 5" deep and no more than 8 wires per sawcut slot.
5) Loop detectors in asphalt shall use rubberized hot melt type sealant (Brewer/Flex or approved equal).

6) Loop detector splices shall be soldered and sealed with heat-shrink containing waterproof sealant.

7) The number of sensor units and lead-in cables required to achieve the specified detection shall be installed.

8) Four (4)-channel sensor units shall not be used.

9) Sensor unit shall be Reno Model C-1101 SS Vehicle Detector or approved equal.

10) The Contractor shall repair asphalt paving and apply slurry seal coat after installation of loops.

3.5.4 Video Detection Installation

When special conditions exist that preclude the installation of in-pavement detection, video detection shall be used. The video detection system shall be Iteris VantageNext system (or City approved equivalent). All installation shall include video processor(s), a flat panel monitor (10.4" TFT LCD video monitor or City approved equal), SURGEPAN assembly, one VantageNext Wide Dynamic Range camera for each approach and one spare camera per intersection, and sufficient extension modules to satisfy the presence detection requirement of the intersection.

3.5.5 Video Detection Cameras Installation

When video detection is to be used, the video detection cameras shall be Iteris Vantage Vector Hybrid (or City approved equivalent) and all related setup equipment including but not limited to Vector Setup Tool (VST). The video detection camera shall have 110VC power provided, operate within the temperature limits of -35ºF to +165ºF with a humidity range of 0-95% RH, have an IP67 rated enclosure. The camera image sensor shall be ¼"CCD, 380,000 effective pixels, 550 Horizontal TV lines, >50 dB S/N ratio, 1.0 lux minimum illumination, 2D/3D Noise Reduction, automatic white balance, and 1.0 Vp-p (sync negative). The lens shall be 12x optical zoom lens with f=3.7mm (wide) to 44.4mm (tele). The camera shall communicate with the video processor via data embedded on a video signal. The radar shall operate at a frequency of 24GHz (K-band), with an accuracy to detect vehicles from 0 to 150 mph ± 1 mph, have the ability to track up to 20 objects, and be able to detect across (4) four lanes of traffic.

3.6 352i ATC Cabinet and Equipment

The model 2070 LX controller and 352i ATC cabinet shall be manufactured and furnished by the same manufacturer.

3.6.1 Conflict Monitor

The conflict monitor shall meet all the requirements of the latest edition of the Caltrans Standard Specifications and shall also meet the following specifications:

1) The conflict monitor shall be a model 2212-HV-MC by McCain (or City-approved equivalent).

2) The base design shall be tested by an independent lab for transient and environmental requirements.

3) The conflict monitor shall have 32 channel capability with a 10/100 Ethernet port.

4) A portable laptop computer shall be required to program or verify monitor setting (only used for log events).

5) The conflict monitor shall be capable of monitoring 5 section heads.

6) The conflict monitor shall display active colors independently during operation.

7) The conflict monitor shall display active colors independently at time of fault.

8) Shall be compatible with a Program Omni eX software.

3.6.2 Controller

1) The Controller shall conform to Caltrans "Traffic Signal Control Equipment Specifications" (latest edition) and be on the latest Caltrans qualified products list.
2) The controller unit shall be a 2070 LX running McCain Omni eX firmware.
3) The 2070 LX controller shall be delivered pre-loaded with the latest version of McCain Omni-eX controller firmware. The controllers shall be delivered at least two weeks prior to scheduled signal turn on.
4) The CONTRACTOR shall furnish a Transparity intersection user license with each controller furnished.

5) The controller manufacturer shall submit a notarized Certificate of Compliance with the State testing specifications prior to or at the time the controller is delivered to the jobsite. The controller shall not be installed until the Certificate is received and approved by the Traffic Engineer /Inspector/City Electrician or their assigned representative. Testing of control equipment and cabinet wiring shall be accomplished by the controller manufacturer in accordance with the State Standard Specifications (all references to State testing facilities or laboratories shall be interpreted as the controller manufacturer's testing facility; however State testing procedures referred to shall remain in effect). All testing costs for the complete control system shall be borne by the CONTRACTOR.

6) The CONTRACTOR shall furnish one (1) maintenance and operation manual for all new controller units, auxiliary equipment, vehicle detector sensor units, ITS and communication equipment and interactive plug-ins to the City's Electrical Lighting Supervisor. The operation and maintenance manuals shall be submitted upon

equipment delivery. The O&M manual(s) shall include, but need not be limited to, the following items:

a) Specifications.
b) Design characteristics.
c) General operation theory.
d) Function of all controls.
e) Troubleshooting procedure (diagnostic routine).
f) Block circuit diagram.
g) Geographical layout of components.
h) Schematic diagrams.
i) List of replaceable component parts with stock numbers.
j) As-built drawings.
k) Detector assignment table.

