Colorado
Department of Transportation
Special Provisions
25359 Crosby Avenue Multimodal Improvements
Final / Bid Documents

The 2025 *Standard Specifications for Road and Bridge Construction* controls construction of this project. The following special provisions supplement or modify the Standard Specifications and take precedence over the Standard Specifications and plans.

Project Special Provisions

Colorado
Department Of Transportation
Special Provisions
25359 Crosby Avenue Multimodal Improvements
Standard Special Provisions
Final / Bid Documents

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Notice To Bidders

Bidders shall refer to the City of Grand Junction Invitation For Bid for all bidding information related to this project.

Commencement and Completion of Work
(Working or Calendar Day)

The Contractor shall commence work under the Contract on or before the date provided in the "Notice to Proceed." The Contractor shall complete all work within 180 calendar days per the "Notice to Proceed."

Revision of Section 102
Project Plans and Other Data

Revise Section 102 of the Standard Specifications for this project as follows:

Subsections 102.01, 102.02, and 102.04 are replaced by the City of Grand Junction Invitation for Bid.

Subsection 102.05 shall include the following:

The supplemental data available to all bidders consists of:

(a) Project right-of-way plans – PDF file
(b) Project geotechnical report – PDF file

Additional supplemental data available to the low bidder consists of:

(c) 2-dimensional CAD linework – DWG file
(d) Project Alignments - LandXML file
(e) Surfaces – LandXML files of the following:
1. Existing Terrain Model
2. Finished Grade Terrain Model

The Owner does not warrant the supplemental data and this information is not considered to be a part of the Contract. If bidders use or modify the supplemental data in preparing a proposal or planning and prosecuting the work, all associated data is used at their own risk, and bidders are responsible for all conclusions, deductions, and inferences drawn from the original or modified supplemental data.

REVISION OF SECTION 105
HOT MIX ASPHALT PAVEMENT SMOOTHNESS
STRAIGHTEDGE TESTING

Section 105.07 is hereby revised for this project as follows:

Sections 105.07 shall be deleted and replaced with the following:

This project shall not be subject to incentive payments for smoothness. The finished transverse and longitudinal surface elevation of the pavement shall be measured using a 10 foot straightedge. Areas to be measured will be directed by the Engineer and will include the joints to the existing pavement. The Contractor shall furnish an approved 10 foot straightedge, depth gauge and operator and shall aid the Engineer in testing the pavement surface. Areas showing high spots of more than 3/16 inch in 10 feet shall be marked and corrective work shall be required until the high spot does not exceed 3/16 inch in 10 feet.

If corrective work is required, the Contractor shall submit a written corrective work proposal, including the proposed methods and procedures, to the Engineer. The Contractor shall not commence corrective work until the proposal has been approved in writing by the Engineer.

Corrective work shall be performed using one of the following methods:

1. Diamond Grinding. Grinding shall not reduce planned pavement thickness by more than 0.5 inches. Unless otherwise directed by the Engineer, when grinding is complete the entire ground area of the final pavement surface shall be covered in accordance with Section 407 with a tack coat of CSS-1H. In the interest of safety, tack coat shall not be placed on curves. The tack coat shall be placed at 0.1 gallons of diluted emulsion per square yard. The emulsion shall be diluted with water at the rate of 50 percent water and 50 percent emulsion. Where directed by the Engineer, cores shall be taken to verify that minimum pavement thicknesses have been maintained. A minimum of one core shall be taken for every 100 cumulative lane-feet or fraction thereof, per lane of diamond grinding. Coring shall be at the Contractor's expense.
2. Removal and Replacement. If diamond grinding cannot be completed without reducing the planned pavement thickness by more than 0.5 inches, the pavement requiring corrective work shall be removed, full width of the lane and full thickness of the layer, in accordance with subsection 202.09. The removal area shall begin and end with a transverse butt joint, which shall be constructed with a transverse saw cut perpendicular to centerline. Replacement material shall be placed in sufficient quantity so the finished surface conforms to grade and smoothness requirements. Sections removed and replaced shall be at least 0.10 miles in length, unless the entire planned section is less than 0.10 miles, in which case the entire planned section shall be removed and replaced.

All testing and corrective work shall be at the Contractor's expense, including traffic control and any other items required to complete the work, except that traffic control for the initial testing shall be paid for using contract traffic control items.

July 1, 2025

Revision of Section 212
Soil Amendments, Seeding, and Sodding

Delete Section 212.02 (c) of the Standard Specifications for this project and replace it with the following:

Materials

212.02 Seed, Fertilizers, Soil Conditioners, Mycorrhizae, Elemental Sulfur, and Sod.

(c) Compost Compost used for soil amendment in planting areas shall consist of a blended mix of 50% composted manure and 50% aged sawdust by volume. The compost shall meet the following requirements:

(a) Organic Matter: 35–55% by dry weight
(b) Electrical Conductivity (EC): < 4.0 mmhos/cm
(c) pH: 6.0 to 8.0
(d) Carbon to Nitrogen Ratio (C:N): 20:1 to 40:1
(e) Particle Size: 98% passing ½-inch screen
(f) Weed-Free: Certified or sterilized
(g) Stability: Must pass a maturity test (Solvita or CO_2 respiration)
(h) Testing: Supplier shall provide results from a lab enrolled in the US Composting Council's Seal of Testing Assurance (STA) program
(i) Compost containing biosolids, food waste, or uncomposted green waste will not be accepted.

Compost for permanent seeding soil conditioner locations onsite and application rates shall be as shown on the plans.

Organic matter in compost shall be no more than 2 inches in length.

Compost (Mechanically Applied) for permanent seeding shall meet the gradation and physical properties as shown in Table 212-4 and Table 212-5. The Contractor shall provide a written explanation for compost tested parameters not within the acceptable requirements for review and consideration.
The Contractor shall provide documentation from the composting facility confirming that the material has been tested per USCC TMECC.

Construction Requirements

Delete Sections 212.03-212.08 and replace with New Section 212.03 to the Standard Specifications the following to account for Construction Methods not involving Seeding:

212.03 Compost. Soil amendment shall be applied and incorporated as follows:

- Apply compost at a rate of 6 cubic yards per 1,000 square feet to designated planting areas
- Incorporate to a depth of 6 inches using a rototiller or soil spader
- Mixing shall be uniform and completed only when soil moisture conditions are appropriate
- Final grading shall be smooth and ready for planting or mulching

Method of Measurement

212.09
The quantity of Compost will be measured by the actual quantity of material applied and accepted.

Basis of Payment

212.10 The accepted quantities of Compost, will be paid for at the contract unit price for each of the pay items listed below that appear in the bid schedule.

Payment will be made under:

Pay Item	Pay Unit
Organic Fertilizer	Pound
Compost (Mechanically Applied)	Cubic Yard
Biotic Soil Amendments (Hydraulic Applied)	Pound
Humate	Pound
Mycorrhizae	Pound
Elemental Sulfur	Pound
Seeding (Native) Drill	Acre
Seeding (Native) Hydraulic	Acre
Seeding (Native) Broadcast	Acre
Seeding (Wetland) Drill	Acre
Seeding (Wetland) Hydraulic	Acre
Seeding (Wetland) Broadcast	Acre
Seeding (Temporary)	Acre
Seeding (Lawn)	Acre
Sod	Square Foot

Topsoil preparation including incorporating and applying amendments, seedbed preparation, water, and seed mix (LBS PLS / Acre) will not be measured and paid for separately but shall be included in the work.
Calibrating, adjusting, or readjusting seeding or fertilizing equipment will not be measured and paid for separately but shall be included in the work.
No additional cost will be accepted for approved substitution of specified seed mix.
No payment will be made for areas seeded using one of the seeding methods without receiving signed Seed and Amendment Quantities Worksheet from the Engineer.

Additional seedbed preparation before seeding to correct compaction or erosion from storm events will not be measured and paid for separately but shall be included in the work.

Additional mobilizations as needed to complete seeding within allowed seeding seasons will not be measured and paid for separately but shall be included in the work.

Removal of all competitive, non-native vegetation before spreading amendments will not be measured and paid for separately but shall be included in the work.

June 9, 2023

Revision of Section 213
Landscape Rock Mulch (Special)

Revise Section 213 of the Standard Specifications for this project as follows:

Subsection 213.01 shall include the following:

This work consists of furnishing and installing landscape rock mulch, including four (4) distinct types as shown on the plans and described herein. Work shall include delivery, placement, grading, and cleanup of all rock mulch areas as specified or directed by the Engineer.

Subsection 213.02 materials shall include the following:

(k) Rock mulch shall meet the following type and installation requirements:

- (a) 1½" Tan Granite
- (b) 1" Tan Granite
- (c) 3/4" Gray Crushed and Washed Gravel
- (d) 1-1/2” La Sal Purple Granite, broadcast over Type a

All mulch shall be clean, washed, free of fines, dust, or organic matter, and screened to uniform size with no significant flat or flaky material. Materials shall be subject to approval prior to delivery.

213.03 Construction Requirements

Rock mulch shall be installed to the specified depth over prepared soils, using uniform raking or leveling methods. Final surfaces shall be:

- Even in depth and appearance
- Free of mounding or low spots
- Contained within curbs, mow strips, or edge restraints
- When one rock type abuts another, Install by blending without clean lines.

Type (d) (La Sal Purple Granite) shall be surface-broadcast only, over Type (a) 1-1/2” Tan Granite, Only where shown on the drawings, at a rate of 1/2 CF per 100 SF. Avoid clean lines of demarcation of La Sal Purple.
Contractor shall take care to prevent contamination of adjacent surfaces.

Subsection 213.04 shall include the following:

The pay items 1-1/2” Tan Granite (Special), 1” Tan Granite, 3/4" Gray Crushed and Washed Gravel and 1-1/2” La Sal Purple Granite will be measured by the number delivered, stockpiled and spread.

Subsection 213.05 shall include the following:

Pay Item	Pay Unit
Type (a) Landscape Rock (Special)	CY
Type (b) Landscape Rock (Special)	CY
Type (c) Landscape Rock (Special)	CY
Type (d) Landscape Rock (Special)	CY

June 9, 2023

Revision of Section 213
Landscape Boulder (Special)

Revise Section 213 of the Standard Specifications for this project as follows:

Subsection 213.01 shall include the following:

This work consists of furnishing and placing boulders in accordance with these specifications and in conformity with the details shown on the plans, or as directed.

Subsection 213.02 materials shall include the following:

(h) Landscape Boulders (Special) Landscape boulders shall consist of hard, dense, sound boulders as are locally available, subject to approval. Thin slab type stones and flaking rock will not be accepted. The boulders shall be spherical two foot to three-foot diameter Tan or Gold granite, unless otherwise approved.

Locate suitable boulders and obtain the Engineer's approval of the selected boulders prior to transport. Deliver boulders to a stockpile area designated by the Engineer.

Subsection 213.04 shall include the following:

The pay item Landscape Boulder (Special) will be measured by the number delivered to and stockpiled.

Subsection 213.05 shall include the following:

Pay Item	**Pay Unit**
Landscape Boulder (Special)	Each

The pay item Landscape Boulder (Special) will include locating suitable boulders, obtaining Engineer approval, moving boulders from project site to the stockpile area and unloading at the stockpile area.

Section 240
Protection of Migratory Birds
Biological Work Performed by The Contractor's Biologist

Add Section 240 to the Standard Specifications for this project as follows:

Description

240.01 This work consists of protecting migratory birds during construction.

Materials and Construction Requirements

240.02 The Contractor shall schedule clearing and grubbing operations and work on structures to avoid taking (pursue, hunt, take, capture, or kill; attempt to take, capture, kill or possess) migratory birds protected by the Migratory Bird Treaty Act (MBTA). The Contractor shall retain a qualified wildlife biologist for this project. The wildlife biologist shall have a minimum of three years' experience conducting migratory bird surveys and implementing the requirements of the MBTA. The Contractor shall submit documentation of the biologist's education and experience to the Engineer for acceptance. A biologist with less experience may be used by the Contractor subject to the approval of the Engineer based on review of the biologist's qualifications.

The wildlife biologist shall record the location of each protected nest, bird species, the protection method used, and the date installed. A copy of these records shall be submitted to the Engineer.

(a) Vegetation Removal. When possible, vegetation shall be cleared before the time when active nests are present. Vegetation removal activities shall be timed to avoid the migratory bird breeding season which begins on April 1 and runs to August 31. All areas scheduled for clearing and grubbing between April 1 and August 31 shall first be surveyed within the work limits for active migratory bird nests. The Contractor's wildlife biologist shall also survey for active migratory bird nests within 50 feet outside work limits. Contractor personnel shall enter areas outside CDOT right of way only if a written, signed document granting permission to enter the property has been obtained from the property owner. The Contractor shall document all denials of permission to enter property. The Contractor shall avoid all active migratory bird nests. The Contractor shall avoid the area within 50 feet of the active nests or the area within the distance recommended by the biologist until all nests within that area have become inactive. Inactive nest removal and other necessary measures shall be incorporated into the work as follows:

1. Tree and Shrub Removal or Trimming. Tree and shrub removal or trimming shall occur before April 1 or after August 31 if possible. If tree and shrub removal or trimming will occur between April 1 and August 31, a survey for active nests shall be conducted by the wildlife biologist within the seven days immediately before the beginning of work in each area of tree and shrub removal or trimming. The survey shall be conducted for each phase of tree and shrub removal or trimming.

   If an active nest containing eggs or young birds is found, the tree or shrub containing the active nest shall remain undisturbed and protected until the nest becomes

inactive. The nest shall be protected by placing fence (plastic) a minimum distance of 50 feet from each nest to be undisturbed. This buffer dimension may be changed if determined appropriate by the wildlife biologist and approved by the Engineer. Work shall not proceed within the fenced buffer area until the young have fledged or the nests have become inactive.

If the fence is knocked down or destroyed by the Contractor, the Engineer will suspend the work, wholly or in part, until the fence is satisfactorily repaired at the Contractor's expense. Time lost due to such suspension will not be considered a basis for adjustment of time charges but will be charged as contract time.

2. *Grasses and Other Vegetation Management*. Due to the potential for encountering ground nesting birds' habitat, if work occurs between April 1 and August 31, the area shall be surveyed by a wildlife biologist within the seven days immediately before ground disturbing activities.

   The undisturbed ground cover to 50 feet beyond the planned disturbance, or to the right of way line, whichever is less, shall be maintained at a height of 6 inches or less beginning April 1 and continuing until August 31 or until the end of ground disturbance work, whichever comes first.

   If birds establish a nest within the survey area, an appropriate buffer of 50 feet will be established around the nest by the CDOT biologist. This buffer dimension may be changed if determined appropriate by the CDOT biologist and approved by the Engineer. The Contractor shall install fence (plastic) at the perimeter of the buffer. Work shall not proceed within the buffer until the young have fledged or the nests have become inactive.

   If the fence is knocked down or destroyed by the Contractor, the Engineer will suspend the work, wholly or in part, until the fence is satisfactorily repaired at the Contractor's expense. Time lost due to such suspension will not be considered a basis for adjustment of time charges but will be charged as contract time.

(b) Work on structures. The Contractor shall prosecute work on structures in a manner that does not result in a taking of migratory birds protected by the Migratory Bird Treaty Act (MBTA). The Contractor shall not prosecute the work on structures during the primary breeding season, April 1 through August 31, unless he takes the following actions:

(1) The Contractor shall remove existing nests before April 1. If the Contract is not awarded before to April 1 and CDOT has removed existing nests, then the monitoring of nest building shall become the Contractor's responsibility upon Notice to Proceed.

