14.0 SIGNING, PAVEMENT MARKING, SIGNALIZATION, AND LIGHTING INFRASTRUCTURE

The Contractor shall design and construct signing, pavement marking, and lighting elements in accordance with the requirements of the standards listed in Table 14-1 as appropriate for the jurisdictional ownership, oversight and Approval of the Work, and in accordance with Standard Specials in Book 2, Section 20.

All requirement for temporary traffic control including temporary traffic signals and/or short-term modifications of existing traffic signals, signing, and striping in conjunction with construction are found in this Section and in Book 2, Section 16.

Temporary and permanent ramp metering signal technical requirements are discussed in Book 2, Section 19.

14.1 Design Requirements

The Contractor shall prepare signing, pavement markings, and lighting designs and plans for all areas on the Project in accordance with the requirements of the following sections. These plans shall be a component of all Released for Construction (RFC) Documents where any signing, pavement marking, or lighting element is required for the Work. No Material, part, or attachment of any Equipment shall be substituted or applied contrary to the manufacturer's recommendations and standard practices.

The Contractor shall provide permanent signing, pavement marking, delineation, and other traffic control devices that facilitate safe flow of traffic through the completed Project elements. Within the Final Environmental Impact Statement (FEIS) alignment area, overhead sign structures shall accommodate all future phases of the Project (subsequent phases and any Additional Requested Elements [ARE] not included in the Basic Configuration).

The Contractor shall provide express lane signing, striping, and pavement markings in accordance with Federal Highway Administration (FHWA) *Manual on Uniform Traffic Control Devices* (MUTCD) and Book 2, Section 19.

The electrical designs shall include the electrical and communications requirements for the Intelligent Transportation Systems (ITS) as described in Book 2, Section 19 and all electrical assets. The Contractor shall be responsible to determine electric, power, and communication requirements for the Project and to develop the Project lighting design and construction requirements. The Contractor shall coordinate with all Utility Owners including, but not limited to, Xcel Energy, Poudre Valley REA (PVREA), Loveland Power, and the Zayo Group.

The Contractor shall obtain Approval of the power service design from the power service provider and from the Colorado Department of Transportation (CDOT) and coordinate and meet all requirements as specified by the power service provider for the complete and operational power service to all required locations. All power connections to devices shall include a quick-disconnect.

The Contractor shall be responsible for the coordination of power source Work. The Contractor shall contact the appropriate electrical supplier to request and process to completion the required coordination to establish the power sources for all Roadway, electrical assets, and Street lighting. The Contractor shall perform all Work necessary to maintain existing or establish new power sources. The Contractor will be responsible for installing the power meter(s) and lighting control centers for the Project. All cost charges from the power service provider, and all necessary Materials, including meter (if required), labor, and coordination required to maintain existing or establish new power sources shall be included in the Work.

The Contractor shall design and construct signing, traffic signalization, pavement marking, and lighting elements in accordance with the requirements of the standards listed in Table 14-1 as appropriate for the jurisdictional ownership, oversight and Approval of the Work and in accordance with standard specials in Book 2, Section 20. The Contractor shall use the latest adopted edition at the time of the Proposal Due Date unless otherwise agreed to by CDOT in advance.

Table 14-1 Standards

Author	Title
CDOT	*Standard Specifications for Road and Bridge Construction*
Xcel Energy	*Xcel Outdoor Lighting Manual*
Loveland Power	*Street Lighting Standards* http://www.ci.loveland.co.us/departments/water-and-power/development-building/street-lighting-standards
Loveland Power	*Requirements for Electrical Service* http://www.ci.loveland.co.us/departments/water-and-power/development-building/requirements-for-electric-service
CDOT	*Sign Design Manual*
CDOT	*M&S Standards*
FHWA	*MUTCD*
FHWA	*Standard Highway Signs (including supplements)*
American Association of State Highway and Transportation Officials (AASHTO)	*A Policy on Geometric Design of Highways and Streets*
AASHTO	*Roadside Design Guide*
AASHTO	*Standard Specifications for Highway Bridges*
Local Jurisdiction	*Design Standards, Details, and Specifications*
CDOT	*Lighting Design Guide*
AASHTO	*Guide for the Development of Bicycle Facilities*
CDOT	*Retroreflective Sheeting Materials Guide*

14.1.1 Permanent Signing

14.1.1.1 Signing Design

The Contractor shall prepare signing designs and plans for the Project area. These plans shall include all necessary guide, warning, supplemental, and regulatory signs. See Book 2, Section 19 for requirements for Project related dynamic signage such as variable message signs (VMS), variable toll message signs (VTMS), and others. This shall also include additions, removals, or modifications to existing signs and appurtenances. In addition, a continuous scroll plot shall be prepared for overhead signs covering the entire Project area. This plot should be maintained and updated after every Project signing submittal involving overhead signing.