3.6.3 Controller Cabinet

The controller cabinet shall be model 352i ATC with an anodized aluminum finish and include front and back door switches per Section 700-5.4.3.5 of the 2015 Greenbook Standard Specifications for Public Works Construction.

1) The preferred location for cabinets shall be on the approach-side corner of the minor arterial. Where sufficient right of way exists, a minimum of 48-inches of concrete sidewalk and clearance shall be provided at the front and rear of the cabinet(s) and a minimum of 36- inches of sidewalk and clearance on the sides of the cabinet(s). Clearances shall be unobstructed by any above ground facilities. The City Traffic Engineer must approve any variance from the preferred location.

2) The front side of traffic signal controller cabinet shall be oriented such that the technician faces the intersection when viewing the controller front panel and the front door shall not obstruct the view of the street.

3) The controller cabinet shall be equipped with two LED lights activated by door switches and equipped with fuses (AVA Technology Part # US2324 or City approved equal).

4) The controller cabinet shall be wired for red monitoring.

5) The controller cabinet shall be wired for door alarm monitoring.

6) The controller cabinet shall include emergency vehicle preemption equipment as required.

7) The controller cabinet shall be wired for full 8 phase capability;

8) The controller cabinet shall have vehicle loop detector cards on the Caltrans Qualified Product List, Reno 1101 SS preferred.

9) The controller cabinet shall include an integral rack mounted document drawer assembly for the purpose of document storage, writing surface, and laptop computer placement. The document drawer shall have an interior depth of approximately 1.5 inches, have drawer guides made of anodized aluminum, have drawer mounting brackets made of stainless steel, and have a hinged lift top writing area with a

textured powder coat surface.

10) The controller cabinet output files shall be equipped with UL rated multi-conductor terminal lug.

11) The controller cabinet shall include an "AS-BUILT" blueprint of the signal and timing plan inside the cabinet.

If the controller cabinet design deviates in any way from the specification in this manual, such deviation shall be submitted to the Traffic Engineer or their assigned representative for review before fabrication of the contract cabinets. If deemed necessary by the Traffic Engineer or their assigned representative, one complete prototype cabinet shall be delivered to him for review at least 30 days before fabrication of the contract fixtures. The prototype cabinet will be returned to the CONTRACTOR and if permitted by the Traffic Engineer or their assigned representative, the cabinet may be installed.

3.7 Service and Electric Service Cabinet

Per Section 701-3 of the 2015 Greenbook Standard Specifications for Public Works Construction, the following language is added as follows:

Except for false work lighting, the CONTRACTOR shall be responsible for applying for and arranging with the serving utility to complete service connections for both temporary and permanent installations. The CONTRACTOR shall pay all costs and fees required by the utility.

The City will provide the SDG&E service address for the meters.

The electrical service cabinet shall:

1) Be fabricated with an anodized aluminum finish.

2) Provide Type III-C dual meter electrical service for all new signal installation. Deviations shall be approved by the City Engineer.

3) Meet the SDG&E Service Guide service requirements and the Caltrans Standard Plan Drawing ES-2C cabinet specifications.

4) Have separate main disconnect circuit breakers for metered and unmetered sections.

5) Have plug-in type circuit breakers. Cable bussing is not allowed.

6) Be a model, part, class or type number fabricated by a manufacturer listed below (or a SDG&E and City-approved equal):

Table 3.2 Service Cabinet Product Numbers

Manufacturer	Single Meter Pedestal	Dual Meter Pedestal
B-Line Systems	(special order only)	(special order only)
Milbank West	CPIIIB12121AAL	CPIIIB2214BAL
Myers	MEUGS/TS	MEUGSD
Pacific Utility Products	USP-M100-188CTB-SD	USPD-M100-1888CTB2-SD
Tesco	26-000	28-102

3.8 Battery Back-Up System

The battery back-up system (BBS) cabinet shall:

1) Be housed in a standalone City approved cabinet. The location of the BBS cabinet shall be approved by the City of San Marcos Public Works Department.

2) For existing signal modifications, a side attached piggy back cabinet shall be subject to approval by the City Engineer.

3) The BBS shall be a CLARY SP1250LX-N or other as approved by the City Engineer. The system shall include a UPS Inverter (1100 VA, 1100 watt, with integrated Ethernet communications interface), Battery Cable Kit with Quick Connect terminals (48V with Alpha Guard), AlphaCell 85GXL HP batteries (12V, 50Ah Gel Top Terminal, 5 year warranty), auto/manual transfer switch, generator transfer switch, battery mats, on-battery lamp, rack mount brackets for inverter, and right door hinge.

4) The BBS must be Ethernet/IP compatible and wired for communication to the TMC and for an alarm output to the controller unit. The wiring shall consist of a CAT5 cable and 2 pair #20 cable. The alarm output shall provide Railroad 1 operation upon 40% remaining battery power.