(2) During the time that the birds are trying to build or occupy their nests, between April 1 and August 31, the Contractor shall monitor the structures at least once every three days for any nesting activity.

(3) If the birds have started to build any nests, they shall be removed before the nest is completed. Water shall not be used to remove the nests if nests are located within 50 feet of any surface waters.

(4) Installation of netting may be used to prevent nest building. The netting shall be monitored and repaired or replaced as needed. Netting shall consist of a mesh with openings that are ¾ inch by ¾ inch or less.

If an active nest become established, i.e., there are eggs or young in the nest, all work that could result in abandonment or destruction of the nest shall be avoided until the young have fledged or the nest is unoccupied as determined by the wildlife biologist and approved by the Engineer. The Contractor shall prevent construction activity from displacing birds after they have laid their eggs and before the young have fledged.

If the project continues into the following spring, this cycle shall be repeated. When work on the structure is complete, the Contractor shall remove and properly dispose of netting used on the structure.

(c) *Taking of a Migratory Bird.* The taking of a migratory bird shall be reported to the Engineer. The Contractor shall be responsible for all penalties levied by the U. S. Fish and Wildlife Service (USFWS) for the taking of a migratory bird.

Method of Measurement

240.03 Wildlife Biologist will be measured by the actual authorized number of hours a wildlife biologist is on site performing the required tasks.

Removal of nests will be measured by the actual number of man-hours spent removing inactive nests just before and during the breeding season, April 1 through August 31. During this period, the Contractor shall submit to the Engineer each week for approval a list of the workers who removed nests and the number of hours each one spent removing nests.

Netting will be measured by the square yard of material placed to keep birds from nesting on the structure. Square yards will be calculated using the length of netting measured where it is attached to the ground and the average height of the netting where it is attached to the structure.

Basis of Payment

240.04 The accepted quantities measured as provided above will be paid for at the contract unit price for each of the pay items listed below that appear in the bid schedule.

Payment will be made under:

Pay Item	Pay Unit
Wildlife Biologist	Hour
Removal of Nests	Hour
Netting	Square Yard

Payment for Wildlife Biologist will be full compensation for all work and materials required to complete the item, including wildlife biologist, wildlife survey, and documentation (record of nest location and protection method)

Payment for Removal of Nests will be full compensation for all work and material required to complete the work.

Payment for netting will be full compensation for all work and material required to complete the item. Overlaps of netting will not be measured and paid for separately but shall be included in the work. Maintenance and replacement, removal, and disposal of netting will not be measured and paid for separately but shall be included in the work.

Clearing and grubbing will be measured and paid for per Section 201. Mowing will not be measured and paid for separately but shall be included in the work.

Removal and trimming of trees will be measured and paid for per Section 202.

Fence (Plastic) will be measured and paid for per Section 607

REVISION OF SECTION 250
ENVIRONMENTAL, HEALTH, AND SAFETY MANAGEMENT
(RADIOACTIVE MATERIAL HANDLING AND WASTE DISPOSAL)

Section 250 of the ***Standard Specifications*** is hereby revised for this project as follows:

Subsection 250.03 shall include the following:

This project may involve work with radioactive soils associated with the Uranium Mill Tailings Radiation Control Act (UMTRCA, 1978) and the Uranium Mill Tailings Remedial Action (UMTRA) project by the Department of Energy. Uranium mill tailings may, or may not, have been identified at properties adjacent to the project area; however, per the CDPHE, radioactive contaminated soils may be present in the project location due to past uranium mill tailings uncovered in the area. Areas of excavation shall be scanned for radioactive readings. If gamma readings are at or above 20 uR/H, excavated materials shall be considered contaminated with radioactive tailings and shall be handled and disposed of properly.

Subsection 250.05 (d) Hazardous Waste Disposal shall include the following:

The Contractor shall review and implement material handling protocols for radioactive materials outlined in the CDPHE's *Uranium Mill Tailings Management Plan -- for managing Title I uranium mill tailings encountered during construction activities in Western Colorado*," (latest version). Upon request, a copy of this plan is available from the CDPHE's website, or from the CDOT Region 3 Environmental Unit.

As referenced in the *Uranium Mill Tailings Management Plan*, if on-site disposal of tailings is not feasible, off-site disposal of radioactive tailings shall be coordinated by the Health and Safety Officer (HSO) and with Mr. Michael Cosby, CDPHE Environmental Protection Specialist (Phone: 970-248-7171). Off-site disposal of radioactive material shall be approved by the Project Engineer. Work shall cease when the Monitoring Technician or Project Engineer determines that the required material handling procedures are not, or cannot, be followed (i.e. with high winds or worker non-cooperation).

Subsection 250.10 add the following to the sixth paragraph:

Additional excavation of uncontaminated material to accommodate burial of tailings will be paid as unclassified excavation or shall be included in the work if the project is an embankment (CIP) project. Additional work for implementing the CDPHE's Uranium Mill Tailings Management Plan will not be paid for separately but shall be included in the work.

Payment for Hazardous Waste Disposal (Radioactive) will be made at the appropriate contract unit price for the disposal of material determined to be radioactive hazardous waste. The contract unit price will be full compensation for furnishing all materials, labor, equipment, tools, storage containers for transport, containerization of material for up to 60 days, and incidentals necessary to complete this work. This includes all handling of the material, loading for disposal, unloading for disposal, and borrow material required for replacement of excavated material disposed of off-site.

Pay Item	**Pay Unit**
Environmental Health and Safety Management	Lump Sum
Monitoring Technician	Hour

Health and Safety Officer	Hour
Hazardous Waste Disposal (Radioactive)	Cubic Yard

REVISION OF SECTIONS 401 AND 403
HOT MIX ASPHALT (GRADING SX) (75)

Sections 401 and 403 of the Standard Specifications are hereby revised for this project as follows:

Delete subsection 401.02(a) *Mix Design* and replace with the following:

For the Hot Mix Asphalt (HMA) to be used on this project, the Contractor shall submit to the Engineer an approved CDOT mix design (Form 43) issued and verified on a CDOT project within the last 36 months. The asphalt cement binder grade shall be PG 64-28 for all layers. PG 58-34 or PG 76-28 may be substituted for the PG 64-28 at no additional cost to the project. The HMA mix design shall conform to the gradation requirements for Hot Mix Asphalt (Grading SX). The Region Materials Engineer may adjust the target asphalt cement content from the submitted Form 43.

A minimum of one percent hydrated lime by mass (weight) of the combined aggregate shall be added to the aggregate for all hot mix asphalt. The HMA may contain reclaimed asphalt pavement per the aforementioned pre-approved CDOT mix design.

Subsection 403.02 shall include the following:

The Contractor shall prepare a quality control plan outlining the steps taken to minimize segregation of HMA. This plan shall be submitted to the Engineer and approved prior to beginning the paving operations. When the Engineer determines that segregation is unacceptable, the paving shall stop and the cause of segregation shall be corrected before paving operations will be allowed to resume.

Acceptance samples shall be taken by the Contractor in accordance with either Method B or C of CP 41, as determined by the Engineer. Sampling shall be coordinated with and witnessed by the Engineer or the Engineer’s representative. Samples shall be taken at random locations determined by the Engineer or the Engineer’s representative.

Subsection 403.03 shall include the following:

The Contractor shall construct the work such that all roadway pavement placed prior to the time paving operations end for the year, shall be completed to the full thickness required by the plans. The Contractor's Progress Schedule shall show the methods to be used to comply with this requirement.

REVISION OF SECTIONS 401 AND 403
HOT MIX ASPHALT (GRADING SX) (75)
-2-

Delete Subsection 403.04 and replace with the following:

Hot Mix Asphalt will be measured by the ton for work completed in accordance with the project plans and specifications and accepted by the Engineer. No payment will be made for widths exceeding plan widths completed for the convenience of the Contractor or to match the width of the Contractor's equipment. The Engineer may direct additional width and the Contractor shall complete the work as directed. The tonnage shall be the weight used in the accepted pavement. Deduction will not be made for the weight of asphalt cement in the mixture.

Subsection 403.05 shall include the following:

Aggregate, asphalt recycling agent, asphalt cement, warm mix asphalt and/or other additives, hydrated lime, and all other work and materials necessary to complete each Hot Mix Asphalt item will not be paid for separately but shall be included in the unit price bid. Any change to the submitted mix design optimum asphalt cement content to establish production targets on the Form 43 will not be measured and paid for separately, but shall be included in the work. No additional compensation will be considered or paid for any additional asphalt cement, plant modifications, or additional personnel required to produce the HMA as a result in a change to the mix design asphalt cement content. Historically, typical asphalt cement increases reflected on the Form 43 are up to 0.5 percent. However, the Contractors bidding the work should anticipate the AC increases typical of their mixes and factor it into their unit prices. Saw cutting, excavation, preparation, and tack coat of areas to be patched will not be measured and paid for separately, but shall be included in the work.

REVISION OF SECTION 614
TRAFFIC CONTROL DEVICES

Section 614 of the Standard Specifications are hereby revised for this project as follows:

Subsection 614.02 shall include the following:

In compliance with the City of Grand Junction TEDS, §29.40.040 Materials Specifications, posts shall conform with the following:

(1) 12' length 3#/foot U-channel posts shall be used for:
   i. Single signs less than 7 sq. ft. wind loading area.
   ii. Double post mounting for signs 8 sq. ft. wind loading area.

(2) 14' length 3#/foot U-channel posts shall be used for:
   i. Warning sign assembly (2 signs) up to 9 sq. ft. wind loading area.
   ii. Single square or diamond shaped signs 9 sq. ft. wind loading area.
   iii. Double post mounting for all signs 10 - 16 sq. ft. wind loading area.

(3) 8' length 3#/foot U-channel posts shall be used for:
   i. End of road markers.
   ii. Object markers.

(4) All other signs use MUTCD lateral clearance specifications.

Section 623

Irrigation System

Revise Section 623 of the Standard Specifications for this project as follows:

Description

623.01 ~~This work consists of furnishing and constructing an irrigation system per these specifications and in conformity with the lines and grades shown on the plans or established.~~

This work consists of furnishing and installing a complete and operational landscape irrigation system, including a 2-wire controller, decoders, valves, backflow preventer, piping, drip emitters, control wiring, quick couplers, sensors, and appurtenances in accordance with the plans and these specifications.

Materials

623.02 General. All materials and equipment incorporated into the irrigation system shall be new and of recognized standard quality. In the case of computer software or hard coded instructions, the latest available version from the manufacturer is required. All materials shall be of a standard line from a name brand manufacturer or must be approved.

623.03 Backflow Preventer. ~~Pressure vacuum breakers shall be the pressure type with a bronze body and a machined valve seat. Reduced pressure-type backflow preventers shall include two check valves, a relief valve, two gate or ball valves, and test cocks for field testing. Vacuum breakers and reduced pressure-type backflow preventers shall meet the requirements in the Colorado Department of Health, Cross Connection Manual, and shall have a non-shock cold-water rating of at least 150 psi.~~

The backflow preventer shall be Febco 825Y, installed above ground with a blowout tee and full-port ball valve on both the inlet and outlet sides. The complete assembly shall be housed in a GuardShack GS-2 aluminum enclosure mounted on a concrete pad extending a minimum of 3 inches beyond the frame on all sides. Install per manufacturer specifications and applicable plumbing codes.

623.04 Automatic Controllers. ~~The automatic controller shall be an electro-mechanical or microprocessor based/microelectronic solid-state type capable of operating in an automatic or manual mode. The controller shall have a minimum of six stations. Each station shall be programmed to operate for 1 to 99 minutes, or 0.1 to 9.9 hours. The controller shall have two independent programs with three automatic starts per day for each program. Each station on the controller shall be assigned to either or both programs. The controller shall be capable of watering any day or sequence of days~~

~~on a six or seven-day cycle.~~

~~The controller shall operate on a minimum of 117 volts AC power input. Controller electrical output shall be capable of 26.5 volts AC at 1.5 amps. The controller shall have a reset circuit breaker (1.5 amps holding and 2.5 amps break) to protect it from power overload.~~

~~Primary surge protection for 117-volt lines and valve (24 volt) output surge protection shall be installed to protect the controller.~~

~~The automatic controller shall be grounded using two 5/8-inch x 8-foot copper clad grounding rods driven into the soil. A #10 AWG bare copper wire shall be used to connect the ground rods to the automatic controllers' protective grounding circuit. The resistance of the ground shall not exceed 5 ohms.~~

~~The controller enclosure (including satellite controllers) shall be of a vandal and weather- resistant nature, manufactured entirely of metal or steel mill-treated with zinc for rust resistance. The main housing shall have louvers in the upper and lower body to allow for crossflow ventilation.~~

Furnish and install a Rain Bird ESP-LXIVM 2-wire irrigation controller with all accessories required for complete operation and remote communication. The controller shall be installed in a Rain Bird stainless steel pedestal cabinet, model LXMMSS or equivalent, as shown on the plans.

The controller system shall include:

- Rain Bird ESP-LXIVM controller (with modular output support)
- Rain Bird IQ4G-USA communication cartridge for remote system access
- Stainless steel cabinet with factory knockouts and rain-tight gasketed doors
- Factory-recommended surge protection (incidental to this item)
- Electrical service connection, grounding, and lightning protection per NEC and manufacturer's requirements

Controller shall be fully configured with station IDs, flow sensor calibration, master valve assignment, and IQ4 communication setup at the time of final inspection. The Contractor shall demonstrate successful connection to the IQ4 remote interface.

623.05 Remote Control. Remote control shall consist of an FM, AM, UHF, or VHF radio transmitter/receiver pair with a minimum range of one mile in congested areas and shall include battery charger and replacement battery. The receiver shall plug into a receptacle installed in the enclosure or panel of the automatic controller. Remote control shall be capable of turning on/off any station in any order. Remote control shall comply with all applicable FCC rules and regulations.

623.06 Control Wiring 24 Volt. ~~Connection between automatic controller and automatic control valves, flow sensors and moisture sensors shall be made with direct burial copper, 600 volt, UF, UL approved wire. Minimum wire size shall be #14 AWG. One wire shall be provided for each valve. Wires shall be color coded according to the basic plant materials irrigated by the lateral. Wire colors shall be:~~

~~Tabl6~~
~~23-1 Control Wiring Color Key~~

~~Wire Color~~	~~Plant Materials~~
~~Black~~	~~Master (power)~~
~~Purple~~	~~Spares~~
~~Green~~	~~Turf~~
~~Brown~~	~~Tree~~
~~Yellow~~	~~Perennials~~
~~Red~~	~~Shrubs~~
~~White~~	~~"common" or ground wire~~

Wiring shall consist of a two-conductor, 24V AC direct burial copper communication bus, UL-rated for 600 volts, UF-type, #14 AWG minimum. Wiring shall run continuously from controller to decoders. All wire splices shall be made with waterproof connectors per manufacturers' recommendations.

623.07 Sprinkler Heads. The sprinkler head shall be of the pop-up spray and pop-up rotor internal drive type. All sprinkler heads shall be capable of accepting a check valve where head elevation varies more than 5 feet within a control zone.

(a) Pop-up Sprays. The pop-up sprayhead body, stem, and screen shall be constructed of heavy-duty plastic. Spray heads shall have the following components:

(1) A soft pressure-activated wiper seal for cleaning debris from the pop-up stem as it retracts into the case to prevent stem and nozzle from sticking in the up position.