Signing design shall comply with the requirements of the most current publications of the CDOT *Standard Specifications for Road and Bridge Construction*, *M&S Standard Plans*, and *Sign Design Manual*; and the FHWA MUTCD as modified by the Colorado Supplement as well as all Interpretation issued by FHWA.

The requirements of the MUTCD shall include both the standard requirements and the guidance recommendations of the manual. Unless stipulated otherwise by CDOT in writing, all MUTCD "Should" and "Shall" standards and guidance recommendations are to be assumed Project Technical Criteria and as part of the base Contract design. MUTCD standards take primacy over any Request for Proposal (RFP) exhibit or preliminary design. MUTCD Section 2E.07 Characteristics of Urban Signing as well as Section 2A.17, Overhead Sign Location should be assumed urban for all portions of Interstate 25 (I-25) within the construction limits.

The design and plans shall include modifications to permanent signing inside and outside the Project that is rendered inaccurate, ineffective, confusing, or unnecessary by the Project. Signing plans shall provide layouts showing the locations of ground-mounted and overhead signs, special sign details, and structural cross sections for overhead sign Structures. Signs created for use in the CDOT Right-of-Way (ROW) must meet current Colorado and MUTCD specifications.

Signing design for local intersections and Streets shall comply with the respective local agency guidelines. Contractor shall submit signing and striping design plans to respective local agencies for review.

The Contractor shall submit plans for all signs including Class III, overhead signs, and regulatory and guide signs to CDOT for Acceptance. These plans shall identify the location and legend for each sign. The Contractor shall submit sign layouts for all special signs of any size to CDOT for Acceptance. All existing non-monotube overhead sign Structures shall be replaced with new monotube Structures.

Where CDOT sign Structure standards cannot be met, the Contractor shall provide custom-designed monotube sign Structures and foundations for Acceptance from CDOT. Permanent signage near Bridges shall not be hung from or be attached to Bridge Superstructures. Existing signs attached to Bridge Superstructures shall be removed and replaced with monotube sign bridges or cantilever Structures if signs are to remain.

The Contractor shall mount all overhead signs with a minimum vertical clearance of 17.5 feet, measured from the high point on the Roadway surface under the sign panels to the bottom of the VMS, VTMS, ITS device over the travel way, or guide sign (whichever is lowest).

Sign lighting and walkways shall not be used on overhead sign Structures.

Sign Structures shall be designed in accordance with CDOT Standard S-614-50 and S-614-60.

All ground mounted signage, delineators, etc., shall be installed within a full depth polyvinyl chloride (PVC) sleeve at locations where the device is installed within concrete Sidewalk, median cover material, concrete pavement, slope paving, etc.

14.1.1.2 Materials

Wood posts for mounting permanent ground signs shall not be used. All delineators shall be Shur-Tite per Project Special Revision 612 in this Section.

Sheeting shall be Type IV and Type XI, as defined in the CDOT *Retroreflective Sheeting Materials Guide*, and shall conform to Subsections 713.04 and 713.06 when applicable. For all permanent signs, the legend, borders, and background shall be Type XI.

All signs shall be replaced and not reused. All sign structures shall be removed and replaced except for those listed in Book 2, Section 15.

14.1.2 Permanent Pavement Marking

14.1.2.1 Pavement Marking Design

The Contractor shall prepare pavement marking designs and plans for Roads affected by the construction of the Project. These plans shall include, but not be limited to, all striping required for center lines, edge lines, lane lines, gore areas, lane drops, merging lanes, transition lanes, bike lanes, arrows, legends, symbols, object markings, delineation, and other striping, as well as any modifications required for transitions to existing pavement markings.

