

TECHNICAL SPECIFICATIONS

The Colorado Department of Transportation (CDOT) 2019 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 plan.

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**REVISION OF DIVISION 100
GENERAL PROVISIONS**

Division 100 of the Standard Specifications is hereby revised for this project as follows:

Division 100 – General Provisions is replaced in its entirety with applicable sections of the City of Thornton Special Conditions and General Conditions of the Contract included herein.

END OF SECTION REVISION

**REVISION OF SECTION 201
CLEARING AND GRUBBING**

Section 201 of the Standard Specifications is hereby revised for this project as follows:

Subsection 201.02 – General shall include the following:

Any structures or obstructions that are unknown or not designated to remain on the plans to remain shall be clear and grubbed.

Subsection 201.04 shall include the following:

The removal of shrubs will not be measured and paid for separately, but shall be included in the work for Clearing and Grubbing.

Chipping, stockpiling, and hauling vegetative debris will not be paid for separately but shall be included in the work.

Pay Item	Pay Unit
Clearing and Grubbing	LS

END OF SECTION REVISION

**REVISION OF SECTION 202
REMOVAL OF STRUCTURES AND OBSTRUCTIONS**

Section 202 of the Standard Specifications is hereby revised for this project as follows:

Subsection 202.02 – General shall include the following:

Where it is required to cut existing paving or concrete, the cutting shall be done to a true line with a vertical face with a saw or other method as approved by the Engineer.

Delete: Removed concrete and asphalt material may be used to construct embankments in accordance with subsection 203.06

Replace with: Removed concrete and asphalt material shall not be used to construct embankments.

Subsection 202.03 – Salvable Material shall include the following:

Signs and Traffic Signals:

All traffic signal equipment, signs, posts and roadside delineators that are removed as required by this project are to be delivered to the City of Thornton's Infrastructure Maintenance Center yard located at 12450 Washington Street, Thornton, Colorado, 80241. Coordinate the delivery of materials with Edward Sanchez at the City of Thornton (720-977-6477).

All conduit, pull boxes, conductors, and foundations that are removed as required by this project are to be removed from the site and disposed of by the Contractor.

Subsection 202.11 – Method of Measurement shall include the following:

Removal of traffic signal equipment not included in separate pay items will be paid on a lump sum basis. Payment for this item shall include removal of all stipulated structures including, but not limited to signs and posts, conduit, pull boxes, conductors, and foundations. Delivering salvable material to the City of Thornton Infrastructure Maintenance Center shall be included.

END OF SECTION REVISION

REVISION OF SECTION 203 EXCAVATION AND EMBANKMENT

Section 203 of the Standard Specifications is hereby revised for this project as follows:

Subsection 203.03(a) – Embankment Material shall include the following:

Roadway Embankment Fill: Fill placed for the embankments associated with widening may consist of the on-site soils exclusive of claystone bedrock. Imported fill shall be free of claystone, contain a maximum of 70 percent passing the No. 200 sieve, and have a maximum liquid limit of 40 and a maximum plasticity index of 25. Also, the swell potential when remolded to 95% of the AASHTO T 99 standard Proctor maximum dry density at optimum moisture content shall be less than 1% under a 200 pcf surcharge pressure.

All fill material shall be free of vegetation, brush, sod and other deleterious substances and shall not contain rocks, debris or lumps having a diameter of more than 6 inches. Rocks, debris or lumps shall be dispersed throughout the fill and "nesting" of these materials shall be avoided. The geotechnical engineer shall evaluate the suitability of proposed import fill materials prior to placement.

Subsection 203.06 – Embankment shall include the following:

Delete: Broken concrete, broken asphalt, or other solid material more than 6 inches in greatest dimension removed on the project may be disposed of in embankment side slope areas not supporting the roadway shoulders and pavement structures, as defined above.

Replace with: Broken concrete, broken asphalt, or other solid material more than 6 inches in greatest dimension removed on the project shall not be disposed of on the project or incorporated into the work including in embankment side slope areas.

Subsection 203.07 – Construction of Embankment and Treatment of Cut Areas with Moisture Density Control

Delete: Soil embankments shall be constructed with moisture and density control, and the soil upon which the embankments are to be constructed shall be thoroughly scarified to a depth of 6 inches and compacted with moisture and density control. The moisture content of the soil at the time of compaction shall be as specified or directed.

Replace with: Soil embankments shall be constructed with moisture and density control, and the soil upon which the embankments are to be constructed shall be thoroughly scarified, plowed and well mixed to a depth of 12 inches (minimum) and compacted with moisture and density control. The moisture content of the soil at the time of compaction shall be as specified or directed.

Subsection 203.13– Method of Measurement shall be revised as follows:

Unclassified Excavation (Haul) will not be measured but will be the quantities designated in the contract. The work includes all labor and material needed to excavate and move on-site material needed to construct the road and driveway embankments and the work includes all labor and material needed to export surplus material from the site and legally dispose of it.

Subsection 203.14– Basis of Payment shall be revised to include:

Pay Item	Pay Unit
Unclassified Excavation (Cut to Fill)	Cubic Yard
Embankment Material (Import)	Cubic Yard

END OF SECTION REVISION

**REVISION OF SECTION 206
EXCAVATION AND BACKFILL FOR STRUCTURES**

Section 206 of the Standard Specifications is hereby revised for this project as follows:

Subsection 206.06 – Method of Measurement shall include the following:

Delete “Structure Excavation, structure backfill, and bed course material will not be measured but will be the quantities designated in the Contract.” and replace with “Structure excavation, structure backfill, and bed course material will not be measured separately but shall be incidental to the pipe and structure installation. Dewatering will be incidental for the installation of the structures.

Subsection 206.07 – Basis of Payment shall include the following:

Structure excavation and structure backfill required for all pipe and structure installation will not be measured and paid for separately but shall be included in the work and incidental to the pipe and structure installation.

END OF SECTION REVISION

**REVISION OF SECTION 207
TOPSOIL**

Section 207 of the Standard Specifications is hereby revised for this project as follows:

Subsection 207.02 - Materials is revised to include the following:

TOPSOIL & TOPSOIL MIX

Textural classification of sandy loam, loam, or sandy clay loam. pH less than 8.5, soluble salts less than 5.0 mmhos/cc, with organic matter of 2% - 5%.

Topsoil Mix = 80% specified topsoil, 20% specified compost, as measured by volume

Material Submittal:

Refer to Section 212 – Seeding, Fertilizer, Soil Conditioner, and Sodding for submittal requirements.

Soil Amendment: A minimum 4 cubic yards (6 cubic yards for City maintained landscapes and all metropolitan district parks) per 1,000 sf of a class I or II compost shall be distributed across all soil surfaces and incorporated into the soil with a rototiller capable of tilling the to 8 inches in depth.

Subsection 207.04 – Method of Measurement shall be replaced with the following:

Topsoil salvaged from onsite sources or imported topsoil secured from the Contractor’s source will measured by Cubic Yard of material in place. Stockpiling of topsoil (including erosion control and temporary stabilization) salvaged from onsite sources will not be measured or paid for separately but will be incidental to the work.

Subsection 207.04 – Method of Measurement shall include the following:

A topsoil stockpile is on-site. Topsoil (Stockpiled) shall be measured on a Cubic Yard basis and shall include hauling topsoil from the stockpile and placing the topsoil directly on completed cut and fill slopes.

Subsection 207.05 – Basis of Payment shall include the following:

207.05 The accepted quantities measured as provided above will be paid for at the contract unit price per cubic yard for each of the pay items listed below:

Pay Item	Pay Unit
Topsoil (Stockpiled)	Cubic Yard
Amended Topsoil	Cubic Yard

Water will not be paid for separately but shall be included in the work.

END OF SECTION REVISION

**REVISION OF SECTION 208
EROSION CONTROL**

Refer also to City of Thornton Special Conditions of the Contract Article 30 – “Storm Water Management”

Section 208 of the Standard Specifications is hereby revised for this project as follows:

Subsection 208.01 Description shall include the following:

The Contractor shall keep the work area dry of standing water and shall keep the excavations areas free from storm run-off.

Subsection 208.12 – Basis of Payment shall be replaced with the following:

Payment for erosion control items shall be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
Erosion Log	Linear Feet
Construction Fence	Linear Feet
Aggregate Bag	Linear Feet
Concrete Washout Structure	Each
Rock Check Dam	Each
Inlet Protection	Each
Outlet Protection	Each
Vehicle Tracking Pad	Each
Stabilized Staging Area	Lump Sum
Fence (Temporary)	Linear Feet

Fence (Temporary) shall be paid under pay item 607-11525 and be considered orange construction fence.

Payment includes the installation, removal, and restoration of affected areas to the proposed condition for all items listed.

Payment shall be full compensation for all items and work necessary to comply with applicable details, permits and Erosion Control Manual requirements (project requirements).

Temporary erosion or pollution control measures required due to the Contractor’s negligence, carelessness, or failure to install permanent controls as a part of the work scheduled or ordered by the Engineer for the Contractor’s convenience, shall be performed at no additional cost to the project.

Repair, including removal, replacement, or reconditioning of work damaged by standing water or from storm run-off shall be performed at no additional cost to the project.

Should the Contractor fail to complete construction within the approved contract time, payment will not be made for Section 208 pay items for the period of time after expiration of the approved contract time. These items shall be provided at the Contractor’s expense.

END OF SECTION REVISION

**REVISION OF SECTION 209
WATERING AND DUST PALLIATIVES**

Section 209 of the Standard Specifications is hereby revised for this project as follows:

Subsection 209.02 shall include the following:

The Contractor is responsible for obtaining a legal source for water to complete the work as specified in the Contract Documents, including any necessary permits or fees.

Subsection 209.07 – Method of Measurement shall be replaced with the following:

Measurement of water use is defined in Special Conditions Section 34 – Water Use.

Subsection 209.08 – Basis of Payment shall be replaced with the following:

Water and/or Dust Palliative will not be measured and paid for separately but shall be included in the cost of the work.

END OF SECTION REVISION

REVISION OF SECTION 210 RESET STRUCTURES

Section 210 of the Standard Specifications is hereby revised for this project as follows:

Subsection 210.04 – Fences and Gates shall include the following:

The Contractor shall supply and install any new materials required to restore the fence to acceptable conditions including but not limited to posts, mounting hardware, wire, and footings.

Subsection 210.10 – Adjust Structures shall include the following:

The Contractor shall notify each Utility prior to any construction that will involve the adjustment of its structures.

Each Utility will mark all its structures that will be involved in the specified construction area.

Prior to commencing construction, the Contractor shall coordinate and conduct, with the Utility, an inspection of all impacted structures. The purpose of this inspection will be to account for all structures involved in the construction and document their accessibility and condition. The Contractor shall be responsible for traffic control for this inspection and for the final inspection. The Contractor shall coordinate construction with the Utility to allow sufficient time for the Utility to make all necessary repairs to the structures before construction begins in the area of the structures. All parties shall agree on the condition of each structure prior to construction.

The Contractor shall replace all structures, including but not limited to manhole rims, lids, and valve box sections damaged or misplaced during construction with new materials complying with the requirements of the Utility's specifications.

Structures in the traveled roadway shall be adjusted to ¼-inch below the surface of the roadway.

Each valve box shall be set so that it is plumb and centered over the operating nut of the valve.

Modify Manhole shall include all work needed to connect the new storm or sanitary sewer pipe to the existing manhole including, but not limited to, saw cutting to remove existing manhole barrel for the new pipe penetration, concrete collars, and patching the existing manhole penetration.

Prior to the final inspection the Contractor shall thoroughly clean each valve box of all foreign debris such that the operating nut of the valve is fully accessible to operation.

The Contractor shall prevent tools, concrete, dirt, or debris of any kind from falling into existing manholes. The Contractor shall immediately clean and remove debris from the structure and downstream pipe that enters as a result of the Contractor's work.

When the project includes planing prior to resurfacing, the Contractor shall first lower all structures below the surface to be planed and then adjust them up to final grade after the paving operation is complete.

The Contractor shall coordinate and conduct, with the Engineer and each Utility, a final inspection of all impacted structures upon completion of construction. This inspection shall assure that all

structures are in compliance with these requirements. Prior to the Owner accepting the Work, the Contractor shall submit written acceptance from each Utility to the Engineer.

Add Subsection 210.10A – Reset Entry Sign shall include the following:

The Contractor shall identify all work necessary to reset entry sign for Margaret Carpenter park to be functional operational, including but not limited to possible relocation, change in grade, foundation, electrical, lighting, etc. Contractor shall try to minimize impact of the entry sign, including not relocating sign, and perform all necessary work for entry sign to be operational and visible from the roadway with approval from the owner. It is assumed that the foundation of the sign will not need to move, but contractor to verify.

Subsection 210.12 Method of Measurement shall include the following:

Traffic control for initial and final inspection shall be the responsibility of the Contractor and will not be measured or paid for separately but shall be included in the Work.

Structures lowered prior to planing and restored for service at new elevation, complete and accepted shall be paid for on an “Each” basis.

Adjusted structures shall be paid on an “each” basis and includes all work required to adjusted to final grade.

Reset Entry Sign shall be paid under item 210-00810 but include all work described in subsection 210.10A.

Reset fence shall include all fence posts and work required to reset item.

Reset Irrigation shall be paid for under a pay item under Force Accounts.

<u>Pay Item</u>	<u>Pay Unit</u>
Adjust Valve Box	Each
Adjust Manhole	Each
Reset Fire Hydrant	Each

END OF SECTION REVISION

**REVISION OF SECTIONS 212
SEEDING, FERTILIZER, SOIL CONDITIONER, AND SODDING**

Sections 212 of the Standard Specifications are hereby revised for this project as follows:

Section 212 – Seeding, Fertilizer, Soil Conditioner, and Sodding shall be replaced with the following:

**(City of Thornton Technical Specifications for)
SODDING, SEEDING, PLANTING & LANDSCAPING**

Note: This applies to small areas for sodding and a few trees to be planted for mitigation. See plan and profile sheets in design plan set.

PART 1: GENERAL

1.01 WORK INCLUDED

The work of this Section consists of 1) broadleaf weed control in preparation for planting, 2) fine grading, soil preparation, amendment & fertilization, 3) planting trees, shrubs and sod, 4) native grass seeding, 5) installation of mulches, fabrics and landscape edging, 6) winter soil moisture monitoring, 7) winter watering as needed and 8) proper off-site disposal of existing removed materials.

1.02 REQUIRED SUBMITTALS

Submit one-gallon samples of compost, wood mulch, rock mulch and a one square foot sample of porous ground fabric, at least two (2) weeks prior to site delivery.

Provide a list of all plant materials, sod and seed, by vendor, at least three (3) weeks prior to site delivery. Prior to installation, submit copies of lab analysis dated within three months of date of submittal for compost and topsoil. Provide delivery tickets and invoices verifying source type, quality and quantity of materials delivered to site.

1.03 QUALITY ASSURANCE

Inspection: Trees shall be inspected, approved and tagged with locking tree tag by the City Forester at the nursery or at the Contractor's off site holding area prior to site delivery. Trees and shrubs which, in the opinion of the City Forester, are not of specimen quality or otherwise do not meet specifications or standards shall not be delivered or installed. Any plant material not meeting Owner's approval may be rejected at any time prior to Initial Acceptance without impacting guarantee. Plant material shall meet nursery standards.

Plant Qualification and Protection: Plants shall have a habit of growth that is normal for the species and shall be of sound health, vigorous growth and free from insect pests, diseases and injuries. All plants shall equal or exceed the measurements specified in the plant lists, which are minimum acceptable sizes. Plants shall be measured and approved by the Owner on-site before pruning with branches in normal position. Any pruning shall be done at the time of planting, and only with Owner authorization. Requirements for the measurement, branching, grading, quality,

balling and burlapping of plants, shall equal or exceed the code of standards currently recommended by the American Association of Nurserymen as published in the current edition of "American Standard for Nursery Stock". The City Forester will be the sole judge of acceptable quality for all plant material. Only specimen quality plant material will be acceptable.

Protection During and After Delivery: Cover plants with tarp to prevent drying and wind damage during transport. Rootballs of plants which cannot be planted immediately on delivery shall be covered with moist soil or mulch. Water plants as needed until planted.

Plant Identification: Label plants with securely attached waterproof tag bearing legible designation of botanic and common name. Plant identification tags, and the City Forester's approval tags, shall remain in place until Initial Acceptance/Final Settlement. No substitutions shall be made to plant material without written permission of the Owner.

1.04 DISPOSAL OF REMOVED MATERIALS

Unless otherwise directed or specifically noted for salvage, provide proper off-site disposal of all materials removed as a part of demolition & site preparation. Deliver salvaged materials to the Owner's designated location.

1.05 PLANTING CONDITIONS

Planting operations shall be conducted under favorable weather conditions, as approved by the Owner.

Installation of plant materials will not be permitted until adjacent irrigation piping, site improvements and pavements are substantially complete.

PART 2: MATERIALS

2.01 HERBICIDES

Glyphosate for non-selective control. Owner-approved selective broadleaf control for native seed areas.

2.02 SOD

Small areas of disturbed sod shall be replaced "in kind". See plan and profile sheets in design plan set.

Sod shall be inspected and approved by the Owner at the time of delivery. Sod shall be sufficiently rooted and moistened sufficiently so that the soil will adhere to the roots when handled. Delivered sod shall contain not more than five percent (5%) broken rolls. Each sod strip shall have a minimum width of 12" and a minimum length of 24", with at least ¾" depth of soil adhering to roots. Sod shall have been cut to a maximum height of two (2) inches and thoroughly watered prior to harvest. Sod that has become moldy, withered, or discolored from storage or drying will be rejected. Sod out for more than thirty-six (36) hours from the time of cutting shall not be used without the approval of the Owner.