5) The BBS cabinet shall have an auxiliary generator plug installed.

6) The vendor shall provide intersection turn-on support.

3.9 Signal Indication Hardware Finish Specifications

Except for anodized components, all exposed metal signal housings, doors, visors, backplates and framework parts shall have a powder coated finish and be a City approved process. The minimum requirements are as follows:

1) A 3-5 stage pretreatment consisting of: Degrease, Rinse, Iron Phosphate, Rinse, and Seal.

   Note: Degrease and Iron Phosphate can be combined, thereby eliminating Rinse, making this a 3-stage process.

2) A dry off cycle for at least 10 minutes at 300° to 400° F.

3) Electrostatically applied powder at 75-90KV.

4) Thermal setting cycle for 20 minutes at 400° F.

5) All parts shall be coated with an ultraviolet resistant polyester powder. The only exception is for items of flat black, which can be coated with a self-cleaning flat black epoxy.

The CONTRACTOR shall furnish manufacturer's certificate of compliance with City approved powder coating process prior to installation of equipment.

3.10 Foundations

Foundations shall be constructed per Section 701-8.2, Foundations, of the 2015 “Greenbook” Standard Specifications for Public Works Construction. Foundations shall be installed per 2015 Caltrans Standard Plan ES-3C.

3.11 Grounding and Bonding

1) The grounding jumper shall be attached by a 3/16 inch or larger brass bolt in the signal standard or controller pedestal and shall be run to the conduit, ground rod, or bonding wire in the adjacent pullbox.

2) The grounding jumper shall be visible after the cap has been poured on the foundation.

3) Equipment grounding conductor #8 AWG is required in all conduit.

3.12 Single Face Reflectorized Street Name Sign (RSNS)

3.12.1 Fabrication

1) Sign panels shall be fabricated from a single sheet of eight hundredths of an inch (0.080") thickness 6061-H12 aluminum. Panels shall be a minimum of seventeen inches (17") high and either six feet (6') or eight feet (8') as required. Sign panels over six feet (6') in length shall be furnished with a one inch (1") 6063 T6 U channel attached across the longest span of the rear face of the panel.

2) The front face of the sign shall be laminated with a white reflectorized vinyl sheet background, and overlaid with a green vinyl sheet. The green layer shall be appropriately cut with a mechanical plotter to form borders, letters, numbers, symbols or characters as specified in pole schedule of the traffic signal plans or the special provisions.

3) Exposed mounting hardware (bolt heads, rivets, etc.) on the face of the sign shall be painted to closely match the color of the area in which they are placed. Nylon washers shall be used beneath bolt heads at vinyl surfaces of the sign face.

4) White vinyl sheeting for borders, letters, numbers, symbols or characters shall be 3M reflective sheet Diamond Grade Vip #3990 or approved equal. Vinyl overlay shall be 3M Scotchlite Electronic Cutable Transparent Film Green #1177 or approved equal. Letters shall be white reflectorized, eight inch (8") uppercase and six inch (6"), with style and spacing established by Caltrans. Sign faces shall include a one inch (1") minimum white reflectorized border.

3.12.2 Mounting

1) Reflectorized street name signs shall be furnished with a sign mounting assembly. The sign mounting assembly shall consist of a minimum four foot (4’) length by two inch (2”) diameter aluminum tube with ends formed to mount flush with the rear of the sign surface and a cast aluminum sign mounting bracket with stainless steel bands to attach the aluminum tube to the signal mast arm. The sign mounting assembly shall be universally adjustable and suitable for mast arm mounting. The formed tube shall be extruded from 6063-T5 aluminum. The sign mounting bracket shall be cast from aluminum alloy 713. Each sign mounting assembly shall be complete with all necessary hardware and not require use of special tools to install or adjust.

3.13 Emergency Vehicle Preemption

1) Provide emergency vehicle preemption (EVPE) for all approaches (except minor driveways) and the major street left turn at half signals.

2) Emergency vehicle pre-emption shall conform to the provisions in Section 86-3.08B, *Pre-emption Equipment,* of the State Standard Specifications and these Special Provisions.

3) The emergency vehicle preemption (EVPE) detector shall be an Opticom Model no. 721 (or approved equal).

4) The emergency vehicle preemption (EVPE) discriminator module shall be an Opticom Model no. 764 (or approved equal).

5) The detector shall be mounted on the mast arm using an astro bracket with threaded nipples and lock washers.

6) EVPE detectors shall not be mounted on the signal head, unless exception made by the Engineer.

3.14 Signal Heads

1) All traffic signal modules shall be light emitting diode (LED). Approved manufacturers are GE and Dialight.

2) All LED traffic signal modules shall be fully compliant with the latest Institute of Transportation Engineers (ITE) specifications and Circular supplements.