Pavement marking design for CDOT facilities shall comply with the requirements of the most current publications of the *CDOT Standard Specifications for Road and Bridge Construction* and *M&S Standard Plans*; and the FHWA MUTCD. The requirements of the MUTCD shall include both the standard requirements and the guidance recommendations of the manual.

Pavement marking design for the local Streets and intersections shall comply with the respective local agency guidelines.

The conceptual mainline and other Roadway striping as shown in the Reference Documents is for information and reference only.

14.1.2.2 Materials

The Contractor shall use pavement marking Materials specified in **Error! Reference source not found.**~~Table 14-2~~ below and be in conformance with CDOT Standard S-627-1, Standard Specification Sections 627 and 713, and Modifications to *Standard Specifications* in Book 2, Section 20.

Table 14-2 Pavement Marking Materials

Location	Pavement Marking Type
Edge lines and channelization lines	Modified Epoxy Pavement Marking
Broken lines of any type on Portland concrete cement pavement (PCCP)	Preformed Plastic Pavement Marking (Type II)(Inlaid) (contrast)
Broken lines of any type on Hot Mix Asphalt (HMA)	Preformed Plastic Pavement Marking (Type I)
Word/symbols/cross walks/stop lines	Preformed Plastic Pavement Marking (Type I)

14.1.3 Temporary and Permanent Traffic Signalization Traffic Signal Design

The Contractor shall prepare traffic signal plans for each signalized intersection (temporary and permanent) within CDOT ROW on the Project and shall submit the plans to CDOT for Approval 30 days prior to issuance of RFC Documents. These plans shall include, but are not limited to, existing and proposed intersection plan details, traffic signal pole locations, mast arm and signal head locations, descriptions and directions, pedestrian button and signal locations, descriptions and directions, approach striping and marking locations and types, cabinet and power source locations, conduit and pull boxes, detection systems and locations, and all other plan and component details for complete traffic signal installation and non-signal lighting placed on the poles. All temporary and permanent traffic signals shall be designed and constructed in conformance to the CDOT *Standard Specifications* and shall be subject to the review and Acceptance of CDOT. The Contractor shall submit the plans to CDOT for review 30 days prior to issuance of RFC Documents. Video detection shall be required for all permanent traffic

signals. Permanent traffic signalization appurtenances will not be allowed to hang from, or be attached to any part of a Bridge.

Materials. The Contractor shall use traffic signal equipment, including traffic signal poles, for all temporary and permanent installations as specified in the CDOT *Standard Specifications*.

14.1.4 Lighting

14.1.4.1 Permanent Lighting Design

Roadway lighting for I-25 shall be provided for the interchange areas, including ramps, being constructed by the Project and from the outside edges of the Roadways, unless otherwise Approved by CDOT. Lighting on ramps impacted by the Project shall be replaced such that, at a minimum, partial interchange lighting for all ramp entrances and exits is provided. The design report for certification shall be signed and sealed by the Contractors Engineer and submitted to CDOT for Acceptance. If any structural modifications to existing luminaire poles, mast arms, or structural connections are proposed, Shop Drawings and calculations shall be submitted to CDOT for Acceptance. The calculations shall be signed and sealed by the Contractor's Engineer.

The Contractor shall prepare lighting designs and plans for the I-25 parking lot, interchange areas including ramps, and all existing permanent lighting conditions on Roadways impacted by the Project. All permanent lighting within the Project shall be designed and constructed to be consistent with current CDOT guidelines and revisions to the *Standard Specifications* included herein, unless otherwise specified. Designs and Plans shall be subject to the review and Acceptance by CDOT.

Lighting plans shall address both temporary and permanent Work and shall include existing topography, ROW, Utilities, drainage facilities, Structures, and all other existing and proposed facilities. The plans shall include location and orientation of standards and fixtures, wiring, conduits, pedestals, power sources, lighting control centers, and all other lighting components required to construct the lighting on the Project.

The Contractor shall submit to CDOT for Acceptance lighting calculations, including voltage-drop calculations for each circuit, showing that the design meets the performance criteria for Roadway design to include average, maximum, minimum foot-candles and average to minimum and maximum to minimum luminance on the horizontal Roadway plane. The lighting design shall include iso-foot-candle curve plots showing foot-candle levels at 1.0, 0.5, 0.2, and 0.1 foot candles. The design and plans shall also include circuit layouts showing underground circuits alongside and under the Roadway and through retaining wall and Bridge Structures.