Submit delivery tickets to the Owner verifying type and source of sod prior to installation.

2.03 NATIVE SEED

Pawnee Buttes Seed Inc., www.pawneebutteseed.com, (800) 782-5947, (970) 356-7263.

Native Prairie Mix or Approved Equivalent to be placed in open space areas.

Organic compost – 4 cubic yards / 1,000 sf planting area

(29%) Blue Grama

(25%) Buffalograss

(5%) Green Needlegrass

(20%) Sideoats Grama

(20%) Western Wheatgrass

(1%) Sand Dropseed

Seed shall be bulk mixed and stored in a dry well-ventilated environment prior to site delivery. Delivery seed in unopened bags with bag tags attached. Deliver bag tags to Owner and obtain Owner's verification and approval of seed mix prior to seeding.

2.04 ORGANIC SOIL AMENDMENT

'Biocomp' Class 1 non-manure based compost by A1 Organics, Eaton, Colorado, or approved equal; screened to 3/8" minus; 25% - 35% organic matter as measured on a dry matter basis; pH 6.0-7.0; maximum conductivity of 5 mmhos/cc @ 25c 1:5; C/N ratio of 12-16. Provide a one (1) gallon sample w/ current lab analysis for approval at least 2 weeks prior to site delivery.

2.07 FERTILIZER FOR NATIVE SEED AREAS

Biosol Forte Mix 7-2-3 from Rocky Mountain Bio Products or Biosol from Pawnee Buttes Seed Company. 6 cy/1,000 organic compost to be included in soil mixture.

2.08 MULCH FOR NATIVE SEED AREA

Hydro-mulch with wood (not paper) fiber.

2.09 ROCK MULCH FOR LANDSCAPED AREAS

Contractor to utilize existing landscape rock to repair landscaping and provide in areas as shown on the plans. Existing landscape rock is typically white river rock of varying sizes. Contractor to provide samples of landscape rock if the existing material is not of adequate volume or cannot be reused.

2.10 POROUS GROUND FABRIC

Mirafi® 140N or equal non-woven polypropylene geotextile meeting AASHTO M288 Specification for Class 3, Subsurface Drainage, Stabilization, and Separation. Source: Bowman Construction Supply, 303-696-8960. Submit sample per Section 1.02. Geotextile fabric shall be utilized in all areas where rock mulch or crusher fines are installed.

2.11 LANDSCAPE EDGER

JD Russell Company Dura-edge 14 gauge x 4" roll top green-painted steel edger with raised stake pockets and interlocking ends for staking and splicing with 12" minimum length tapered steel stakes, or equal.

2.12 WATER

Water will be provided at the Owner's source in accordance with the Special Conditions of the Contract. Distribution of water for all portions of this Section including installation, establishment, and maintenance shall be the responsibility of the Contractor. Failures in the irrigation system shall not relieve the Contractor from applying the water necessary to irrigate plantings at no additional cost to the Owner.

City of Thornton hydrant water will be available for winter watering.

2.13 STAKING, GUYING AND WRAPPING

As detailed.

PART 3: EXECUTION

3.01 GENERAL – REPAIRS AND RESTORATION

Refer to General and Special Conditions for additional contract requirements regarding protection and repair of existing improvements. Methods and materials for any needed repairs shall be approved by the Owner in advance.

3.02 TRAFFIC CONTROL & CONSTRUCTION FENCING

Provide vehicular and pedestrian traffic control signage, fencing and barriers as needed for work area and as needed for conformance with the latest revision of the 'Manual on Uniform Traffic Control Devices for Streets and Highways. Submit traffic control plan(s) for Owner approval at least three (3) weeks prior to anticipated start date.

3.03 VEGETATION STRIPPING AND BROADLEAF WEED CONTROL

Obtain Owner's on-site verification of herbicide application limits prior to application. Apply glyphosate when vegetation is actively growing, when ambient temperature is less than 85°, and only under conditions of no wind, and when rain is not forecast for at least 24 hours. Reapply after ten (10) days if needed.

Following herbicide kill, strip vegetation.

Provide additional broadleaf weed control with Owner-approved selective herbicide in preparation for native grass seeding. Apply only by spot application via backpack and wand or by other approved methods. Broadcasting of herbicide with larger tank-and-boom type equipment will be prohibited.

Repeat as needed for the lesser period between new seed germination or until Initial Acceptance/Final Settlement.

3.04 FINE GRADING & SOIL PREPARATION FOR PLANTED AREAS

Planted areas include all areas to receive plants, sod or wood mulch. Prior to fine grading, rip all future landscape areas that have been compacted by construction traffic, to a minimum depth of 12" by approved method.

Fine grade prior to spreading soil amendments. Fine grade for uniform, minimum 2.0% gradient sheet drainage except where noted, with minimum 3% gradient in swales and maximum 4:1 slopes. Provide laser transit and rod man when requested for Owner's verification of grades.

Inspect the finished surface with the Owner immediately prior to spreading soil amendments. Verify finished surface is to grade with specified hold-downs, free from wash-outs and other surface irregularities which would prevent even distribution of amendment materials, free from contaminants from concreting and other construction activities, and weed free.

Surfaces shall be suitably dry before spreading soil amendment materials to allow for thorough and uniform blending of amendment materials. Since only native seeding used, 4 CY compost is required plus Biosol.

Obtain Owner's inspection and approval for spreading of soil amendments, then mix soil amendments thoroughly into the soil to a minimum depth of eight inches (8") by means of a rototiller, soil mixer (discs, chisel plows and similar are not acceptable), or, in the case of restricted areas such as pipe trenches, by hand tools.

Final finished grading and preparation shall be achieved by fine raking until the surface is smooth, friable and of a uniform fine texture and compaction having no lumps or stones over three-quarters (3/4) inch. Obtain Owner's approval of prepared areas prior to planting. Provide a 1" hold down $\pm 1/4"$ on sod areas adjacent to pavements, curbs, and existing sod edges to accommodate sod depth. Back of curb and landscape median areas shall be graded to a minimum of 3% from crown of bed or lawn to either sidewalk or curb.

3.05 SODDING

Obtain Owner's approval of finished sod bed immediately prior to sodding.

Transport sod on or across the site on pallets by forklift, skid loader, or similar. Damage to the sod bed or other improvements in place shall be repaired to the satisfaction of the Owner prior to sodding the affected area(s).

Lay sod on a firm, moist bed with tight joints so that no voids occur under or between strips, with ends of strips staggered at least one foot, resulting in 100% cover of the intended area. No partial sodding, plugging, or checker boarding of sod shall occur. Top of sod thatch adjacent to pavements, curbs, and planting bed edging shall be set flush or recessed no more than 1/2" below top of pavement/curb, except where sheet drainage from sod across pavement is needed, where top sod thatch shall be set flush.

Correct any depressions or mounds occurring after sodding prior to Initial Acceptance/Final Settlement. Do not lay sod on a frozen bed without written permission from the Owner. As soon as sod has been laid, water and roll thoroughly so that the sod makes a tight bond to the prepared bed. In the event that sod dries and shrinks, a mixture of screened topsoil and compatible seed shall be brushed into the cracks and tamped flush. If, in the Owner's opinion, drying and shrinking of sod is extensive enough to prohibit acceptable establishment and appearance within a reasonable period of time, the sod in those areas of concern shall be replaced at no additional cost.

3.06 SEEDING

Apply seed with a sharp disc type range drill set to ½" depth. Seed to total rate of 18 lbs PLS/acre or 3 lbs PLS/1000 SF. Seed half rates in two directions resulting in a cross-slope diamond pattern. Areas of hand broadcast to be seeded at 80lbs PLS/acre.

Immediately following seeding, topically apply 1500 lbs/Ac Biosol. Hydro-mulch. Mix water, 2000 lbs/Ac of mat fiber mulch and 100 lbs/Ac of tackifier, or at manufacturer's recommended rates, whichever is greater.

3.07 TREES AND SHRUBS

Trees shall be planted in pits to such a depth that the top of rootball after settlement is 1"-2" above surrounding grade as detailed. Plant material shall be oriented to give the best appearance or relationship to adjacent areas. Remove bottom of wire basket from rootball prior to final placement within the planting pit, and completely remove wire basket and surplus binding material once trees are stabilized in planting pits. Place wire basket and surplus binding material to side of pit for verification by Owner that it was removed from the tree ball. Fold burlap wrapping down off rootball and leave in bottom of planting pit. Do not pull burlap out from under rootballs. While backfilling, lightly tamp and puddle the backfill mix to eliminate air pockets. After the backfill settles, taper backfill to the top of rootball and to the level of the finished subgrade, adding backfill material as needed.

Install shrubs with top of container soil approximately 1" above surrounding finished planting bed subgrade.

When planting trees, the 1st structural root shall be placed 1-inch above finished grade. Pull mulch away from the tree trunk.

Hand water plant material immediately following planting.

3.08 FABRIC INSTALLATION AND MULCHING

Install porous ground fabric on smooth, uniform finished subgrade in all planting bed areas, excluding any ornamental grass planting areas. Provide at least six (6) inches of overlap between fabric edges. Secure fabric to subgrade with minimum 8" length metal soil staples at maximum 36" spacing along fabric edges, and at minimum 36" spacing throughout planter areas.

Area with wood mulch for tree plantings shall have no fabric. Obtain Owner's approval of wood mulch two (2) weeks prior to installation.

3.09 GUYING, STAKING AND WRAPPING

Stake trees immediately after planting as detailed. Nylon support straps shall be placed around the trunk in a single loop. Straps shall be of sufficient length to avoid touching of bark with wire & grommets. Wire shall be tightened and kept taut. Wrap tree trunks between October 15 and November 1 of the year in which trees were planted, as part of the Base Bid price. Honeylocust trees shall receive a double thickness of wrap. Remove wrapping materials in the following spring as part of Base Bid tree pricing.

3.10 STAKING REMOVAL

Remove tree stakes one (1) year following Initial Acceptance/Final Settlement when directed by the Owner, as part of the Base Bid tree pricing.

3.11 SOD AND SEED MAINTENANCE, ACCEPTANCE AND GUARANTEE

Protect and maintain sod and seed areas until Initial Acceptance/Final Settlement of all Work. Maintenance shall include sod mowing and controller programming as needed for sod establishment, seed area mowing when vegetation reaches a maximum height of 12", repair of damaged areas, weed control, grade repair and reseeding and sod replacement as needed. Care should be given to avoid standing water, surface wash, or erosion from overwatering. Failure of the irrigation system shall not relieve the Contractor from applying the water required during this period.

If Initial Acceptance/Final Settlement does not occur within one month of sod installation, apply fertilizer to sod areas that will provide actual nitrogen of at least 1 lb/1000 s.f. (20-10-5 plus iron and 8% sulfur fertilizer, 50% sulfur coated urea, after initial mowing. Continue fertilizer applications every 30 days thereafter at the rate of ½ lb actual nitrogen per 1000sf until Initial Acceptance of project.

Initial Acceptance will be contingent upon 1) sod establishment and 2) when the City has received and approved all seed product certifications and quantities and given written acknowledgement that the designated area has been prepared, seeded, mulched and maintained to meet the specification requirements.

Sod will be considered established when fully rooted and capable of healthy growth with normal 1 ½" per week post-establishment watering schedules. At the time of Initial Acceptance/Final Settlement, sod shall be in a healthy condition and of a good, green color typical of healthy improved Texas Hybrid bluegrass varieties and shall have no bare, dead, or discolored spots larger than six (6) inches in any dimension.

Prior to Final Acceptance at the end of the one year guarantee period, any seeded areas where the stand of grass does not display uniform coverage at minimum three to five leaf stage of the seed mix planted (minimum 80% healthy grass coverage over any 10 square foot area and bare spots not exceeding 10" by 10"), minimal weeds present and the area free of surface irregularities (no rills & gullies), as determined by the City, shall be reseeded one time by the Contractor in accordance with these specifications, using specified materials and methods.

3.12 PLANT MATERIAL MAINTENANCE, ACCEPTANCE AND GUARANTEE

Protect and maintain plantings until Initial Acceptance/Final Settlement of all Work. Maintenance shall include watering, weeding, cultivating, mulching, tightening and repairing of guys, removal of dead branches, and resetting plants to proper grade or upright position. All plant material installed prior to installation of the sprinkler system shall be hand watered as necessary at no additional cost to the Owner.

Contractor shall be responsible for repair or replacement of plantings or related work until Initial Acceptance/Final Settlement. Replacement of plants prior to Initial Acceptance/Final Settlement will not waive normal plant guarantee.

Initial Acceptance/Final Settlement: Initial Acceptance/Final Settlement relative to plantings will be made upon completion and approval of all Work under this Contract. Plants must be in excellent and vigorous condition. Excessively pruned trees and shrubs that, in the opinion of the Owner, are no longer excellent representatives of their species shall be replaced prior to Initial Acceptance/Final Settlement.

Plant Warranty and Replacement: Guarantee all planting for one year from date of Initial Acceptance/Final Settlement. At no additional cost to the Owner, replace any new or transplanted plant material that is dead, or which, in the opinion of the Owner, is in unhealthy or unsightly condition, or that has lost its natural shape due to dead branches or excessive pruning of dead branches.

Replacement plantings shall be completed within 30 days of notice to replace such plants. Replacement of planting shall be performed in accordance with the original specifications and its costs are considered to be included in the Base Bid price. Areas damaged by tree or shrub planting or replacement operations shall be fully restored to their original condition as specified.

3.13 SOIL MOISTURE MONITORING & WINTER WATERING PRIOR TO FINAL ACCEPTANCE

Periodically check soil moisture and the condition of plant material throughout the warranty period, and notify the Owner in writing when over/under watering is identified during the irrigation season. Provide soil moisture checks at least twice per month between the time of irrigation system winterization and subsequent spring start-up, and notify the Owner in writing regarding soil moisture conditions.

Provide winter watering of plant materials as needed. Winter watering shall be provided via tanker truck. Pressurization of irrigation systems will not be allowed for winter watering. Deliver water to trees, shrubs and ornamental grasses by approved methods. Notify the Owner at least two (2) working days in advance when winter watering is needed, and, upon Owner's request, adjust watering schedules as needed to allow for Owner's presence during watering. When winter watering, deliver the following minimum amounts of water to each plant: 15 gal. per B&B tree; 5 gal. per #5 shrub; and 2-3 gal. per 100 s.f. (approx. 2" precipitation) in ornamental grass planting areas. Apply additional amounts of water during each application as needed and at no additional cost to the Owner.

Under no circumstances shall plant warranties be voided by Contractor's claims of inadequate or excessive watering.

PART 4: MEASUREMENT AND PAYMENT

Measurement of Plants. Measure plants when branches are in their normal upright position. Height and spread dimensions specified refer to main body of plant and not branch tip to tip. Take caliper measurement at a point on the trunk six inches (6") above natural ground line for trees up to four inches (4") in caliper

No separate measurement or payment will be made for site restoration and sodding needed for various work items. Contractor's pricing shall be provided and payment made for site restoration and sodding, relative to other work items, under the pricing for those items as outlined in the SCHEDULE OF CONTRACT ITEMS AND PRICES. No separate measurement or payment will be made for other incidental site restoration as may be required due to Contractor's operations.

Contractor's pricing for fine grading, soil preparation, fertilization, seeding, sodding, & mulching shall be provided and payment made on a unit price basis under the appropriate line items as outlined in the Base Bid

Contractor's pricing for plants, amendments, fabric and mulches shall be provided and payment made on a unit price basis under the appropriate line items as outlined in the Base Bid.

No separate payment will be made for soil moisture monitoring. Contractor shall include anticipated costs for soil moisture monitoring in plant materials base bid pricing.

Include pricing for four (4) winter waterings in the base bid for new trees only (sod must be established before winter freezing weather).

The Owner will pay use fees for City of Thornton water used in winter watering. The Contractor shall pay refundable water meter deposits and rental fees. Include water meter rental fees in the line item pricing for winter watering. Refer to 'SPECIAL CONDITIONS OF THE CONTRACT' for additional conditions and meter costs as they relate to City of Thornton water use.

METHOD OF MEASUREMENT

Measurement shall be for each tree, shrub or perennial, planted, accepted, and maintained. Large bark will not be measured, but shall be the plan quantity.

BASIS OF PAYMENT

Restore Landscaping shall be paid under a pay item under Force Accounts.

This basis of payment for tree protection in general and restricted zone fencing will be considered incidental to all project costs. No extra cost for tree protection, restricted zone fencing or watering of trees and shrubs will be paid. Payment will be made under the following:

<u>Pay Item</u>	<u>Pay Unit</u>
Seeding (Native)	Acre
Mulch (Native Seed) (Hydro-Mulch)	Acre
Trees	Each
Shrubs	Square Feet

Payment shall include all digging, soil preparation, soil amendments, transporting, planting, protection, maintenance, warranty, and all materials, equipment, labor, and incidentals require to perform this item. Payment for trees, shrubs, and perennials shall be full compensation for all labor, materials, and equipment necessary to perform the work described.

END OF SECTION REVISION

**REVISION OF SECTION 213
MULCHING**

Section 213 of the Standard Specifications is hereby deleted and replaced with the following:

Section 213 – Mulching shall be replaced with City of Thornton Specifications for Sodding Seeding, Planting and Landscaping (Refer to Revision of Section 212).

