

X. TRAFFIC SIGNAL PLAN

A. INTRODUCTION

Traffic signal and striping plans are required for new traffic signal installations and/or traffic signal modifications. Traffic safety, capacity, delay, and fuel efficiency are some of the elements that shall be considered when designing a traffic signal plan.

Traffic signal plans can be part of the signing and striping plan set or “stand alone” set of plans. Do not show existing topography, contours, or elevations on signal plans unless such information is necessary to perform traffic signal work. No references and/or notes shall be directed to the street improvement plans. Each signal needs to be on a separate set of plans.

It is understood that each traffic signal project has its unique characteristics. Design criteria provided here is to be used as a general design guideline only. Good traffic engineering judgment shall be called upon to provide an integrated traffic signal design. Following these guidelines will help expedite the plan check process.

B. GENERAL REQUIREMENTS

See subsection B. General Requirements under Section VIII, Traffic Signing and Striping Plan.

C. DESIGN REQUIREMENTS

1. Traffic Signal plan shall use 1"=20' scale. 1"=10' scale shall be used when additional clarity is required.
2. Signal Plan Number (SG-xxxx)
Contact your respective County Development Review Plan Checker for signal plan number to be shown on each design plan, as well as the address for the electrical meter.
3. **Lines and Symbols**
Line weights, line style, symbols, construction notes, and abbreviations used on all plans shall follow Caltrans Standard Plans A10C, A10D, ES-1A, ES-1B and ES-1C, or as directed by the Transportation Department.
4. **Intersection Base Map**
The plan shall clearly show existing, proposed, and ultimate roadway geometrics with the major street horizontal on the plan if feasible. Including but not limited to the following and labeled as such:
 - a. Curb and gutter
 - b. Asphalt berm and dike
 - c. Edge of pavement
 - d. Driveways
 - e. Sidewalk and access ramps

- f. Right-of-way and maintenance easement
- g. Drainage facilities
- h. Underground and above ground utilities
- i. Traffic control devices, markings, and striping

5. **Access Ramps**

Access ramps shall be installed per County of Riverside Standard No. 403 wherever crosswalks or pedestrian signals are proposed.

Where standard access ramp cannot be installed, a modified version that met American with Disabilities Act requirements shall be used and shown, and detailed on the street improvement plans.

6. **Right-of-way**

It is necessary to show right-of-ways (ROW) in order to determine whether additional ROW is required to construct the traffic signal. Evidence of ROW shall consist of recorded maps or legal instruments of property transfer. If additional ROW is required, dedication from the developer shall be processed concurrently with the improvement plans. If additional ROW required is offsite on private property, the developer is required to obtain the necessary ROW from the property owner and process a separate dedication concurrently with the improvement plans.

7. **Maintenance/Construction Easement**

Maintenance easement for traffic control device installed on project site has to be identified on plans and dedicated by the developer. If maintenance and/or construction easement required is offsite on private property, the developer is required to obtain the necessary easement from the property owner. Easement dedication shall be processed concurrently with the improvement plans. Owner shall apply for and annex all new or modified signals conditioned for the project into L&LMD for signal maintenance.

8. **Dimensions**

Distance of advance detectors and flashing beacons from limit lines shall be shown on the plans. When a separate striping plan is not required, complete dimensioning shall be shown. This includes road and lane widths, right-of-way, turn lane storage lengths, striping taper lengths, and distance of signs and markings.

If a separate signing and striping plan is required it shall be prepared per Section VIII, Traffic Signing and Striping Plan of this document, except in those situations where minimal striping changes are required, or as determined by the Transportation Department.

9. **Traffic Signal Poles**

Traffic signal poles designed for 100 MPH wind loading shall be used. Wherever possible, traffic signal poles that will accommodate the ultimate condition shall be installed.

Pole height shall be 30 feet for standards with luminaire.

Type 1A poles shall be spun aluminum except tapered steel Type 1A poles shall be used in high wind areas or when a five-section signal head will be mounted on top.

Poles shall be placed within five feet from the crosswalk or the extension thereof. If this minimum distance cannot be maintained, pedestrian push button posts shall be installed at locations per Figure 4E-2 of CA MUTCD.

Median mounted poles shall not be permitted except for unusual design requirements.

Show pole and equipment schedule, and pole location diagram on plans. Poles shall be placed at least 3' from the curb face.