Lighting on and underneath all Bridge Structures and within Structures for public use facilities, such as Sidewalks, bikeways, and trails within the Project boundaries shall comply with the design criteria in CDOT *Lighting Design Guide* for average and minimum luminance for the Roadway or pedestrian/bicycle facility. Roadway and pedestrian lighting on Bridge Structures shall comply with the requirements of the CDOT *Lighting Design Guide.*

Lighting for the Kendall Parkway parking lot shall comply with design criteria of the City of Loveland as supplemented by Millennium General Development Plans. The SH 402 parking lot shall comply with the City of Loveland lighting standards.

14.1.4.2 Permanent Lighting Materials

The Contractor shall use lighting Equipment for all permanent installations on I-25 including ramps as specified in the CDOT *Lighting Design Guide M&S Standards*, and the City of Loveland Street Lighting Standards.

The contractor shall be responsible for lighting maintenance for the Project. The Contractor shall submit the Materials lists for the proposed lighting, including under deck lighting, for Approval prior to ordering Material. Contractor shall return all salvaged materials to CDOT at 10601 W 10th St, Greeley, CO.

14.2 Construction Requirements

14.2.1 Permanent Signing

With the exception of the Materials installed with the Crossroads Interchange Project and the structures included in Book 2, Section 15, the Contractor shall remove and dispose of all existing sign Structures, ground-mounted signs, and delineators, which shall become the property of the Contractor. See Book 2, Section 16 for additional construction signing requirements.

14.2.2 Permanent Pavement Marking

Prior to placing permanent markings all temporary markings shall be removed without Roadway scarring. To remove curing agent, new PCCP shall be sandblasted prior to placement of any primer or pavement-marking Material.

14.2.3 Permanent Signalization

All new traffic signal equipment should be constructed per CDOT *Standard Specifications* and the latest version of the MUTCD.

14.2.4 Permanent Lighting

With the exception of the Materials installed with the Crossroads Interchange Project, the Contractor shall remove the existing lighting as required within the Project area.

14.3 Deliverables

At a minimum, the Contractor shall submit the following to CDOT for review, Approval, and/or Acceptance.

Table 14-3 Deliverables

Deliverable	Review, Acceptance, or Approval	Schedule
Preliminary Signage and Pavement Marking Plans	Review	As Part of The Preliminary Design Plans (30%) Submittal
Signage and Pavement Marking Plans	Review/ Acceptance	As Part of The Pre-RFC Review Documents and Final RFC Documents Submittals
Class III, overhead signs, and regulatory and guide signs plan including signing scroll plot	Review/ Acceptance	Prior to fabrication of overhead sign panels and As Part of The Pre-RFC Review Documents and Final RFC Documents Submittals
Sign layouts for all special signs of any size	Review/ Acceptance	As Part of The Pre-RFC Review Documents and Final RFC Documents Submittals
Custom-designed monotube sign Structure and foundation plans	Review/ Acceptance	As Part of The Pre-RFC Review Documents and Final RFC Documents Submittals

Deliverable	Review, Acceptance, or Approval	Schedule
Median butterfly sign Structure and foundation plans	Review/ Acceptance	As Part of The Pre-RFC Review Documents and Final RFC Documents Submittals
Preliminary Lighting Plans	Review	As Part of The Preliminary Design Plans (30%) Submittal
All permanent lighting plans	Review/ Acceptance	As Part of The Pre-RFC Review Documents and Final RFC Documents Submittals
Lighting and electrical design calculations	Review/ Acceptance	As Part of The Pre-RFC Review Documents and Final RFC Documents Submittals
Materials lists for the proposed lighting, including underdeck lighting	Acceptance	As Part of The Pre-RFC Review Documents and Final RFC Documents Submittals and Prior to Ordering Material
Inspection and design report certification for reuse of existing luminaire poles, mast arms, and all structural connections	Review/ Acceptance	As Part of The Preliminary Design Plans (30%), Pre-RFC Review Documents, and Final RFC Documents Submittals
Reuse of existing ground signs	Review/ Acceptance	As Part of The Pre-RFC Review Documents and Final RFC Documents Submittals
Temporary and Permanent Traffic Signal Design	Acceptance	30 Days prior to issuance of RFC

14.4 Project Special Provisions

The following specifications modify and take precedence over the Standard Specifications.