END OF SECTION REVISION

**REVISION OF SECTION 214
PLANTING**

Section 214 of the Standard Specifications is hereby deleted and replaced with the following:

Section 214 – Planting shall be replaced with City of Thornton Specifications for Sodding Seeding, Planting and Landscaping (Refer to Revision of Section 212).

END OF SECTION REVISION

**REVISION OF SECTION 306
RECONDITIONING**

Section 306 of the Standard Specifications is hereby revised for this project as follows:

Subsection 306.02 - Construction Requirements shall be replaced with the following:

A minimum 1 foot of moisture conditioned, compacted fill shall be placed beneath any geotextile base course. If a minimum 1 foot of fill is not proposed as a result of the proposed profile and street section, overexcavation shall be performed. The overexcavation shall carry through the cut areas and transition from cut to fill until a minimum of 1 foot of moisture conditioned, compacted material exists beneath the paving (unless Geotextile is utilized to reduce the required overexcavation as specified in the Construction Plans). Any overexcavation shall be included in the cost of reconditioning. The reconditioned surface shall not vary above or below the lines and grades as staked by more than 0.08 foot. The surface shall be tested for smoothness and density prior to the application of any geotextile and base course material. Where asphalt surfacing materials are to be placed directly on the subgrade, the subgrade plane shall not vary more than 0.04 foot. All irregularities exceeding the specified tolerance shall be corrected to the satisfaction of the Engineer at no additional cost. The surface shall be satisfactorily maintained until base course has been placed.

Reconditioning shall not be paid for separately, but included in the cost of base course or paving items.

END OF SECTION REVISION

**REVISION OF SECTION 304
AGGREGATE BASE COURSE**

Section 304 of the Standard Specifications is hereby revised for this project as follows:

Subsection 304.02 - Aggregate shall include the following:

Materials for the base course shall be Aggregate Base Course (Class 6) as shown in subsection 703.03 – Aggregate for Bases

The Aggregate Base Course (Class 6) shall meet the gradation requirements and have a resistance value of at least 78 when tested by the Hveem Stabilometer method.

Subsection 304.07 – Method of Measurement shall include the following:

Aggregate Base Course will not be measured but will be the quantities designated in the contract. Payment shall be made for Aggregate Base Course the following bid items:

- Aggregate Base Course, (Class 6) – This item is for the aggregate base course as part of all aggregate items for 144th Avenue.

Subsection 304.08 – Basis of Payment shall include the following:

<u>Pay Item</u>	<u>Pay Unit</u>
Aggregate Base Course, (Class 6)	Cubic Yard
Aggregate Base Course, (Class 6)(Driveway)	Cubic Yard

END OF SECTION REVISION

**REVISION OF SECTION 403
HOT MIX ASPHALT**

Section 403 of the Standard Specifications is hereby revised for this project as follows:

Subsection 403.02 – Materials shall include:

Table 403-1					
Property	Test Method	Value For Grading			
		SX (75)	S (75)	S (75) (Sidewalk)	Patching
Air Voids, percent at N (design)	CPL 5115	3.5 – 4.5	3.5 – 4.5	3.5 – 4.5	3.5 – 4.5
Lab Compaction (Revolutions): N (design)	CPL 5115	75	75	75	75
Stability, minimum	CPL 5106	30	30	30	30
Aggregate Retained on the 4.75 mm (No. 4) Sieve for S, SX and SG, and on the 2.36mm (No. 8) Sieve for ST and SF with at least two Mechanically Induced fractured faces, % minimum*	CP 45	65	65	65	65
Accelerated Moisture Susceptibility Tensile Strength Ratio (Lottman), minimum	CPL 5109 Method B	80	80	80	80
Minimum Dry Split Tensile Strength, kPa (psi)	CPL 5109 Method B	205 (30)	205 (30)	205 (30)	205 (30)
Grade of Asphalt Cement, Top Layer		PG 76-28		PG 58-28	
Grade of Asphalt Cement, Layers below Top			PG 64-22	PG 58-28	PG 64-22
Voids in the Mineral Aggregate (VMA) % minimum	CP 48	See Table 403-2	See Table 403-2	See Table 403-2	See Table 403-2
Voids Filled with Asphalt (VFA), %	AI MS-2	65-75	65-75	65-75	65-75
Dust to Asphalt Ratio Fine Gradation Coarse Gradation	CP 50	0.6 – 1.2 0.8 – 1.6	0.6 – 1.2 0.8 – 1.6	0.6 – 1.2 0.8 – 1.6	0.6 – 1.2 0.8 – 1.6
<p>Note: AI MS-2 = Asphalt Institute Manual Series 2</p> <p>Note: Mixes with gradations having less than 40% passing the 4.75 mm (No. 4) sieve shall be approached with caution because of constructability problems.</p> <p>Note: Gradations for mixes with a nominal maximum aggregate size of one-inch or larger are considered a coarse gradation if they pass below the maximum density line at the #4 screen. Gradations for mixes with a nominal maximum aggregate size of 3/4" to 3/8" are considered a coarse gradation if they pass below the maximum density line at the #8 screen. Gradations for mixes with a nominal maximum aggregate size of #4 or smaller are considered a coarse gradation if they pass below the maximum density line at the #16 screen.</p> <p>*Fractured face requirements for SF may be waived by the Engineer depending on project conditions.</p>					

All mix designs shall be run with a gyratory compaction angle of 1.25 degrees and properties must satisfy Table 403-1. Form 43 will establish construction targets for Asphalt Cement and all

mix properties at Air Voids up to 1.0 percent below the mix design optimum.

Table 403-2

Nominal Maximum Size*, mm (inches)	Minimum Voids in the Mineral Aggregate (VMA)			
	***Design Air Voids **			
	3.5%	4.0%	4.5%	5.0%
37.5 (1½)	11.6	11.7	11.8	N/A
25.0 (1)	12.6	12.7	12.8	
19.0 (¾)	13.6	13.7	13.8	
12.5 (½)	14.6	14.7	14.8	
9.5 (⅜)	15.6	15.7	15.8	
4.75 (No. 4)	16.6	16.7	16.8	16.9
	* The Nominal Maximum Size is defined as one sieve larger than the first sieve to retain more than 10%. ** Interpolate specified VMA values for design air voids between those listed. *** Extrapolate specified VMA values for production air voids beyond those listed.			

Hot mix asphalt for patching shall conform to the gradation requirements for Hot Mix Asphalt (Grading S). A minimum of 1 percent hydrated lime by weight of the combined aggregate shall be added to the aggregate for all hot mix asphalt.

Fiber reinforced Hot Mix Asphalt mixes shall include reinforcement fiber strands with virgin aramids that meet the following requirements:

Property	Requirement
Nominal Specific Gravity	0.91 to 1.44
Maximum Length	0.75-1.5 in

Only reinforcing fiber strands that are not detrimental to the pavement will be allowed. The Contractor shall store and maintain reinforcing fiber strands in accordance with the manufacturer's recommendations and shall ensure that the fiber blend corresponds with the manufacturer's recommendations for the hot mix asphalt materials being used on the project. The Contractor shall follow the manufacturer's recommended procedures for placement of fiber strand reinforced warm or hot mix asphalt pavement.

Acceptable products are: ACE FIBERTM, FORTA-FI®, or an approved equivalent.

Subsection 403.03 – Construction Requirements shall include:

At locations where new Hot Mix Asphalt is to abut existing asphalt, saw cut the existing pavement a minimum of 2 feet back from the existing edge with a neat line and remove pavement. Saw cutting will not be measured and paid for separately, but shall be included in the work.

At locations where utility valves and manholes are in areas of mill/overlay only, minor adjustments may be needed. These adjustments will not be measured and paid for separately, but shall be included in the work.

If liquid anti-stripping additive is added at the plant, an approved in-line blender must be used. The blender shall be in the line from the storage tank to the drier drum or pugmill. The blender shall apply sufficient mixing action to thoroughly mix the asphalt cement and anti-stripping additive.

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.

The Contractor shall ensure there is a manufacturer's representative experienced in incorporating reinforcing fibers and placing fiber reinforced warm or hot mix asphalt present on the project when placement of the fiber reinforced mix begins. The manufacturer's representative shall have past experience with fiber reinforced pavements on the basis of the support of at least three projects previously constructed in the western United States. This representative may be a representative of the fiber supplier, the asphalt mix designer, or a private consultant, able to provide sufficient documentation including applicable projects and experience. The representative's name, qualifications, and previous experience shall be provided to the Engineer for approval at least 5 working days before the fiber reinforced paving operation begins. The representative shall remain on site for the first two days of placing fiber reinforced pavement, at a minimum, and until an acceptable production sequence is established. Any changes to the asphalt mix or fiber material beyond the allowed tolerances during production shall be disclosed by the representative and submitted in writing to the Engineer by the Contractor as a change in mix design.

The Contractor shall inject reinforcement fiber strands through the Recycled Asphalt Pavement collar, or prior to the addition of liquid asphalt cement, with a metered blower system. The Contractor shall ensure that reinforcement fiber strands are added at the specified rate per the mix design. The Contractor shall ensure that virgin aramid fibers are introduced at a minimum dosage rate of 2.1 ounces per ton of hot or warm mix asphalt pavement. If there is evidence of fiber balls at the discharge chute, the Contractor shall immediately adjust operations according to the manufacturer's recommendation to correct the problem. The Contractor shall also remove all observed fiber balls during placement. The Engineer may require the Contractor to cease operations if fiber balls are present, until a correction plan has been submitted and approved. Any delays due to shutting down due to the presence of fiber balls shall be considered non- excusable and non-compensable.

The Contractor shall provide the Engineer with documentation detailing total reinforcement fiber strands added to the warm or hot mix asphalt at the end of each day's production. The documentation shall include total reinforcement fiber strands added and the percentage of total reinforcing fibers that are virgin aramid fibers.

Subsection 403.05 – Basis of Payment shall include the following:

Payment will be made under:

Pay Item	Pay Unit
Hot Mix Asphalt (Grading S) (75) (PG 64-22) (Fiber Reinforced)	Ton

Hot Mix Asphalt (Grading SX) (75) (PG 76-28) (Fiber Reinforced)	Ton
Hot Mix Asphalt (For Asphalt Sidewalk) (Grading S) (75) (PG 58-28)	Ton
Hot Mix Asphalt (Grading S) (75) (PG 64-22)	Ton
Hot Mix Asphalt (Grading SX) (75) (PG 76-28)	Ton
Hot Mix Asphalt (Patching)	Ton

Aggregate, asphalt recycling agent, asphalt cement, additives, hydrated lime, fiber reinforcement 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. When the pay item includes the PG binder grade, the asphalt cement will not be measured and paid for separately, but shall be included in the work. Tack coat will not be measured and paid for separately, but shall be included in the work.

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.

END OF SECTION REVISION

REVISION OF SECTION 514 PEDESTRIAN RAILING (STEEL)

Section 514 of Standard Specification is hereby revised for this project as follows:

Section 514.01 shall include the following:

Pedestrian railings are required as part of this project at the locations indicated on the plans.

Section 514.03 shall include the following:

Railing shall be hot dip galvanized in accordance with ASTM A123 prior to application of any coatings. It shall be coated with a three layer coating system consisting of zinc rich primer, an epoxy intermediate coat, and a fluoropolymer finish coat. Railing shall be powder coated semi-gloss black, CDOT black baking enamel TT-E-489, Class B, or approved equal. Anchor bolts, washers, and nuts shall be stainless steel. Lock washers shall be used on all anchor bolts. Stainless fasteners should conform to the requirements of ASTM F593, "Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs" and ASTM F594 "Standard Specification for Stainless Steel Nuts." Nuts and washers should match the steel type of the bolt or fastener. Stainless steel bolts shall be hot finished and have an ultimate tensile strength of 516 MPa (75 ksi).

At least four weeks prior to coating the railings, the contractor shall submit two color samples for the Engineer's approval. The Engineer will either approve the color for use on the test section, or shall be entitled to order a change in the color, and request additional coating samples. All color samples shall be submitted on a 6"x6"x1/8" steel plate.

The contractor shall fabricate and submit a full-scale section of the railing for approval by the Engineer after the review of the shop drawings. The test section shall be submitted at least four weeks in advance of the start of fabrication. The Engineer may order changes to the fabrication if the results observed in the test section are unacceptable. The test section shall not be installed on the project unless it is accepted. Otherwise, the rejected sample shall be returned to the contractor for correction or disposal.

If rust or rust bleeding occurs on the railing at any time prior to the final inspection, by any reason, the contractor shall remove the rusted section and completely clean the section of all paint and primer, and completely re-prime and re-paint the entire section at no additional cost to the project.

Section 514.06 shall include the following:

Working drawings are required to be submitted in accordance with Sections 101 and 105 for all railing on this project.

Anchor bolts shall be long enough to protrude between 0.5 and 1.0 inches above the nut after installation of the railing base plate, washer and nut.

Section 514.08 shall include the following:

Pay Item
Pedestrian Railing (Steel)

Pay Unit
Linear Foot

END OF SECTION REVISION

**REVISION OF SECTION 602
REINFORCING STEEL**

Section 602 of the Standard Specifications is hereby revised for this project to include the following:

Subsection 601.07 – Method of Measurement shall be revised as follows:

Reinforcing steel will not be paid for separately but shall be incidental to the Work containing the reinforcement.

END OF SECTION REVISION

**REVISION OF SECTION 603
CULVERT AND SEWERS**

Section 603 of the Standard Specifications is hereby revised for this project to include the following:

Subsection 603.13 – Basis of Payment shall include:

All pipe accessories required for the complete installation of the pipe including, but not limited to: runners and steel bands, rubber O-rings or gaskets, concrete encasement collar and brick course needed to install the pipe through the existing steel casing; joint gaskets; cradles; collars; and pipe connections will not be measured and paid for separately but will be included in the work

Excavation, water control, dewatering, pipe bedding and backfill will not be measured and paid for separately but shall be included in the work. All work shall be completed in dry conditions.

Pay Item	Pay Unit
10'x5' Concrete Box Culvert (Precast)	LF
7'x5' Concrete Box Culvert (Precast)	LF

END OF SECTION REVISION

**REVISION OF SECTION 604
MANHOLES, INLETS AND METER VAULTS**

Section 604 of the Standard Specifications is hereby revised for this project as follows:

Subsection 604.07 – Basis of Payment shall include the following:

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

Payment will be made under:

Pay Item	Pay Unit
Inlet Type R L5 (5 Foot)	Each
Inlet Type R L10 (10 Foot)	Each
Inlet Type C	Each
5' Manhole	Each

END OF SECTION REVISION

**REVISION OF SECTION 609
CURB AND GUTTER**

Section 609 of the Standard Specifications is hereby revised for this project as follows:

Subsection 609.01 – Description shall be revised as follows:

This work consists of the construction of curb, gutter, and curb turn fillets, cross pans, driveway aprons, and valley gutters.

The types of curb and Gutter are designated as follows:

- Type 2 Curb and Gutter (Section IB)
- Type 2 Curb and Gutter (Section IIB)

Subsection 609.02 – Materials shall be revised as follows:

Concrete for curb, gutter, curb turn fillets, driveways, cross pans, and valley gutters shall be 4500PSI CDOT Class D and contain fibrous concrete reinforcement materials at the rate of one and one-half (1 ½) pounds per cubic yard of concrete.

Subsection 609.03 (c) – Mixing and Placing shall include the following:

Fibrous concrete reinforcement materials shall be incorporated into each batch of concrete at the plant prior to delivery to the project site. Each batch delivery ticket shall indicate the amount of fibrous concrete reinforcement material added to each batch of concrete.

Subsection 608.06 – Method of Measurement shall be revised to include the following:

Curb and gutter will be measured along the back of curb.

Subsection 608.07 – Basis of Payment shall be revised as follows:

Pay Item	Pay Unit
Type 2 Curb and Gutter (Section IB)	Linear Foot
Type 2 Curb and Gutter (Section IIB)	Linear Foot

Bed course material will not be measured and paid for separately but shall be included in the work.

Fibrous concrete reinforcement material will not be measured and paid for separately but shall be included in the work.

END OF SECTION REVISION

**REVISION OF SECTION 613
TRAFFIC SIGNAL, LIGHTING, AND COMMUNICATION CONDUIT**

Section 613 of the Standard Specifications is hereby revised for this project as follows:

General Requirements

Underground utility information shown on the plans is for information only. The Contractor is responsible for field locating and verifying utility information before starting installation of underground conduit runs and traffic signal pole foundations.

The Contractor shall cooperate with any other Contractor under contract with the Owner and with utility companies providing services to the City of Thornton while installing underground conduit runs.

Electrical conduit shall be installed in accordance with the applicable requirements described in the latest revision of the Colorado Department of Transportation Utility Manual, as amended.

All buried wiring included in this project shall be placed in a conduit. It will be the option of the Contractor, at his own expense, to use larger size conduit if desired. Where larger size conduit is used, it shall be for the entire length of the run from outlet to pull box or from pull box to pull box. No reducing coupling will be permitted in any conduit run. The Owner must approve increased sizes prior to installation.

Conduits shall be installed under existing pavement through use of directional boring operations. Conduits under pavement may be installed through use of open trench operations only where approved by the Owner.

Conduits shall be rigid plastic (PVC) or galvanized rigid steel (GRC) type conforming to the plans and these specifications. Conduit runs shown on the plans are tentative as to routing and may be changed as directed by the Owner to avoid underground obstructions. In the event of any change from the location shown on the plans, accurate records shall be incorporated into the as-built drawings, and all necessary details and as-built drawings submitted to the Owner before final payment is made.