(2) A matched precipitation rate brass or plastic nozzle with an adjusting screw capable of regulating the radius and flow.

(3) A screen to protect it from clogging and a strong stainless-steel retract spring for positive pop-down.

(4) A threaded cap that will allow easy removal of the screen and all other internal components from the top without removing the body from the ground.

Minimum pop-up height for turf heads shall be 4 inches. Spray head pop-up height for turf in roadway medians shall be at least 6 inches, and shrub, flower, and ground cover spray heads shall be at least 12 inches.

(b) *Rotor Heads.* The pop-up rotor heads shall be an internal drive type, with heavy-duty plastic housings and non-corrosive internal components. The rotor head shall have a soft pressure-activated wiper seal for cleaning debris from the pop-up stem as it retracts into the case, to prevent the stem and nozzle from sticking in the up position. The rotor head shall have a screen to protect it from clogging and a strong stainless-steel retracting spring for positive pop-down. Minimum pop-up height for rotor heads shall be 3 inches. The rotor head shall have a fully adjustable arc or full circle capability and an adjustable break-up pin capable of reducing the radius up to 25 percent.

623.08Flow Sensor. ~~The flow sensor shall be an in-line type and shall transmit an electronic pulse through conductors to a compatible automatic controller with interface unit for subsequent transmission to a compatible central computer.~~

Furnish and install Netafim 1½" Hydrometer w/ ER Register, flow sensor with water meter and Hydraulic Valve and normally-closed master valve in a single assembly. Cast Iron with Baked Powder-Coated finish, Minimum working pressure 14 psi. Male Pipe Thread Connection, ER Register, High Frequency. Solenoid shall be DC-latching type. Install in a Jumbo valve box with all required wiring and grounding. Sensor shall provide pulse output to the ESP-LXIVM controller.

623.09 Drip Emitters. ~~The drip emitter shall be of the pressure compensating type with flow rates of 0.5, 1, or 2 gallons per hour plus or minus a 10 percent deviation at 10 to 40 psi. The emitter shall be constructed of durable plastic with a barbed inlet, and the outlet shall be capable of a watertight connection compatible with the polyethylene capillary tubing. Emitters shall be of the self-flushing type and capable of clog-free operation with a 150-mesh strainer. Emitters shall be multi-outlet (six outlets) and shall be installed on the polyethylene drip lateral line. The ends of the capillary tubing shall be installed on 6-inch plastic stakes with debris caps on the end of the tubing.~~

Provide drip irrigation using the following emitter types:

- (a) Netafim WPC 2.0 gph inline emitters for linear Streetscape plantings
- (b) Rain Bird UXB-360-025 Xeribubblers for Mosquito District Repair Area, as shown on drawings.
- (c) Tree rings consisting of multi-outlet emitter loops per drawings and details.

Emitters shall be matched with proper pressure regulation and filtration as required.

623.10 Plastic Pipe and Fittings. ~~All pipe shall be identified with the following indelible markings: manufacturer's name, nominal pipe size, schedule or class of pipe, pressure rating in pounds per square inch, date of extrusion, and NSF seal of approval.~~

~~*(a) Mainline Pipe.* Mainline pipe shall be Class 200 PVC manufactured from virgin polyvinyl chloride (PVC) compound per ASTM D1784 and D2241, cell classification 12454-B, Type I, Grade I. Pipe sizes 3 inches and smaller shall be of the solvent weld type, and sizes larger than 3 inches shall have rubber gasketed fittings. Fittings shall be standard weight schedule~~

~~40 injection molded PVC conforming to ASTM D1784 and D2466, cell classification 12454-B. Threaded nipples shall be schedule 80 PVC with molded threads conforming to ASTM D2464. Threaded fittings shall be kept to a minimum. Cement and cleaner for solvent weld pipe and fittings shall conform to ASTM D2564.~~

~~*(b) Lateral Line Pipe*. Lateral line pipe shall be 80-pound NSF polyethylene manufactured from virgin material in conformance with ASTM D2239 and designated as PE 2306 or PE 3408. Pipe size shall not exceed 2 inches. Fittings shall be *injected*-molded schedule 40 PVC conforming to ASTM D2609, cell classification 12454-B. Pipe shall be clamped onto the fitting using 100 percent stainless-steel screw clamps (two clamps on 1 1/2 inch and 2-inch pipe).~~

~~*(c) Drip Lateral Line Pipe and Capillary Tubing*. Drip lateral line pipe and capillary tubing shall be made of linear low density, UV resistant polyethylene with a pressure rating of 50 psi.~~

(d) Swing Joint Assembly. Swing joints shall be premanufactured with full rotation capacity. Swing joints shall consist of threaded fittings combined with elastomer seals and solvent weld or threaded fittings when attaching to supply line, valve, or sprinkler head. The swing joint assembly shall consist of injection-molded schedule 40 PVC conforming to ASTM D1784 and D2466, cell classification 12454-B, Type I, Grade I.

~~*(e) Detectable Underground Marking Tape*. The Contractor shall provide utility line marking tape for installation above all mainline pipe, which does not have control wire placed in the same trench.~~

Plastic Pipe and Fittings (Revised).
(a) Mainline Pipe: Schedule 40 PVC, ASTM D1785
(b) Lateral Line Pipe: Class 200 PVC, ASTM D2241
(e) Detectable Marking Tape: Install over mainline and lateral lines, 6 inches below grade, minimum of 12 inches from top of pipe, labeled “Caution: Irrigation Line Below”. Each run must be overlapped by a minimum of 20 ft or must be joined so as not to be separated.

623.11 Valves.

~~*(a) Automatic Control Valves*. The automatic control valve shall be a normally closed 24-volt AC, 60-cycle solenoid actuated globe or angle pattern, diaphragm type valve. The valve body and bonnet shall be heavy duty glass filled nylon or brass and internal components (not including diaphragm and seat disc) shall be non-corrosive brass, bronze, stainless-steel, or a combination thereof. Control valve diaphragms shall be of a one-piece molded reinforced fabric. Control valve shall have a non-shock cold-water rating of at least 150 psi.~~

~~Control valves shall function manually (without electrical power) by means of an internal bleeder device on the bonnet assembly. Control valves 1 inch or greater shall have manual flow control capacity. Control valves shall be constructed so that the bonnet assembly and all operating parts can be removed without disturbing the valve body. Valve closure time (measured in actual seat disc movement time) shall be at least 0.5 second.~~

~~*(b) Quick-Coupler Valves*. The quick-coupler valve shall have a two-piece brass body, a non-shock cold water rating of at least 150 psi, and 1-inch female pipe threads at the base. The quick-coupler valve shall be designed to permit operation with a special connecting device (lug type coupler) designed for this purpose. The quick-coupler shall be provided with a rubber-like vinyl hinged locking cover. Quick-coupler keys and hose swivels shall be compatible with the quick-coupler valves furnished. Hose swivels shall be of all brass construction designed to rotate freely.~~

(c) Drip Pressure Reducing Valve. The drip pressure-reducing valve shall be of the non-adjustable, pre-set type, consisting of a two-piece body molded from sturdy long lasting plastic. The internal spring shall be of stainless-steel. Each pressure-reducing valve shall have a minimum flow range of 0.5 gallons per minute with a regulated outlet pressure of 20 to 35 psi, with an inlet pressure range of 35 to 100 psi.

(d) Mainline Pressure Reducing Valve. Valves 2 inches or smaller shall be of the diaphragm spring cage construction type with a bronze body, renewable stainless-steel seat, and stainless-steel integral strainer. Valves larger than 2 inches shall be the balanced piston type with a ductile-iron or cast-iron body.

~~*(e) Manual Drain Valves*. The manual drain valve shall be constructed of heavy-duty cast bronze and machined brass. The drain valve shall be a rising stem globe valve with a non-shock cold water rating of at least 150 psi. The drain valve shall have a reverse flow capability, removable bonnet, and cast bronze cross handle.~~

~~*(f) Mainline Isolation Valves*. Mainline isolation valves 3/4 inch through 3 inches shall be full port ball valves with a bronze body and have a stainless-steel ball and Teflon seat. The valves shall have a blow-out proof stem and be rated at a minimum of 400 psi, WOG. Mainline isolation valves larger than 3 inches in size shall be resilient seated gate valves with a cast iron body and have a 2-inch square nut operator. All isolation valves shall be rated at 200-psi differential pressure.~~

(a) Automatic Control Valves: Rain Bird XCZ-100-LC kits for wide range of flow, including 1" PEB valve and 40 psi pressure-regulating filter basket
(b) Quick Coupler Valves: ¾" Rain Bird 33DRC, locking, with key
(e) Manual Drain Valves: ¾" Mueller brass ball stop with key
(f) Mainline Isolation Valves: Resilient wedge gate valves in boxes
(g) Air/Vacuum Relief Valves. Install 1-inch Combination Air/Vacuum Relief Valves, Netafim 65ARIB1-150 or approved equal, at all designated high points along the mainline or as shown on the plans.

Each valve shall provide both large-volume air discharge during fill-up and vacuum relief during system shutdown, automatically release trapped air during operation, be constructed of corrosion-resistant nylon, rated to 150 psi, include threaded male inlet for connection to PVC saddle, tee, or riser, and be installed in a dedicated round valve box, flush with finish grade. Relief valves shall be protected from dirt and debris and installed vertically per manufacturer specifications.

623.12 Valve Box. The valve box, cover and necessary extensions shall be as shown on the plans, and shall be manufactured or molded, virgin plastic materials conforming to ASTM D638 and D648. Box extensions shall be used as necessary to completely expose the remote-control valve and shall seat in place under the valve box. Valve box lids shall be imprinted "Irrigation Control Valve."

623.13 **Strainer.** Strainer shall be a wye pattern type with a polypropylene body. The strainer shall contain a 150 mesh stainless-steel screen accessed by removing a threaded non-corrosive cap. Strainer shall be flushed via a ball valve located on the strainer.

Construction Requirements

623.14 General. Irrigation systems shall be installed in conformity with applicable local codes. Information on the plans shows general locations only. The Contractor shall establish exact locations of all irrigation equipment to fit field conditions, and locations will be approved by the Engineer before start of construction. Contractor shall maintain and protect the approved staking layout. Before purchase of any irrigation equipment, the Contractor shall submit a list of suppliers and specification sheets for all irrigation components. This submittal must be approved by the Engineer before any equipment purchase is made. At the submittal stage, all changes in equipment shall be brought to the attention of the Engineer.

623.15 Site Review. At least 14 days before the start of irrigation work on the project, a Pre-construction Conference shall be held. During irrigation installation, monthly meetings shall be held. Those in attendance shall be a representative of the Contractor's staff, the Landscape and Irrigation Subcontractors, the Engineer, and a CDOT Landscape Architect. A written description of work methods, and time schedules and milestone dates shall be presented. The Contractor shall notify the Engineer before mainline pressure testing, coverage tests, and final review. The Contractor shall provide two radio transceivers with necessary personnel or remote-control devices to operate automatic controllers during coverage tests and final review.

623.16 Excavation and Backfill. Excavation and backfill shall conform to the requirements of Section 206 and subsection 703.08(b) (Class 2 Structure Backfill), except that compaction of backfill outside of the roadway prism may be done by water flooding, with the approval of the Engineer. The Contractor shall maintain bottoms of trenches flat to permit all piping to be supported on an even grade. Where lines occur under paved areas, dimensions shall be considered to be below the subgrade. All mainline pipe shall be bedded in sand to allow a minimum of 2 inches of sand on all sides. Rock larger than 1 inch shall not be placed in the backfill material.

Where it is necessary to excavate adjacent to existing trees or shrubs, the Contractor shall use all possible care to avoid injury to the plant root system.

623.17 Pipe Installation. Minimum cover for irrigation pipe shall be as follows:

Table 623-2

Minimum Cover for Irrigation Pipe

Mainline Pipes	24 inches below finished grade
Lateral Pipes	18 inches below finished grade
Pipe under roadways	30 inches below subgrade finished grade
Irrigation sleeving	30 inches below finished grade

All pipes under roadways shall be encased in a steel pipe sleeve that shall be jacked or placed in a hole bored under present roadways, or in a steel or plastic pipe sleeve placed by trenching on new construction. At least 4 inches of clearance shall be provided between lines and at least 4 feet of clearance between lines of other trades. Parallel pipes shall not be installed directly over any other line. Manual drain valves shall be installed at all low points in the mainline. Minimum grade of pipe to drains shall be 3 inches per 100 feet. Plastic threaded fittings shall be assembled using Teflon tape applied to male pipe threads only. Threaded fittings shall be kept to a minimum. The Contractor shall tape all open ends of the pipe during installation to prevent entry of any foreign matter into the system.

623.18 Kick Blocks. Concrete kick blocks shall be installed when the following conditions occur on 4 inch or greater mainline pressure pipe:

(1) 22 degree or greater change in pipe direction.

(2) Change in pipe size.

(3) Dead ends in pipes

623.19 Wiring. ~~All 24-volt wire to automatic control valves and flow sensor wiring shall be installed at a minimum depth of 28 inches below finished grade. Power source wire shall conform to subsection 715.07.~~

~~Wiring shall be installed at the side of and under mainline whenever possible. When more than one wire is placed in a trench, the Contractor shall tape wires together with electrical tape at intervals of 15 feet or less. A 24-inch coiled expansion loop shall be provided every 300 feet along wire run, before controller enclosure, at each connection, and at directional changes. Each automatic controller shall have its own separate ground wire, colored green. Wiring between automatic controller and automatic control valves or sensors shall be continuous. At locations where splicing is approved by the Engineer, moisture proof splices shall be made in a valve box. Two extra wires shall be installed along the entire mainline pipe from each automatic controller to the last automatic control valve. Wire splices shall be compatible in effectiveness to wire coating. All wire under roadways shall be encased in a separate steel or plastic conduit.~~

~~Wires not following the mainline shall be installed using open trench excavation. Wiring shall not be installed using a vibratory plow.~~

~~Tubing shall be installed to an even grade in an open trench. Flush valve assemblies shall be installed at all ends of the drip lateral lines.~~

~~Before backfilling, all capillary drip lines shall be staked with an approved staple, 6 feet on center.~~

Two Wire Control System
The Contractor shall furnish, install, and test a complete two-wire irrigation control system, including the controller, two-conductor communication path, surge protection devices, field decoders, and all related appurtenances necessary to provide fully functional, remotely operable irrigation control.

All materials and installation shall be in accordance with the manufacturer's recommendations and as shown on the plans.

(a) Layout and Routing. Two-wire path shall consist of a continuous, direct-burial, UF-rated cable connecting the controller to all field devices. Wire shall be #14 AWG minimum, solid copper, 600V, UL-listed, rated for direct burial, installed at a minimum depth of 18 inches, unless in conduit, routed along mainline trench where practical, avoiding unnecessary splices, shall not exceed manufacturer's maximum allowable cable length or total decoder capacity. Where the 2-wire path crosses pavement or driveways, it shall be installed in conduit sleeves of appropriate size and material.

(b) Decoders. Each automatic control valve, master valve, and flow sensor shall be connected using a dedicated Rain Bird field decoder.
The standard decoder model for this project shall be the Rain Bird FD-101, providing one output per device. Each decoder shall be installed in a valve box alongside the connected device, match the electrical and functional requirements of the ESP-LXIVM controller, be labeled in the field with the corresponding station number using permanent marker, and be logged by serial number and mapped to its location in the as-built documentation.
Alternative decoder models (e.g., FD-102 or FD-401) may only be used with written approval by the Engineer and shall match the functional intent and wiring design of the system.

