

Barnum Park East

1. Background and General Goals of the Project

Barnum Park East is a heavily used park owned and maintained by the Denver Parks and Recreation Department. The park is located at the southeast corner of Federal Ave. and 6th Ave. The park provides multiple athletic facilities including an adult sized baseball field and a youth sized baseball field. In addition, other field sports such as soccer and football are played in the outfields of both baseball fields. Other existing park amenities include a parking lot with 168 parking spaces, a plumbed restroom facility, a plaza area, free standing bleacher seating for the adult baseball field, built-in bleacher seating for the youth baseball field, sports lighting for both fields, pedestrian and parking lot lighting, extensive mature landscaping throughout the park, a sand play area, and an irrigation system among other improvements.

Portions of Barnum Park East, (in particular the eastern half of the park) will be significantly impacted by the proposed improvements to 6th Ave. The City's intent is to redesign portions of the park to maintain a similar type and level of use on the site that exists today. As this will require significant reconstruction of large portions of the park, the City recognizes an opportunity to upgrade certain systems in the park to bring those to current park standards as well.

As shown on the Basic Configuration, the City intends to preserve the existing adult baseball field and western parking lot, with some minor modifications. The eastern portion of the park will require significant re-design and re-construction in order to provide the required functionality. The City intends to replace the youth baseball field with a synthetic turf multi-use sports field. The parking on the eastern portion of the site will need to be redesigned, and the City intends for the re-constructed park to maintain the current number of parking spaces (168). The City also plans to add a play area to provide more opportunities for families with young children. The intent is to remove the existing restroom building and replace it with a new plumbed restroom that meets the standards for Denver Parks restroom facilities (included in Book 3 – Standards). Also, the irrigation system for the entire park will be replaced with a new system that meets the current Denver Parks standards.

2. Recreational Park Design Manager Qualifications

As a consequence of the Park's size, scope, and the overall importance, CDOT has established minimum designer manager qualification requirements to ensure that proposers for this contract have the requisite experience, skill, and ability to perform the work.

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The Recreational Park Design Manager for the Barnum Park East design shall be a licensed landscape architect in the state of Colorado with a minimum of 10 years of experience in landscape architecture. Other design consultants shall be licensed in fields appropriate to their scope of work.

For purposes of satisfying these qualification requirements, an “Athletic Field Facility” must include, but is not necessarily limited to, the following elements: (1) new sports field consisting of either irrigated bluegrass turf or synthetic turf, designed for use for club level, high school or higher level of play; (2) paved parking area; (3) paved areas for pedestrian circulation. In addition, a “Synthetic Turf Field” must include, but is not necessarily limited to, the following elements: (1) an athletic field constructed of synthetic turf with rubber and/or sand infill; (2) installation and fine grading of aggregate base course and subsurface drainage system, and (3) concrete edging. At a minimum, each proposer submitting a proposal for this contract must meet the following requirements:

Each proposer must provide information sufficient to demonstrate that:

- On or before the time of such submission, the landscape architect has prepared 100% construction documents for a minimum of five (5) constructed Athletic Field Facilities as the project’s prime designer in the past five (5) years. Each Athletic Field Facility project must have had a verifiable construction value of at least \$500,000.
- On or before the time of such submission, the landscape architect has prepared 100% construction documents for a minimum of three (3) constructed Synthetic Turf Fields as the project’s prime designer in the past five (5) years. Each Synthetic Turf Field shall have a minimum size of 30,000 square feet.
- On or before the time of such submission, the landscape architect has experience working with the City and County of Denver Parks and Recreation Department.
- On or before the time of such submission, the landscape architect has prepared 100% construction documents for ten (10) projects working as the prime consultant and managing a design team of at least five (5) subconsultants.
- The landscape architect will be in direct charge of the design work for Barnum Park East, and will be the primary point of contact for design related issues. The landscape architect shall be a key employee of the proposer and the proposer shall not change this key person at any time during the specified period of performance without the written permission of the Project Manager. Proposers are required to submit documentation of the landscape architect’s qualifications.