10. **Mast Arms**

The mast arm length will vary depending on the number, location, and configuration of signal heads to be installed. Wherever possible, the ultimate mast arm shall be installed.

Tenon mounts shall be provided and dimensioned ("F" distance) for any anticipated future signal heads. Unused tenons shall be covered in a waterproof, durable and removable manner.

11. **Traffic Signal Heads**

A minimum of two indications shall be provided for each phase including overlap phases.

Near right heads shall be installed for all Secondary Highways or above, when the distance from the limit line to the related far side mast arm exceeds 120 feet, or as directed by the Transportation Department.

On road curves, visibility of the signal heads for approaching vehicles shall be checked. Additional signal head indication shall be installed at the near left signal pole to mitigate visibility issue.

Signal section housing, backplates and visors shall be metal. Signal section housing for 12" indications shall be used. Backplates shall be louvered. Visors shall be the tunnel type. Terminal compartments shall be provided for all side and top mounted heads.

Programmed visibility (PV) head shall be used only when approved or directed by the Transportation Department. The PV head for protected left-turn phase shall be placed 2' into the extension of the left run lane.

All vehicle indications shall be 12" light emitting diode (LED) signal modules.

Provide a signal head detail on plans if it is not a regular 3-section ball or arrow signal head.

12. **Luminaires**

Luminaires shall be full cut-off flat glass fixtures utilizing 120 Volt, 200-Watt high-pressure sodium vapor bulb or LED as directed by Transportation Department. Lighting calculations are required to insure appropriate lighting levels for crosswalks.

Luminaire mast arms shall be 15 feet unless otherwise noted. Straight luminaire mast arm if required shall be per County Standard No. 1202.

Luminaires shall be placed at each far right approach. Locations shall be coordinated with the street light plans (See Section XI, Street Light Procedure of this document).

Existing street lights which conflict with the traffic signal luminaire shall be identified on the signal and/or street light plans and labeled "To be removed by SCE or serving utility." Arrangements for removal shall be coordinated between the construction inspector and the serving utility.

13. **Internally Illuminated Street Name Signs**

Internally illuminated street name signs (IISNS) shall be LED IISNS per County Specifications.

The IISNS shall be mounted on a 10' straight mast arm that clamps onto signal pole per County Standard No. 1200.

Street addresses and road name suffixes (Ave, St, etc.) shall not be included on IISNS.

Street name legend shall use ClearView or Series E font with 8" upper and 6" lower case, for example, "Van Buren."

14. **Photo-Electric Controls**

Photo-electric control shall be Dual Type V for luminaries and internally illuminated street name signs that conforms to the County Standard No. 1202.

15. **Pedestrian Signal Heads**

Pedestrian signal heads shall be metal type with a polycarbonate eggcrate or Z-crate screen (Type 2). The pedestrian signal face shall utilize a light emitting diode (LED) module.

Far side pedestrian signal heads shall be placed on the same pole as the associated signal head unless otherwise directed.

Near side pedestrian signal heads shall be placed on the Type 1A pole unless otherwise directed.

16. **Push Buttons**

All push buttons shall be Type B, constructed of high density thermoplastic and utilize solid-state Piezo switch technology. Button shall be yellow, outer body color shall be black.

Pedestrian Push Buttons (PPB) shall be ADA compliant and mounted on the traffic signal poles. PPB's shall not be placed further than five feet from the associated crosswalk. PPB posts shall be installed when signal poles cannot be installed within five feet of the associated crosswalk.

Equestrian Push Buttons (EPB) shall be installed per County of Riverside general plan designated equestrian trails crossing at a proposed traffic signal location. EPB shall be mounted six feet above finish sidewalk grade and wired with corresponding PPB.

Bicycle Push Buttons (BPB) shall be installed per County of Riverside general plan designated bike lanes at a proposed traffic signal location. BPB's shall be mounted four feet above finish sidewalk grade and wired with corresponding PPB.

17. **Pull boxes**

No. 5 pull box (PB) shall be installed unless directed otherwise.

No. 6 PB shall be installed when three or more conduits are installed in the PB.

No. 6E PB (No. 6 PB with extension) shall be installed adjacent to the controller assembly.

No. 5T or 6T traffic bearing type PB shall be installed in unimproved areas not protected by curb or dike.

A PB shall be installed within five feet of each traffic signal and lighting pole but not within one foot of access ramp.

A dedicated PB shall be installed for the left turn lane loops.

Maximum spacing between pull boxes shall be 500 feet.