(c) Surge Protection Devices. Surge protection shall be installed at the controller, using manufacturer-supplied modules (incidental to controller), along the 2-wire path, using Rain Bird SD-220 or approved equal surge suppression devices at maximum 500-foot intervals or as required by the manufacturer at critical junctions and end-of-line locations, including near master valve and flow sensor.

Surge protection devices shall be installed in accessible valve boxes with waterproof connections, grounded to a minimum 8-foot copper-clad ground rod with #6 AWG wire, and installed per NEC and manufacturer grounding diagrams.
Each surge protection device shall be tracked and labeled on the as-built plans and included in final documentation.

(d) Programming and Commissioning. The Contractor shall power on and initialize the controller, address each decoder with the appropriate station number, enter flow sensor and master valve data into the controller, configure zone settings, scheduling, and operational modes, manually activate each station to verify operation and communication, and demonstrate system functionality to the Engineer and Owner's representative.

(e) Documentation. At project closeout, the Contractor shall submit a complete decoder and surge protection location map with serial numbers and zone assignments for each decoder, 2-wire path layout and grounding points, Programming logs and flow sensor calibration settings.

623.20 Drip Systems. Drip lateral lines and capillary tubing shall be installed after 5 gallon and larger plant materials are in place and finished grade is established. The Contractor shall tape all open ends of pipe during installation to prevent entry of debris into the system. All pipe shall be cut with a knife or blade type pipe cutter to prevent entry of pipe debris into the system; a saw shall not be used.

Tubing shall be installed to an even grade in an open trench. Flush valve assemblies shall be installed at all ends of the drip lateral lines.

Before backfilling, all drip lines shall be staked with an approved staple, 6 feet on centers.

623.21 Valve Boxes. All valve boxes shall be installed flush with the finished grade. A "branding iron" type of tool shall be used to imprint the automatic control valve number (letters and numbers 2 inches high) on the valve box lid. Valve numbering system shall be as indicated on the plans. Geotextile filter fabric shall be placed under valve box and extend a minimum of 4 inches beyond bottom rim of valve box. Valves shall be grouped so that three or four valves are located together. Valves shall not be installed in low areas subject to standing water.

623.22 System Flushing. After all irrigation pipelines and valves are in place and connected, and before installation of irrigation sprinklers, rotary heads, etc., the Contractor shall thoroughly flush all lines with water at system operating pressure.

623.23 Pressure and Coverage Tests, and Adjustments. After installation of valves, pipe, and fittings, mainlines shall be inspected for leaks after a minimum 90 psi static pressure (or point-of-connection static pressure if higher) has been maintained for four hours in a hydro static test. Mainline pipes shall not be buried until completion of the test. If the system does not pass the test, the Contractor shall detect and correct problems until the system reaches the acceptable test standard. This test shall be passed before payment for the pipe.

Gasketed pipe shall be tested using a volumetric (make up water) test and leak rates supplied by the pipe manufacturer and commonly accepted in the industry.

The Contractor shall perform coverage tests in the presence of the Engineer, after the irrigation system is completed and before any planting, seeding or sodding to assure that all irrigated areas are watered completely and uniformly. The Contractor shall make all necessary adjustments to provide required coverage as directed.

Drip lateral and emitter coverage tests shall be performed after planting and before backfilling of lateral lines and emitters.

623.24 Inspections. Inspections by the Engineer or the Engineer's representative can be made at any point during construction. Milestone progress dates shall be established at the Pre-construction Conference and 72-hour notice shall be given by the Contractor when a milestone event is approaching.

623.25 Irrigation As-Constructed Plans. The Contractor shall dimension from two permanent reference points, building corners, sidewalk corners, road intersections or any permanent structures, the location of the following items:

(1) Routing of irrigation mainline.

(2) All drip and sprinkler automatic control valves.

(3) Quick coupling valves, isolation gate valves, and manual drain valves.

(4) Other related equipment as directed.

The Contractor shall provide an accurately detailed irrigation as-constructed layout of the irrigation system at the same scale as the design plans and on 24-inch by 36-inch waterproof medium within 90 days after installation is complete and before notice of substantial landscape completion as defined in subsection 214.04. An in-progress as-constructed plan shall be kept on the construction site at all times and available for impromptu review by the Engineer or the Engineer's representative.

Provision of the final as-constructed plan is a condition for final acceptance and release of retainage.

All changes in the irrigation system layout, including lateral layout, shall also be indicated on irrigation as-constructed plans.

The Contractor shall provide finalized as-constructed plans to the Engineer at the time of Final Landscape Acceptance.

623.26 Maintenance Manuals and Training. Before Final Landscape Acceptance, the Contractor shall provide two individually bound maintenance manuals to the Department for the irrigation system, and shall train the owner's maintenance personnel in the proper operation of all irrigation equipment, including winterization procedures. Each manual shall contain the following:

1. Index sheet, stating irrigation contractor's name, address, telephone number and name of person to contact.
2. Duration of equipment or component warranty and warranty form.
3. Equipment list providing the following for each item:
   A. Manufacturer's name
   B. Make and model number.
   C. Name and address of manufacturer's local authorized distributor
   D. Spare parts list in detail
   E. Detailed operating and maintenance instructions for major equipment
4. Descriptions of all installed materials and systems in sufficient detail to permit maintenance personnel to understand, operate, and maintain the equipment.

   A printout of the as-constructed plans shall be provided, showing the area covered by that automatic controller. The area of coverage of each automatic control valve shall be identified using a distinctly different pastel color, drawn over the entire area of coverage.

   Following approval of charts by the Engineer, they shall be hermetically sealed between two layers of plastic sheet, each 20 mils thick.

623.27 Warranty. The Contractor shall warranty the irrigation system for the duration of the Landscape Establishment period specified in subsection 214.04. To ensure proper operation of the system, the Contractor shall perform, as required, warranty activities including, but not limited to the following:

1. Inspection of the system and correction of system leaks, improperly operating valves, clogged emitters, malfunctioning automatic controllers and other components.
2. Maintaining optimum sprinkler coverage.
3. Adjusting sprinkler head elevations relative to finish grade.

In an emergency the Contractor shall correct all deficiencies within 24 hours of notification by the Engineer. The Contractor shall perform irrigation system inspections at least once per week and after each mowing. The Contractor shall make corrections as necessary to ensure proper operation. The Contractor shall document each inspection in writing and submit it to the Engineer.

623.28 Final Landscape Acceptance. Before final landscape acceptance is granted, the Contractor shall perform an overall operation and pressure test and confirm the irrigation system is correctly functioning. This includes two weeks on "Flow" to be verified by the CDOT "Central Computer". The Contractor shall inspect every sprinkler and as necessary, raise or lower those sprinklers that are no longer at the proper elevation relative to the finish grade as shown in the plans. The Contractor shall complete Spring start-up (pressurization) and repair all damage to the irrigation system.

623.29 Cleanup. Upon completion of the work, the Contractor shall restore ground surfaces to required elevations and remove excess materials, debris, and equipment from the site.

623.30 Keys and Repair Components. Three keys shall be furnished for manual operation of valves. When valves require different kinds of keys, three keys of each kind shall be furnished. Keys shall be of adequate length and made of non-corrosive metal.

The following sprinkler components shall be furnished for system repair:

1. Two Automatic Control Valves.
2. Two Manual Drain Valves.
3. Four of Each Type of Sprinkler Specified.
4. Two Valve Boxes.
5. Two Mainline Isolation Valves.
6. Two Quick Coupler Valves.

623.31 Irrigation Scheduling. The Contractor shall submit recommendations for the project's initial irrigation operating schedule for optimum plant establishment to the Engineer.

Method of Measurement

623.32 Automatic controller will be measured by the number of units of each size installed and accepted, including concrete pad, conduit, bolts, ~~enclosure~~ cabinet, ground wire, communication cartridge and antenna, and all other items necessary to complete the work as shown on the plans.

Drip emitters will be measured by the number of ~~multi-outlet~~ emitters and shall include the capillary tubing, and tubing stakes, ~~enclosure box, and debris caps. Each drip emitter shall have six outlets~~.

Emitter valve assemblies will be measured by the number of units of each size installed.

~~Vacuum breakers,~~ backflow preventers, ~~strainers,~~ and all other valves of the various types and sizes, including fittings, valve boxes, copper risers, and sleeves, will be measured by the number of units installed and accepted.

Quick couplers, sprinkler of the various types and sizes including risers, check valves, swing joints and fittings, will be measured by the number of units installed and accepted.

Plastic and copper pipe will be measured by the linear foot installed and will include the cost of the detectable underground marking tape.

Power source wire and ~~24-volt wire~~ 2 wire control wire will be measured by the linear foot installed.

~~Water meter pay item includes all appurtenant fittings, valves, meter pit, and related equipment~~.

Surge protectors and decoders will be paid for by the number of units installed.

Air/Vacuum Relief Valves will be measured by the number of units installed.

Basis of Payment

623.33 The accepted quantities will be paid for at the contract unit price for the various items below that appear in the bid schedule.

Payment will be made under:

~~Pay Item~~	~~Pay Unit~~
~~Shrubbery Spray and Flood Irrigator~~	~~Each~~
~~_____Inch Pop-up Spray Sprinkler~~	~~Each~~
~~_____Inch Pop-up Rotary Sprinkler~~	~~Each~~
~~_____Inch Above Ground Rotary Sprinkler~~	~~Each~~
~~_____Inch Above Ground Spray~~	~~Each~~
~~Hose Swivel~~	~~Each~~
~~Hose Bib~~	~~Each~~
3/4 Inch Copper Pipe	Linear Foot
1 Inch Plastic Pipe	Linear Foot
1 ½ Inch Hose	Linear Foot
~~_____Inch Valve Box~~	~~Each~~
3/4 Inch Backflow Preventer	Each
~~_____Inch Pressure Reducing Valve~~	~~Each~~
3/4 Inch Drain Valve	Each
~~_____Inch Automatic Drain Valve~~	~~Each~~
~~_____Inch Manual Control Valve~~	~~Each~~
1 Inch Automatic Control Valve	Each
Power Source Wire	Linear Foot
3/4 Inch Quick-Coupler Valve	Each
~~_____Inch Gate Valve~~	~~Each~~
1 ½ Inch Mainline Isolation Valve	Each
~~_____Inch Water Meter~~	~~Each~~
~~_____Inch Station Automatic Controller~~	~~Each~~
~~_____Inch Station Satellite Controller~~	~~Each~~
Control Wire, ~~24 Volt 2 Wire~~	Linear Foot
~~_____Inch Strainer~~	~~Each~~
Automatic Controller Transmitter/Receiver Unit	Each
Drip Emitter a) Netafim WPC 2.0 gph Drip Emitter b) UXB-360-025 Xeribubblers c) Tree Rings	Each
~~Emitter Valve Assembly~~	~~Each~~
3/4 Inch Flush Unit	Each
1 ½ Inch Flow Sensor/Master Valve	Each
1 Inch Air/Vacuum Relief Valve	Each
Two Wire Decoder	Each
Surge Protection Device	Each

Water lines will be paid for as provided in Section 619.

Kick blocks, unions, fittings, filter fabric, valve access sleeves, valve boxes, piping and wire inside boxes, keys, and aggregate for valves will not be paid for separately but shall be included in the work.

Structure excavation and backfill including compaction and water will not be paid for separately but shall be included in the work.

Concrete pad, bolts, enclosure, ground wire, and all other items necessary to complete the work shall be included in the price of the automatic controller.

Capillary tubing, tubing stakes, enclosure box and debris caps shall be included in the price of the drip emitter.

System flushing and adjustment, pressure and coverage tests, maintenance manuals, and training will not be paid for separately but shall be included in the price of the work.

The backflow preventer enclosure and pad will not be paid for separately but shall be included in the work.

Detectable Underground Marking Tape will not be paid for separately but shall be included in the work.

Advisor Message Receiver pagers and handheld two-way radios will not be paid for separately but shall be included in the work.

Warranty work will not be measured and paid for separately but shall be included in the work.

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Force Account Items

Description

This special provision contains the Department's estimate for force account items included in the Contract. The estimated amounts marked with an asterisk will be added to the total bid to determine the amount of the performance and payment bonds. Force Account work shall be performed as directed by the Engineer.

Basis of Payment

Payment will be made in accordance with subsection 109.04. Payment will constitute full compensation for all work necessary to complete the item.

Force account work valued at $5,000 or less, that must be performed by a licensed journeyman in order to comply with federal, state, or local codes, may be paid for after receipt of an itemized statement endorsed by the Contractor.

Estimated

Force Account Item	Estimated Quantity	Amount
F/A Minor Contract Revisions	F.A.	$ 75,000.00
F/A Quality Incentive Payment	F.A.	6% of Asphalt bid amount

Traffic Control Plan – General

The key elements of the Contractor's method of handling traffic (MHT) are outlined in subsection 630.10(a).

The components of the TCP for this project shall conform with the following:

(1) Subsection 104.04 and Section 630 of the specifications.
(2) Schedule of Construction Traffic Control Devices.
(3) Signing Plans.

Unless otherwise approved by the Engineer, the Contractor’s equipment shall follow normal and legal traffic movements. The Contractor’s ingress and egress of the work area shall be accomplished with as little disruption to traffic as possible. Traffic control devices shall be removed by picking up the devices in a reverse sequence to that used for installation. This may require moving backwards through the work zone. When located behind barrier or at other locations shown on approved traffic control plans, equipment may operate in a direction opposite to adjacent traffic.

Special Traffic Control Plan requirements for this project are as follows:

During the construction of this project, traffic shall use the present traveled roadway unless identified on the plans or approved by the Engineer.

The Contractor shall not have construction equipment or materials in the lanes open to traffic at any time, unless approved by the Engineer.

During the work the Contractor shall maintain tractor-trailer (WB-67) access to Mesa County's driveway (215 Rice St.) at all times. The Contractor shall phase the construction of Crosby Avenue to accommodate this requirement. The Contractor shall obtain Mesa County's written consent for any closure or access limitation. The Contractor shall provide a point person for the Mesa County Sheriff's Office to contact in case emergency access through the project site is required.

During the work the Contractor shall maintain safe, ADA-compliant pedestrian, bicycle, wheelchair, and other mobility device access between the pedestrian bridge and the sidewalk at West Main Street.

During the work the Contractor shall maintain passenger car access to 443 Crosby Ave., 445 Crosby Ave., 527 W Ouray Ave., 690 Crosby Ave., 464 Base Rock St., 468 Base Rock St., 470 Base Rock St., 472 Base Rock St., and the south entrance to the Railyard apartments on Base Rock St.

At least one week before starting construction, the Contractor shall notify the Engineer of the date the Contractor intends to start construction.

All costs incidental to the foregoing requirements shall be included in the original contract prices for the project.

Utilities

Known utilities within the limits of this project are:

1. City of Grand Junction water, sanitary sewer, and storm drain.
2. Private irrigation lateral (maintained by shareholders, no ditch company).
3. Xcel power and gas.
4. Century Link fiber.
5. Emery Telcom fiber.
6. Highline / NextCity Networks fiber.

The work described in these plans and specifications requires coordination between the Contractor and the utility companies per subsection 105.11 in conducting their respective operations as necessary to complete the utility work with minimum delay to the project.