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In addition, each proposer must submit a minimum of 5 references from clients for the above listed projects. (3 for Athletic Field Facilities, and 2 for Synthetic Turf Field projects). Whether or not a proposer meets or exceeds the minimum requirements will be at the sole discretion of CDOT and Denver Parks and Recreation.

3. Recreational Park Construction Manager Qualifications

As a consequence of the Park's size, scope, and the overall importance, the City has established minimum contractor qualification requirements to ensure that proposers for this contract have the requisite experience, skill, and ability to perform the work.

See previous sections for definition of "Athletic Field Facility" and "Synthetic Turf Field".

1. Each proposer must provide information sufficient to demonstrate that:
 - On or before the time of such submission, the Recreational Park Construction Manager or any subcontractors performing more than 20% of the work in the park has successfully completed (notice of substantial completion or beneficial occupancy issued) construction of a minimum of five (5) Athletic Field Facilities as the project's prime contractor in the past five (5) years. Each Athletic Field Facility project must have had a verifiable construction value of at least \$500,000.
 - On or before the time of such submission, Recreational Park Construction Manager or any subcontractors performing more than 20% of the work in the park has successfully completed (notice of substantial completion or beneficial occupancy issued) construction of a minimum of three (3) Synthetic Turf Fields as the project's prime contractor in the past five (5) years. Each Synthetic Turf Field shall have a minimum size 30,000 square feet.
 - On or before the time of such submission, the Recreational Park Construction Manager or any subcontractors performing more than 20% of the work in the park has experience working with the City and County of Denver Parks and Recreation Department.
 - Has one of the following certifications: Irrigation Association (IA) Certified Irrigation Contractor (CIC) or a Certified Landscape Irrigation Auditor (CLIA), or a Professional Landcare Network (PLANET) Landscape Industry Certified Manager (formerly known as the CLP) or a Planet, Certified Industry Technician (formerly known as a CLT).
 - The Recreational Park Construction Manager shall be a key employee of the Contractor and the Contractor shall not change this key person at any time during the specified period of performance without the written

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permission of the Project Manager. Proposers are required to submit documentation of the Superintendent's qualifications.

In addition, each proposer must submit a minimum of 5 references from clients for the above listed projects. (3 for Athletic Field Facilities, and 2 for Synthetic Turf Field projects). Whether or not a proposer meets or exceeds the minimum requirements will be at the sole discretion of CDOT and Denver Parks and Recreation.

4. Design Process

To ensure that the City has sufficient opportunity to review all aspects of the park re-design, and to eliminate inefficiencies in the design process, the design team will be required to keep Denver Parks well informed of the design progress through regular design meetings. In addition, the design team will be required to submit design drawings for review at several stages of design. These submittals shall include design progress drawings and specifications for all aspects of the design. The following design review submittals are required:

- A. *Design Development* (30% Construction Documents)– this submittal shall include preliminary plans depicting the general layout of all site elements with critical dimensions, preliminary grading and drainage information including spot elevations and 1' contours, preliminary utility plans showing points of connection and general utility alignment, irrigation plans showing points of connection and mainline layout, landscape plans showing preliminary tree, shrub and ground cover layout and potential plant species, elevations of any walls or other structures, and preliminary details. This submittal shall also include proposed material choices for the site work (paving types, wall finishes, site furnishings, etc).

The intent of this submittal is to provide Denver Parks with an understanding of the proposed site design, the location of, and relationship between various site elements, and to provide sufficiently detailed information to demonstrate that the design can be constructed as shown. In addition, this submittal gives Denver Parks an opportunity to provide direction on design themes, material selections, color choices, etc.

- B. *60% Construction Documents* – this submittal shall include more detailed plans including demolition plans, erosion control plans, layout plans, materials plans, grading and drainage plans, landscape plans, lighting plans, utility plans, irrigation plans, restroom building plans, construction details, and an outline of any specifications that may be required for materials that are not included in the appendix for section 17.

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The purpose of this submittal is to provide Denver Parks with an opportunity to review more refined and developed site plans. This submittal should provide a level of detail on all aspects of the design so that Denver Parks can review all site elements, park systems, and critical park functions. The plans should include detailed information showing aesthetic design of any pavements, walls, or other park structures.