PB lid for No. 6 PB shall be Christy's Fibrelyte lid or equivalent.

18. **Conduit and Conductors**

All traffic signal conduits shall be rigid galvanized steel.

Non-metal conduit shall not be permitted except for utility service as required by the serving utility company.

All new traffic signal installations shall utilize 12-signal conductor cables (SCC) for vehicle and pedestrian signal runs and 3-SCC for pedestrian push button runs.

Signal modifications may utilize individual conductors if multiple conductors were used.

Conduit sizes shall be determined based on 26% maximum fill for multiple conductors and 40% maximum fill for signal conductor cable.

The following table shows the minimum conduit sizes for the various applications:

Interconnect Only	- 2"
Detector Lead Cable Only	- 1 1/2"
Street Crossings	- 3"
Controller to No. 6E Pull Box	- 2-3.5"
Power Service	- 3"
All Other	- 2"

In numbering conduit runs, it is preferred to label run one furthest from the controller, rise in number to the "home-run" into the controller, and continue to rise from the controller to the last conduit run.

Provide conductor schedule on design plan.

19. **Detectors**

Detector phasing input shall be assigned per County Standard No. 1203 or 1204.

Detector used shall be video detection per County Specifications or as directed by Transportation Department. Video detection cameras shall be mounted on luminaire mast arms for both advance and presence detections, or on signal mast arms with 6' extension for presence detection only. If advance detection zone is more than 300' from the camera, a second camera mounted on a nearside pole or advance loop detectors shall be installed.

Where the loop detectors will be installed, the existing asphalt concrete must be free from cracks or ruts. If such a condition exists, the existing asphalt concrete and possibly the existing aggregate base material shall be removed and replaced. Location, dimensions, and quantities of asphalt concrete work shall clearly show on the plans. A signal modification plan is required for all changes in loops.

Loop detector's configuration shall be Type E per Caltrans Standard ES-5B.

Loop detectors' spacing shall be per County Standard No. 1201.

20. **Power Source**

The power source shall clearly show on the plans. It shall be the Design Engineer's responsibility to obtain the power location from the serving utility company and provide written documentation to the County during the plan check process.

120/240 Volt dual meter service is required. Both traffic signal and luminaires will have its own meter.

Circuit breakers shall be installed per the current County Specifications.

A three-inch conduit with pull rope shall be designated between the service point and the service equipment enclosure per the serving utility company's requirements.

A ten-foot service conduit riser shall be designated for utility pole service points.

For signal modification projects that relocate service a new service shall be required and the old one to be salvaged.

21. **Service Equipment Enclosure**

The service equipment enclosure shall be Type III-CF per the Caltrans Standard Plans and County Specifications.

It shall be the Design Engineer's responsibility to obtain a service address for the service pedestal.

Service address shall be provided on the traffic signal plan and included on the service equipment enclosure. Contact GIS Department of the County at (951) 955-8156 for an address. The County will apply for service once the address is finalized.

Location of the service equipment enclosure shall be the curb return area closest to the service point unless otherwise required. A minimum of 15 feet shall be maintained between the controller and the service equipment enclosure. A minimum of ten feet shall be maintained between the service equipment enclosure and the power source.

22. **Controller Assembly**

Controller shall be Model 170E controller per County Specifications.

The controller cabinet shall be Type 332, finished with an anodic coating, and the foundation shall extend 4 inches above finish grade. Portland cement concrete sidewalk shall be constructed in front of the controller cabinet per Caltrans detail ES-4B and shown on the street improvement plans.

Controller assemblies shall be installed in the appropriate location per the following guidelines:

- a. Close to the power source.
- b. Not obstructing existing or proposed landscaped corner cutback areas or decorative entry monuments.
- c. Easy access for maintenance personnel with adequate visibility of vehicular movements.
- d. Avoid poor drainage/flooding areas.
- e. Avoid collision hazards.
- f. Avoid obstructing pedestrian/handicap access movement.

23. **GPS Time Source**

A GPS time source/clock shall be installed per County Specifications or as directed by the Transportation Department.

24. **Battery Backup System**

An external mounted Battery Backup system shall be installed per County Specifications or as directed by the Transportation Department.

25. **Phase Diagram**

N.E.M.A. dual-ring type phase diagram shall be shown on traffic signal plan.

Phasing on major street shall be phase two and phase six, and on minor street shall be phase four and phase eight unless otherwise required by the Transportation Department.