Conduit installation shall include the installation of marking tape laid in the backfilled trench at a depth not more than 8 inches or less than 4 inches below finished grade. Heavy gauge polyethylene film (0.004 inch tape, with legend "Caution Buried Electric Line Below"), shall be used. Where tape length ends and conduit run continues, lapping of not less than 6 inches will be provided. No glue or adhesive will be allowed to join separate tape sections.

Nonmetallic Conduit (PVC)

Rigid PVC conduit shall be Schedule 80, Type 2 and shall be manufactured of high-impact PVC, and shall conform to industry and commercial standards No. CS-207-60. Each length of PVC conduit and the various PVC fittings (coupling, adapter, etc.) shall bear the label of Underwriter's Laboratories, Inc., or be approved by the Owner. The conduit shall be of the size or sizes shown on the plans or as indicated in these specifications.

Rigid PVC conduit ends shall be squared and trimmed after cutting to remove rough edges. All connections shall be made using E-Loc couplings or approved equal.

Rigid PVC conduit shall only be used for underground installations; conduit used above ground shall be galvanized rigid steel.

Galvanized Rigid Conduit Steel (GRC)

Steel conduit and fittings shall be rigid galvanized steel and shall be uniformly and adequately zinc-coated by the hot-dipped process conforming to ASTM Designation A153. Joints shall be set up tight with squared ends. Fastenings shall be secured and of a type appropriate in design and dimensions for the particular applications. Couplings, connectors, and fittings shall be approved types specifically designed and manufactured for the purpose. Fittings shall be installed to provide a good electrical ground throughout the conduit system. The interior as well as the exterior of a 6-inch sample cut from a center of a standard length of conduit when tested in accordance with the applicable portion of ASTM Designation A239 shall not show a fixed deposit of copper after four one-minute immersions in the standard copper sulfate solution. The interior of the rigid conduit shall have a continuous coating of lacquer or enamel. Each length shall bear the label of Underwriter's Laboratories, Inc., and shall conform to appropriate articles of the Code. The contractor shall provide catalog information for review by the Owner prior to purchase and installation of GRC.

The end of metallic conduit shall be threaded and well-reamed to remove burrs and rough edges. Field cuts shall be made true and square so that the ends will butt or come together for the full circumference, thereof. Slip joints or running thread will not be permitted for coupling conduit. When a standard coupling cannot be used, weatherproofed threaded three-piece union shall be used. All three-piece unions must be threaded; non-threaded couplings shall not be accepted.

The threads on all conduits shall be well painted with a good quality lead or rust-preventive paint before couplings are made up. All couplings shall be tightened until the ends of the conduits are brought together so that a good electrical connection will be made throughout the entire length of the conduit run. Conduit stubs, caps, and exposed threads, as well as any point along the surface of the conduit that has been injured in handling or installation, shall be painted with good quality asphalt bituminous or other paint suitable for the purpose.

Installation Methods

Conduit sizes and locations shall be as shown on the plans. Conduit shall be stubbed and capped for future uses where shown on the plans or where specified.

Existing empty underground conduit to be incorporated into a new system shall be cleaned with a mandrel or cylindrical wire brush and blown out with compressed air. The Contractor shall search for such conduit in the general vicinity shown on the plans, and shall notify the Owner in advance as to when this operation will take place. The Owner may, at his option, be present to monitor the activity. The cost of such activity shall be incidental to the project. In the event that such conduit has been rendered inoperative prior to the signal installation, the Contractor shall notify the Owner and payment for new conduit shall be made as per the unit costs provided in the bid.

Conduits terminating in poles, cabinets, and pedestal bases shall extend a maximum of 3 inches and a minimum of 2 inches above the foundation vertically, and shall be sloped toward hand holes in poles or base opening where transformer bases are used. Conduit entering pull boxes shall terminate a minimum of 2 inches and a maximum of 3 inches above the bottom of the box.

Conduit ends shall be accomplished by a ninety (90) degree elbow with a minimum radius of forty-eight (48) degrees. Where two (2) or more conduits meet, all ninety (90) degree elbows shall be brought together in the center of the pull box or cabinet foundation. Conduit shall only enter through the bottom of a pull box. Galvanized rigid conduit terminations within pull boxes shall be fitted with an end coupling as well as insulating bushings to prevent chafing the wire.

Conduits required to be terminated, stubbed, and plugged shall be as shown on the plans and as directed by the Owner. Conduit ends shall be capped with standard conduit caps. The location of ends of conduit for future electrical circuits under curbs, gutters, sidewalks, or structures shall be marked by a "Y" at least 3 inches high, cut into the face of the curb, gutter, or structure directly above the conduit.

Ends of unused metal type conduit shall be threaded and shall be capped with standard pipe caps until conductors are in place. When caps are removed, the threaded ends shall be provided with conduit bushings. Ends of unused non-metallic type conduit shall be plugged with a removable conduit plug. Ends of conduit populated with wire shall be plugged with duct seal putty to prevent water infiltration and rodent infestation of the conduit.

Conduit installed outside of the traveled portion of the roadway and out of future roadway areas shall be laid as follows: maximum depth of 30 inches and a minimum depth of 24 inches.

Concrete replacement within intersection islands created by installation of conduit will not be paid for separately, but included in the unit price for conduit. Replacement of roadway, sidewalk, or native growth areas created by installation of conduit will not be paid for separately, but included in the unit price for conduit.

All conduits, including conduits from the home run pull box to the controller cabinet, shall include 14 gauge copper stranded tracer wire inside the conduit for future locating of conduits. The sheathing for the tracer wire shall be purple in color. A minimum of two feet of slack tracer wire shall be left in each pull box and in the controller cabinet. At the end of each conduit run, the tracer wire shall be grounded at each traffic signal pole grounding lug.

Excavation and Backfilling

The excavations required for the installation of conduit shall be performed in such a manner as to avoid unnecessary damage to streets, sidewalks, landscaping and other improvements. Trenches shall not be excavated wider than necessary for the installation of the electrical appurtenances. Concrete removal limits shall be to the nearest pavement, sidewalk or curb and gutter control joint. Excavation shall not be performed until immediately before installation of conduits. The material from the excavation shall be placed in a position not to cause damage or obstruction to vehicular or pedestrian traffic or interfere with surface drainage.

Trenches outside the traveled portion of the roadway shall be backfilled with granular material as approved by the Owner, in six inch lifts and each lift compacted. Off-street trenches in native soil areas shall be backfilled with native soil and shall be compacted and shaped to match the surrounding surface. Surface materials in native soil areas disturbed by excavation and backfilling operations shall be replaced in kind equal to or exceeding original conditions. This shall include replacement of sod in lawn areas or reseeding in native soil areas at no additional cost to the project as directed by the Owner.

Trenches within islands, under sidewalks, in parking lots or other trenches in paved areas outside the traveled portion of the roadway shall be backfilled with Class 6 granular aggregate base course material as approved by the Owner. The backfill shall be in 6-inch lifts and each lift compacted up to a point within 3 inches of existing grade.

Trenches within or across the roadway, bike paths, trails and sidewalks shall be backfilled with CDOT-approved structural backfill (flow-fill) within 3 inches of existing grade, except on concrete surfaces which shall be removed to the nearest control joint and replaced in kind to match existing thickness, grade and finish. The top 3 inches of all trenches in asphalt roadways or asphalt off-roadway areas shall be filled to match existing grade and surfacing materials with hot asphalt mix. All roadways shall be repaired within forty-eight hours of cutting the surface.

Excavations in the street or highway shall be performed in such a manner that not more than one traffic lane is restricted in either direction at any time, unless otherwise permitted by the Owner. A minimum of one lane of traffic in each direction shall be kept open for each direction.

Excavations at intersections being reconstructed or improved shall be performed and backfilled before other improvements are completed so as to not require the repair or replacement of newly installed sidewalks, curbs and gutters, pavement, or landscaping.

Prior to backfilling, the Owner shall have the opportunity to inspect the trench, conduit and tape placement.

Measurement and Payment

Payment of conduit shall be by linear foot of conduit measured horizontally from centerline of pull box to centerline of pull box and/or centerline of pull box to centerline of controller cabinet. Elbow, vertical, and slack quantities shall be incidental to the horizontal dimension. The cost for conduit installations will include costs for all necessary items including but not limited to backfill, saw cutting, patching, jacking, drilling pits, removal of pavement, sidewalk, gutters and curbs, and their replacement in kind to match existing grade, pull rope, tracer wire, and other incidentals necessary to complete the conduit installation in place for acceptance.

Subsection 613.11 shall include the following:

Conduit for intersection wiring will be measured and paid for separately.

Subsection 613.12 shall include the following:

Pay Item	Pay Unit
3 Inch Electrical Conduit (Plastic)	LF

END OF SECTION REVISION

REVISION OF SECTION 613 CONDUCTORS AND CABLES: SIGNAL WIRING

Section 613 of the Standard Specifications is hereby revised for this project as follows:

General

Aerial cable shall be installed where specified on the plans and secured to messenger cable with cable ties or rings. No self-supported cable shall be installed unless that cable is specifically designed for this purpose. Drip loops shall be provided on all conductors where they enter pole weatherheads or signal heads.

Conductors shall be permanently identified as to function. Identification shall be placed on each conductor, or each group of conductors comprising a signal phase, in each pull box and near the end of terminated conductors.

Identification shall be by bands fastened to the conductors in such a manner that they will not move along the conductors.

All cables and conductors not shown on the plans as aerial cable or imbedded loop detector shall be installed in conduit unless installed in poles, pedestals, or mast arms.

Codes

Grounds and bonding wire, straps, and electrodes shall conform to NEC Article 250.

Wiring and splices shall conform to appropriate article of the Code. Wiring within cabinets, hand holes, junction boxes, etc., shall be neatly arranged and shall be laced.

Conductors shall be stranded, tinned copper wire, rated at 600 volts and individually insulated with heat stabilized polyethylene. Conductors and cable shall conform to IMSA Specification 19-1.

Bonding and Grounding

Metallic cable sheaths, conduit, metal poles, and pedestals shall be made mechanically and electrically secure to form a continuous system and shall be effectively grounded. Bonding and grounding jumpers shall be a bare copper wire or copper strap of the same cross sectional area, No. 8 AWG, for all systems. Sheath for detectors shall be grounded in control cabinet only. The other end of the sheath shall be taped, and left ungrounded.

Bonding of poles and pedestals shall be by means of connecting to the ground rod a bonding strap attached to an anchor bolt or a 3/16-inch or larger brass or bronze bolt installed in the lower portion of the shaft.

A ground electrode shall be installed at each control box. Each ground electrode shall be one-piece copper-weld rod of 5/8-inch diameter and eight-feet in length, driven to a depth of at least 8 feet below the surface of the ground (top of rod flush with ground or top of cabinet base).

The ground terminal of controller shall be connected to the ground rod with a No. 8 AWG bare copper wire with an approved ground rod clamp.

Wire Splices

Splices shall be made in the handholes or cabinet. No splices shall be allowed in pull boxes or conduit unless authorized by the Owner. Method of splicing must be approved by Owner.

Installation

Sufficient signal light conductors shall be provided to perform the functional operation of signal system. Twenty-one (21) conductor cable shall be run to each signal pole. Seven (7) conductor cable shall be run from the handhole of each signal pole to each signal head. A minimum of three (3) spare conductors per through phase shall be provided throughout the signal light circuit. Additional conductors for service, interconnect, etc., shall be provided as noted on the plans.

Signal light conductors shall conform to the red-yellow-green color sequencing with different colored tracers for each phase provided.

All signal light cable conductors shall have individual terminal lugs for connection to terminal strips in cabinet.

Neutral conductors shall be individually landed on the neutral bus in the traffic signal controller cabinet. Grouping or splicing together of neutral conductors prior to landing on the neutral bus shall not be permitted.

When conductors and cables are pulled into the conduit, the ends of all these conductors and cable shall be taped to exclude moisture and shall be so kept until the splices are made or terminal appliances attached. Ends of spare conductors shall be taped to exclude moisture.

Powdered soapstone, talc, or other approved lubricant shall be used in placing conductors in conduit.

Pull rope - (1/4 inch nylon rope) shall be installed in all new conduit and all existing conduit where a cable is added or an existing cable is replaced. At least two feet of pull rope shall be doubled back into the conduit at each termination.

Five feet of slack shall be left for each conductor at each support pole and two feet of slack at each pull box containing cable connections.

At least two feet (2') of slack for both power feed and loop wire is to be provided in each pull box so that testing and splicing can be done outside the pull box.

Splicing of cable will not be permitted in the conduit or outside of pull boxes, standards, or at the hand hole location in pedestals unless authorized by the Owner.

Multi-conductor cable shall be spliced and insulated to provide a watertight joint to prevent absorption of moisture by the cable.

Three-pair Belden twisted cable shall be used for pedestrian push buttons. Each pair shall be individually twisted and shielded 18 gauge stranded wire. The cable shall have polyethylene outer insulation and shall conform to IMSA specification 50-2, Belden part # YC47326 or approved equal. The three pairs of conductors shall be colored white/black, red/black, and green/black.

The white/black pair shall be used for eastbound and westbound pedestrian movements. The red/black pair shall be used for northbound and southbound pedestrian movements. The green/black pair shall be spare conductors.

The power feed for the traffic signal controller cabinet shall be continuous without splicing from the power source to the meter, from the meter to the circuit breaker, and from the circuit breaker to the traffic signal controller cabinet. A second power feed for the illuminated overhead signage and luminaires shall be continuous without splicing from the meter to the circuit breaker, and from the circuit breaker to the home run pull box. From the home run pull box, the power feed for the illuminated overhead signage and luminaires shall be split through the use of a URD submersible bus type connector, with separate conductors run to the base of each traffic signal pole. Additional URD submersible bus type connectors shall be used in successive pull boxes that serve more than one traffic signal pole. From the base of each traffic signal pole, the power feed shall be split, with separate conductors run to the luminaire and to the illuminated overhead signage. Daisy-chaining of the conductors shall not be permitted.

Meter

The Contractor shall install a meter housing as required for the project. Meter housing shall be a bare aluminum Myers Power Products Inc. MEUG3A-12 series, Milbank U5949 Cold Sequence Meter Main Pedestal, or approved equal. The anchor bolt and foundation design for the Myers Power Products Inc. MEUG3A-12 Series meter housing shall be per manufacturer's recommendation. Concrete for the foundation shall be Class BZ per Colorado Department of Transportation SSRBC, latest revision. The contractor shall coordinate with the relevant electrical service provider on the source and connection of the power feed, the installation of the meter in the meter housing, and the connection of the power feed to the meter. Within Xcel Energy territory, the contractor shall coordinate with Xcel Energy to obtain the MI rate for traffic signal electrical service. The contractor shall zip tie all doors on the meter housing that can be padlocked. Padlocks shall not be used.

Payment

This will be intersection wiring for the entire signal intersection including wiring for power from the Xcel Energy or United Power approved location and installation of a meter pedestal at each intersection that is necessary and shall be paid for in a lump sum basis as follows:

Subsection 613.12 is hereby revised to include the following:

Pay Item	Pay Unit
Wiring (for proposed modifications)	Lump Sum

END OF SECTION REVISION

REVISION OF SECTION 614 GENERAL TRAFFIC SIGNAL SPECIFICATIONS

Section 614.08 of the Standard Specifications is hereby revised for this project as follows:

General Requirements

These specifications for traffic signals shall govern the materials used for and the installation of traffic signals.

Construction of traffic signal systems shall be done in accordance with these specifications, the latest revision of the Manual on Uniform Traffic Control Devices (MUTCD) for Streets and Highways, published by the FHWA, the latest revision of the Colorado Supplement, thereto, and in conformity with the details as shown on the plans.

The Contractor shall have an IMSA Certified Traffic Signal Level II Technician on-site during the period of any splicing and/or termination of wiring for head and controller installation, and shall provide the Owner with a copy of the individual's certification prior to the start of work.

Conditions of Materials Furnished

Items furnished shall be new state-of-the-art equipment and materials. The Contractor shall submit for review and approval a list of equipment and materials as indicated in Appendix B – Submittals that are proposed to be installed, prior to the Contractor ordering such materials. Each item shall be identified by the trade name, size, and catalog number.

Traffic control equipment installed in the controller cabinet shall be products from the same manufacturer, or fully compatible if equipment from more than one manufacturer is used. At existing traffic signal installations being rebuilt, all traffic control equipment furnished by the Contractor shall be compatible with the existing equipment that will remain.

The Contractor shall supply and install all necessary materials, equipment, and labor for the complete installation and operation of the traffic signal system whether specifically mentioned or not on the traffic signal plans and in these specifications. The furnishing and installing of such non-listed items shall be considered incidental to the contract.

The Contractor shall supply and furnish all labor, tools, equipment, and incidentals necessary to complete the project in an efficient and workmanlike manner.

Definitions

General

Whenever in these specifications or in other contract documents special engineering terms and words are used, the intent and meaning shall be as defined in the Traffic Engineering Handbook, Institute of Transportation Engineers, latest edition and the Transportation Planning Handbook, Institute of Transportation Engineers, latest edition.

The following special terms and words shall have meanings as defined below:

AASHTO- American Association of State Highways and
Transportation Officials

ANSI	-	American National Standards Institute
ASTM	-	American Society for Testing Materials
CDOT	-	Colorado Department of Transportation
FHWA	-	Federal Highway Administration
IMSA	-	International Municipal Signal Association
ITE	-	Institute of Transportation Engineers
NEC	-	National Electrical Code
NEMA	-	National Electrical Manufacturers Association
SSRBC Construction	-	CDOT Standard Specifications for Road and Bridge
UL	-	Underwriters Laboratories, Inc.