- C. *95% Construction Documents* – this submittal represents a nearly complete set of construction documents. This submittal shall include erosion control plans, demolition plans, layout plans, materials plans, grading and drainage plans, landscape plans, lighting plans, utility plans, irrigation plans, restroom building plans, any required enlargement plan areas, scoring plans for concrete areas, construction details, and specifications.

The intent of this submittal is to provide Denver Parks with a nearly complete set of construction documents for review. This set will include detailed plans, details, and specifications of all site elements and systems.

- D. *100% Construction Documents* – Final drawings and specifications.

All drawing submittals shall be formatted on 22"x34" sheets utilizing Denver Park's standard title block. The scale for overall site plans shall be 1"=40' unless otherwise noted. Detailed area plans should be developed at a larger scale as required to provide the appropriate level of detail.

5. Design and Construction Requirements

All aspects of the site design and construction shall meet the requirements for all applicable design standards and guidelines including:

- A. The specifications included Section 17 Landscaping (Appendix A – Barnum Park East)
- B. The Planning Design and Construction Standards for Denver Parks and Recreation (PDCS) included in Book 3 - Standards
- C. The most recent edition of the Americans with Disabilities Act (ADA) Design Guidelines

6. Site Design Elements and Project Requirements

- A. **Vehicular Circulation/Access**

Vehicular access to Barnum Park East will be altered due to the roadway work occurring along Federal Blvd. and 5th Ave as part of the project. The western access drive to the parking lot (from Federal Blvd.) will be

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removed. Therefore all vehicular access to the site will be from 5th Ave. The parking lot must be designed to meet the Denver Fire Department access criteria. In addition, the site design shall not include dead-end parking lots.

The design should include at a minimum the same number of parking spaces currently available on the site (168 spaces). The minimum size for parking spaces shall be 9' wide x 18' long, except accessible parking spaces which shall meet the requirements of the ADA Design Guidelines. As shown on the Basic Configuration, the intent is to protect the western parking lot in place. To achieve the required number of parking spaces, the existing parking lot may be re-striped to provide additional parking spaces.

The site design shall include a drop-off at least 95' long. The drop-off area shall be sited to provide convenient access to the main plaza area.

Parking lot surfacing shall be asphalt paving except in areas where the existing parking lot is renovated where concrete pavement shall be utilized to match the existing pavement.

Maximum slopes for parking areas or drop-off areas shall be 5%, except accessible parking spaces or drop-off areas which shall meet the requirements of the ADA design guidelines. Maximum slopes for driveways shall be 10%.

B. Maintenance Access

The site design must provide routes for maintenance vehicles to access various portions of the site. In general, maintenance vehicles will include pick-up trucks, larger trucks to empty dumpsters, mowing equipment, and field grooming equipment. Access routes shall be designed so that they will not be blocked by parked cars in the parking lots.

Access routes for pick-up trucks must be provided throughout the site including access to each sport field, to the restroom building, to all parking lot and pedestrian light standards, to all trash receptacles, and to the play area.

These access routes shall be a minimum of 8' wide, and shall be paved with concrete per the specifications included in Book 2 – Section 17 – Landscaping (Appendix A – Barnum Park East), or with another approved material. The access routes must allow acceptable turning radii for the pick-up trucks to adequately maneuver the site.

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Access for mowers shall be a minimum of 8' wide. All bluegrass and dryland seed areas shall be a minimum of 8' wide, and have an access route to the area that is a minimum of 8' wide.

Three trash dumpsters will be placed on the site adjacent to the parking lot. The designer shall coordinate with Denver Parks maintenance staff for the location of the dumpsters. Dumpster enclosures shall be provided per the PDCS. The locations shall allow ease of access for garbage trucks to empty the bins.

C. Pedestrian Circulation/Access

Pedestrian access shall provide safe and efficient routes to all points ingress and egress on the site, and to all park and recreation amenities on the site including the fields, spectator areas, restroom building, and play area. Pedestrian access should be included to the sidewalk along Federal Blvd. The site design shall also include a sidewalk along 5th Ave. extending from Federal Blvd to at least the eastern most driveway entrance to Barnum Park East.