The work listed below shall be performed by the Contractor per the plans and specifications, and as directed by the Engineer. The Contractor shall keep each utility company advised of any work being done to its facility, so that the utility company can coordinate its inspections for final acceptance of the work with the Engineer.

FOR:

Storm drain improvements for the City of Grand Junction as indicated on the plans.
Relocation (removal and replacement in another location as specified on the plans) of an existing sanitary sewer manhole for the City of Grand Junction.
All electrical components and lights (except those noted as by Xcel Energy / others) indicated on the plans prepared by ACM Consulting for the City of Grand Junction.
All irrigation components indicated on the plans and specifications by GreenBox Studio for the City of Grand Junction.

The work listed below will be performed by the utility owners or their agents:

Street light and transformer installation by Xcel.
Fiber pull box and pedestal relocation by Emery Telcom.
Fiber conduit relocation by Highline / NextCity Networks (if required).
Telephone pedestal relocation by Century Link (if required).
Sanitary sewer force main relocation by City of Grand Junction.
Lining of the sanitary sewer by City of Grand Junction.

General:

The Contractor shall comply with Article 1.5 of Title 9, CRS ("Excavation Requirements") when excavation or grading is planned in the area of underground utility facilities. The Contractor shall notify all affected utilities at least two (2) business days, not including the day of notification, before commencing such operations. The Contractor shall contact the Utility Notification Center of Colorado (UNCC) at (8-1-1) or 1-800-922-1987 to have locations of UNCC registered lines marked by member companies. All other underground facilities shall be located by contacting the respective company. Utility service laterals shall also be located before beginning excavating or grading.

The location of utility facilities as shown on the plan and profile sheets, and herein described, were obtained from the best available information.

All costs incidental to the foregoing requirements will not be paid for separately but shall be included in the work.

Revision of Sections 106
Buy America (BA) and Build America Buy America (BABA)
– No Federal-Aid or Projects with Less than $500,000 in Federal-Aid Highway Funding

Revise Section 106 of the Standard Specifications as follows:

Delete Section 106.11 of the Standard Specifications and replace with the following:

106.11 Buy America (BA) and Build America Buy America (BABA) Requirements

(a) *Contractual Documents.* This specification shall be used in conjunction with the applicable version of the Special Notice to Contractors Section of the CDOT Field Materials Manual (FMM), and the requirements therein, in effect at the time of bidding.

(b) *Glass Beads for Pavement Marking.* All post-consumer and industrial glass beads for pavement marking shall have been manufactured from North American glass waste streams in the United States of America. The bead manufacturer shall submit a COC in accordance with subsection 106.12 confirming that North American glass waste streams were used in the manufacture of the glass beads.

(c) *Buy America and Build America Buy America, Requirements.* Buy America and Build America Buy America documentation for iron and steel, construction materials, and manufactured products are not required for this project.

Revision of Section 103
Colorado Resident Bid Preference

Section 103 of the Standard Specifications is hereby revised for this project as follows:

Subsection 103.01 shall include the following:

(a) Colorado Resident Bid Preference. A resident bidder shall be allowed a preference against a nonresident bidder from a state or foreign country equal to the preference given or required by the state or foreign country in which the nonresident bidder is a resident.

Resident bidder means:

(1) A person, partnership, corporation, or joint venture which is authorized to transact business in Colorado, and which maintains its principal place of business in Colorado: or,

(2) A person, partnership, corporation, or joint venture, which is authorized to transact business in Colorado, which maintains a place of business in Colorado, and which has paid Colorado unemployment compensation taxes in at least seventy-five percent of the eight quarters immediately prior to bidding on a construction contract for a public project.

To determine the resident bid preference status of a bidder, the bidder shall submit a completed Form 604 with the proposal. Failure to submit the residency Form with the proposal will be justification for and may result in the rejection of the proposal and forfeiture of the proposal guaranty.

The proposals will be treated as follows:

(1) All proposals will be checked for accuracy by the Department.

(2) The dollar amount of the checked proposal from nonresident bidders will be adjusted by a percentage equal to the percentage preference given or required by the state or foreign country of the bidder's residency. If the state or foreign country does not give or require a residency preference, no adjustment in the proposal dollar amount will be made.

(3) Adjusted proposals from nonresident bidders will then be compared to proposals from resident bidders, and the bidder with the lowest total will be considered the apparent low bidder.

(4) Should a nonresident bidder be the apparent low bidder, in accordance with paragraph (3) above, an award will be made on the basis of the original proposal, not the adjusted proposal.

(5) The Department will proceed with its normal award procedure.

Revision of Section 106
Conformity to the Contract of Hot Mix Asphalt
(Less Than 5000 Tons with Volumetric Verification)

Revise Section 106 of the Standard Specifications for this project as follows:

Delete subsection 106.05 and replace with the following:
106.05 Sampling and Testing of Hot Mix Asphalt. All hot mix asphalt, Item 403, except Hot Mix Asphalt (Patching) and temporary pavement shall be tested in accordance with the following program of process control testing and acceptance testing:

The Contract will specify whether process control testing by the Contractor is mandatory or voluntary.

(a) Process Control Testing.

1. Mandatory Process Control. When process control testing is mandatory the Contractor shall be responsible for process control testing on all elements and at the frequency listed in Table 106-1. Process control testing shall be performed at the expense of the Contractor.

   After completion of compaction, in-place density tests for process control shall be taken at the frequency shown in Table 106-1. The results shall be reported in writing to the Engineer on a daily basis. Daily plots of the test results with tonnage represented shall be made on a chart convenient for viewing by the Engineer. All of the testing equipment used for in-place density testing shall conform to the requirements of acceptance testing standards, except nuclear testing devices need not be calibrated on the Department's calibration blocks.

   For elements other than in-place density, results from process control tests need not be plotted, or routinely reported to the Engineer. This does not relieve the Contractor from the responsibility of performing such testing along with appropriate plant monitoring as necessary to assure that produced material conforms to the applicable specifications. Process control test data shall be made available to the Engineer upon request.

2. Voluntary Process Control. The Contractor may conduct process control testing. Process control testing is not required but is recommended on the elements and at the frequency listed in Table 106-1.

   All of the testing equipment used for in-place density testing shall conform to the requirements of acceptance testing standards, except nuclear testing devices need not be calibrated on the Department's calibration blocks.

(b) Acceptance Testing. Acceptance testing is the responsibility of the Department. For acceptance testing the Department will determine the locations where samples or measurements are to be taken and as designated in Section 403. The maximum quantity of material represented by each test result, the elements, the frequency of testing and the minimum number of test results will be in accordance with Table 106-1. The location or time of sampling will be based on the stratified random procedure as described in CP

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Revision of Section 106
Conformity to the Contract of Hot Mix Asphalt
(Less Than 5000 Tons with Volumetric Verification)

75. Acceptance sampling and testing procedures will be in accordance with the Schedule for Minimum Materials Sampling, Testing and Inspection in the Department's Field Materials Manual. Samples for project acceptance testing shall be taken by the Contractor in accordance with the designated method. The samples shall be taken in the presence of the Engineer. Where appropriate, the Contractor shall reduce each sample to the size designated by the Engineer. The Contractor may retain a split of each sample which cannot be included as part of the Contractor's process control testing. Dispute of the acceptance test results in accordance with CP-17 will not be allowed unless a provision for check testing has been included in the Contract and it has been successfully completed. All materials being used are subject to inspection and testing at any time prior to or during incorporation into the work.

(c) Stability Verification Testing. After the mix design has been approved and production commences, the Department will perform a minimum of three stability verification tests to verify that the field produced HMA conforms to the approved mix design:

The test frequency shall be one per day unless otherwise directed by the Engineer.

The test results will be evaluated, and the Contractor shall adjust if required in accordance with the following:

1. The minimum value for stability will be the minimum specified in Table 403-1 of the specifications. There will be no tolerance limit.

2. Quality Level. Calculate a QL for stability. If the QL for stability is less than 65, then production shall be halted, and the Contractor shall submit a written proposal for a mix design revision to the Engineer. The Engineer shall give written approval to the proposed mix design revision before production continues.

   After a new or revised mix design is approved, three additional stability tests will be performed on asphalt produced with the new or revised mix design. The test frequency shall be one per day unless altered by the Engineer.

   If the stability QL is less than 65, then production shall be halted until a new mix design has been completed and approved using plant produced material or the Contractor shall submit a written proposal for a mix design revision to the Engineer. The Engineer shall give written approval to the proposed mix design revision before production continues.

3. New or Revised Mix Design. Whenever a new or revised mix design is used and production resumes, three additional stability field verification tests shall be performed, and the test results evaluated in accordance with the above requirements. The test frequency shall be one per day unless altered by the Engineer.

4. Field Verification Process Complete. When the field verification process described above is complete and production continues, the sample frequency will revert back to 1 per 10,000 tons.

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Revision of Section 106
Conformity to the Contract of Hot Mix Asphalt
(Less Than 5000 Tons with Volumetric Verification)

(d) Mix Verification Testing. After the mix design has been approved and production commences, the Department will perform a minimum of three volumetric verification tests for each of the following elements to verify that the field produced hot mix asphalt conforms to the approved mix design:

(1) Air Voids

(2) Voids in Mineral Aggregate (VMA).

(3) Asphalt Content (AC).

The test frequency shall be one per day unless altered by the Engineer.

The test results will be evaluated, and the Contractor shall adjust if required in accordance with the following:

1. Target Values. The target value for VMA will be the average of the first three volumetric field test results on project produced hot mix asphalt or the target value specified in Table 403-1 and Table 403-2 of the specifications, whichever is higher. The target value for VMA will be set no lower than 0.5 percent below the VMA target on Form 43 prior to production. The target values for the test element of air voids and AC shall be the mix design air voids and mix design AC as shown on Form 43.

2. Tolerance Limits. The tolerance limits for each test element shall be:

AC	± 0.3 percent
Air Voids	± 1.2 percent
VMA	± 1.2 percent

3. Quality Levels. Calculate an individual QL for each of the elements using the volumetric field verification test results. If the QL for VMA or AC is less than 65 or if the QL for air voids is less than 70, the production shall be halted, and the Contractor shall submit a written proposal for a mix design revision to the Engineer. Production shall only commence upon receipt of written approval from the Engineer of the proposed mix design revision.

   After a new or revised mix design is approved, three additional volumetric field verification tests will be performed on asphalt produced with the new or revised mix design. The test frequency shall be one per day unless altered by the Engineer.

   If the QL for VMA or AC is less than 65 or the QL for the test element of air voids is less than 70, then production shall be halted until a new mix design has been completed in accordance with CP 52 or CP 54, a new Form 43 issued, and the Contractor demonstrates that he is capable of producing a mixture meeting the verification requirements in accordance with A or B below:

   A. The Contractor shall produce test material at a site other than a CDOT project. The Contractor shall notify the Engineer a minimum of 48 hours prior to the

requested test. The location and time of the test are subject to the approval of the Engineer, prior to placement. Three samples will be tested for volumetric properties. If the QL for VMA or AC is equal or greater than 65 and the QL for the element of air voids is equal or greater than 70, full production may resume; or

B. The Contractor may construct a 500 ton test strip on the project. Three samples in the last 200 tons will be tested for volumetric properties. After construction of the test section, production shall be halted until the testing is complete and element QLs are calculated. If the QL for VMA or AC is equal or greater than 65 or the QL for the element of air voids is equal or greater than 70, full production may resume. If the QL for VMA or AC is less than 65 or the QL for the element of air voids is less than 70, the material shall be removed and replaced at no cost to the Department. The time count will continue, and any delay to the project will be considered to have been caused by the Contractor and will not be compensable.

The costs associated with mix designs shall be solely at the Contractor's expense.

If the Contractor fails to verify the new mix design in accordance with A or B, then production shall be halted until a new mix design has been completed in accordance with CP 52 or CP 54, a new Form 43 issued, and the Contractor demonstrates they are capable of producing a mixture meeting the verification requirements in accordance with A or B.

4. New or Revised Mix Design. Whenever a new or revised mix design is used and production resumes, three additional volumetric field verification tests shall be performed, and the test results evaluated in accordance with the above requirements. The test frequency shall be one per day unless altered by the Engineer.

5. Field Verification Process Complete. When the field verification process described above is complete and production continues, the sample frequency will revert back to a minimum of 1/10,000 tons. The Engineer has the discretion to conduct additional verification tests at any time.

(e) Reference Conditions. Three reference conditions can exist determined by the Moving Quality Level (MQL). The MQL will be calculated in accordance with the procedure in CP 71 for Determining Quality Level (QL). The MQL will be calculated using only acceptance tests. The MQL will be calculated on tests 1 through 3, then tests 1 through 4, then tests 1 through 5, then thereafter on the last five consecutive test results. The MQL will not be used to determine pay factors. The three reference conditions and actions that will be taken are described as follows:

1. Condition green will exist for an element when an MQL of 90 or greater is reached, or maintained, and the past five consecutive test results are within the specification limits.

2. Condition yellow will exist for all elements at the beginning of production or when a new process is established because of changes in materials or the job-mix formula, following an extended suspension of work, or when the MQL is less than 90 and equal

to or greater than 65. Once an element is at condition green, if the MQL falls below 90 or a test result falls outside the specification limits, the condition will revert to yellow or red as appropriate.

3. Condition red will exist for any element when the MQL is less than 65. The Contractor shall be notified immediately in writing and the process control sampling and testing frequency increased to a minimum rate of 1/250 tons for that element. The process control sampling and testing frequency shall remain at 1/250 tons until the process control QL reaches or exceeds 78. If the QL for the next five process control tests is below 65, production will be suspended.

   If gradation is the element with MQL less than 65, the Department will test one randomly selected sample in the first 1250 tons produced in condition red. If this test result is outside the tolerance limits, production will be suspended. (This test result will not be included as an acceptance test.)

   After condition red exists, a new MQL will be started. Acceptance testing will stay at the frequency shown in Table 106-1. After three acceptance tests, if the MQL is less than 65, production will be suspended.

   Production will remain suspended until the source of the problem is identified and corrected. Each time production is suspended, corrective actions shall be proposed in writing by the Contractor and approved in writing by the Engineer before production may resume.

   Upon resuming production, the process control sampling and testing frequency for the elements causing the condition red shall remain at 1/250 tons. If the QL for the next five process control tests is below 65, production will be suspended again. If gradation is the element with MQL less than 65, the Department will test one randomly selected sample in the first 1250 tons produced in condition red. If this test result is outside the tolerance limits, production will be suspended.

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Revision of Section 106
Conformity to the Contract of Hot Mix Asphalt
(Less Than 5000 Tons with Volumetric Verification)

Table 106-1
Schedule for Minimum Sampling and Testing

Element	Process Control	Acceptance
Asphalt Content	1/500 tons	1/1000 tons
Theoretical Maximum Specific Gravity	1.1000 tons, minimum 1/day	1/1000 tons, minimum 1/day
Gradation	1/Day *	1/2000 tons
In-Place Density	1/500 tons	1/500 tons #
Joint Density	1 core/2500 linear feet of joint	1 core /5000 linear feet of joint
Aggregate Percent Moisture ◂	1/2000 tons or 1/Day if less than 2000 tons	1/2000 tons
Percent Lime ◂ , ▸	1/Day	Not applicable

Table 106-1 Notes:

*Process control tests for gradation are not required if less than 250 tons are placed in a day. The minimum number of process control tests for gradation shall be one test for each 1000 tons or fraction thereof.