REVISION OF SECTION 612
DELINEATOR AND REFLECTORS

Section 612 of the Standard Specifications is hereby revised for this project as follows:

In Subsection 612.02 (a) 2. Delete the first and third paragraphs and replace with the following:

2. Flexible Posts. Flexible posts shall be SHUR-TITE® Products manufactured and supplied by:

   Shur-Tite Products
   PO Box 2283
   Round Rock TX 78680
   Contact: David Riker
   512-218-9500 (office)
   512-388-0417 (FAX)
   512-971-0340 (Cell)

   Posts shall be manufactured from an impact resistant flexible material and shall conform to the following requirements:

   B. Base Anchoring. The posts shall be designed to facilitate a permanent installation that resists overturning, twisting, and displacement from wind and impact forces. Drivable post supports shall have an anchoring depth of 22.5 inches per CDOT Standard Plan

S-612-1 or manufacturer's recommendation. A concrete foundation shall be used for delineator support in soft soils per the Plans or as directed by the Engineer.

3. Shur-Flex® Drivable Delineator shall be used for ground-mounted delineators for typical conditions in firm soils. Ground-mounted delineators for Soft Soil Conditions shall use a Shur-Flex® Drivable Delineator in a concrete footing. Concrete footings shall be Class B concrete. For guardrail post mounted delineators, a Shur-Tite® Guardrail Post Flat Mount Delineator shall be used. Delineators mounted directly to pavements shall use a Shur-Flex® Surface Mount Delineator. See CDOT Standard Plan S-612-1 for delineator and installation details.

Delete subsection 612.02 (a) 2.E and replace with the following:

E. Dimensions. The post shall be round with a minimum 2 3/8 inch outside diameter and 0.22 inch minimum wall thickness. The post shall be 48 inches in length, as measured from the edge of pavement. The drivable anchor shall be 2 inches square by 24 inches deep using 12 gauge galvanized steel square tubing.

In subsection 612.02 (a) 2. F. shall include the following:

(8) The post (excluding flat mount types) shall have a simple non-mechanical flexible joint. The flexible joint shall have a square to round configuration that transitions from the ground anchor to the post and shall enable the posts to self-right after omni-directional impacts. The square end shall be molded to exactly fit inside the 2 inch square tubing opening and transitions to a round configuration to exactly fit inside the delineator post. The flexible joint shall be fully inserted in both ends to allow proper installation of securing hardware and self-righting properties.

(9) The post shall be permanently sealed at the top and have a 13 inch flattened surface to accommodate up to three (3" by 3") reflective sheets. A Type I delineator shall have one (3" by 3") reflective sheet on one side, a Type II shall have two (3" by 3") reflective sheets on one side and a Type III shall have three (3" by 3") reflective sheets on one side. Reflective sheets shall be placed in a straight vertical column starting one-half to three-quarters inch from the top edge of the delineator. Type II and III delineators shall have reflective sheets separated by one inch vertically in the column. All reflective sheets shall be placed at the factory by the fabricator prior to on-site delivery of delineators.

(10) The post shall be comprised of a minimum of 70 percent recycled material by volume and include a premium UV inhibitor.

(11) The anchor shall be galvanized steel perforated tubing.

Subsection 612.03 shall include the following:

It shall be the Contractor's responsibility to insure that delineators are properly installed and meet all the requirements of this Special Provision. A SHUR-TITE® Products Factory Representative shall be on site to provide training to insure that the Contractor knows how to correctly install all SHUR-TITE® delineator types.

REVISION OF SECTION 613
LIGHTING

Section 613 of the CDOT Standard Specifications and Special Provisions (Jan.30, 2014) is hereby revised for this project to include the following:

In subsection 613.02, delete (e) and replace with the following:

(e) *Luminaire* – A complete luminaire includes the housing, lens, Light Emitting Diode (LED) luminaire, luminaire housing, 0-10V dimmable driver, slip-fitting clamp or approved manufacturer mounting, all necessary internal wiring, multi-contact twist-lock outdoor lighting dimming 7 pin control receptacle per ANSI C136.41, and photoelectric control. Luminaires shall operate at either 120 VAC, 60 Hz or 277 VAC, 60 Hz. Luminaires shall meet electrical utility company requirements.