All sidewalks and pedestrian routes within the park shall be a minimum of 8' wide. Walks may be wider where appropriate. Sidewalks and walkways shall be paved with concrete per the specifications.

In an effort to reduce maintenance, the City would like to eliminate stairs from the design wherever possible. At the same time the City understands that there is significant grade change between the east and west portions of the site and there is a need to provide direct access from the eastern portion of the site to the western portion. To provide the access, the City will plan for a single stairway between the two areas as shown on the Basic Configuration.

D. Design Palette

A palette of design materials, colors, textures, etc. will need to be developed for the various design elements on the site. Among other things, these design elements will include the plaza area, other pavements, retaining walls, seat walls, and the restroom building. It is critical that each of these elements work together to create a cohesive aesthetic expression for the site. The aesthetic design of these elements will also need to consider other elements such as the existing pavements that will remain on the site, and the wall that is proposed as part of the 6th Ave. ramp located along the north side of the park.

All materials and color selections shall be reviewed and approved by the Denver Parks Representative.

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E. Plaza Area

The Basic Configuration includes a plaza area behind the adult baseball field backstop providing connections to the restroom building, the play area, and along the south side of the ball field to provide a connection to the sidewalk along Federal Blvd. This area serves as the central gathering area in the park and should be designed to accommodate large groups of people and spectators.

Due to its relative importance to the function and character of the park, the City plans for the plaza to be constructed with a material that includes an aesthetic quality. The material must withstand loading similar to 6” thick concrete pavement.

In addition, as the plaza will provide spectator viewing areas for the adult baseball field, areas for people to gather, and areas for parents to watch their children at the play area, shade will be an important component of the plaza design. This could be accomplished through various design elements including shade trees, shelters over spectator seating, tables with umbrellas, etc. Again, the intent is to provide shade in a manner that improves the aesthetic quality of the plaza area.

F. Adult Baseball Field

As previously mentioned, the intent is to preserve the adult baseball field in place. Preserved items would include the turfgrass outfield, the dugouts, the backstop, the maintenance and pedestrian access gates, the skinned infield, the outfield fencing to the extent possible, and the sport lighting to the extent possible.

It is likely that portions of the outfield fencing and sport lighting (particularly along the west side) of the field will have to be removed due to the planned reconstruction of Federal Blvd. The sport lighting shall be salvaged and re-set. Any fencing that is removed shall be disposed of and new fencing meeting the specifications included in Book 2 – Section 17 Landscaping (Appendix A – Barnum Park East) shall be provided. In addition, a “safety tube” meeting the specifications shall be installed on all outfield fencing, existing or new. The scoreboard shall be removed and disposed of.

The adult baseball field shall have the following minimum sizes:

1. From right foul line to west outfield fence: 340’
2. From left foul line to east outfield fence: 360’

The field size shall be kept as large as possible.

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If additional soil is required to be imported for the skinned infield for any reason, the material shall meet the specifications included in Book 2 – Section 17 Landscaping (Appendix A – Barnum Park East).

A black mesh screen shall be installed on the outfield fences in the adult baseball field to eliminate distraction by passing motorists. The press box building located behind the backstop shall be removed in its entirety including foundations. Denver Parks no longer has a need for press boxes at this facility.

The existing spectator bleachers shall be salvaged and re-installed along the backstop in the plaza area.

G. Multi-use Field

The multi-use field shall be a synthetic turf field meeting the specifications listed in the appendix to the section. The field shall accommodate a play field with a minimum size of 50 yards x 85 yards, as well as a 10 yard safety zone surrounding the entire play field. Colored striping shall be integral to the synthetic turf and shall include the colors and dimensions shown on the conceptual plans.

Fencing and netting (as shown on the Basic Configuration) should be installed as necessary to prevent balls from leaving the field area at locations near hazards or downhill slopes where errant balls would be difficult and dangerous to retrieve.

H. Spectator viewing

Spectator viewing will be required for both fields. As previously mentioned, the adult baseball field will have bleachers installed behind the backstop. The multi-use field will not be required to have bleachers, however spectator viewing should still be considered as part of the design. Spectators may sit around the edges of the field.