For coordination purposes, phasing shall be consistent with existing traffic signals that are within a 1/2-mile radius.

26. **Emergency Vehicle Pre-emption**

Emergency Vehicle Pre-emption (EVP) cable and detector shall be installed for each approach or as directed by the Transportation Department. EVP phase selectors shall be installed in the controller cabinet.

EVP detector mounting detail shall follow County Standard No. 1202.

EVP detector cable shall be indicated in the conductor schedule.

27. **Signal Interconnect**

A separate 2" conduit and No. 5 pull boxes for the signal interconnect only shall be installed between controller assemblies within 1/2-mile radius. Minimum conduit bend radius or sweep shall be 36". All conduit bends shall be galvanized factory bends for rigid steel conduits.

Interconnect cable shall be a minimum of six pair #20 AWG copper conductor per Rural Electrification Administration Specification PE-22 or as directed.

28. **Flashing Beacons**

Flashing beacons with appropriate signing shall be installed when one or more of the following conditions exist as stated in section 4K.102 of CA MUTCD or as directed by the Transportation Department:

- a. At an isolated traffic signal on either a conventional highway or on an expressway in a rural area.
- b. The first traffic signal approaching an urban area.
- c. Any traffic signal with limited approach visibility.
- d. In geographical areas where seasonal conditions; such as, heavy fog, heavy rainfall, and sand storms limit visibility.

On undivided two lane roadways, flashing beacon installations shall be Type 1 with a W3-3 symbol sign per Caltrans Standard Plan ES-7J.

On divided roadways, two Type 1 standards with a W3-3 symbol sign may be installed. One standard will be installed in the median and the other will be installed off the right shoulder.

A Type 9 cantilever flashing beacon per Caltrans Standard Plans ES-7K and ES-7L is the preferred installation for multi-lane roads. The Type 9 flashing beacon shall be installed with fluorescent lighting fixtures and a W3-3 symbol sign.

The standard distance from the flashing beacon to the limit line shall be 750 feet and shall be dimensioned on the plans.

If curved street limits sight of signal head, adjustment or additional heads may be required.

29. **Street Improvements**

No street improvements shall be shown on the traffic signal plans. See street improvement plans for all civil work required.

A construction traffic control plan for the street improvements may be required if one or more of the following situations occurs:

- a. The complexity of the street improvements jeopardizes safety for the construction workers and the traveling public.
- b. The roadway geometrics pose confusion for the traveling public.
- c. The length of time the traveling public will be exposed to the temporary construction exceeds one month.
- d. If required by County or other affected agency for any reasons.

If extensive roadway or drainage improvements are a part of the project, plan and profile street improvement plans shall be prepared. Street improvements shall be constructed per the County of Riverside and the State of California Standard Plans and Standard Specifications (See Street Improvement Plan Checklist section of this document for preparation of plans).

Median islands shall provide for WB-50, 60-foot minimum truck turning radius unless otherwise required.

Portland cement concrete sidewalk shall be provided for pedestrian landing pads as shown on the street improvement plans.

30. **Utilities**

It is the Design Engineer's responsibility to contact all utility companies/agencies to obtain existing and proposed overhead and underground facilities. This information shall be shown clearly and accurately on the plans.

The Design Engineer shall identify conflicts between existing utilities and proposed traffic signal equipment on the plans during the design process. The Design Engineer shall provide written documentation for an appropriate solution to the conflicts shall be coordinated with the serving utility company prior to finalizing the design.

Developer shall be responsible for utility clearance for the required traffic signal(s) for development projects.

Traffic signal equipment and overhead power lines shall have minimum 10' radial clearance or more depended upon the power lines' voltage and the serving utility agency.

D. GENERAL NOTES

The following general notes shall be shown on the title sheet:

1. All material and work shall conform to the latest edition of County of Riverside Standard Plans, Caltrans Standard Plans and Standard Specifications, and California Manual on Uniform Traffic Control Devices.

2. The Contractor shall notify Underground Service Alert, (800) 227-2600, and all concerned utility companies at least two working days in advance of excavation.

Locations of all underground utilities are approximate. The Contractor shall determine the exact locations and verify all conditions on the job site prior to commencing work. The Contractor is fully responsible for all damages occurred due to failure to locate and preserve all underground utilities. Hand dig as needed or as directed by the Engineer until clear of obstructions.