Regulations and Codes

In addition to the requirements of the plans, these specifications, the Special Conditions, and the General Conditions, all items and workmanship shall conform to the requirements of the National Electrical Code (NEC) hereinafter referred to as the Code; Rules for Overhead Electrical Line Construction of the Colorado Public Utilities Commission; standards of ASTM, ANSI, and local ordinances which may apply.

Wherever reference is made to any of the standards mentioned above, the reference shall be construed to mean the Code, order, or standard that is in effect on the date of advertisement for bids.

Schedule of Work and Working Conditions

The Contractor shall provide constant attention to the work necessary to facilitate the progress thereof, and shall cooperate with the Owner, utility representatives and other contractors in every way possible.

At the end of each working period, all excavations shall be barricaded and/or covered to provide safe pedestrian and vehicular passage.

At points where the Contractor's operations are adjacent to properties of traffic signal interconnect, railway, telegraph, telephone, power companies, cable television or any other utility to which damage might result in considerable expense, loss or inconvenience, work shall not be commenced until all arrangements necessary for the protection, thereof, shall have been made.

The Contractor shall cooperate with owners of all underground and overhead utility lines in their removal and rearrangement operations in order that these operations may progress in a

reasonable manner, that duplication or rearrangement work be reduced to a minimum, and that services rendered by those parties not be unnecessarily interrupted.

In the event of interruption of water or utility services as a result of accidental breakage; being exposed or unsupported, the Contractor shall promptly notify the proper authority and shall cooperate with the authority in restoration of service. If water service is interrupted, repair work shall be continuous until the service is restored. Work shall not be undertaken around fire hydrants until approved by the local fire authority.

Distribution of Keys and Instruction Manuals

When the project is complete, two keys for each controller cabinet and police panel shall be delivered to the Owner. The instruction manual for the controller shall be left inside the controller cabinet.

Contractor Supplied Documents

Upon completion of the Work, the Contractor shall submit as-built drawings or corrected plans and/or additional data required by the Owner to show in detail all construction changes. This shall include, but not be limited to wiring, cable, location, depth of conduit, and modifications to original cabinet wiring.

The Contractor shall submit two sets of schematic wiring diagrams to the Owner for the traffic signal controller, the signal installation's light circuits and auxiliary equipment, including units and values of each component used in the cabinet. The diagrams shall show in detail circuits and components. Such components shown, thereon, shall be identified by name or number and in such a manner as to be readily interpreted.

All diagrams, plans, and drawings shall be prepared using graphic symbols shown in ANSI Y32.2, *Graphic Symbols for Electrical and Electronic Diagrams*.

One copy of the controller cabinet diagram and the intersection and phase diagram, as approved by the Owner, shall be placed in a heavy duty plastic envelope with side opening, and placed inside of each controller cabinet in the plan drawer prior to Initial Acceptance of the project.

Maintaining Existing Traffic Signal Operations

Existing traffic signals shall be kept in effective operation for the benefit of the traveling public by the Contractor.

At intersections where power to the signals must be turned off, the Contractor shall contact the Owner requesting a Police Officer(s). This request must be made at least two weeks prior to the time the officer is needed.

The above does not apply to intersections which are completely closed to traffic due to construction.

The Contractor shall maintain a minimum of two three-section (red, yellow, green) traffic signal heads for each approach. Lane assignment changes during construction at existing or temporary traffic signals with video detection shall have the detection zones modified to reflect the lane assignments. In the event that temporary signals are necessary to maintain the minimum signal

display, the Contractor shall be responsible for furnishing materials, equipment, tools, and labor necessary to install and maintain the temporary signals. Temporary signals must be in the plans or be approved by the Owner prior to installation. The Contractor shall maintain any temporary signal installed. The City shall furnish electrical energy for operation of a temporary signal.

Temporary span-wire traffic signals are not permitted unless shown on the plans or approved in writing by the Owner.

Field Test of Equipment

Prior to completion of Work, the Contractor shall make the following tests on traffic signal circuits in the presence of the Owner and the controller representative, if a new controller is used (the Contractor shall notify the Owner 48 hours prior to conducting the tests):

1. Each circuit shall be tested for continuity.
2. Each circuit shall be tested for grounds.
3. An insulation resistance test shall be made on each circuit between the circuit and a ground. The insulation resistance shall not be less than the values specified in the provisions of the NEC code.
4. Initial functional testing of a new traffic signal system shall be completed while the traffic signal heads are bagged. Heads shall be bagged with orange colored covers.
5. Louvers, hoods, and signal heads shall be directed to provide maximum visibility.
6. Initial activation shall be between 9:00 a.m. and 2:00 p.m., unless otherwise specified or shown on the plans. Prior to activation, the equipment shown on the plans shall be installed and operable. This includes, but is not an inclusive list: pedestrian signals; pedestrian push buttons; vehicle detectors; system communications; and Opticom. Any exceptions to this must be approved by the Owner.
- 7.
8. Flash and permanent activation shall have the Owner present.
9. The signal shall be run on flash cycle for a minimum of twenty-four hours prior to turn-on. After flash operations a functional test shall be made which demonstrates that every part of the system functions as specified. The functional test for each traffic signal system shall consist of at least five days of continuous satisfactory operation. If unsatisfactory performance of the system develops, the conditions shall be corrected and the test shall be repeated until five days of continuous, satisfactory operation is obtained.
10. Prior to the functional test, the contractor shall make every effort to have resolved all operating difficulties and problems. Components of the system must be complete and in operational condition to the satisfaction of the Owner prior to the functional tests being performed.

Functional tests shall start on any working day except Friday or the day preceding a legal holiday, or on a legal holiday. The owner reserves the right to require the test on any day of the calendar week.

During the test period, the Owner will provide the electrical energy. Repair costs of any damage caused by public traffic and all other maintenance costs will be the responsibility of the Contractor until Initial Acceptance of the project by the Owner.

Activation of Traffic Signal Equipment

Activation of new or modified signal systems shall be made only after all traffic signal circuits have been thoroughly tested as specified and the Owner concurs with the activation.

Intersection Power

The Contractor shall coordinate with Xcel Energy sufficiently prior to the signal turn-on so that orders may be issued for power connection to the intersection on the specified turn-on date. The Contractor shall also coordinate with Xcel Energy to ensure that each intersection is checked for and meets the appropriate power requirements for the traffic signal and other equipment. The Xcel Energy contact shall be Mr. Brent Aldred (555 Zang Street, Suite 250, Lakewood, CO 80228, 303-592-2726, brent.aldred@xcelenergy.com).

Permits

The Contractor shall obtain a Traffic Control Permit from the City of Thornton Infrastructure Department and an excavation permit from the City of Thornton City Infrastructure Department prior to construction.

Concrete Work, Asphalt Work, Aggregate Base Course

All concrete work, asphalt work and aggregate base course installation to be performed under this Contract shall conform to the requirements of the **2011 Edition of the Colorado Department of Transportation's Standard Specifications for Road and Bridge Construction or as otherwise specified in these specifications and plans**. All concrete, except traffic signal pole foundations and sidewalks, shall be Class D. Traffic signal pole foundation concrete shall be Class BZ. Sidewalk concrete shall be Class B with a fiber mesh. All asphalt shall be Grade Sx, (PG 64-22). All aggregate base coarse shall be Class 6.

Removals

All traffic signal equipment, poles, signs and posts that are removed as required by this project are to be delivered to the Owner's Infrastructure Maintenance Center located at 12450 Washington Street. Coordinate with the Owner at least 24 hours in advance of delivery.

APPENDIX B

SUBMITTALS

The Contractor shall submit for review and approval the following list of equipment and materials as required by the plans, prior to the Contractor ordering such materials. Submittals shall consist of product cut sheets and necessary supporting material and each item shall be identified by the trade name, size, and catalog number. Additional documentation may be requested at the discretion of the Traffic Engineer.

Conduit
Conduit Coupler
Conduit Plug
Pull Box
Pedestrian Pole and Base
Luminaire
Vehicle Detection (including mounting hardware and monitor)
Pedestrian Push Button and Station (including instruction sign)
Signal Head (including mounting hardware)
Backplate
Signal Indication
Pedestrian Signal Head (including mounting hardware)
Pedestrian Signal Face
Emergency Vehicle Preemption
Traffic Signal Controller Cabinet
Ethernet Field Switch
Ethernet Telemetry (including antenna and antenna cable)
Concrete Mix Design (Class BZ)
Concrete Mix Design (Class D)
Uninterrupted Power Supply
Uninterrupted Power Supply Beacon
Wire (traffic signal conductors, pedestrian pushbutton. etc.)
Meter Housing

END OF SECTION REVISION

REVISION OF SECTION 614 SIGNAL HEADS

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

General

Signal equipment shall be manufactured and be designed to operate from a 115 volt 60 cycle single-phase source.

All traffic signal equipment shall be designed to operate between ambient temperatures of -30 degrees F to +165 degrees F, with relative humidity up to 95 percent.

Twelve (12) inch signal heads shall be polycarbonate and shall come complete with mounting opening plugs, washers and gaskets for mounting. Heads shall be highway signal black in color (both faces and housings). Visors shall be polycarbonate and shall be highway black for outside and flat black inside. LED arrows shall not be the outline type.

All signal faces installed prior to final activation of the system shall be covered with orange bags to clearly indicate that the signal is not operational. The covering shall be over the entire head and shall be securely fastened. No adhesive used to secure the head covering shall touch any part of the head or mounting assembly. Signal heads and faces shall not be installed sooner than five (5) days prior to activation, unless approved in writing by the Owner.

All signal hardware to be furnished under this contract shall be of standard design and manufacture. No special fittings and/or components shall be used or furnished which are not shelf type items by the manufacturer and/or vendor.

All vehicle signal faces and pedestrian signal faces shall be of the adjustable, vertical type as shown on the plans. They shall provide light indication in one direction only and shall be adjustable through 360 degrees about a vertical axis.

All mast arm mounted heads shall be mounted at the location determined by the Owner. No holes shall be placed into the mast arms until actual head location has been determined in the field by the Owner.

All mast arm mounted heads shall be installed at a uniform elevation above the roadway surface.

Unless otherwise shown on the plans, traffic signal faces shall be standard 12-inch LED and shall contain three sections arranged vertically; red--top; yellow--center; green--bottom.

All vehicle signal faces shall be focused to allow maximum visibility to approaching motorists. All signal heads installed at any one intersection shall be of the same make and type, unless otherwise stated in the Schedule of Bid Items, or these Technical Specifications, or approved by the Owner.

General Standards

The signal housing and LED faces shall conform to the Institute of Transportation Engineers most recent standards. LED on-board circuitry must meet FCC Title 47, CFR Subparts B, Section 15.107, 109 regulations concerning emission of electronic noise. Certificate of Compliance with ITE standards shall be provided upon delivery of material.

Physical

The traffic signal housing shall be for direct LED use or be a retrofit LED in a traffic signal housing built to the ITE Vehicle Traffic Control Signal Head (VTCSH) standards without modification to housing or need of special tools. The lens, lamp module, and gasket shall be weather tight and fit securely in the housing and shall be Gelcore, Dialight, or approved equal.

LED Signal Lens Module

The lens may be uniformly tinted to enhance ON/OFF contrasts in a manner not to affect luminous intensity or chromaticity. The lens shall be easily replaceable in the field without the need of any special tools or any adhesives in the event of vandalism or vehicle impact. The lens shall be keyed to the housing to assure proper orientation. The lens material shall be Ultraviolet (UV) stabilized polycarbonate to withstand direct sunlight exposure for a minimum of five years without exhibiting evidence of deterioration.

Lamp Construction

The LED signal shall be a self-contained device not requiring on-site assembly and be capable of withstanding mechanical shock and vibration.

Mounting Hardware

Mast Arm Mounts

Signal head placement as shown on the plans are representative only. All mast arm signal head mounts shall be a Pelco Astro-Brac Tallon Series AB-0617 (no paint) with ninety-six inch (96" cable) or Sky Bracket type mount. Each head shall be mounted with a separate mount. Horizontal clustering of two arrowed heads next to a three section standard head will be permitted on one Sky Bracket type signal mast arm mount.

All pedestrian hybrid beacon (HAWK) mast arm and side of pole mounts shall be Sky Bracket HAWK Beacon Mount, part number SS-SB29-HPB-18 or approved equal.

Side of Pole and Top of Pole Mounts

One-way side and top mounts shall be aluminum and shall be highway black in color. The upper and lower arm assemblies for one-way side of pole mounts shall use elbows and not "T" fittings. Two-way side of pole mounts for signal and pedestrian signal heads shall be aluminum, and shall be highway black in color. Two-way side of pole signal head mounting assemblies shall use a "T" fitting in the center frame pipe. Elbows shall be used on the upper and lower arm assemblies at the signal head mounting locations. .

Backplates

Backplates shall be furnished and installed on all overhead vehicular signal heads on mast arms. No background light shall show between the backplates and the signal face or between sections of the signal head.

Backplates shall be either all one piece or sectional. Sectional backplates shall be riveted together. No screws shall be allowed for putting backplates together. Backplates shall be 5 inches in width unless otherwise approved by the Owner and shall be louvered to allow airflow and yet not permit background light to be visible to the motorist. Backplates shall be aluminum painted Flat Black. Backplates shall be installed to the signal head using the appropriate screws and 1/4-inch zinc plated flat washers.

Subsection 614.14 shall include the following:

Signal heads will be paid for each unit, totally installed, and operational with backplate at location shown on the plans.

Pay Item	Pay Unit
Traffic Signal Face (12-12-12)	Each
Traffic Signal Face (12-12-12-12-12)	Each

END OF SECTION REVISION

REVISION OF SECTION 614 TRAFFIC SIGNS

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

General

The City shall review and approve what type of controls and where they shall be installed based on standard City practices and the MUTCD. These controls shall include traffic control signs, street name signs, delineators, fiber markers, permanent barricades, and pavement markings.

Sign panels shall conform to City requirements for material composition and reflective sheeting. Items used in the fabrication, manufacturing, and installation of traffic control signing in the City shall be manufactured in the United States with domestic materials and parts. Domestic Materials and parts are those which are melted, cast, formed, shaped, drawn, extruded, forged, fabricated, or otherwise processed in the United States using raw materials produced in the United States.

Sign sizes shall conform to the MUTCD sizes for conventional roads unless otherwise approved in writing by the Development Engineering Manager.

Sign Fabrication

- Standard control and street name signs shall be fabricated on .080/50-52 H 38 anodized aluminum blanks with standard radius corners.
- Traffic control signs and street name signs shall be fabricated using 3M Company diamond grade retroreflective sheeting or approved equivalent. Sign facings shall be covered with 3M #1160 protective overlay or approved equivalent.
- Traffic control sign faces shall be screened in conformance with methods prescribed by 3M Company using 3M inks or approved equivalent. No substitutions shall be allowed unless approved by the Development Engineering Manager prior to fabrication in writing.
- Standard signs, except street name signs, shall be fabricated to conform exactly to the detailed drawings of standard highway signs as shown and detailed in the latest Standard Highway Signs Manual as published by the U.S. Department of Transportation/Federal Highway Administration.
- School, bicycle crossing, and pedestrian crossing signs shall be strong fluorescent yellow green. All warning signs shall be fluorescent yellow.
- Street name signs shall be fabricated in accordance with these Standards and Specifications. The City shall furnish a sample of the City logo decals to be installed on street name signs.
- Capitalization of letters shall be in compliance with the MUTCD, latest revision.
- Signs shall be fabricated with new materials. No used or reconditioned sign blanks or outdated sheeting and/or precut letters or numbers shall be used.

Sign Installation

- Signs shall be installed in conformance with the latest edition of the MUTCD and Revisions. Signs shall be mounted on either the approved City breakaway supports, or banded to street light poles.
- Signs mounted to street light poles shall have the sign support banded to pole with two (2) one-half (1/2) inch stainless steel "band-it" straps.
- The Responsible Party shall, prior to installing sign support bases, contact utility agencies providing services, to locate buried services and to avoid damage when the base is installed. This shall include contacting the Utility Notification Center of Colorado.

Sign Maintenance

It is the responsibility of the Responsible Party to maintain required signs after installation until the City has officially granted the initial acceptance of the adjacent ROW improvements. Signs installed under this standard shall be maintained during the development construction period in two manners.

- Signs damaged which do not constitute an immediate hazard to the public shall be repaired by the Responsible Party within a reasonable time, not to exceed 10 working days after Responsible Party has been notified.
- Signs damaged, which constitute an immediate hazard to the public, shall be repaired or replaced by City personnel. The Responsible Party shall be responsible for the cost of repairs and/or replacement.

Measurement and Payment

Payment for a Traffic Signs shall be per unit installed and shall include all labor and materials to the satisfaction of the Owner.

END OF SECTION REVISION

**REVISION OF SECTION 614
GLOBAL POSITIONING SYSTEM**

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

General

North American Datum 83 (NAD83) Colorado State Plane Central Zone coordinate system (grid) units in feet shall be provided for all roadway devices within the project limits. This shall include traffic signal controller cabinets, sign posts, pull boxes, water valve type pull boxes, traffic signal poles, pedestal poles, and street light poles. The elevation datum shall be based upon the North American Vertical Datum 1988 (NAVD 88).

Data Format

The GPS data collected shall be provided to the City in an AutoCAD drawing format using model space or using the GPS Device Installation form in Appendix A. The use of AutoCAD drawings or the GPS Device Installation Location form in Appendix A shall be at the discretion of the Traffic Engineer. If AutoCAD drawings are required, the drawings shall include a note describing how the coordinates were established along with the primary control points that were used. The AutoCAD information shall also be incorporated into the asbuilts for the project.