Subsection 613.06 Luminaires and Lamps paragraph shall include the following:

Roadway luminaires shall each be provided with a multi-contact 7 pin twist-lock outdoor lighting dimming control receptacle per ANSI C136.41 to enable compatibility with future wireless dimming control system by CDOT. Under this contract, each roadway luminaire shall be provided with and controlled via photoelectric control device installed on each luminaire. The window of the photoelectric control shall be oriented north to minimize exposure to direct sunlight.

After luminaires are installed and prior to their acceptance, lenses shall be cleaned to provide maximum lumen output.

Underdeck pendant luminaires shall be mounted as shown on the plans. All pendant luminaires shall include side shielding to prevent glare in the motorist's view.

Subsection 613.09 shall include the following:

Lighting Control Center (Pedestal Only) – Provide a hot-sequence meter housing with lever by-pass, tab lockable cover in NEMA 3R enclosure and lighting control center pedestal with NEMA 3R, 100A, 2-pole, 250V, service entrance rated, heavy duty, fusible disconnect switch, with neutral and ground bars, 4-pole, 100A, fuse block, 20A control fuse block, 100A, 2-pole lighting contactor, ground bar, neutral bar, ground rod and connection to the utility transformer utilizing the appropriate utility provider's specifications.

"Arc-Flash Hazard Warning" labels shall be furnished and installed by the electrical contractor per the National Electric Code-2014 NEC 110.6 and the NFPA 70E-2015, and all other labels required by NFPA 70.

Photoelectric Cell – Contractor shall provide and install a non-metered, 2-pole, 60A relay box with fusing and a twist-lock receptacle built into the top of the NEMA 4 relay box, and a twist-lock receptacle base type photocell. Contractor shall install this photocell relay box on the side of the Lighting Control Center Panel NEMA 3R enclosure, to control the LED underdeck luminaires for dusk to dawn 'on' control.

Breakaway Wiring System – Contractor shall provide an approved means of breakaway disconnect in each of the transformer bases at each light standard details. Attach plug inside the transformer base such that in the event of a motor vehicle collision with the light standard, the wiring will disconnect at the plug inside the pull box and leave no live wiring outside of the transformer base.

REVISION OF SECTION 613
TEMPORARY LIGHTING

Section 613 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

This work consists of furnishing and installing temporary lighting including poles and luminaires and other related work for illumination in accordance with these specifications and in conformance with the details, lines, grades and locations shown on the plans or established.

MATERIALS

Temporary lighting materials shall conform to the requirements of Section 715.

CONSTRUCTION REQUIREMENTS

The Contractor shall keep existing illumination systems, their approved temporary replacements, or temporary construction lighting in effective operation for the benefit of the traveling public during construction progress, except when shutdown is permitted to allow alteration or final removal of the systems. Temporary lighting shall provide lighting levels equal to or exceeding the existing lighting levels and quality by using the same luminaire quantity and type as existing until the new lighting system is energized. Lighting system shutdowns shall not interfere with the regular lighting schedule unless otherwise permitted. Shutdown schedules are subject to approval by CDOT.

The Contractor shall determine the exact location of existing conduit runs and pull boxes before using equipment that may damage such facilities or interfere with any system.

All circuits to lighting outside of project scope shall stay energized without interruption. If damage is caused by the Contractors' operations, damaged facilities shall be repaired or replaced promptly at no additional compensation.

Where roadways are to remain open to traffic and existing lighting systems are to be modified, the existing systems shall be kept in operation until the final connection to the modified circuit is made. The modified circuit shall be complete and operating by nightfall of the same day the existing system is disconnected.

The Contractor shall keep temporary sidewalks lit at all times, including underneath the structures. Construction lighting installations shall remain in effective operation until they are no longer required for the protection of the traveling public.

Reusable equipment damaged when the Contractor is removing and salvaging existing material shall be replaced or repaired at the Contractor's expense.

Existing installations to be removed shall be kept in operation until the new installations are ready to be turned on or as directed.

Existing materials which interfere with or which are incompatible with new construction shall be removed or salvaged in the order directed, as specified or approved, before completion of the new construction. The Contractor shall notify the Engineer at least four calendar days in advance of removing or salvaging the existing materials