3. The Contractor shall be responsible for any clean up on County right-of-way affected by Contractor's work. The Contractor shall keep County right-of-way clean of debris, with dust and other nuisances being controlled at all times. Method of street cleaning shall be dry sweeping of all paved areas. There shall be no stockpiling of construction materials within the County right-of-way without the permission of the Engineer.
4. Existing privately owned improvements on public right-of-way shall be protected or replaced.
5. See Caltrans Standard Plan ES-1A, ES-1B, and ES-1C for symbols and abbreviation legends.
6. The Contractor shall furnish and install all traffic signal equipments, signs, and striping in accordance with the plans and special provisions. All signs shall be reflectorized and standard size unless otherwise noted.
7. Controller cabinet and service cabinet shall be placed at a minimum of 15 feet apart.
8. Electrical conduit shall be placed at a minimum of 2 feet from telephone conduit.
9. All pull boxes size shall be No. 5 unless otherwise noted or approved by the Engineer. Pull boxes in unimproved areas not protected by curb and gutter shall be traffic bearing type. Maximum spacing between pull boxes shall be 500 feet.
10. All conduits shall be 2-inch rigid galvanized steel conduit unless otherwise noted. All conduits placed under paving shall be installed without open cutting.
11. Detector loops shall be placed per County of Riverside Standard Plan No. 1201 and centered within the driving lane unless otherwise noted. Striping layout (Cat-Tracking) shall be approved by the County prior to detector loop installation. All loop detector configurations shall be Type "E" per Standard Plan ES-5B. All curb terminations shall be Type "A" per Standard Plan ES-5D. Detector loop wires shall be tested and approved prior to filling sawcuts.
12. All cables and conductors shall be continuous with a minimum of 6 feet of slack inside each pull box unless otherwise noted. 20 feet of signal interconnect cable slack shall be provided inside the controller cabinet.
13. Traffic signal interconnect cable (SIC) shall be 6-pair, AWG #20 cable unless otherwise noted. Traffic signal interconnect conduit shall have a minimum factory conduit bend radius of 36 inch.
14. All combination pedestrian and vehicle signal indications including PV heads shall utilize light emitting diode (LED) signal modules. All vehicle signal section and indications shall be 12 inch.

15. All signal housings, visors, and backplates shall be metal. Vehicle signal housing shall be provided with louvered backplate. A tunnel visor shall be provided for each signal face.
16. All unused tenons shall be capped in a waterproof method as directed by the Engineer.
17. All equipment locations shall be approved by the Engineer prior to final placement.
18. Plan signature is good for 1 year, additional plan review is required if no construction began by then.

E. ENGINEER'S ESTIMATE

A complete engineer's estimate of construction quantities and costs shall be furnished. If the signal is part of a development with street improvements, the total signal costs should also be shown on the Construction Cost Worksheet for the street improvements as a single line item with a lump sum amount or with separate line items required for the project.

F. ENVIRONMENTAL CLEARANCE

Environmental clearance shall be obtained for all traffic signal projects. Project conditions shall initiate environmental clearance procedures through the Planning Department.