#The minimum number of in-place density tests for acceptance will be 5.

◂ Not to be used for incentive/disincentive pay. Test according to CP-33 and report results from Form 106 or Form 565 on Form 6.

▸ Verified per Contractor's PC Plan.

Revision of Section 108
Liquidated Damages

Revise Section 108.09 of the Standard Specifications as follows:

In subsection 108.09 delete the schedule of Liquidated Damages and replace it with the following:

Original Contract Amount ($)		Liquidated Damages per Calendar Day ($)
From More Than	To And Including	
0	1,000,000	1,300
1,000,000	2,000,000	2,300
2,000,000	5,000,000	3,100
5,000,000	10,000,000	6,800
10,000,000	25,000,000	8,800
25,000,000	-----	9,700

Revision of Section 401
Composition of Mixtures – Voids Acceptance

Section 401 of the Standard Specifications is hereby revised for this project as follows:

Subsection 401.02(a) shall include the following:

On projects with voids acceptance of hot mix asphalt, mix designs based on a theoretical rejection of baghouse fines may be used when necessary to meet CDOT mix design requirements if the following additional requirements are met. Written approval for use of theoretical rejection of baghouse fines mixture design shall be obtained before production of project material.

(1) Price adjustment for the hot mix asphalt shall be made based on voids acceptance criteria as prescribed in the latest version of the Standard Special Provision, Revision of Sections 105 and 106, Conformity to the Contract of Hot Mix Asphalt (Voids Acceptance). All costs associated with theoretical rejection of baghouse fines mix design, production, and acceptance shall be at the Contractor's expense.
The Contractor shall submit a separate Quality Control (QC) plan for handling the rejection of baghouse fines. The plan shall identify the plan, equipment, and procedures that will be used for the rejection of baghouse fines. The plan shall include detailed information on baghouse control systems and actual data demonstrating consistent system functionality. The QC plan shall be approved in writing before production.

(2) The Contractor shall demonstrate that the material can be produced per one of the two procedures listed below. The Contractor shall supply project aggregate material for use in establishing acceptance testing equipment correction factors. Aggregate samples that have been produced according to CP-L 5117 to represent plant-produced material shall be provided by the mix design lab.

(i) The Contractor shall produce a minimum of 3000 tons of material. This material shall be placed on non-thru lanes or offsite in locations approved by the Engineer. A minimum of 3 samples will be tested for AC content, air voids and VMA. QL's for each element will be determined per the contract documents. If the QL is equal to or greater than 65 for VMA and Asphalt Cement Content and the QL for the element of air voids is equal to or greater than 70, full production may commence. This material may be considered a separate process, and price adjustment will be per subsection 105.05; or,

(ii) The Contractor shall construct a 500-ton test strip on the main line on the project. Tonnage other than 500 tons may be produced only if approved. Three samples in the last 200 tons will be tested for volumetric properties. After construction of the test section, production shall be halted until the testing is complete and element QL's are calculated. If the QL is equal to or greater than 65 for VMA and Asphalt Cement Content and the QL for the element of air voids is equal to or greater than 70, full production may commence. If the TQL is less than 65 or the QL for the element of air voids is less than 70, the material shall be removed and replaced at the Contractor's expense.

Revision Of Section 401
Plant Mix Pavements - General

Section 401 of the Standard Specifications shall be revised as follows:

Delete Subsection 401.17 of the Standard Specifications and replace with the following:

401.17 Compaction. The hot mix asphalt shall be compacted by rolling. Both steel wheel and pneumatic tire rollers will be required. The number, weight, and type of rollers furnished shall be sufficient to obtain the required density while the mixture is in a workable condition. Compaction shall begin immediately after the mixture is placed and be continuous until the required density is obtained. When the mixture contains unmodified asphalt cement (PG 58-28 or PG 64-22) or modified (PG 58-34), and the surface temperature falls below 185 °F, further compaction effort shall not be applied unless approved, provided the Contractor can demonstrate that there is no damage to the finished mat. If the mixture contains modified asphalt cement (PG 76-28, PG 70-28 or PG 64-28) and the surface temperature falls below 230 °F, further compaction effort shall not be applied unless approved, provided the Contractor can demonstrate that there is no damage to the finished mat.

Warm Mix Asphalt compaction requirements shall conform to CP 59.

All roller marks shall be removed with the finish rolling. Use of vibratory rollers with the vibrator on will not be permitted during surface course final rolling and will not be permitted on any rolling on bridge decks covered with waterproofing membrane.

SMA shall be compacted to a density of 93 to 98 percent of the daily theoretical maximum specific gravity, determined according to CP 51. All other HMA shall be compacted to a density of 92 to 98 percent of the daily theoretical maximum specific gravity, determined according to CP 51. If more than one theoretical maximum specific gravity test is taken in a day, the average of the theoretical maximum specific gravity results will be used to determine the percent compaction. Field density determinations will be made per CP 44 or 81.

The longitudinal joints shall be compacted to a density of 90 to 98 percent of the theoretical maximum specific gravity. The theoretical maximum specific gravity used to determine the joint density will be the average of the daily theoretical maximum specific gravities for the material that was placed on either side of the joint. Density (percent relative compaction) will be determined per CP 44.

The Contractor shall obtain one 6-inch diameter core at a random location within each longitudinal joint sampling section for determination of the joint density. The Contractor shall mark and drill the cores at the location directed by the Engineer and

in the presence of the Engineer. The Engineer will take possession of the cores for testing. The Contractor may take additional cores at his own expense. Coring locations shall be centered on the visible line where the joint between the two adjacent lifts abuts the surface. The center of all joint cores shall be within 1 inch of this visible joint line. Core holes shall be repaired by the Contractor using materials and methods approved by the Engineer. PC and OA joint coring shall be completed within five calendar days of joint construction.

Longitudinal joint coring applies to all pavement layers. When constructing joints in an echelon paving process, the joints shall be clearly marked to ensure consistent coring location. In small areas, such as intersections, where the Engineer prescribes paving and phasing methods, the Engineer may temporarily waive the requirement for joint density testing.

Incentive or disincentive payment determined for joint density per subsection 105.05 will apply to the HMA on each side of the joint. If a layer of pavement has joints constructed on both sides, incentive or disincentive payment for each of those joints will apply to one half of the pavement between the joints.

Along forms, curbs, headers, walls, and all other places not accessible to the rollers, the mixture shall be thoroughly compacted with mechanical tampers.

Any mixture that becomes loose and broken, mixed with dirt, or is in any way defective, shall be immediately removed and replaced with fresh hot mixture, and compacted to conform to the surrounding area.

The Contractor shall construct a compaction pavement test section (CTS) for each job mix where 2,000 or more tons are required for the project. The CTS will be used to evaluate the number of rollers and the most effective combination of rollers and rolling patterns for achieving the specified densities. Factors to be considered include, but are not limited to, the following:

(1) Number, size, and type of rollers.

(2) Amplitude, frequency, size and speed of vibratory rollers.

(3) Size, speed, and tire pressure of rubber tire rollers.

(4) Temperature of mixture being compacted.

(5) Roller patterns.

The CTS shall be constructed according to the following procedures:

The CTS shall be constructed to provide the nominal layer thickness specified. The first 500 tons of hot mix asphalt on the project location shall constitute the CTS. The production and placement rates of the CTS shall closely approximate the anticipated production and placement rates for the remainder of the Contract.

Compaction of the CTS shall commence immediately after the hot mix asphalt has been spread and shall be continuous and uniform over the entire CTS. For the CTS, compaction shall continue until no discernible increase in density is obtained by additional compactive efforts. All compaction shall be completed before the surface temperature of the mixture drops below 185 °F.

Approved types of rollers shall be used to achieve the specified density. The Contractor shall determine what methods and procedures are to be used for the compaction operation. The compaction methods and procedures shall be used uniformly over the entire last 200 tons. The Contractor shall record the following information and a copy of this data shall be furnished to the Engineer.

(1) Type, size, amplitude, frequency, and speed of roller.

(2) Tire pressure for rubber tire rollers, and whether the pass for vibratory rollers is vibratory or static.

(3) Surface temperature of mixture behind the laydown machine and subsequent temperatures and densities after each roller pass.

(4) Sequence and distance from laydown machine for each roller, and number of passes of each roller to obtain specified density.

Two sets of random cores shall be taken within the last 200 tons of the CTS. Each set shall consist of seven random cores. The Engineer will determine the coring locations using a stratified random sampling process. The locations of these cores will be such that one set can serve as a duplicate of the other. One set of these cores shall be immediately submitted to the Engineer. This set will be used for determining acceptance of the CTS and determining density correction factors for nuclear density equipment. Densities of the random samples will be determined by cores according to CP 44. Density correction factors for nuclear density equipment will be determined according to CP 81. Coring shall be performed under CDOT observation. Coring will not be measured and paid for separately but shall be included in the work. For SMA, a CTS is not used. The Contractor shall follow the requirements for the demonstration control strip per the Revision of Section 403, Stone Matrix Asphalt Pavement.

The CTS meets requirements if the Quality Level of the random samples is greater than or equal to 75. The Quality Level will be determined according to CP 71. Once constructed and accepted, the CTS shall remain in place and become part of the hot mix asphalt on the project.

When the Quality level is less than 75 the Contractor shall construct an additional test section, utilizing different rollers, or roller positions, or roller patterns as required. A written proposal detailing the changes in methods and procedures that will be used to obtain density is to be submitted to the Engineer for review before constructing the additional test section.

If the Quality Level of a CTS is less than 75 and greater than or equal to 44, the Engineer may accept the material at a reduced price per Section 105.

If the Quality Level of a CTS is less than 44, the Engineer may:

(1) Require complete removal and replacement with specification material at the Contractor’s expense.

(2) Where the finished product is found to be capable of performing the intended purpose and the value of the finished product is not affected, as determined by the Engineer, permit the Contractor to leave the material in place with a pay factor, but not more than 75 percent of the bid price.

Each CTS shall be 500 tons. If in-place densities of the CTS, as determined by nuclear density equipment before determining density of the cores, meet the CTS density requirements, the Contractor may begin production paving and continue to place hot mix asphalt pavement under the following conditions:

(1) The period during which the Contractor continues to pave without test results from cores shall not exceed one workday.

(2) Construction proceeds at the Contractor's risk. If correlation with the cores reveals that the densities do not meet the CTS requirements, the hot mix asphalt pavement placed subsequently will be subject to price reduction or removal and replacement.

After production paving work has begun, a new CTS shall be required for different layers of pavement, unless otherwise approved by the Engineer. Each additional CTS shall be constructed and documented as specified herein, and shall be sampled, tested, and accepted or rejected as described herein.

All additional costs associated with construction of the CTS shall be at the Contractor’s expense. The hot mix asphalt placed in the CTS will be paid for per subsection 401.22, at the contract price for the hot mix asphalt.

If the Contractor requests changes to the roller pattern that was established during the CTS, the Contractor must perform a Roller Pass Study to demonstrate that the specified density is obtained with the new roller pattern before proceeding with the paving operation with Engineer Approval.

Revision of Section 401
Reclaimed Asphalt Pavement

Revise Section 401 of the Standard Specifications for this project as follows:

Subsection 401.02(b) shall include the following:

Reclaimed Asphalt Pavement (RAP) is allowed in hot mix asphalt (HMA) up to a maximum binder replacement of 23 percent for all lifts, provided all specifications for HMA are met. Fine Aggregate Angularity requirements shall apply only to the virgin fraction of the fine aggregate. The RAP shall not contain clay balls, vegetable matter, or other deleterious substances, and must meet the uniformity requirements as outlined below.

HMA Project Verification Testing for asphalt content and gradation will be performed at the frequencies listed in the Field Materials Manual per CP-L 5120.

The Contractor shall have an approved mix design for the amount of RAP to be used. The AC content of the RAP utilized in the Contractor RAP mix design shall be the average AC content determined per 1B or 1C, below, or alternatively, a minimum of five samples of the Contractors RAP stockpile may be sampled and the average AC content of the RAP be determined using AASHTO T-164, Method A or B, or per 1C below. The Contractor shall determine the total binder replaced by the binder in the RAP pursuant to the following equation:

Total Binder Replaced = (A x B) x 100/E

Where:

A = RAP % Binder Content *

B = RAP % in Mix *

E = Total Effective Binder Content *

* In decimal format (2% is 0.02)

The Total Binder Replaced by the binder in the RAP shall not exceed 23 percent of the effective binder content of either the mix design or the produced mix.

The use of RAP shall be controlled per subsections 105.05 and 106.05. If the Contractor elects to use RAP, the following additional conditions shall apply:

1. The Contractor shall have an approved Process Control (PC) Plan that details how the RAP will be processed and controlled. The PC plan shall address the following:

   A. RAP Processing Techniques. This requires a schematic diagram and narrative that explains the processing (crushing, screening, and rejecting) and stockpile operation for this specific project.

   B. Control of RAP Asphalt Binder Content (AASHTO T-164, Method A or B). RAP Asphalt Binder Content may also be determined per CP-L 5120, provided a RAP AC content correction factor is determined through correlation testing with AASHTO T-164, Method A or B. The correction factor shall be determined by performing correlation testing on the first five samples of the RAP AC content, then at a frequency of one for every five AC content tests thereafter. The correction factor shall be determined by calculating the average difference in AC content between CP-L 5120 and AASHTO T-164, Method A or B, and applying the correction to the AC content determined per CP-L 5120 :

Frequency: 1/1000 tons of processed RAP material (minimum five tests)

C. Alternative Control of RAP Binder Content. The Contractor may propose a RAP asphalt content correction factor to be used in conjunction with CP-L 5120. The proposed CP-L 5120 RAP asphalt content correction factor shall be used with all RAP asphalt contents tested for the mixture design and quality control sampling and testing. The methodology of the proposed CP-L 5120 RAP asphalt content correction factor shall be outlined in detail in the approved RAP PC Plan. At a minimum, the proposed CP-L 5120 correction factor shall identify the principal source locations of the RAP aggregate, gradation of the material tested, and specific ignition oven serial number used in all the RAP asphalt content testing. The RAP source locations, material gradation, and specific equipment used shall substantiate the CP-L 5120 asphalt content correction factor used for the testing. The substantiation must be from data gathered from historical information or specific asphalt content correction data obtained from tests performed on similar virgin aggregate sources, virgin material gradations, and the specific equipment used.

D. Control of RAP Gradation (CP31 or AASHTO T-30):

Frequency: 1/1000 tons of processed RAP material (minimum three tests)

E. Process Control Charts shall be maintained for binder content and each screen listed in subsection 401.02(b), during addition of any RAP material to the stockpile. The Contractor shall maintain separate control charts for each RAP stockpile. The control charts shall be displayed and shall be made available, along with RAP AC extraction testing laboratory reports, to the Engineer upon request.

2. The processed RAP must be 100 percent passing the 31.5 mm (1 1/4 inch) sieve. The aggregate obtained from the processed RAP shall be 100 percent passing the 25.0 mm (1 inch) sieve. The aggregate and binder obtained from the processed RAP shall be uniform in all the measured parameters per the following:

Uniformity*

Parameter	Standard Deviation
Binder Content	0.5
Percent Passing 19 mm (3/4”)	4.0
Percent Passing 12.5 mm (1/2”)	4.0
Percent Passing 9.5 mm (3/8”)	4.0
Percent Passing 4.75 mm (#4)	4.0
Percent Passing 2.36 mm (#8)	4.0
Percent Passing 600 μm (#30)	3.0
Percent Passing 75 μm (#200)	1.5

***Uniformity is the Maximum allowable Standard Deviation of test results of processed RAP.

3. If RAP millings generated are incorporated in the same project, per CPL 5145 the Contractor shall pave with a virgin mix design until sufficient amount of processed RAP has been stockpiled and tested to allow full production of a RAP HMA mix.