The horizontal and vertical positional accuracy of the data collected shall be within a tolerance of ± 0.3 feet.

Payment

GPS information gathering will not be measured or paid for separately, but shall be considered subsidiary to the pay item being installed. This work shall include all labor, materials, and equipment required to complete the work.

**APPENDIX A
GLOBAL POSITIONING SYSTEM (GPS) DEVICE INSTALLATION LOCATION**

Date of GPS Locate:

Item Being Located – “Device”, “Pull Box”, etc:

Location of Item – “Street”, “Direction of Travel”, “Side of Street”, etc.:

North American Datum:

Northing _____
(based on NAD83 Colorado State Plane Central Zone Coordinate System)

Easting _____

(based on NAD83 Colorado State Plane Central Zone Coordinate System)

Vertical _____
(based on NAVD 88)

Remarks (primary control points used and how coordinates were established):

END OF SECTION REVISION

REVISION OF SECTION 619 WATER LINES

Section 619 – Water Lines shall be replaced in its entirety with the following specifications derived from the City of Thornton Standards and Specifications for the Design and Construction of Public and Private Utilities (October 2012)

204 WATER DISTRIBUTION SYSTEM CONSTRUCTION SPECIFICATIONS

204.1 Materials

Materials furnished shall be new and undamaged. Everything necessary to complete all installations shall be furnished and installed whether shown on approved drawings or not, and all installations shall be completed as fully operational.

Acceptance of materials or the waiving of inspection thereof shall in no way relieve the Responsible Party of the obligation to furnish materials meeting the requirements of these Standards and Specifications.

The City reserves the right to direct or deny use of certain types of materials in specific circumstances. Materials delivered to the job site shall be adequately housed and protected so as to ensure the preservation of their quality and fitness for the work.

A. Ductile Iron Pipe (DIP)

DIP shall be manufactured in accordance with AWWA Standard C-150 and C-151, "Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-lined Molds for Water or Other Liquids", with the following additional requirements or exceptions:

1. "Push-on single gasket" type conforming with applicable requirements of AWWA Standard C-111, "Rubber Gasket Joints for Cast Iron and Ductile Iron Pressure Pipe and Fittings".
2. The grade of iron shall be 60-42-10 having a minimum tensile strength of 60,000 psi, minimum yield strength of 42,000 psi, and a minimum % of elongation of 10%.
3. Pipe furnished under this specification shall conform to AWWA C-150 and C-151, and have nominal laying lengths of either 18 or 20 feet. Random lengths are not acceptable.
4. Pipe furnished shall have standard thickness cement mortar linings in accordance with AWWA Standard C-104, "Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water", and the exterior coating shall be the standard outside bituminous coating as specified in AWWA C-151.
5. The Contractor shall furnish a manufacturer's certified statement that the inspection and specified tests have been made and the results thereof comply with the requirements of the applicable standard(s) herein specified. A copy of the certification shall be sent to the Engineer upon request.

6. Ductile iron water pipe shall be installed per AWWA C-600.
7. Provide corrosion protection per City of Thornton Corrosion Protection Detail, Drawing No. 200-15.

B. Polyvinyl Chloride Pressure Pipe (PVC)

1. All polyvinyl pipe for water mains 12 inches and less, except that 10 inch diameter is not permitted, shall be manufactured in accordance with AWWA Standard C-900-07, "Polyvinyl Chloride (PVC) Pressure Pipe.", and shall meet the requirements for DR-25 for all distribution mains, and shall meet the requirements of DR-18 for hydrant leads. All PVC pipe larger than 12 inches shall meet C-905-97, and shall be DR-21 or DR-18 as determined by the Development Engineering Manager.
2. Solvent cement joints are strictly prohibited.
3. Each length of pipe shall be a standard laying length of 20 or 12 feet. Random lengths shall only be acceptable at fittings and hydrant branch lines. PVC pipe must be laid with tracer wire (16-gauge wire only).
4. PVC must conform to cast iron outside diameters. Pipe stored outside which may be exposed to sunlight for more than 30 days, shall be covered with an opaque material such as canvas. Clear plastic sheets shall not be used to cover the pipe. Air circulation shall be provided under the covering. Sunburned pipe shall not be permitted for installation and shall be removed from the job site immediately. Pipe must be UL approved.
5. The Contractor shall furnish a manufacturer's certified statement that the inspection and specified tests have been made and the results thereof comply with the requirements of the applicable standard(s) herein specified. A copy of the certification shall be sent to the Engineer upon request.
6. Provide corrosion protection per City of Thornton Corrosion Protection Detail, Drawing No. 200-15.

C. Fittings

Cast iron fittings shall be manufactured in accordance with the following AWWA standards: C-104, "Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water," C-110, "Ductile Iron Fittings" and C-111, "Rubber Gasket Joints for Ductile Iron Pressure for Pipe and Fittings," with the following additional requirements or exceptions:

1. Fittings shall be furnished with a cement mortar lining of standard thickness as defined in referenced specifications and given a seal coat of bituminous material.
2. Fittings shall be furnished with mechanical joint, ring tite or flanged ends conforming to referenced specifications and, in addition, the tee-head mechanical joint bolts and hexagon nuts shall be fabricated from a high strength, stainless

steel or approved equal. Swivel fittings as approved by the Development Engineering Manager may also be utilized. Under no circumstances shall repair clamps be permitted on new installations.

3. Fittings shall be of the 250 psi pressure rating and shall conform to the dimensions and weights shown in the tables of referenced specifications.
4. The Contractor shall furnish a manufacturer's certified statement that the inspection and specified tests have been made and the results thereof comply with the requirements of the applicable standard(s) herein specified. A copy of the certification shall be sent to the Engineer upon request.
5. Provide corrosion protection per City of Thornton Corrosion Protection Detail, Drawing No. 200-15.

D. Gate Valves – Detail 200-6A & 200-6B

Refer to Detail 200-6 for gate valve requirements, and Detail 200-15 for corrosion protection.

E. Valve Boxes – Detail 200-6B

Refer to Detail 200-6B for valve box requirements, and Detail 200-15 for corrosion protection.

F. Butterfly Valves – Detail 200-8

Refer to Detail 200-8 for butterfly valve requirements.

G. Pressure Reducing and Regulating Valves (PRV) – Detail 200-12

1. PRV's shall be Cla-Val 90-01 series or an approved equivalent. The valve shall be designed to reduce a high upstream pressure to a constant downstream pressure by way of a pilot control system. The pilot system shall control the main valve which shall be of the single seated, hydraulically operated, diaphragm, globe valve type. The valve seats shall be stainless steel.
2. Material shall be cast iron for valve body. Flanges and covers shall conform to ASTM Standard Designation A-48. Bronze castings or parts for internal trim shall conform to ASTM Standard B-61.
3. Valves shall be furnished with flanged ends and drilled in accordance with ANSI B-16.1 Class 125 specifications. Flanges shall be machined to a flat face or machined to a flat surface with a serrated finish in accordance with AWWA Standard C-207.
4. The pilot valve for controlling operation of the main valve shall be a single seated, diaphragm operated, spring loaded type. The pilot valve shall be attached to the main valve with piping and isolation valves so arranged for easy access in making adjustments and also for its removal from the main valve while the main valve is

under pressure. Pilot control system shall be stainless steel with 316 stainless steel trim.

5. The needle valve shall be bronze and included with the main valve to control the speed of piston travel.
6. The operating pressure shall be 150 psi.
7. The body of the PRV shall be given a hydrostatic test of 50% more than the operating pressure specified herein. A second test to check seating of the cylinder shall be made at the operating pressure.
8. Pressure reducing and regulating valves shall be installed in factory built steel vaults as specified in Detail 200-12. There shall be no dissimilar metals allowed in the piping in the PRV vaults without proper insulation.
9. The manufacturer shall furnish a certified statement that the inspection and specified tests have been made and the results thereof comply with the requirements of the applicable standard(s) herein specified. A copy of the certification shall be sent to the Development Engineering Manager upon request.
10. After approved factory assembly, each valve shall be given the operation and hydrostatic tests in accordance with the referenced specifications.
11. The manufacturer shall furnish a certified statement that the inspection and specified tests have been made and the results thereof comply with the requirements of the applicable standard(s) herein specified. A copy of the certification shall be sent to the Development Engineering Manager upon request.

H. Air Valves – Details 200-13A & 13B

Refer to Details 200-13A and 13B for air valve requirements.

I. Blowoff Assemblies – Detail 200-9

Refer to Detail 200-9 for blowoff assembly requirements.

J. Vaults – Refer to Detail 200-12

1. Vaults shall be fabricated steel and shall be factory built for underground use as manufactured by Engineered Fluid, Inc., or approved equal. Field welding to complete the structure shall not be allowed.
2. The vault shall have a protective coating for corrosion protection and shall be equipped with packaged magnesium anodes for cathodic protection. The anodes shall be buried equally spaced around the vault and connected by heavy copper wire to bags on the vault provided for that purpose.
3. Vaults shall be designed with wall sleeves and link seal and be capable of handling thrusts caused by operating valves.

4. The designing engineer shall submit shop drawings along with design calculations including the electric layout to the Development Engineering Manager for approval prior to the installation.

K. Thrust Blocks – Detail 200-11

Refer to Detail 200-11 for thrust block requirements.

L. Concrete

Refer to Section 600 of these Standards and Specifications for all concrete work requirements.

M. Mechanically Restrained Joints

Megalugs, Cam-Lok or approved equal shall be used. Tie rods may be used as approved by the Development Engineering Manager. If tie rods are used, they shall be mild steel, ASTM Standard Designation A-36. Hex nuts shall be ASTM Standard Designation A-307, grade A or B, Hexagon Heavy series. Tie rods shall be used at bends and fittings where thrust blocks cannot be used due to existing field conditions or where harness rods are specifically required by the Development Engineering Manager. Harness rods shall have a bituminous coating for corrosion protection.

N. Fire Hydrants – Detail 200-10

Refer to Detail 200-10 for fire hydrant requirements.

M. Steel Casing Pipe

Pipe casing shall be smooth wall welded steel cylinder fabricated in accordance with AWWA C200. It shall be round, straight, and free from defects or damage due to improper manufacturing or handling with a minimum yield strength of 35,000 psi.

204.2 Corrosion Protection – Detail 200-15

DIP, steel pipe, steel casing pipe, harness rods, fittings, valves, and valve boxes shall be protected as specified in Detail 200-15.

204.3 Installation of Pipe

- A. Refer to Section 100 for excavation, dewatering, pipe bedding, testing, backfill, and compaction requirements.
- B. Pipe shall be installed in accordance with AWWA C-900 along with the following provisions:
 1. Pipe and fittings shall be loaded and unloaded by lifting so as to avoid shock or damage. Under no circumstances shall such material be dropped. Before the placing of pipe in the trench, each pipe or fitting shall be thoroughly cleaned of foreign material, kept clean, and examined for cracks or defects before installation.

No pipe shall be installed that is damaged by prolonged exposure to the sun or adverse weather conditions.

2. Joint lubricant shall be as supplied by the pipe manufacturer.
3. When laying pipe on curves, the pipe shall be kept in alignment by deflecting joints or using short lengths of pipe. If using deflecting joints, recommended practices and allowances as stipulated by the manufacturer must be adhered to. Pipe shall be laid with the bell ends facing in the direction of laying unless directed otherwise by the Development Engineering Manager.
4. Whenever the pipe is left unattended, temporary plugs shall be installed at openings. Temporary plugs shall be watertight, standard cast iron, and of such design as to prevent children and animals from entering the pipe. Temporary plugs shall be subject to approval by the Development Engineering Manager.
5. Pipe and appurtenant structures shall not be installed upon a foundation into which frost has penetrated or at any time when the Inspector deems there is a danger of ice formation or frost penetration at the bottom of the excavation. Pipe and appurtenant structures shall not be installed unless backfilling can be completed before the formation of ice and frost.
6. Immediately before joining two (2) lengths of pipe, the inside of the bell and the outside of the spigot end and the gasket shall be thoroughly cleaned. Caution shall be exercised to ensure that the correct type of gasket is used. A thin film of gasket lubricant shall be applied according to the manufacturer's recommended practices to either the inside face of the gasket or the spigot end of the pipe or both.
7. The spigot end of the pipe shall be placed in the socket with care to prevent the joint from contacting the ground. The joint shall be completed by pushing the pipe home with a slow steady pressure, without jerky or jolting movements. Stabbing shall not be permitted. Pipe furnished without a depth mark shall be marked before assembly to ensure insertion to the full depth of the joint.
8. Extra care should be used in handling PVC pipe during cold weather due to the reduced flexibility and impact resistance as temperatures approach and drop below freezing.
9. Non-disinfected mains which cannot be isolated shall not be connected to an existing, disinfected main. The Responsible Party shall assume any and all responsibility for damage done by heavily chlorinated water entering existing facilities due to negligence on his part. Water mains shall adhere to the following sequence of tests: (1) chlorine, (2) pressure tests, and (3) clearwater test.

204.4 Installation of Valves and Valve Boxes – Detail 200-6A & 200-6B

Refer to Detail 200-6A & 200-6B for installation requirements for valves and valve boxes.

204.5 Testing

Refer to Subsection 206 of these Standards and Specifications.

205 WATER SERVICES AND APPURTENANCES CONSTRUCTION SPECIFICATIONS

205.1 General

Water services construction connecting to the City water system shall be done in accordance with these Standards and Specifications, which shall cover new water services construction from the water main to the meter pit or vault. Refer to Sections 100, 204, and 206 for installation and testing procedures for water services and appurtenances.

205.2 Materials

- A. Materials furnished shall be new and undamaged. Everything necessary to complete installations shall be furnished and installed whether shown on the approved drawings or not and installations shall be completed as fully operational.
- B. Acceptance of materials or the waiving of inspection thereof shall in no way relieve the Responsible Party of the obligation to furnish materials meeting the requirements of these Standards and Specifications.
- C. The City reserves the right to direct or deny use of certain types of materials in specific circumstances.
- D. Materials delivered to the job site shall be adequately housed and protected so as to ensure the preservation of their quality and fitness for the work.
- E. The minimum size allowable for a water service shall be three-fourths (3/4) inch diameter.
 1. Copper Service Pipe - Type "K" only

Type "K" copper shall be used for service lines three-fourths (3/4) inch through three (3) inch diameter.
 2. Ductile Iron Service Pipe

DIP shall be used for services larger than three (3) inches,
 3. Corporation and Curb Stops
 - a. A curb stop or valve of the same size as the service pipe and conforming to the following standards shall be installed on every commercial service larger than one (1) inch between the water main and the meter which is at a point at or near the property line.

- b. Water service saddles shall be cast bronze with double silicone bronze straps, Type 325 or 327 by Smith-Blair Inc., or an approved equal.
- c. Corporation stops shall be AWWA taper thread to copper connection of pack joint and shall be a Ford Type F600 or an approved equal.
- d. Curb stops shall be compression to compression connections and shall be Ford Ball Valves, B44-666M (one and one-half (1-1/2) inches) or B44-777M (two (2) inches) or approved equal.
- e. Curb stops are set in the service on the inlet side, a minimum of two (2) feet upstream of the vault and provide a means to shut off the service for repairs inside the meter vault.
- f. Curb stop service boxes shall be a cast iron box, Minneapolis pattern, extension type. The curb stop box shall be centered over the curb stop valve and in a vertical position. The top lid of the curb stop box shall be installed a maximum of one (1) inch above the final grade.

205.3 Location - Detail 200-2

Refer to Detail 200-2 for service location requirements.

205.4 Depth – Detail 200-14

Refer to Detail 200-14 for service depth requirements.

205.5 Connections – Detail 200-14

Refer to Detail 200-14 for service connection requirements.

205.6 Abandonment

Only one (1) domestic tap is allocated per single family residence. If it is required by the Development Engineering manager to abandon an existing water tap, it shall be turned off and disconnected at the main. City shall inspect disconnection prior to backfilling. If the City does not inspect prior to backfilling the contractor will be required to re-excavate affected area for inspection. A compression fitting shall be utilized if necessary to relocate a meter pit from a driveway area, only if the installation of a new service line would require the cutting and patching of asphaltic concrete surfacing.

206 WATER MAIN ACCEPTANCE PROCEDURE

206.1 Scope

This procedure is to be followed when releasing a newly installed water main or releasing a repaired pre-existing water main. It covers disinfection, bacteriological sampling, and reporting of results.

206.2 New Mains

Installation shall be in accordance with established AWWA standards (AWWA C-600 or C-603) with particular attention paid to the provision for cleanliness within the pipe itself. Flushing and disinfection shall be performed by the Responsible Party in accordance with AWWA Standard C-601 (more detailed instructions shall be found below). Sampling (bacteriological and chlorine residual) shall be performed by personnel from the Thornton Water Quality Control Laboratory. Chlorine residual analysis shall be performed using accepted test procedures in Standard Methods for the Examination of Water and Wastewater's most recent edition. Bacteriological testing shall be performed by personnel from the Thornton Water Quality Control Laboratory. The release form shall be initiated by personnel from the Thornton Water Quality Control Laboratory with copies to Tri-County Health Department and the Colorado Department of Health (with the Water Quality Control Laboratory being responsible for forwarding copies to the health departments and being responsible for notifying the Responsible Party).

206.3 Repaired Mains

After a main has been repaired and flushed, personnel from the Thornton Water Quality Control Laboratory or Operations Department shall inspect the water for color, turbidity, and chlorine residual, prior to restoring the repaired main into service.