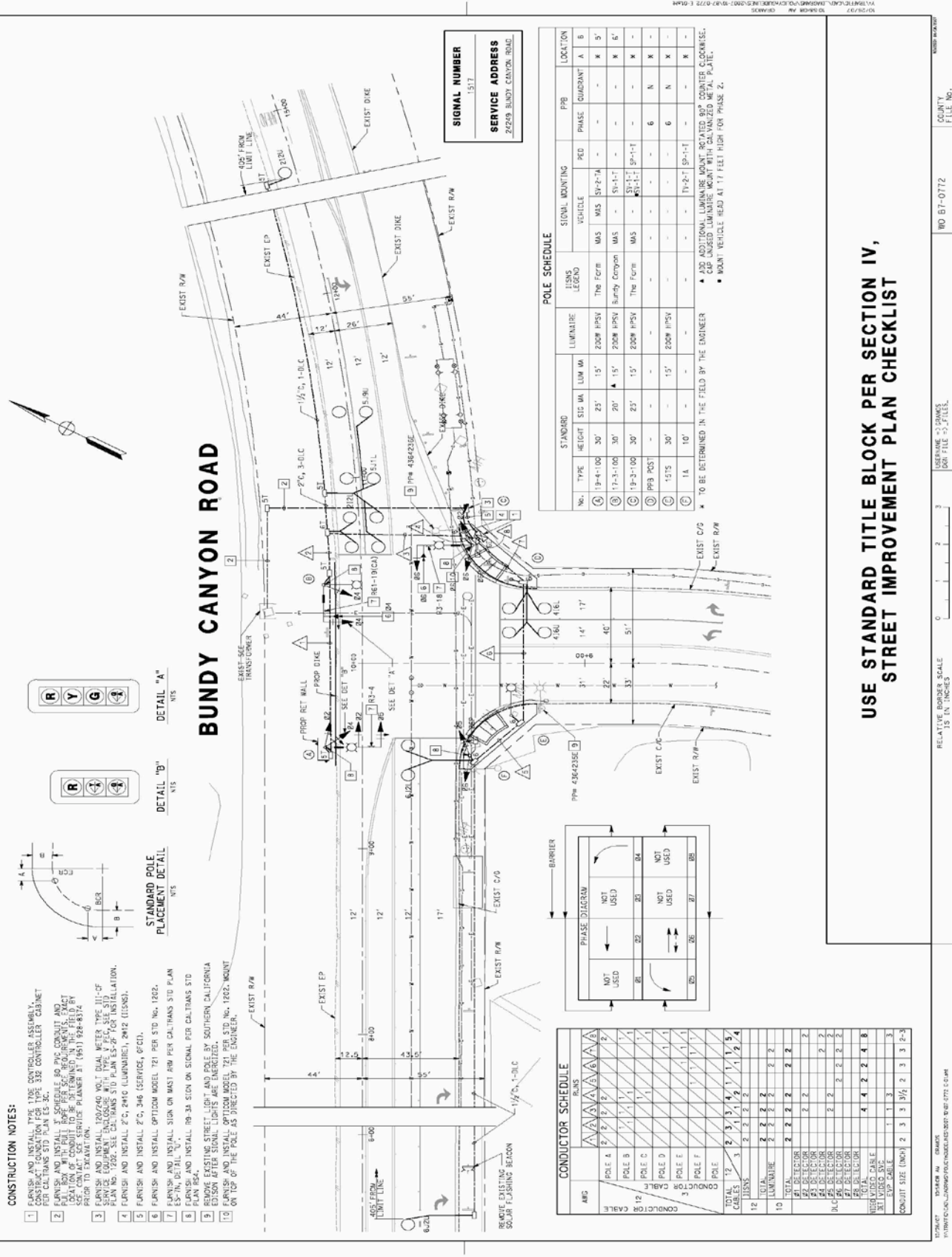


Exhibit TS-2

COUNTY OF RIVERSIDE
TRANSPORTATION DEPARTMENT

PREFERED MICROSTATION
LEVELS, COLORS AND PLOTTED LINE WEIGHTS

TO BE USED FOR ALL DRAWINGS
ELECTRONICALLY SUBMITTED TO THE COUNTY

	COLOR	WEIGHT
LEVEL 1		
TITLE BLOCK	RED	.70mm
EXISTING STREET IMPROVEMENTS	WHITE	.25mm
RIGHT-OF-WAY LINES	RED	.70mm
LEVEL 2		
CONDUCTOR SCHEDULE	BLUE	.35mm
POLE SCHEDULE	BLUE	.35mm
PHASE DIAGRAM	BLUE	.35mm
SENSOR TABLE	BLUE	.35mm
LEVEL 3		
ALL NEW SIGNAL EQUIPMENT	GREEN	.50mm
NEW CONDUIT	GREEN	.50mm
NEW DETECTOR LOOPS	GREEN	.50mm
LEVEL 4		
EXISTING STRIPING, SIGNING AND MARKINGS	BLUE	.35mm
LEVEL 5		
PROPOSED STRIPING, SIGNING AND MARKINGS	GREEN	.35mm
LEVEL 6		
ALL UTILITIES	WHITE	.25mm
LEVEL 7		
TEXT	BLUE	.35mm
DIMENSIONS	BLUE	.35mm
SPECIFIC DETAILS (NORTH ARROW, USA ALERT)	GREEN	.50mm
LEVEL 8		
PROPOSED STREET IMPROVEMENTS	GREEN	.50mm
LEVEL 9		
CENTERLINES	WHITE	.25mm
LEVEL 10		
AREAS FILLED WITH HATCHED LINES	WHITE	.25mm
LEVEL 11		
AREAS CONAING HATCHED LINES	GREEN	.50mm
LEVEL 12		
EXISTING SIGNAL EQUIPMENT	WHITE	.25mm