3) Each LED product bid must be certified in the Intertek LED Traffic Signal Modules Program. Proof of certification must be documented and approved by the Engineering Department Inspector prior to installation.

3.14.1 Vehicular Signal Heads

1) Signal heads should be located as follows:

    a) Provide a minimum of two vehicular signal heads for each signal phase.
    b) Provide a minimum of 50 feet from the limit line to the far side indications
    c) Provide a maximum of 150 feet from the limit line to the far side indications, unless a near side indication is installed.
    d) There should be two signal heads for the through movement visible within a 40 degree cone measured at the center of the approach at a point 10 ft behind the limit line (20 degrees to the right and 20 degrees to the left of the center of the approach extended, see CAMUTCD, Figure 4D-4)

2) Signal section housing shall be aluminum per 86-4.01 "Signal Sections" of the latest edition of the Caltrans Standard Specifications.

3) All (red, yellow, and green) LED signal modules shall be Type 1 and meet the following specifications:

    a) LED signal modules for all balls and arrows shall be twelve-inch diameter (12").
    b) LED signal modules shall be complete and factory installed in aluminum signal sections

c) LED signal modules shall be mounted and soldered onto a printed circuit board

4) The normal failure of one LED signal module shall not deactivate any other LED signal module

5) LED signal module shall have a minimum 5-year warranty beginning after traffic signal system has been accepted by the City.

6) When modifying existing signalized intersections, if the mast arms do not currently extend to within site of the midpoint of a single left-turn lane or to the dividing lane line between dual left-turn lanes, and it is cost prohibitive to replace the pole and mast arm, Programmed Visibility (PV) heads shall be used. All PV heads shall have LED lamps. City approved models are GE Lamination DR3-RCFB-01A (Red), DR3-YCFB-01A (Yellow), and DR3-GCFB-01A (Red).

7) All signal faces shall have one-piece backplates and tunnel visors.

8) Left turn signal modules shall be all arrows

9) Plastic signal heads, plastic visors, or plastic backplates are not acceptable.

10) Terminal block shall be mounted in red section on MAS/MAT signal heads. There shall be a drip loop for field installed signal wires.

3.14.2 Pedestrian Signal Heads

1) All pedestrian indications shall be of the LED type.

2) All new traffic signals and traffic signal modifications with pedestrian phasing shall use pedestrian indications of the “Countdown” type. For traffic signal modifications, new pedestrian housings may be necessary to accommodate the “Countdown” type pedestrian indications.

3) Where specified per design, Accessible Pedestrian Signals (APS) shall be field wired models utilizing pedestrian head mounted control boards, Polara 2-Wire Navigator or approved equal. Such systems shall be installed per the manufacturer’s instructions. When installing a system requiring a programmer unit, one such programmer unit shall be provided to the City with each installed system.

4) Plastic pedestrian heads are not acceptable.

5) Provide curb ramps and truncated domes at every corner that has a pedestrian crossing.

3.15 Pedestrian Push Button Assembly

1) If the signal standard is more than 10 feet from the landing area of the curb ramp, then install the push button(s) on a push-button pole adjacent to the curb ramp.

2) PPB shall be 2-inch minimum in diameter complying with all Federal ADA requirements.

3) The PPB assembly shall be Type B with a five inch (5”) by seven inch (7") international symbol push button plate per the latest edition of the Caltrans Standard Specifications. Fasteners for PPB sign plate shall be installed with anti-seize compound.

4) The push button frame shall include adjustable mounting brackets to accommodate most standard Caltrans traffic signal poles.

5) The pedestrian push button housing shall be:

   a. Made of die cast aluminum.
   b. A telescoping, vandal-proof design.
   c. Painted a Federal Standard color (black, green or yellow) as specified by the Traffic Engineer.

6) The pedestrian push button actuator shall be a Polara Model #BDLM2-G or City approved equal.

7) Plastic push buttons housings are not acceptable.

8) A dedicated 3 conductor signal cable shall be wired for each push button.

3.16 LED Blank-Out Signs

1) LED Blank-Out signs may be used at specific locations (upon approval by the City Traffic Engineer) to minimize undesirable vehicular movements.

2) The signs shall be complaint with the latest CA MUTCD requirement.

3) The window dimensions shall be 24”x24” for near side sign, and 30”x30” for far side sign.

3.17 Lighting Standards

1) Luminaires shall conform to latest City of San Marcos Street Lighting Standards with GE Evolve™ LED Roadway Scalable Cobrahead fixtures for safety lighting (GE Model # ERS2_0_E3D1_7_40_7_GRAY_D_L (4000K))

2) Safety Lighting shall be:

   a. Completely assembled.
   b. 120 volt.
   c. Have photoelectric control unit and switches.
   d. Full cutoff type.
   e. Have fifteen FT (15’) mast arms (maximum) unless otherwise directed by the City Engineer.