206.4 Disinfection

Disinfection shall be accomplished using tablet form Hypochlorite. These shall be affixed to the inside (top) with an approved food grade adhesive such as Permatex Form-A-Gasket No. 2 and Permatex Clear RTV silicone adhesive sealant, or approved equivalent. Dosage shall be calculated for a 100 mg/liter chlorine concentration for volume of installed pipe (this is to allow for the refilling of pre-existing pipe attached to the installed sections). For calculating the weight of chlorine required, see Table 200-2. The chlorine solution shall remain in contact with the piping for a minimum of 24 hours.

TABLE 200-2

MINIMUM NUMBER OF HYPOCHLORITE TABLETS
OF 7 GRAM STRENGTH (5 GRAMS AVAILABLE CHLORINE) FOR A DOSE OF 100 MG/L

Length of Section (feet)	Diameter of Pipe (inches)									
	<u>4</u>	<u>6</u>	<u>8</u>	<u>12</u>	<u>16</u>	<u>18</u>	<u>20</u>	<u>24</u>	<u>30</u>	<u>36</u>
13	1	2	3	6	11	13	16	24	36	52
18	1	2	3	8	15	18	23	32	50	72
20	1	3	4	9	16	20	25	36	56	80
30	2	2	6	14	24	30	37	54	83	120
40	2	5	8	18	32	40	50	71	111	160

206.5 Flushing

After chlorination or disinfection of the pipeline, flushing shall commence to remove the chlorine solution. Flushing shall continue for a minimum of five (5) minutes beyond the time when chlorine residual is present at the same levels as normal distribution system residuals.

206.6 Fire Sprinkler Main Testing

Fire sprinkler system water mains (from the water supply to the system riser) and lead-in connections to sprinkler system risers shall be completely flushed before connection is made to sprinkler piping. The flushing operation shall be continued for a sufficient time to ensure thorough cleaning. The minimum rate of flow shall be not less than one of the following:

- A. The hydraulically calculated water demand rate of the system including any hose requirements;
- B. That flow necessary to provide a velocity of 10 ft/sec (see Table 200-3);
- C. The maximum flow rate available to the system under fire conditions.

TABLE 200-3

FLOW REQUIRED TO PRODUCE A VELOCITY OF 10 FT/S (3 M/S) IN PIPES

Pipe Size Inches	Flow Rate Gpm
4	390
6	880
8	1560
10	2440
12	3520

206.7 Hydrostatic Testing

- A. No hydrostatic tests shall be made on any portion of the pipeline until field placed concrete has had adequate curing time as defined for thrust blocks in Detail 200-11 and compaction test results have been submitted to and approved by the Development Engineering Manager. Only potable water may be used in testing procedures.
- B. The pipeline shall be tested in accordance with AWWA C-600 or C-900 except as follows:
- C. The pipeline shall be tested with water at a pressure of 150 psi or 50 psi above working pressure, whichever is greater.

- D. The Development Engineering Manager shall be notified 24 hours in advance of testing. Acceptance testing shall be made in the presence of the Development Engineering Manager only after the pipeline is in a state of readiness for testing.
- E. Air in the line shall be properly purged. Where blowoffs or hydrants are not available or effective in purging air from the line, the Development Engineering Manager may require a tap to purge the line. The location and size of the tap shall be at the Development Engineering Manager's discretion. The cost for such a tap shall be borne by the Responsible Party.
- F. No leakage is allowed through the bonnet of the line valve. Any valve leaking through the bonnet shall be removed and replaced.
- G. The pressure test shall be a two (2) hour test taken at the high point in the line. Every time the water line pressure drops five (5) psi, the pump shall be started to bring the line pressure back to the initial pressure.
- H. PVC or DIP shall be considered to have passed the pressure test when the total leakage in (24) hours is less than 11.5 gallons per inch of inside diameter per mile of pipeline. The Development Engineering Manager shall direct the Responsible Party to repair specific leaks regardless of test results, if in his opinion they are serious enough to endanger the future service of the pipeline. Pipelines shall be tested in sections as rapidly as such section may be isolated. Should any leakage of the pipeline become apparent during the one (1) year warranty period, the City shall perform the necessary repairs. The Responsible Party shall be invoiced for all work performed during the one (1) year warranty period. Blowoffs, pressurizing pump, corporation stops, and water measuring apparatus shall be provided by the Responsible Party, or at his expense. At the Development Engineering Manager's discretion, measuring apparatus may be required to be calibrated by Thornton personnel at the Responsible Party expense.
- I. The City shall not be held responsible for water tightness of its valves on existing facilities. If existing valves leak, the City shall assist in reducing the influx of water, but the Responsible Party must use methods at his own disposal to work with the resulting leakage.

TABLE 200-4

MAXIMUM PERMISSIBLE LEAKAGE LOSS
FROM WATER MAINS

(Adapted from AWWA C-601 – Formula – Permissible Leakage Loss = 11.5 gal/Inch Dia/Mile/24 hrs)

Pipe Size	6 inch				
Length (feet)	Time (hours)				
	1/2	1	1 1/2	2	24
50	0.01	0.03	0.04	0.05	0.65
100	0.03	0.05	0.08	0.11	1.31
200	0.05	0.11	0.16	0.22	2.61
300	0.08	0.16	0.25	0.33	3.92
400	0.11	0.22	0.33	0.44	5.23
500	0.14	0.27	0.41	0.54	6.53
600	0.16	0.33	0.49	0.65	7.84
700	0.19	0.38	0.57	0.76	9.15
800	0.22	0.44	0.65	0.87	10.45
900	0.25	0.49	0.74	0.98	11.76
1000	0.27	0.54	0.82	1.09	13.07

Pipe Size	8 inch				
Length (feet)	Time (hours)				
	1/2	1	1 1/2	2	24
50	0.02	0.04	0.05	0.07	0.87
100	0.04	0.07	0.11	0.15	1.74
200	0.07	0.15	0.22	0.29	3.48
300	0.11	0.22	0.33	0.44	5.23
400	0.15	0.29	0.44	0.58	6.97
500	0.18	0.36	0.54	0.73	8.71
600	0.22	0.44	0.65	0.87	10.45
700	0.25	0.51	0.76	1.02	12.20
800	0.29	0.58	0.87	1.16	13.94
900	0.33	0.65	0.98	1.31	15.68
1000	0.36	0.73	1.09	1.45	17.42

Pipe Size	12 inch				
Length (feet)	Time (hours)				
	1/2	1	1 1/2	2	24
50	0.03	0.05	0.08	0.11	1.31
100	0.05	0.11	0.16	0.22	2.61
200	0.11	0.22	0.33	0.44	5.23
300	0.16	0.33	0.49	0.65	7.84
400	0.22	0.44	0.65	0.87	10.45
500	0.27	0.54	0.82	1.09	13.07
600	0.33	0.65	0.98	1.31	15.68
700	0.38	0.76	1.14	1.52	18.30
800	0.44	0.87	1.31	1.74	20.91
900	0.49	0.98	1.47	1.96	23.52
1000	0.54	1.09	1.63	2.18	26.14

Pipe Size	16 inch				
Length (feet)	Time (hours)				
	1/2	1	1 1/2	2	24
50	0.04	0.07	0.11	0.15	1.74
100	0.07	0.15	0.22	0.29	3.48
200	0.15	0.29	0.44	0.58	6.97
300	0.22	0.44	0.65	0.87	10.45
400	0.29	0.58	0.87	1.16	13.94
500	0.36	0.73	1.09	1.45	17.42
600	0.44	0.87	1.31	1.74	20.91
700	0.51	1.02	1.52	2.03	24.39
800	0.58	1.16	1.74	2.32	27.88
900	0.65	1.31	1.96	2.61	31.36
1000	0.73	1.45	2.18	2.90	34.85

206.8 Bacteriological Sampling

24 hours after flushing, personnel from the City shall sample hydrants for bacteriological contamination. A minimum of two (2) samples shall be analyzed. Samples shall be collected in duplicate, that is, two (2) samples from each hydrant tested. Bacteriological samples may be required at blowoffs at the direction of the Development Engineering Manager. If the samples show no bacteriological growth and are free from excessive turbidity, the Thornton Water Quality Control Laboratory shall release the main for service and shall initiate the required forms. If samples do not warrant approval for main release from the Thornton Water Quality Control Laboratory, lines must be re-flushed. If again, samples do not warrant approval for main release after flushing, re-chlorination shall be required.

206.8 Method of Measurement and Basis of Payment

Water line includes all work associated with the water line installation including tracer wire, polywrap, megalugs, disinfection and testing.

Irrigation Water Service includes labor and material for tapping the existing water main; saw cutting, removing and disposing of existing asphalt; excavation, bedding and backfill; and trench patch.

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

END OF SECTION REVISION

**REVISION OF SECTION 620
FIELD FACILITIES**

Section 620 of the Standard Specifications is hereby revised for this project to include the following:

Subsection 620.08 Method of Measurement and Basis of Payment shall be replaced with the following:

The various facilities complete with utilities will not be measured or paid for separately but will be included in the Mobilization pay item.

END OF SECTION REVISION

**-REVISION OF SECTION 624
DRAINAGE PIPE**

Section 624 of the Standard Specifications is hereby revised for this project as follows:

Subsection 624.02 – Materials shall be replaced with the following:

The provision in the General Notes for Standard Plan M-603-2, which allows the use of non-reinforced concrete pipe in lieu of reinforced concrete pipe, is deleted.

All irrigation pipe shall be high density polyethylene.

All storm sewer pipe shall be reinforced concrete pipe or polypropylene pipe. Polypropylene pipe shall not be used within 50 feet upstream or downstream of outfalls, detention ponds, or drainage ways. Transitions between pipe material types shall occur in manholes. In addition to any deficiencies covered by the applicable AASHTO & ASTM Specifications, concrete pipe, which has any of the following visual defects, will not be accepted:

- (1) Porous spots on either the inside or the outside surface of a pipe having an area of more than 10 square inches and a depth of more than 1/2 inch.
- (2) Pipe which has been patched to repair porous spots, cracks, or other defects, when such patching was not approved by the Engineer.
- (3) Exposure of the reinforcement when such exposure would indicate that the reinforcement is misplaced.
- (4) Pipe that has been damaged during shipment or handling, even if previously approved before shipment.

Acceptance of the pipe at the point of delivery will not relieve the Contractor of full responsibility for any defects in material or workmanship of the completed pipeline

Polypropylene compound for pipe and fitting production shall be impact modified copolymer meeting the material requirements of ASTM F2881, Section 5 and AASHTO M330, Section 6.1.

Use and installation of Polypropylene pipe shall be in conformance with ASTM F2764.

Subsection 624.03 – Construction requirements shall include the following:

Flared end sections shall be installed with joint fasteners.

The Contractor shall use rubber gasketed joints conforming to ASTM C443 in all storm sewer pipe work. All joints shall be constructed in such a manner that the alignment and flow line grade of the bottom of the pipe is accurately maintained.

Polypropylene Pipe shall be joined using a bell & spigot joint meeting the requirements of ASTM F2881 or AASHTO M330. The joint shall be watertight according to the requirements of ASTM D3212. Gaskets shall meet the requirements of ASTM F477. Gasket shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and

bell during assembly. 12- through 60-inch (300 to 1500 mm) diameters shall have an exterior bell wrap installed by the manufacturer.

Fittings shall conform to ASTM F2881 or AASHTO M330. Bell and spigot connections shall utilize a welded or integral bell and valley or inline gaskets meeting the watertight joint performance requirements of ASTM D3212.

To assure watertightness, field performance verification may be accomplished by testing in accordance with ASTM F1417 or ASTM F2487. Appropriate safety precautions must be used when field-testing any pipe material. Contact the manufacturer for recommended leakage rates.

Installation shall be in accordance with ASTM D2321 and manufacturer recommended installation guidelines, with the exception that minimum cover in traffic areas for 12- through 48-inch (300 to 1200 mm) diameters shall be one foot (0.3 m) in addition to base course and asphalt and for 60-inch (1500 mm) diameter the minimum cover shall be 2 ft. (0.6 m) in single run applications. Backfill for minimum cover situations shall consist of Class 1 (compacted), Class 2 (minimum 90% SPD), or Class 3 (minimum 95%) material. Maximum fill heights depend on embedment material and compaction level; contractor shall confirm application with manufacturer's recommendations.

Backfill materials per ASTM D2321 shall be used for the bedding, haunch, and initial backfill zones per City of Thornton Standards and Specifications Section 400, Detail 400-2, "Storm Drainage Pipe Bedding Details".

At Thornton's request, polypropylene pipe shall meet the minimum joint performance requirements per ASTM D3212: a 10.8-psi gauge, laboratory pressure test for 10 minutes with no visible leaks at the joint. Watertight joints shall be bell-and-spigot and gaskets shall be made of polyisoprene meeting the requirements of ASTM F477.

At Thornton's request, deflection testing by use of a mandrel shall be completed by the contractor or independent agency agreed to by Thornton, and paid for by the contractor. Deflection testing shall be done prior to paving not less than thirty days after installation. The maximum allowable deflection shall not exceed five-percent (5%) during this testing. Pipes 36-inches in diameter or larger may be entered and deflection levels measured directly. This allows for specific equipment such as "Go/No Go" sticks, cut to ninety-five percent (95%) of the inside diameter. If using a mandrel, it shall be a nine (or greater odd number) arm mandrel and shall be sized and inspected by the Engineer of Record prior to testing. Pipe through which the mandrel does not pass will be considered unacceptable, and shall be re-laid, and also re-tested.

No open trench for storm sewer, culverts, or other pipeline construction shall be left exposed during non-working hours by the Contractor.

Trench excavation that is made in advance of pipe or structure installation shall be utilized by placing pipe and backfilling during the same working shift. If any open trench remains after pipe laying or structure construction takes place, the trench shall be backfilled or adequately protected with construction fencing at the Contractor's expense prior to the time that the Contractor's work stops and the site is vacated.

The length of trench permitted to be open at any one time may be limited when such limitation is necessary for the safety and convenience of the public. All excavation, trenching, shoring, and stockpiling of excavated materials shall be in strict compliance with applicable OSHA rules/regulations.

Subsection 624.05 – Basis of Payment shall include the following:

All pipe accessories required for the complete installation of the pipe including, but not limited to, joint gaskets, cradles, collars and pipe connections will not be measured and paid for separately but will be included in the work.

All modifications required to install the Canal Gate and Intake Filter are shown on the plans. This work will not be measured and paid for separately but will be included in the work.

Installation and removal of plugs (temporary) will not be measured and paid for separately, but shall be included in the work.

Foundation shown on city standard drawing 400-2 shall be installed if high groundwater table or unsuitable subgrade is encountered as approved by the Engineer. Measurement of foundation shall be based on neat-line trench dimensions per the detail times the length of pipe requiring foundation as approved by the Engineer. Payment shall be under Aggregate Base Course (Class 6).

Excavation, water control, dewatering, pipe bedding, geotextile (if required for foundation described above), and backfill will not be measured and paid for separately but shall be included in the work. All work shall be completed in dry conditions.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
18 Inch Reinforced Concrete Pipe	Linear Foot
24x14 Inch Reinforced Concrete Pipe Elliptical	Linear Foot
18 Inch Reinforced Concrete End Section	Each
18 Inch Pipe (HDPE N-12 WT)	Linear Foot
18 Inch End Section (HDPE)	Each
Canal Gate	Each
Intake Filter	Each

END OF SECTION REVISION

**REVISION OF SECTION 626
MOBILIZATION**

Section 626 of the Standard Specifications is hereby revised for this project as follows:

Section 626 - Mobilization shall be replaced in its entirety with applicable sections of the City of Thornton Special Conditions and General Conditions of the Contract included herein.

END OF SECTION REVISION

REVISION OF SECTION 627 PAVEMENT MARKINGS

Section 627 is hereby revised for this project as follows:

DESCRIPTION

This Work consists of furnishing and applying pavement marking in accordance with these specifications, the Manual of 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

In general, paint will not be used unless approved by the Owner. On existing pavement, Preformed Plastic Pavement Markings shall be used. On new pavement, Preformed Plastic Inlaid Pavement Markings shall be used.

1. Preformed Plastic Pavement Markings and Legends

A. General

1. The prefabricated markings described shall consist of white or yellow pigmented plastic films with reflective glass spheres, uniformly distributed throughout their entire cross-sectional area, and shall be capable of being affixed to bituminous or Portland cement concrete pavements by either a pressure sensitive precoated adhesive or a liquid contact cement. The markings shall be provided in complete, a form that shall facilitate rapid application and protect the markings in shipment and storage. The contractor shall use proper solvents and/or adhesives for application, all equipment necessary for proper application, and recommendations for application that shall assure an effective performance life. The marking film shall have resealing characteristics such that it shall fuse with itself and with previously applied marking materials of the same composition under normal conditions of use.
2. Prefabricated legends and symbols shall conform to the applicable shapes and sizes as outlined in the MUTCD.

B. Classification

The markings shall be highly durable retroreflective pliant polymer materials, designed for longitudinal and word/symbol markings subjected to high traffic columns and severe wear conditions, such as shear action from crossover, or encroachment on typical longitudinal configurations such as edge lines, barrier lines and lane lines.

- C. Long lines and skips shall be 3M Series 270 ES or approved equal. For concrete pavement, long lines and skips shall be 3M Series 380I-5ES or approved equal.