Revision of Section 401
Tolerances for Hot Mix Asphalt (Voids Acceptance)

Section 401 of the Standard Specifications is hereby revised for this project as follows:

In subsection 401.02(b) delete Table 401-1, including the footnotes, and replace with the following:

Table 401-1
Tolerances for Hot Mix Asphalt

Element	Tolerance
Asphalt Cement Content	± 0.3 %
Voids in the Mineral Aggregate (VMA)	± 1.2 %
Air Voids	± 1.2 %

Revision Of Section 401
SafetyEdge℠ for Pavement

Revise Section 401 of the Standard Specifications as follows:

Subsection 401.01 shall include the following, at the end of the second paragraph:
This work consists of one or more courses of asphalt mixture constructed on a prepared foundation per these specifications and the specific requirements of the type under contract, and in conformity with the lines, grades, thicknesses, and typical cross sections shown on the plans or established, including a beveled SafetyEdge℠.

Subsection 401.02 shall include the following, before Table 401-2:

HMA for safety edge treatment must comply with Section 403, Hot Mix Asphalt, of the Standard Specifications.

Materials used in constructing the SafetyEdge℠ shall match the adjacent roadway material requirements.

In subsection 401.10, replace the third sentence within the fourth paragraph as shown below:

The system shall provide a sloped SafetyEdge℠ as per M-400-1, SafetyEdge℠ for Pavement.

In subsection 401.10, include the following after the fifth paragraph:

Provide a SafetyEdge℠ as per M-400-1, SafetyEdge℠ for Pavement, or as shown on the plans.

In subsection 401.21, add the following after the first sentence:

Full compensation for constructing the SafetyEdge℠ treatments is included in the contract price for the type of HMA designated. Site preparation and/or grading required to receive the SafetyEdge℠ treatment shall be paid per M-400-1, Note 8.

Full compensation to furnish, place, and compact shoulder or embankment material to the top of the SafetyEdge℠ is included in the contract price for the type of shoulder backing material designated or as equipment hours.

Full-depth sawing to remove integrally placed SafetyEdge℠ where not required, or construction of formed “box-out” to prevent placement during paving, is incidental to the contract.

No additional compensation will be allowed.

Revision Of Section 412
SafetyEdge$_{sm}$ for Pavement

Revise Section 412 of the Standard Specifications as follows:

Subsection 412.03 shall include the following:

Materials used in constructing the SafetyEdge$_{sm}$ shall match the adjacent roadway material requirements.

Replace the third sentence within the fourth paragraph of Subsection 412.07 as shown below:

The system shall provide a sloped SafetyEdge$_{sm}$ as per M-400-1, Safety Edge for Pavement.

Include the following after the fifth paragraph of Subsection 412.07:

Modify paver screed to create a SafetyEdge$_{sm}$ that meets the final cross-section as per M-400-1, Safety Edge for Pavement.

Provide a SafetyEdge$_{sm}$ as per M-400-1, Safety Edge for Pavement, or as shown on the plans.

Add the following at the end of Subsection 412.23:

Full compensation for Concrete SafetyEdge$_{sm}$ will be measured by the actual number of linear feet that are installed and accepted. Site preparation and/or grading required to receive SafetyEdge$_{sm}$ treatment shall be paid per M-400-1, Note 8.

Full compensation to furnish, place, and compact shoulder or embankment material to the top of the SafetyEdge$_{sm}$ is included in the contract price for the type of shoulder backing material designated or as equipment hours.

Full-depth sawing to remove integrally placed SafetyEdge$_{sm}$ where not required, or construction of formed “box-out” to prevent placement during paving, is incidental to the contract.

No additional compensation will be allowed.

Subsection 412.24 shall include the following:

Pay Item	Pay Unit
Concrete SafetyEdge	Linear Foot

Revision of Section 601
Structural Concrete

Revise Section 601, Structural Concrete, of the Standard Specifications as follows:

Revise Section 601.08 as follows:

601.08: Air Content Adjustment. When a batch of concrete delivered to the project does not conform to the minimum specified air content, an air-entraining admixture listed on the approved mix design may be added per subsection 601.17. After the admixture is added, the concrete shall be re-mixed for a minimum of 20 revolutions of the mixer drum at mixing speed. The concrete shall then be re-tested by PC.

Section 627
Pavement Marking

Revise Section 627 by removing and replacing the existing Section 627 of the Standard Specifications with the following:

Description

627.01 This work consists of furnishing and applying pavement marking, and furnishing, installing, and removing temporary pavement marking per these specifications, the Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD), the Colorado supplement thereto, and in conformity to the lines, dimensions, patterns, locations and details shown on the plans or established.

Materials

627.02 Materials shall conform to the requirements of the following subsections:

Material Requirements	Subsection
Paint	708.05
Glass Beads	713.08
Modified Epoxy Pavement Marking Material	713.17
Thermoplastic Marking Material	713.12
Pavement Primer	708.07
Preformed Plastic Pavement Marking Material	713.13
Pavement Marking Tape	713.15
Pavement Marking Tape (Removable)	713.16
Raised Pavement Marker	713.18
Preformed Thermoplastic Pavement Marking Material	713.14
Methyl Methacrylate Pavement Marking Material	713.19

Construction Requirements

627.03 General. All pavement markings shall be placed per the following requirements. When the term “full compliance” is used, it means the pavement markings shall meet the requirements of Standard Plan S-627-1.

(a) Pavement Marking Plan. When pavement-marking location details are not provided in the Contract, the Contractor shall submit a layout of existing conditions to the Project Engineer for approval. The approved layout is to be used as the final pavement-marking plan.

(b) Roadways Closed to Traffic During Construction. Full-compliance final markings shall be in place before opening the roadway to traffic.
Pavement markings on detour routes shall be full-compliance markings.

(c) Roadways Constructed Under Traffic. Full compliance final pavement markings shall be placed within two weeks after final surfacing is completed. Full compliance pavement markings shall also be placed on any roadways opened to traffic when the project pavement work is discontinued for more than two weeks.

(d) Temporary Pavement Markings. Temporary pavement markings and control points for the installation of those pavement markings for roadways that are being constructed under traffic shall be installed as follows:

1. When one roadway of a normally physically divided highway is closed, and a crossover is constructed, full-compliance pavement markings shall be placed along the tapers and through the median crossovers to the two-way traffic section. Pavement markings through the two-way traffic section shall be as shown on the plans.

   All temporary paved roadways shall have full-compliance centerline, lane line, and edge line markings before they are open for traffic.

   Upon removal, markings applied to a final surface shall not leave a scar that conflicts with permanent markings.

2. The following criteria apply to all construction on roadways open to traffic other than (d)1. above:

   Full-compliance centerline, lane line, and edge line temporary markings shall be in place at the end of each workday.

   No-passing zone restrictions shall be identified by full compliance no-passing zone markings. No-passing zone markings shall be in place daily.

   Temporary pavement stencils (SCHOOL, RR Xing, etc.) are not required unless specified in the plans.

   Temporary pavement markings shall be installed according to the manufacturer's recommendations in such a way that the markings adequately follow the desired alignment.

3. Control Points consisting of 4-inch by 1-foot marks at 40-foot intervals may be placed as guide markers for the installation of temporary or final pavement markings. Raised flexible pavement markers may be substituted for these marks. Control points shall not be used as a substitute for any required marking.

(e) Pavement Marking for Seal Coats (Section 409).

1. Raised flexible pavement markers, suitable for use on seal coats, shall be installed as follows:

   No-passing zones shall be marked with two markers placed side-by-side at 40-foot intervals throughout the zone.

   Passing zones shall be marked with one marker at 40-foot centers. Closer spacing shall be used on curves, as deemed appropriate.

   Raised flexible pavement markers, installed on 40-foot centers, may also be used to mark lane lines through multi-lane roadway sections. Auxiliary lanes and shoulder lines may be marked with flexible markers on 80-foot centers or as appropriate.

2. Full-compliance final pavement markings shall be placed within one week of completion of the seal coat project.

(f) **Procedures for Items Paid by the Gallon**

Either of the following methods are acceptable unless otherwise specified by the Project Engineer.

1. **Method #1 - Use of Data Logging System (DLS)**
   Equipment: The Contractor shall use a "Skip-line by SPEC-RITE" Data Logger System (DLS) or equivalent DLS equipment as approved by the Project Engineer.
   Calibration: Pavement marking vehicles using a Data Logging System (DLS) shall be calibrated at intervals no longer than 12 months. Calibration requirements and allowable tolerances will be determined by the equipment manufacturer. Prior to the installation of materials paid by the gallon, a copy of the most recent certification report for each DLS equipment system used shall be submitted to the Project Engineer.
   Verification: A verification test section may be conducted at any time during production at the discretion of the Project Engineer. The verification test shall be performed according to Method #2 and the pavement marking shall be at least 1 mile (5,280 feet) in length, and shall be a width of four, six or eight inches. If the test section cannot be performed as a result of limitations, then method #2 shall be used to verify quantities for payment. If the calibration application rate cannot be verified, then method #2 shall be used to verify quantities for payment.

2. **Method #2 - Performing Tank Stabs and Field Measurement**
   Tank stab measurements shall be used to verify the application rate by calculating the volume of material used over the corresponding application (square foot) area. Tank stab measurements shall be performed by the Contractor at the beginning and end of the pavement marking installation with the pavement marking vehicle parked at the same location and direction of travel for each measurement. Tank stab measurements shall be taken to the top of the fluid level from a fixed point. These measurements will be visually observed and recorded before the pavement marking operations begin, at the end of the pavement marking operations, and before and after each tank is replenished. The difference in the height of the fluid level corresponds to the volume of material used per the manufacturer's tank conversion chart. Measurements will be recorded to the nearest 1/4 inch.

   Plural component materials, such as modified epoxy pavement markings, are applied as a combination of resins and catalysts from separate tanks. Tank stabs shall be recorded for each tank and the volumes combined to determine the total volume, in gallons, applied. Pavement markings shall be field measured to determine the total area of material installed. The tank stab and field measurements will be used to verify the application rate is within the rate specified by the contract.

627.04 Pavement Marking with Low Temperature Acrylic Paint and High Build Acrylic Paint. Striping shall be applied on asphalt or portland cement concrete pavements when the air and pavement temperatures are as follows: for high-build waterborne paint, at least 45 °F and expected to remain 45 °F or above for at least 24 hours; for low temperature waterborne paint, at least 35 °F and expected to remain 35 °F or above for at least 24 hours. The pavement surface shall be dry and clean, and free of all latent materials, per the manufacturer's recommendations. Weather conditions shall be conducive to satisfactory results. Glass beads shall be applied into the paint by means of a low pressure, gravity drop bead applicator.

The Contractor shall use equipment that meets the following requirements, as approved:

(1) Equipment shall permit traffic to pass safely within the limits of the roadway surface and

shoulder while operating.

(2) Equipment shall be designed for placement of both solid and broken line pavement markings with a reasonably clean-edged pavement marking of the width and location as shown on the contract and no overspray on the road surface.

(3) Equipment shall have a glass bead dispenser directly behind and synchronized with the paint applicator. Each applicator shall have individual control and automatic skip control that will paint a strip with a gap as shown in the Contract.

(4) The equipment may be equipped with a heat exchanger to heat the paint to reduce drying time.

(5) The operation shall include a trailing vehicle equipped with a flashing arrow board.

The Contractor shall prevent traffic from crossing a wet pavement marking. Pavement markings that have been marred or picked up by traffic before they have dried shall be repaired at the Contractor's expense. Removal of paint material from vehicles that encountered wet paint shall be at the Contractor's expense.

The water-based paint pavement markings shall fall within the following minimum and maximum ranges:

Table 627-1
Application Rates and Tolerances for Pavement Markings

Description	Units	Pavement Marking Paint Low Temp	Pavement Marking Paint High Build	Pavement Marking Paint High Build (Temporary)
Alignment (Lateral Deviation)	Inches	< 2.0	< 2.0	< 2.0
Application Rate	Sq Ft/Gallon	89-94	67-70	100-105
Thickness	Mil	17.5 ± 0.5	23.5 ± 0.5	15.5 ± 0.5
Width	Inches	Per Plans ± 0.25	Per Plans ± 0.25	Per Plans ± 0.25
No Tack Dry Time @ 77° F	Minutes	5-10	7-12	5-10
Glass Bead Application Rate	Lbs, Gallon	7+	9+	5+

(6) High Build (Temporary) shall only be used for temporary pavement marking applications. Equipment shall have a bead dispenser directly behind, synchronized with the paint applicator and shall be capable of painting a clean-edged pavement marking of the designated width plus or minus 1/4 inch with no overspray on the road surface. For centerlines and lane lines, an automatic skip control shall be used. Machines having multiple applicators shall be used for centerlines with "no passing zones." In areas where machines are not practical, suitable hand-operated equipment shall be used as directed by the Project Engineer. Pavement markings shall be protected until dry.

627.05 Modified Epoxy Pavement Marking. The modified epoxy pavement-marking compound shall be applied with equipment that will precisely meter the two components in the ratio given in subsection 713.17(a). The equipment shall automatically shut off or warn the operator if one component is not being mixed. The equipment shall produce the required amount of heat at the mixing head and gun tip to provide and maintain the temperatures specified.

Before mixing, the individual components A and B shall each be heated to a temperature of 80 to 140 °F. After mixing, the application temperature for the combined material at the gun tip shall be 80 to 140 °F. The 140 °F upper limit is the maximum temperature under any circumstances.

Both pavement and air temperatures shall be at least 35 °F at the time of modified epoxy pavement marking application.

The surface areas of new portland cement concrete pavement and decks that are to receive markings shall be waterblasted before placement of the modified epoxy pavement marking. The amount of waterblasting shall be sufficient to remove all dirt, laitance, and curing compound residue.

The surface areas of new asphalt pavement, existing asphalt pavement, and existing concrete pavement that are to receive markings shall be cleaned with a high-pressure air blast to remove loose material before placement of the modified epoxy pavement marking. Should any pavement become dirty, from tracked mud etc. as determined by the Project Engineer, it shall be cleaned before the placement of the modified epoxy pavement marking.

When recommended by the modified epoxy manufacturer, a high-pressure water blast integrated into the gun carriage shall be used to clean the pavement surface before modified epoxy pavement marking application. The water blast shall be followed by a high- pressure air blast to remove all residual water, leaving only a damp surface.

Modified epoxy pavement marking shall be applied to the road surface according to the modified epoxy manufacturer's recommended methods at the application rate or coverage shown below. Glass beads shall be applied into the modified epoxy pavement marking by means of a low pressure, gravity drop bead applicator.

Modified epoxy pavement markings and beads shall be applied within the following limits:

Table 627-2
Application Rates and Tolerances for Modified Epoxy Pavement Marking

Description	Units	Modified Epoxy Pavement Marking
Alignment (Lateral Deviation)	Inches	< 2.0
Application Rate	Sq Ft/Gallon	85 - 90
Thickness	Mil	18.5 ± 0.5
Width	Inches	Per Plans ± 0.25
No Tack Dry Time @ 77° F	Minutes	5 - 7
Glass Bead Application Rate	Lbs per Gallon	23+

627.06 Thermoplastic Pavement Marking.

(a) Equipment-General. The material shall be applied to the pavement by an extrusion method where one side of the shaping die is the pavement and the other three sides are contained by or are part of suitable equipment for heating, mixing, and controlling the flow of the material.