3) Optical Requirements for street lighting luminaires are as follows:

   Certified luminaire performance data shall be furnished with “Equipment List and Drawings,” conforming to State Standard Specifications. This data shall include complete photometric test data in the form of isolux charts at a scale of one-inch equals twenty feet (1” = 20’) for the luminaire and lamp sizes indicated on the plans. Alternate data may be in the form of horizontal foot-candle values recorded on a fifteen foot x fifteen foot (15’ x 15’) gird, extending one hundred fifty feet (150’) longitudinally from the light source and fifteen feet (15’) behind and one hundred twenty feet (120’) in front of the light source for the luminaire and lamp sizes indicated on the plan. The horizontal foot-candle levels in the data submitted shall provide a minimum horizontal foot-candle

level of at least 0.9 fc average maintained in the intersection with minimum of 0.60 at centerline and 0.15 at the furthest crosswalk. Failure to satisfactorily meet the referenced values will be justification for refusal of equipment by the City of San Marcos.

The test shall be performed by an independent and recognized testing laboratory or by the manufacturer's laboratory. When the tests are performed by the manufacturer's laboratory, the test data shall be certified. Subsequent to the CONTRACTOR's installation of any street light luminaires, field checks may be performed at random by the Traffic Engineer or City Electrician or their assigned representative and calculated according to the "I.E.S. Guide for Photometric Measurement of Roadway Lighting Installations (LM-50)," approved in July 1974. Failure to satisfactorily meet or exceed the referenced values during field check will be justification for replacement by the CONTRACTOR at the sole option of the City.

3.18 Radar Speed Feedback Signs

1) Radar speed feedback signs may be used at specific locations (upon approval of the City Traffic Engineer). The speed feedback signs shall be Information Display Company SpeedCheck SC-15

2) Sign size shall adhere to CAMUTCD requirements and shall be 30" wide by 42" high with 15-inch display digits.

3) The sign shall be solar powered and capable of fully autonomous operation 24 hours per day, 365 days per year if requested.

4) A "SLOW DOWN" message shall be LED characters approximately 6-inch high formed with amber or red LEDs.

3.19 Salvaged Equipment

1) The Contractor shall deliver all salvaged equipment to the San Marcos Public Works Yard at 201 Mata Way. San Marcos, CA 92069. Contact the Traffic Signal Supervisor at (760) 752-7550 ext.3334 forty eight (48) hours in advance.

2) Obtain a receipt for all salvaged equipment.

4.0 Traffic Signal Interconnect

1) Traffic signal interconnect (SIC) shall be provided on all new traffic signals and existing traffic signal modifications to closest connection point providing connectivity to the traffic management center in City Hall.

2) All traffic signal interconnect designs shall be fiber optic unless otherwise approved by the City Engineer and shall be designed and installed per the latest edition of the Caltrans “Fiber Optic Design Guidelines.”

3) Under special conditions wireless Ethernet communication or other methods of interconnect may be used when approved by the City Engineer.

4) The existing SIC system shall be maintained at all times during construction. In the event of damage, the contractor or responsible party, as determined by the project inspector, shall commence repairs immediately. Repairs shall be completed within 10 working days or the City shall have the option to complete necessary repairs and charge the responsible contractor(s) for any associated repair costs.

4.1 Conduit

1) All interconnect conduits shall be three inches (3") minimum. All conduits shall have a detectable pull-rope with integrated corrosion resistant metallic conductor. .

2) All conduits crossing or within the traveled way of roadways or driveways shall be four inches (4”) schedule 80 rigid PVC, encased in 560-C-3250 psi concrete, with minimum of 30” cover.

3) Installation of PVC or High Density Polyethylene (HDPE) conduits (by directional boring) with a minimum of five feet (5’) of cover is acceptable only with approval of the Traffic Engineer.

4) All new intersections shall include separate conduits for SIC and signal wiring (including DLC). Sharing of the DLC and CCTV wiring in the same conduits with SIC will be allowed on intersection modifications, as long as conduit fill is less than 40%.

5) All interconnect conduits shall contain a No. 8 green insulated THWN stranded copper trace wire.

4.2 Interconnect Pull Boxes and Vaults

1) All interconnect pull boxes shall be 6T concrete with extension and installed per Caltrans Standard Plans ES-8, except as approved by the City Engineer for existing facilities.

2) Interconnect pull box and vault lids shall be galvanized steel and stamped or welded “TS COMMUNICATION”.

3) Boxes shall be installed between 800 feet (minimum) and 1,000 feet (maximum) apart unless geographical or site conditions necessitate a shorter run.

4) Contractor shall install a 30” x 60” x 14” concrete electrical vault with two (2) extensions (total depth approximately 3 feet) and a galvanized steel lid at each signalized intersection on the corner near the traffic signal controller.