2. Marking Paint

Marking paint generally will not be approved for permanent markings. The use of pure acrylic high solids for hot application and quick dry to paint centerlines and edgelines on roads, crosswalks, stop zones, parking lots, storage zones, aisles, etc. as approved by the City of Thornton Project Manager shall contain no lead and comply with the EPA's voluntary 30/50

program, and meet the performance standards of federal specifications TT-P-1952. Prior to application, surfaces must be thoroughly dry and free from dirt, loose paint, oil, grease, and other contaminants. Paint may be thinned if necessary up to two (2)%, thin per manufacturer's recommendation. The paint shall be applied at air, surface, and product temperature above 50° F or per manufacturer's specifications.

% solids by weight	77.5 +/- 3%
Viscosity	80 - 90 K.U.
Sheen	Flat
Wet film per coat	14 – 16 mils
Dry film per coat	8.4 – 9.6 mils
Application rate	1 gal / 100 sf
Unit weight	14 lbs / gal

3. Thermoplastic Marking

A. Shall be in conformance with CDOT SSRBC Section 713.12.

4. Reflectorized Glass Beads

A. A blended material consisting of spheres containing refractive indices of 1.50 and 1.65 and conforming to the following specifications:

1. Manufactured from high grade optical crown glass of a composition designed to be highly resistant to traffic wear and to the effects of weathering.
2. Colorless, clean and transparent.

B. Material

The reflectorizing glass beads shall conform to the following:

1. Refracture Index - When testing by the liquid immersion method at 77° F, 70% of the spheres shall have an average index of not less than 1.50, and 30% shall have an average index of not less than 1.65.

1.50 Index Glass Beads

U.S. Standard Sieve Number	% Passing by Weight
20	95 – 100
30	75 - 95
50	9 - 32
80	0 - 15

1.65 Index Glass Beads

U.S. Standard Sieve Number	% Passing by Weight
50	100
80	90 – 100
100	75 - 90
200	0 - 5

CONSTRUCTION REQUIREMENTS

The contractor shall field layout pavement markings for installation, via chalk or paint lines, for approval of owner prior to installation of material. Permanent pavement markings shall have an epoxy binder applied and be tape unless another material is approved in writing by the Traffic Engineer.

Pavement markings shall be so applied as to assure continuous uniformity in the dimensions of the stripe.

Laydown tolerances for each pavement marking shall be one (1) inch longitudinally and one quarter (1/4)-inch transversely.

Permanent pavement markings installed on new asphalt shall be inlaid and installed within four (4) hours of placement of the final lift of asphalt pavement. Pavement markings on existing and new concrete pavement shall be recessed in a one fourth (1/4) inch groove not to exceed one half (1/2) inch wider nor two (2) inches longer than the tape being laid and shall be glued with an epoxy binder. Permanent pavement markings on existing asphalt shall have an epoxy binder applied and be tape.

The pavement marking shall be applied to the pavement either to 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. Tolerance shall be one (1) inch longitudinally and one fourth (1/4) inch transversely. The minimum thickness of thermoplastic line shall be three thirty-secondths (3/32) inch at the edges, not less than one eighth (1/8) inch at the center. Measurements shall be taken as an average throughout any 10 foot section of the line. The material, when formed into traffic stripes, 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. 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.

The marking material as specified shall be installed at the manufacturer's recommended temperature.

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 shall be applied to concrete surfaces prior to the application of the thermoplastic pavement marking. The epoxy resin primer shall be installed per the thermoplastic manufacturer recommendations.

The marking material shall not be applied until the epoxy resin primer reaches the tacky stage. An infrared heating device may be employed to shorten the curing time of the epoxy.

If the City of Thornton Project Manager determines that a new asphalt surface has become soiled, prior to placement of the pavement markings, a pavement primer will be required and preformed plastic pavement markings shall be applied as approved.

The epoxy resin primer material may be accepted at the job site on the basis of a manufacturer's certification, or a sample may be sent to the laboratory for testing, in which case three (3) weeks shall be allowed between sampling and intended use.

BASIS OF PAYMENT

Payment shall be made under:

Pay Item	Pay Unit
Preformed Thermoplastic Pavement Marking (4 Inch)	Linear Feet
Preformed Thermoplastic Pavement Marking (8 Inch)	Linear Feet
Preformed Thermoplastic Pavement Marking (Word – Symbol) (Type 1)	Square Feet
Preformed Thermoplastic Pavement Marking (Xwalk-Stopline) (Type 1)	Square Feet

Removal of existing pavement markings, when required, shall be considered incidental to the work and will not be paid for separately. Preformed Plastic Pavement Markings in accordance with section 1 above is an acceptable substitution for thermoplastic on long lines and skips; however, mixing the two products shall be at the approval of the owner.

Temporary pavement markings required for traffic control shall be considered incidental to Traffic Control and will not be paid for separately.

END OF SECTION REVISION

**REVISION OF SECTION 630
CONSTRUCTION WORK ZONE TRAFFIC CONTROL**

Section 630 of the Standard Specifications is hereby revised for this project as follows:

Subsection 630.02 – Signs and Barricades shall include:

Temporary sign panels scheduled to be in place more than 30 days shall be fabricated and installed in the same manner as a permanent sign panel.

Subsection 630.10 – Transportation Management Plan shall include:

A Traffic Control Plan shall be required for this project and shall include the following:

1. Schedule of Construction Traffic Control Devices.
2. Signed Plans Sheets.
3. Contact information of individual responsible for responding to emergencies during non-working hours including nights, weekends, and holidays. Individual shall have the ability and access to resources required to repair or replace traffic control devices damaged, dislocated, or removed.

The Contractor shall work only between the hours of 8:30 a.m. and 3:30 p.m. on Arterial and Collector streets, with the stipulation that only one direction of travel be interrupted at any given time unless working in median areas. Active traffic control devices shall be installed and removed between the hours of 8:30 a.m. and 3:45 p.m. The Contractor must maintain at least one (1) lane of traffic in each direction as well as a median lane for left turn movements on all Collector and Arterial streets unless otherwise approved by the Owner and incorporated into an approved MHT. Business access traffic control requirements are provided in the Special Conditions. Requests for other hours, special conditions or time allowances will be subject to approval by the Owner. Separate turn lanes will be required at all signalized intersections during the course of construction at intersections.

The Contractor shall install construction traffic control devices where they do not block or impede other existing traffic control devices.

All traffic control devices shall be installed within the Right-of-Way, City of Thornton easements, or temporary construction easements.

The Contractor and his subcontractors shall equip their construction vehicles with flashing amber lights. Flashing amber lights on vehicles shall be visible from all directions.

The Contractor shall maintain access to all roadways, side streets, field approaches, and driveways at all times unless otherwise directed by the Engineer.

At intersections where power to the signals must be turned off or signal operation is interrupted, the Contractor shall contact the Engineer at least two weeks prior to the work for the purpose of obtaining a Police Officer(s) to direct traffic. The Contractor shall not direct traffic at active intersections.

The Contractor shall not have construction equipment or materials in the lanes open to traffic at any time, unless otherwise approved by the Engineer. Equipment shall not be stored within 15 feet of the roadway travel lanes.

Traffic control devices shall not be stored on the shoulders or slopes of the roadway unless laid flat outside the approved clear zone. Traffic control devices shall not be stored on landscaped areas unless otherwise designated or permitted.

Temporary traffic control devices or devices not in use shall not remain in place or visible at the end of the each days work and shall be removed from the work area at the end of each working day.

Traffic control signage intended to be in place longer then 30 calendar days shall be installed per City of Thornton Traffic Technical Specifications Section 16 – Signing.

All costs incidental to the foregoing requirements shall be included in the Traffic Control – Lump Sum price for the project.

Two weeks prior to starting construction, the Contractor shall notify the Adams County and the City of Thornton Traffic Engineers of the intended construction start date. The Contractor shall provide written verification to the Engineer that this has been accomplished.

The components of the Traffic Control Plan (TCP) for this project included CDOT Standard Plan S-630-1: Traffic Controls for Highway Construction, Cases 17, 19, 20 and Standard Plan S-630-2: Barricades, Drums, Concrete Barriers (Temp) and Vertical Panels

The Contractor is cautioned that all personal vehicle and construction equipment parking will be prohibited where it conflicts with safety, access, or the flow of traffic.

Traffic shall be carried on a paved surface at all times.

Subsection 630.15 – Method of Measurement shall be replaced with the following:

Traffic control design, permitting, installation, management, inspection, repair, flagging, signs and devices shall not be measured and paid for separately but shall be paid lump sum.

Scheduled Police Officer(s) will be paid by the City. Unscheduled Police officer(s) will be paid for by the Contractor and will not be measured and paid for separately but shall be included in the work.

Temporary Pavement Markings required configuring traffic control for the various phases of construction will not be measured and paid for separately but shall be included in the work.

Portable Message Sign Panels shall be utilized as part of the traffic control plan. These devices will not be measured and paid for separately but shall be included in the work.

Traffic control items required for haul routes into the project will not be measured and paid for separately but shall be included in the work.

The Traffic Control Plan will not be measured and paid for separately but shall be included in the work.

Subsection 630.16 – Basis of Payment shall include the following:

Payment will be made under:

Pay Item
Traffic Control

Pay Unit
Lump Sum

END OF SECTION REVISION

**REVISION OF SECTION 630
UNIFORMED TRAFFIC CONTROL
(LOCAL AGENCY)**

Section 630 of the Standard Specifications is hereby revised for this project to include the following:

DESCRIPTION

This work consists of furnishing a uniformed police agency officer from the following local agency to perform uniformed traffic control:

City of Thornton Police Department
Loretta Gilpin
720-977-5352

MATERIALS

Qualifications. The local agency officer shall have completed “The Safe and Effective Use of Law Enforcement Personnel in Work Zones” Training Course. The Contractor shall provide copies of documentation certifying the officer’s successful completion of this course.

METHOD OF MEASUREMENT

Uniformed Traffic Control will be measured by the total number of hours that are required for uniformed traffic control including minimum shift hours required by the agency.

BASIS OF PAYMENT

The accepted number of hours of Uniformed Traffic Control will be paid for at the contract unit price per hour.

Payment will be made under:

Pay Item	Pay Unit
Uniformed Traffic Control	Hour

Hours of Uniformed Traffic Control that are not authorized or approved will not be paid for. Scheduling of traffic control will not be measured and paid for separately, but shall be included in the work.

END OF SECTION REVISION

**REVISION OF SECTION 715
LIGHTING AND ELECTRICAL MATERIALS**

Section 715 of the Standard Specifications is hereby revised for this project as follows:

The following subsections shall be replaced in its entirety with City of Thornton Traffic Technical Specifications included herein:

Subsection 715.02 – Light Standard Foundations and Concrete Foundation Pads
Subsection 715.03 – Light Standards

General – Street Lighting

This work shall consist of the furnishing and installation of street light poles, luminaires, and foundations in conformance with the plans. All work shall be done in accordance with these specifications, the National Electrical Code, and in conformity with the details as shown in the plans.

Luminaires

Luminaires will be provided by the City of Thornton Traffic Engineering. No submittals are required.

General – Pull Boxes (for Street Lighting)

Pull box locations shown on the plans are approximate. The Contractor shall locate the exact location in the field and the Contractor shall have the Owner agree to the location prior to installation. Pull boxes for traffic signal conduit runs shall not be spaced more than 150 feet apart from each other unless approved by the Owner. It shall be the option of the Contractor, at his expense, to install additional pull boxes that he may desire to facilitate his work as approved by the Owner.

Pull boxes shall be constructed of an aggregate material consisting of sand and gravel bound together with a polymer and reinforced with continuous woven glass strands. The material shall have the following mechanical properties.

Compressive Strength	-	11,000 psi
Tensile Strength	-	1,700 psi
Flexural Strength	-	7,500 psi

Pull boxes used for loop detectors on sampling stations shall be a minimum of twelve (12) inches wide by sixteen (16) inches long by twelve (12) inches deep. Pull boxes used at junctions of roadway conduit crossing shall be a minimum of twenty (20) inches long by thirty-three (33) inches wide by fifteen (15) inches deep. Pull boxes used for traffic signal

communication interconnect shall be a minimum of twenty-four (24) inches long by thirty-six (36) inches wide by twenty-four (24) inches deep. Pull boxes at the controller cabinet shall be a minimum of thirty (30) inches long by forty-eight (48) inches wide by twenty-four (24) inches deep. Use of two (2) pull boxes in place of the larger one shall not be permitted. Other sizes may be approved by the Owner.

Pull box lids shall have a non-skid surface with a minimum coefficient of friction of 0.5. Covers shall hold a minimum vertical test load of 8,000 pounds over a 10-inch x 10-inch surface with no physical damage or excess deflection. Covers shall have the words Traffic Signal embossed on them and be concrete gray color.

Lids for pull boxes sized thirty (30) inches long by forty-eight (48) inches wide by twenty-four (24) inches deep or larger shall consist of two pieces capable of being removed from the pull box independently. The configuration of the two-piece lid shall be such that access to the pull box is unobstructed when both pieces are removed.

Installation

Pull boxes shown in the vicinity of curbs and gutters shall be placed adjacent to the back of the curb. Pull boxes adjacent to standards shall be placed along the side of foundations as shown on the plans.

The cover of the pull box shall be installed level with the finish grade. The cover of pull boxes located in sidewalks shall be installed level with the sidewalk. The bottom of all pull boxes shall rest on firm ground with 12 inches of three-quarters (3/4) inch to two (2) inch river run rock below the pull box for drainage. Pull boxes installed in a sidewalk must be tied into the sidewalk to prevent the boxes from being pushed down below the top of the sidewalk.

Pull boxes installed in dirt or landscaped areas shall have a twelve (12) inch wide by six (6) inch thick concrete collar placed around the top, level with the cover of the pull box and finish grade. All concrete collars shall be Portland cement concrete conforming to the applicable requirements for Class B as referenced in the SSRBC.

END OF SECTION REVISION

UTILITIES

Known utilities within the limits of this project are:

City of Thornton (Water)	Steve Crow	720-977-6553
City of Thornton (Sanitary Sewer)	Billy Burke	720-977-6554
City of Thornton (Traffic Signal)	Edward Sanchez	720-977-6477
Century Link	Ken Pederson	303-503-2198
Comcast	(No Specific)	503-617-1212
Xcel Energy (Electric & Gas)	Gary Byers	303-284-3811
Blue Chip Oil, Inc.	Tim Hager	970-493-6456
DCP Midstream	Mark Bardwell	713-735-3620
High Plains Water Users	Eloy Trujillo	303-888-8163
RTD Fastracks	Mace Pemberton	303-299-2272
Suncor Energy Pipeline	(No Specific)	303-709-2855
United Power, Inc.	(No Specific)	303-637-1300
Wadley Farms #3 HOA	Joanie Schaefer	303-564-4322
Signal Ditch	Colby Hayden	303-651-1468

The work described in these plans and specifications requires coordination between the Contractor and the utility companies in accordance with subsection 105.10 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 in accordance with 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.

CITY OF THORNTON (WATER)

Contractor Responsibilities – The Contractor is responsible for coordinating with the City for the adjustment of existing water valves and tapping the existing water line.

Prior Notice – Two weeks.

CITY OF THORNTON (STORM SEWER)

Contractor Responsibilities – The Contractor is responsible for coordinating with the City for the adjustment of existing manholes and installing new storm sewer pipe and manholes.

Prior Notice – Two weeks.

CITY OF THORNTON (TRAFFIC SIGNAL)

Contractor Responsibilities – The Contractor is responsible for coordinating with the City for modifications to existing traffic signals being modified as part of the project.

Prior Notice – Two weeks.

CENTURY LINK (Communications/Telephone lines)

Contractor Responsibilities – The Contractor is responsible for coordinating with Century Link for relocations of TELE facilities. A Century Link representative attended project utility meeting on 10-10-19 and agreed with all relocations shown on plans.

Prior Notice – Two weeks.

COMCAST (Communications/FOC lines)

Contractor Responsibilities – The Contractor is responsible for coordinating with Comcast for relocations of FOC facilities. No relocations are shown on plans.

Prior Notice – Two weeks.

XCEL ENERGY (Electric & Gas)

Contractor Responsibilities – The Contractor is responsible for coordinating with XCEL Energy for relocations of Electric and Gas facilities. An XCEL representative attended project utility meeting on 10-10-19 and agreed with all relocations shown on plans.

Prior Notice – Two weeks.

REGIONAL TRANSIT DISTRICT (RTD) (Railroad Crossing)

Contractor Responsibilities – The Contractor is responsible for coordinating with RTD for removal of Railroad Crossing Equipment and modifications to the roadway crossing of the track. The city has coordinated these plans with RTD and they have agreed to all related work as shown on plans.

Prior Notice – Two weeks.

WADLEY FARMS #3 HOA (Irrigation)

Contractor Responsibilities – The Contractor is responsible for completing all related irrigation modifications on the plans. Only notification of work is needed.

Prior Notice – Two weeks.

SIGNAL DITCH (Irrigation)

Contractor Responsibilities – The Contractor is responsible for completing all related irrigation modifications on the plans. Only notification of work is needed.

Prior Notice – Two weeks.

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, prior to 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 prior to beginning excavating or grading.

Utility locations 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.

FORCE ACCOUNT

Contractor's pricing shall be provided and payment made on all irrigation items as outlined under the force account description as outlined in the Summary of Approximate Quantities and Bid Schedule. Pricing for all work items shall include materials, site restoration, trenching, and any work necessary to provide a functioning irrigation to the satisfaction of the owner.

No separate payment will be made for freeze protection needed prior to Initial Acceptance/Final Settlement.

No separate measurement and payment will be made for hand-digging of pipe trenches as needed.

Payment will be made in 700- under:

<u>Pay Item</u>	<u>Pay Unit</u>
F/A Reset Irrigation	F/A
F/A Restore Landscaping	F/A