The equipment shall be constructed to provide continuous mixing and agitation of the material. Conveying parts of the equipment between the main material reservoir and the shaping die shall be so constructed as to prevent accumulation and clogging. All parts of the equipment that come in contact with the material shall be easily accessible and exposable for cleaning and maintenance.

All mixing and conveying parts up to and including the shaping die, shall maintain the material at the plastic temperature.

The equipment shall be so constructed as to assure continuous uniformity in the dimensions of the pavement marking. The applicator shall provide a means for cleanly cutting off square pavement marking ends and shall provide a method of applying "skip" lines. The use of pans, aprons or similar appliances that the die overruns will not be permitted under this specification.

Glass beads for the surface of the completed pavement marking shall be applied by an automatic bead dispenser attached to the applicator in such manner that the beads are dispensed almost instantly upon the completed line. The bead dispenser shall be equipped with an automatic cutoff control synchronized with the cutoff of the thermoplastic material.

The equipment shall be so constructed as to provide for varying die widths to produce varying widths of traffic markings.

The equipment shall be designed to permit agitation of the material to prevent scorching, discoloration or excessive high temperatures of any part of the material.

A special kettle shall be provided for melting and heating the composition. The kettle shall be equipped with an automatic thermostatic control device so that heating can be done by controlled heat transfer liquid rather than direct flame.

The applicator and kettle shall be so equipped and arranged as to satisfy the requirements of the National Fire Underwriters.

The equipment shall be so equipped as to permit preheating of the pavement immediately before application of the material.

The applicator shall be mobile and maneuverable to the extent that straight lines can be followed, and normal curves can be made in a true arc.

(b) Types of Equipment.

1. Portable Applicator. The portable applicator shall be a device typically used for painting crosswalk lines, stop bars, short lane lines and short centerlines. The applicator shall be easily maneuverable and capable of being propelled by the operator.

2. Mobile Applicator. The mobile applicator shall contain equipment to provide for automatic installation of skip lines in any combination of line and skip up to 40 feet. The mobile applicator shall be moved in conjunction with the melting and heating kettles in such a manner as to provide continuous highway operation of the kettles and the mobile applicator as an integral unit.
3. Epoxy Primer Equipment. The epoxy primer application shall be accomplished using equipment having the following features:

   A. The main storage tank shall be equipped with a visible gauge that will allow the Project Engineer to readily ascertain the rate of application.

   B. The main storage tank shall be equipped with a heating device that will maintain the epoxy at a constant efficient temperature.

   C. The spray nozzle and epoxy spray shall be protected from the action of wind to ensure placement where needed.

4. Cleaning Equipment. Equipment must be provided to ensure removal of laitance, dust, debris, paint and other foreign matter from the road surface immediately before the installation of the composition, or immediately before the application of primer.

(c) Application. The pavement marking shall be applied to the pavement to either the right or left of the application unit, dependent upon roadway lane being used. The unit shall not occupy more than one lane of roadway while operating.

The finished lines shall have well defined edges and be free of waviness. All of the equipment necessary to the preheating and application of the material shall be so designed that the temperature of the material can be controlled within the limits necessary to its pourability for good application.

At the time of installation of thermoplastic materials, the pavement shall be clean, dry, and free of laitance, oil, dirt, grease, paint or other foreign contaminants. Pavement and ambient temperatures shall be at least 50 °F.

An epoxy resin primer conforming to subsection 708.07 shall be applied to all pavement surfaces before the application of the thermoplastic pavement marking.

The marking material shall not be applied until the epoxy resin primer reaches the tacky stage, approximately 15 minutes under normal conditions. An infrared heating device may be employed to shorten the curing time of the epoxy.

To ensure the best possible adhesion, the marking material as specified, shall be installed at the manufacturer's recommended temperature.

The minimum thickness of thermoplastic lines as viewed from a lateral cross section shall not be less than 3/32 inch at the edges, or less than 1/8 inch at the center. Measurements shall be taken as an average throughout any 36-inch section of the line. The material, when formed into traffic pavement markings, must be readily renewable by placing an overlay of new material directly over an old line of compatible material. Such new material shall bond itself to the old line in such a manner that no splitting or separation takes place.

Glass beads shall be applied to the thermoplastic pavement marking by means of a low pressure, gravity drop bead applicator at a rate of 10 pounds per 100 square feet, minimum.

627.07 Methyl Methacrylate Pavement Marking. Methyl methacrylate pavement marking shall be installed per manufacturer's recommendations. The Contractor shall use installation equipment, materials, equipment technicians and operators recommended by the manufacturer.

Methyl methacrylate pavement markings shall be applied to the road surface according to the manufacturer's recommended methods at 60-mil minimum thickness. Glass beads shall be applied using a double drop bead application system. The first bead applicator shall apply glass beads at the rate of 3.2 pounds per square yard (10 pounds per gallon) minimum, and 1.9 pounds per square yard (6 pounds per gallon) minimum for the second bead applicator.

Methyl methacrylate pavement marking, and beads shall be applied within the following limits:

Table 627-3

Application Rates and Tolerances for

Methyl Methacrylate Pavement Marking

Description	Units	Methyl Methacrylate Pavement Marking
Alignment (Lateral Deviation)	Inches	< 2.0
Application Rate	Sq Ft per Gallon	26 - 28
Thickness	Mil	60 ± 2.0
Width	Inches	Per Plans ± 0.25
No Tack Dry Time @ 77 ºF	Minutes	< 15
Glass Bead Application Rate	Lbs per Gallon	1st Application = 10+ 2nd Application = 6+

627.08 Preformed Plastic Pavement Marking. This retroreflective preformed plastic strip shall be suitable for application on asphaltic or portland cement concrete pavement. The strip shall be applied at the locations called for on the plans or as directed.

If recommended by the manufacturer, an epoxy resin primer conforming to subsection 708.07 shall be applied to all pavement surfaces before the application of the preformed plastic pavement marking.

The surface of the pavement shall be clean, free of loose foreign material, dry and have no moisture for a minimum of 48 hours before application of the markings.

The air and surface temperature shall be a minimum 40 °F or as recommended by the manufacturer.

The marking strip as applied shall be in good appearance, free of cracks and the edges shall be true and straight.

The preformed plastic pavement marking shall be Type I, Type II, or Type III as shown on the plans.

Before beginning installation operations, the Contractor shall submit to the Project Engineer instructions from the performed plastic pavement manufacturer detailing surface preparation, grooving requirements and material application. The instructions shall include the following:

(1) Equipment Requirements.

(2) Approved Work Methods and Procedures.

(3) Material Application Temperature Requirements.

(4) Ambient Air and Surface temperature Requirements.

(5) Weather Limitations.

(6) Special Precautions.

(7) Any other requirements necessary for successful installation and satisfactory performance of the material.

The Contractor shall secure from the manufacturer all warranties and guarantees with respect to materials, workmanship, performance, or combination thereof, and shall include these warranties and guarantees with the Certification of Compliance.

Materials supplied without installation instructions or with incomplete instructions will not be accepted for use.

Unless otherwise shown on the plans, typical pavement markings shall conform to the shapes and sizes as shown on Standard Plan S-627-1.

The Contractor shall make all arrangements to have a manufacturer-trained installer of the manufacturer's products on-site during the placement of preformed plastic pavement marking to ensure proper installation. A minimum of two weeks before the placement of the preformed plastic pavement marking, the Contractor shall submit written documentation of the installer's qualifications and training in the installation of preformed plastic pavement marking. Upon completion of the work, the Contractor shall obtain and submit to the Project Engineer written documentation from the manufacturer-trained installer certifying that the product was installed in full compliance with this specification and manufacturer's recommendations.

The preformed plastic pavement marking shall be inlaid on new and existing pavements as shown in the Contract. The material shall be usable for patching worn areas of the same type according to the manufacturer's recommendations.

The Contractor shall not perform wet cutting of pavement unless otherwise directed. Application and removal of temporary pavement marking associated with wet cutting of pavement shall be at the Contractor's expense.

The preformed plastic pavement marking shall conform to pavement contours by the action of traffic, and shall be applicable on new, dense, and open graded asphalt wearing courses during the paving operations according to the manufacturer's recommendations. After application, the markings shall be immediately ready for traffic.

(a) Inlaid Preformed Plastic Pavement Marking. The grooved width for inlaid preformed plastic pavement marking is called for in the Contract. The grooved width shall be the pavement marking width plus 1 inch, with a tolerance of plus or minus 1/4 inch. The depth of the grooves shall be 130 mils plus or minus 5 mils. Groove position shall be a minimum of 2 inches from the edge of the pavement marking to the longitudinal pavement joint.

Grooving shall not be performed on bridge decks with Polyester Polymer Concrete Overlays.

The bottom of the groove shall have a smooth, flat finished surface. The spacers between blade cuts shall be such that there will be less than a 10-mil rise in the finished groove between the blades.

Grooves shall be clean, dry and free of laitance, oil, dirt, grease, paint or other foreign contaminants. The Contractor shall prevent traffic from traversing the grooves, and re-clean grooves, as necessary, before application of the preformed plastic pavement markings.

(b) Reserved.

627.09 Preformed Thermoplastic Pavement Marking. The markings shall consist of a resilient white or yellow thermoplastic product with glass beads uniformly distributed throughout the entire cross-sectional area. Legends and symbols shall be capable of being affixed to bituminous pavements by heating.

The markings shall conform to pavement contours, breaks and faults through the action of traffic at normal pavement temperatures. The material shall have resealing characteristics with the capability of fusing with itself and previously applied thermoplastic markings under normal use.

The preformed thermoplastic markings shall be packaged in a protective plastic film with cardboard stiffeners where necessary to prevent damage in transit. The carton in that the material is packed shall be clearly labeled for ease of identification.

(a) Application. Application temperature shall be as recommended by the manufacturer. The pavement and air temperature shall be as recommended by the manufacturer at the time of application. The materials shall be applied using a heating method recommended by the manufacturer. The Contractor shall provide the Project Engineer a copy of the manufacturer's installation recommendations before beginning the work. The pavement shall be clean, dry and free from debris. The preformed thermoplastic markings may be installed on top of existing thermoplastic markings after all loose material has been removed. The preformed thermoplastic markings shall not be installed on top of existing preformed plastic pavement markings without first removing the existing markings to a depth that ensures removal of the adhesive backing of the preformed plastic. It shall not be installed on top of pavement marking paint without first removing the paint.

(b) Equipment. The Contractor shall use a heating method specifically recommended by the manufacturer for the installation of preformed thermoplastic markings.

627.10 Pavement Marking Tape. Retroreflective tape shall be suitable for temporary use on asphaltic or portland cement concrete pavements. The tape shall be applied at the locations shown on the plans or as directed. The tape shall conform to subsection 713.15.

The surface that the tape is applied shall be clean, dry and free of dirt, oils and grease. The tape shall be pressed down immediately after application, until it adheres properly and conforms to the surface. Temporary marking tape sections longer than 1 foot shall be removed before placement of the final pavement course. All tape shall be removed on sections where tape conflicts with revised traffic lanes before opening of new lanes to traffic.

Pavement marking tape (removable) shall be installed per the manufacturer's recommendations and maintained throughout the required construction phase at no additional cost to the Department.

627.11 Raised Pavement Markers. Raised pavement markers (temporary) shall be installed on centerlines, edge lines, and lane lines where specified in the Contract. Single markers shall be installed at 5-foot intervals for solid lines. A group of four markers at 3-foot spacings and at 40- foot intervals shall be installed for skip lines.

Markers supplementing lines shall be installed at the spacing shown on the plans. Raised pavement markers (temporary) shall be installed per the manufacturer's recommendations and shall be maintained throughout the required construction phase at the Contractor’s expense.

Method of Measurement

627.12 The types of pavement marking described will be measured by the following units, complete-in-place and accepted.

Pavement marking paint will be measured by the number of gallons used. Procedures Method #1 or Method #2 will be used to determine the quantities for pavement markings paid by the gallon. The material used in excess of the application rate specified, will not be paid.

Modified epoxy pavement marking, polyurea, and methyl methacrylate pavement marking will be measured by the total number of gallons of components A (pigment/resin) and B (hardener/catalyst) combined to achieve the application requirements as specified. Procedures Method #1 or Method #2 will be used to determine the quantities for pavement markings paid by the gallon. The material used in excess of the application rate specified, will not be paid.

Thermoplastic pavement marking, preformed thermoplastic pavement marking, and preformed plastic pavement marking will be measured by the square foot. The unmarked spaces between markings will not be included in the overall measurement.

The amount of pavement marking tape to be measured will be the linear feet of the specified width tape applied. Gaps in marking will not be measured for payment.

Raised pavement marker (temporary) will be measured as a unit in place and shall include all adhesive necessary for installation. Removal of the raised pavement marker shall be included in the work.

Pavement word and symbol markings, transverse and longitudinal crosswalk lines, and stop lines will not be measured, but shall be the quantities, in square feet, designated in the Contract; except measurements will be made for revisions requested by the Project Engineer. The unmarked spaces within these markings will not be included in the measurement.

Basis of Payment

627.13 The accepted quantities will be paid for at the contract price per unit of measurement for each of the pay items listed below that appear in the bid schedule.

Payment will be made under:

Pay Item	Pay Unit
Pavement Marking Paint	Gallon
Pavement Marking Paint (High Build)	Gallon
Pavement Marking Paint (High Build)(Temporary)	Gallon
Pavement Marking Paint (Low Temperature)	Gallon
Modified Epoxy Pavement Marking	Gallon
Methyl Methacrylate Pavement Marking	Gallon
Thermoplastic Pavement Marking	Square Foot
Preformed Plastic Pavement Marking (Type _) (Inlaid)	Square Foot
Preformed Plastic Pavement Marking (Word-Symbol) (Type I) (Inlaid)	Square Foot
Preformed Plastic Pavement Marking (Xwalk-Stop Line) (Type I) (Inlaid)	Square Foot
___Inch Pavement Marking Tape	Linear Foot
Pavement Marking Tape (Removable) Linear	Foot
Raised Pavement Marker (Temporary)	Each
Pavement Marking Paint (Word-Symbol)	Square Foot
Pavement Marking Paint (Xwalk-Stop Line)	Square Foot
Thermoplastic Pavement Marking (Word-Symbol)	Square Foot
Thermoplastic Pavement Marking (Xwalk-Stop Line)	Square Foot
Preformed Thermoplastic Pavement Marking	Square Foot
Preformed Thermoplastic Pavement Marking (Word-Symbol)	Square Foot
Preformed Thermoplastic Pavement Marking (Xwalk-Stop Line)	Square Foot

Waterblasting will not be measured and paid for separately but shall be included in the work.

Glass beads and cleaning with high-pressure water blast or air blast shall be included in the cost of the work.

Calibration and the verification of DLS equipment will not be measured and paid for separately but shall be included in the work.

Each authorized application of temporary pavement marking will be measured and paid for at the contract unit price for the type of material used.

Control points and Contractor pavement marking plans will not be measured and paid for separately but shall be included in the work.

All costs associated with having the Preformed Plastic Pavement Marking manufacturer-trained installer on-site and providing the documentation will not be measured and paid for separately but shall be included in the work.

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