5) SIC conduit shall be installed in pull boxes using 45-degree, UL approved elbows. These elbows shall be placed as far apart in the pull box as possible, oriented in the direction of the

cable, and offset to one side to facilitate cable pulling and coiling.

6) Approximately 200-feet of SIC slack shall be coiled inside of each vault box (12 and 144 SMFOC).

7) Approximately 20-feet of SIC slack shall be coiled inside of each pull box.

4.3 Tracer Wire

1) All interconnect conduits shall contain a No. 8 green insulated THWN stranded copper trace wire unless a detectable pull-rope is installed per 4.1-1 above

2) No splices are permitted between pull boxes.

3) Proper operation of the tracer wire shall be demonstrated prior to acceptance.

4.4 Cable

1) All fiber optic cable shall be single mode . Approved cable is Altos All Dielectric Gel Free Cables.

2) Cable installed in runs between intersections shall be minimum 144 fiber count unless otherwise directed by the Engineer. Product code is 144EW4-T4101D20.

3) Cable installed in runs between splice enclosures and termination equipment shall be minimum 12 fiber count. Product code is 012EW4-64101D20.

4) Splices are to be made in splice enclosures in fiber optic vaults only. SIC shall be continuous and unspliced between cabinets. Exceptions must be approved by City Engineer.

5) The design engineer shall perform a site survey to determine slack availability on existing SIC runs, or require cable replacement when sufficient slack is not available.

6) A patch panel shall be installed to terminate the 12 SMFOC. In instances where there is insufficient rack capacity a Corning Zeux panel shall be installed upon approval of City Engineer.

7) New SIC shall be connected to the City network and a revised assignment table shall be submitted as part of the final design.

8) Existing copper SIC (CuSIC) is to be retained unless otherwise directed by the City Engineer. New CuSIC installations shall be a minimum of six (6) twisted pair 20 AWG conductor communication cable with standard color code and water resistant as required by Caltrans specifications.

9) Fiber optic cable shall meet the following requirements:

   a. Fiber optic cable shall be all-dielectric gel free loose tube cable construction.
   b. The optical fibers shall be single mode optical glass conforming to ICEA S-87-640.
   c. Maximum tensile loads (short term): 2700N (600lbf), (long term): 890N (200lbf)
   d. The optical performance of each single-mode fiber measured at 1310 nanometers

shall have maximum attenuation of 0.4 decibels per kilometer

e. The optical performance of each single-mode fiber measured at 1550 nanometers shall have maximum attenuation of 0.3 decibels per kilometer.
f. Storage Temperature: -40^{o} to +70^{o}C (-40^{o} to +158^{o}F), Installation Temperature: -30^{o} to +70^{o}C (-22^{o} to +158^{o}F), Operation Temperature: -40^{o} to +70^{o}C (-40^{o} to +158^{o}F)
g. Maximum attenuation (dB/km): 0.3-0.4

Approved manufacturers of fiber optic cables include: Corning, Prysmian or approved equal. Non-listed manufacturers shall be approved by the City Traffic Engineer.

4.5 Fiber Optic Strand Splicing

Splicing of the Fiber Optic Cable shall be performed by the fusion technique. All cables shall be carefully prepared and spliced in accordance with the cable manufacturer's recommendations. Either heat shrinkable tubing shall protect the finished splices, metal protective sleeves or by some other method approved by the City Engineer.

All splices shall be tested and documented after encasement. No splice shall exceed a 0.05 decibel loss.

The completed splices shall be enclosed in re-enterable splice enclosures that seal to form moisture resistant protection. The splice case or enclosure shall contain a removable splice organizer or crib that shall secure the individual fibers and protect the splices.

4.6 Fiber Optic Interconnect Equipment

Termination components for vaults and signal cabinets are listed in Table 4.1 below. The fiber optic cables shall be terminated and/or spliced with these components per the fiber assignment provided by Traffic Engineering during project design or before signal turn-on. A minimum of 5 working days notice will be required for Traffic Engineering to produce this documentation.

Table 4.1 Cabinet and Vault Fiber Termination Components

Description	Manufacturer	Model
Splice Closures	Corning	SCF-6C22-02
Splice Closure Splice Tray	Corning	SCF-ST-099
Splice Housing	Corning	CSH-03U
12 Port Panels	Corning	CCH-CP12-59
Splice Trays	Corning	M67-048
Cabinet Termination	Corning	CCS-01U
6 Port Panels	Corning	CCH-CP06-3C
Fiber Optic Splice Tray	Corning	
Fiber Distribution Unit	Corning	C-MIC-012
Prefabricated Panel	Corning	Zeux
Jumpers	Corning	
Connectors	Corning	SC
Connectors	Corning	SC

4.7 Communication Network

At the onset of project design the communication protocol shall be Ethernet. New or modified signals shall receive the communication standard components in Table 4.2.

Table 4.2 Communication Standards – Ethernet Switches

Description	Manufacturer	Model
Ethernet Switch	See Requirements	
Cat 6 Patch Cable RJ45	Generic	
Power Supply	See Requirements	
Mounting	See Requirements	

4.7.1 Ethernet Switches

Ethernet switches shall provide the following functionality:

1) All switches shall be managed and support advanced features including:
   a. Port based VLAN segregation.
   b. DHCP snooping and/or IGMP snooping
   c. MAC address filtering
   d. Quality of Service
   e. SNMP
   f. Remote management

2) Fiber uplinks shall be single mode and support 10/100/1000 Duplex Ethernet ports and provide long haul capability.

3) In addition to the above requirements. local switches (located at intersections) shall meet the following requirements:
   a. Shall be environmentally hardened (-40 to 160 degrees F) and NEMA TS-2 rated.
   b. Switch ports minimum requirements:
      i. Ethernet Switches (Cabinet Switch Locations – All City of San Marcos Locations):
         1. Provide a minimum of eight 10/100 Base TX copper ports and one duplex fiber port.
      ii. Ethernet Switches Caltrans Locations:
         1. Provide a minimum of six 10/100 Base TX copper ports and two duplex fiber ports.
      iii. Aggregate Switches (Hub Switch Locations):
         1. Provide a minimum of four 10/100 Base TX copper ports, three 1000 Base TX copper ports, and sixteen (16) duplex fiber ports.
         2. The switch shall support rack mount on 19” rack chassis
   c. The fiber uplink ports shall be SC, LX or LC type connectors utilizing SFP modules.
   d. Power supply shall support 120 VAC and/or 24 VDC.
   e. The switch shall support standard 332L rack mount, DIN rail or 19” rack mountable.

4) All switches shall provide a lifetime warranty option on parts and 1 year “live” technical support (either in person or over the phone) during business hours (Pacific time) 9AM to

5PM Monday through Friday, from the date of installation Warranty parts replacement shall be within three business days. A warranty certificate meeting these requirements shall be provided on the date of installation.

The Contractor shall furnish and install all Ethernet switches at the local intersections and test the communication between the field switch and the TMC. Configuration of Ethernet switches shall be performed by others.

The Ethernet switch shall be a Siemens RUGGEDCOM RS900, Comnet CNGE3FE7MS2 , or City approved equal.

Approved manufacturers of Ethernet communications solutions include: Siemens, Ruggedcom, Comnet. Non-listed manufacturers shall be approved by the Engineer.

4.7.2 Broadband Wireless Ethernet Communication

The Broadband Wireless Ethernet Communication System shall provide traffic signal and CCTV video and control communication. The Contractor shall furnish and install such other items or details not mentioned below, that are required to construct a complete and operational system including, antennas, radios, mounting equipment, hardware, cabling, and incidental materials shall be performed, placed, constructed or installed.

The contractor shall follow the manufacturer recommendations and instructions for installation.

Wireless communication shall provide the following functionality:

1) Support Ethernet communications.

2) Support mesh network topology and point-to-point and point-to-multipoint configuration.

3) 802.11 Compliant and operate on a license free band.

4) Provide a minimum of 108 Mbps data rate.

5) Provide a minimum range of 10 miles.

6) Provide security encryption (WPA, WPA2, MAC, and Radius).

7) Be compatible with Ethernet switching and routing protocols including:
   a. VLAN
   b. VPN
   c. DHCP snooping
   d. Quality of Service
   e. SNMP
   f. Remote management

8) Be a NEMA rated enclosure.

9) Power supply shall support 120 VAC and/or 24 VDC.

10) All wireless equipment shall provide a minimum 2 year warranty on parts and 1 year “live” technical support (either in person or over the phone) during business hours (Pacific time) 9AM to 5PM Monday through Friday, from the date of installation Warranty parts

replacement shall be within three business days. A warranty certificate meeting these requirements shall be provided on the date of installation.

The contractor shall perform a wireless site survey to determine the exact radio path and signal strength values to each wireless site. The results of the survey (path quality, data integrity, and spectrum analysis) shall be provided to the Engineer to determine optimized system configuration and performance.

The Contractor shall test the completed system and ensure the proper functioning of all wireless components and connected devices to the satisfaction of the Engineer.

Approved manufacturers of Wireless Ethernet communications solutions include: Comnet, Iteris, Encom, , and Ubiquity Networks. Non-listed manufacturers shall be approved by the Engineer.

4.8 CCTV Video Network

All new traffic signal installations shall include, as part of the standard safety systems, the installation of CCTV camera equipment and transmission equipment and any additional wiring or hardware required to support an operational CCTV system. This requirement shall apply unless otherwise specified by the City Traffic Engineer. Table 4.4 provides the camera equipment.

1) All CCTV communication protocol shall be Ethernet. Ethernet, requirements are provided in Section 4.6.1 above. .

2) A License Key shall be provided for each CCTV camera installed for the City's Video Management System.

3) The approved location for new CCTV camera installations shall be approved by the City Traffic Engineer.

4) Installation: The CCTV system shall be installed per manufacturer's installation recommendations.

5) Power for CCTV systems at new intersections shall consist of a Power on Ethernet with a rugged rated power injector.

6) The CCTV transmission equipment shall be installed and tested for operation by the contractor to the satisfaction of the City Engineer before acceptance of the system.

7) CCTV Encoders for the inclusion of existing Analog video cameras will require a video encoder device.

   a. The Video Encoder shall provide Pan Tilt Zoom (PTZ) capability through a Web GUI.
   b. The Video Encoder shall provide H.264 video compression algorithms.
   c. The Video Encoder shall provide Pelco D PTZ protocol and integrated coaxitron.
   d. The Video Encoder shall provide streams up to 4CIF (704x480) resolution.

CCTV Camera and Transmission components required to accommodate a typical CCTV installation are shown in Table No. 4.4 below or City approved equal.

Table 4.4 CCTV Camera and Transmission Equipment

Description	Manufacturer	Model
IP Outdoor Dome Camera	Pelco	P1220-ESR1 Network Camera or approved equal
Video Encoder	Pelco	NET5401T or approved equal
Network Cable	Generic	CAT6 OSP 24 AWG
Wall Mount	Pelco	IWM24-SR with integrated 24 VAC Transformer
Pole Adapter	Pelco	PA101 Pole Mount

4.9 Testing

1) The contractor will be responsible for ensuring the operability and quality of the SIC delivered from the manufacturer before installation. SIC shall not be removed from the reel or installed until it has been successfully tested by the Contractor. The pre-installation test results shall be documented and provided to the Engineering Department Inspector for approval. SIC found to be defective or damaged shall be returned to the source for replacement by the Contractor.

2) Fiber optic SIC shall be installed, spliced, terminated, and tested in accordance with NECA/FOA 301-2009 standards. This includes pre-installation and post installation testing of the cable.

3) Pre-installation testing shall be performed on all fibers using an Optical Time-Domain Reflectometer (OTDR) to preclude manufacturing and shipping damage. The contractor shall perform such testing either on-site or at a holding facility prior to installing the cable into conduit.

4) Post-installation testing of all terminated fibers shall be performed using launch cables at both ends as specified in NECA/FOA 301-2009 Annex B.3. The contractor shall perform such testing on-site after all termination and splicing work is completed.

5) Test results, in the form of pre-installation test data and post installation OTDR traces, shall be provided to the Engineering Division Inspector in a bound hard copy format along with the electronic file and appropriate viewing software, for review and approval after installation and splicing/termination work is completed.

6) The pre-installation test results shall be in the form of a spreadsheet detailing the length and loss/km for each fiber as well as the parameters used for testing. The post-installation OTDR traces shall clearly show each continuous fiber, the connectors on each end, and the loss for each event.

7) The Engineering Department Inspector shall approve the test results before final acceptance.

4.10 Integration

1) The Contractor shall be responsible to furnish and install all elements for the project. However, the integration and configuration of all ITS improvements including but not limited to fiber ethernet switches, encoders and decoders, CCTV Cameras, and any new IP devices shall be

performed by others.

2) The system integration including but not limited to the development of IP addressing Schema and VLAN design and configuration shall be performed by others and is not part of the Contractor's job responsibility.

5.0 BID DOCUMENT REQUIREMENTS

1) City Standards, Caltrans Standard Specifications and Plans shall be referred to as part of the bidding and contract documents. Caltrans current Standard Special Provisions shall be utilized as the base for contract preparation.

2) Determine prior to design if project(s) may have City-furnished controller assemblies and mast arm signal poles.

3) In addition to the required, applicable Caltrans special provisions, the following City special provisions shall be included, where applicable:

   a. Maintaining existing and temporary electrical systems - Traffic signal system shutdowns shall be limited between the hours of 9:00 a.m. to 3:00 pm, Tuesday or Wednesday, with exception to San Marcos Blvd which is limited to night time periods only (9:00 p.m. to 5:00 a.m.).

   The CONTRACTOR shall:

   b. Prepare a traffic control plan and obtain the signed approval of that plan from the Traffic Engineer prior to any signal shutdown. The plan will depict all signing, striping, delineation, flagging and all other traffic control devices necessary to the operation, per direction of the Traffic Engineer.

   c. Notify the City of San Marcos Public Works Department Traffic Signal Supervisor, through the Traffic Engineer, a minimum of 48 hours before any traffic signal system shutdown.

   d. Arrange to have a signal technician, employed by the controller manufacturer or his representative qualified to work on the controller, present at the project site at the time the equipment is activated. The signal technician shall remain at the jobsite for a minimum of two (2) working hours.