Shade will be an important consideration for spectators for both fields. While trees cannot be planted in the synthetic turf field, the areas surrounding the fields could provide shade trees or shelters to provide some relief for spectators. Any areas that are designed for spectator use around the synthetic turf field should be planted with bluegrass sod or should be paved.

I. Play Area

The site design shall include a play area. The City's intent is for the play area to include non-traditional play features that will be appropriate for both 2-5 year olds and 5-12 year olds. The play equipment shall include

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elements that are climbable, durable, low maintenance materials appropriate for use in public play areas. Post and deck play structures will not be allowed. The play surfacing shall consist of poured in place rubberized surfacing. The play area shall be a minimum of 950 square feet of play area.

The play area shall be sited to allow viewing of either the existing adult baseball field or the new multi-use field. The site design shall include seating areas for parents and/or guardians to watch children on the play area.

The design theme, play equipment, materials, etc. shall be reviewed and approved by the Denver Parks Representative.

J. Restroom/Storage Building

Both of the existing press box buildings, and the existing restroom building shall be demolished and removed from the site. A new restroom building meeting the requirements shown on the Basic Configuration and Book 2 – Section 17 Landscaping (Appendix A – Barnum Park East) shall be installed on site. The restroom shall include a 10' wide utility chase that will also be used as storage by Parks and Recreation staff.

The building shall be sited to provide convenient access to both fields, the play area, and the plaza area. The siting shall also allow sufficient room for doors to open without intruding on the main pedestrian route near the restroom building.

The site will require two separate water taps – one for potable uses such as the restroom building and drinking fountains, and another for the irrigation system.

K. Site Lighting

Lighting shall be provided for the sports fields, parking lots, and pedestrian walkways.

The intent is to protect in place as many light standards as possible for the adult size baseball field. Any light standards that have to be moved due to construction should be salvaged and re-installed. If any sports lighting equipment needs to be replaced as part of the Work, replacement equipment must be supplied by the same sports lighting manufacturer as the existing equipment, and must be of equal or better quality than the existing equipment.

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The light standards for the youth baseball field shall be salvaged and reinstalled for the multi-use field. The contractor shall develop a photometric plan for the multi-use field. The field shall receive a horizontal average of 30 foot candles. The designer shall determine if any modifications to the existing lights are required to obtain that level of light on the field.

The parking lot and pedestrian walkway on the site shall also be lighted. These areas will utilize light standards installed by XCEL Energy through an agreement with the City of Denver. The contractor is responsible for costs associated with XCEL Energy installing the lights. The contractor shall coordinate with XCEL Energy throughout the design and construction process. The design shall utilize fixtures listed in the PDCS that provide a full cut-off light distribution. Parking lot and pedestrian areas shall have a horizontal average of 1 foot candle, and a minimum of 0.2 foot candles. The lighting plans shall show the type and locations of the light standards on the site. The contractor shall layout these locations in the field and coordinate with XCEL Energy for the light installation.

L. Site Grading and Drainage

Due to the grade change from the west to east edges of the site, and due to the large relatively flat areas required for the sports fields, some relatively steep slopes will likely be required on some portions of the site. As a general rule, slopes of dryland seed areas shall not exceed 4:1. However, Denver Parks will consider designs with slopes steeper than 4:1 if they provide benefits such as eliminating or reducing heights of retaining walls. Slopes of dryland seed areas shall not exceed 3:1 in any areas.

Maximum slopes for various surfaces include:

- Bluegrass turf – 4:1
- Dryland seed – 3:1 (4:1 preferred)
- Shrub beds – 4:1
- Paved areas – Per ADA Design Guidelines
- Synthetic turf fields – 1.5%

Slopes of landscape areas shall be a minimum 2% slope. Slopes for synthetic turf fields shall range from 1% to 1.5%.

The site shall be graded so that no drainage shall flow onto sports fields, whether they be natural turf or synthetic turf. Drainage elements such as drain pans can be utilized to prevent drainage onto the sports fields.

The site shall be designed to prevent concentrated drainage from landscape areas draining onto paved areas.

Slopes for paved areas shall meet all requirements of the ADA Design Guidelines.

M. Walls and Other Vertical Structures

The site design may include vertical structures such as retaining walls, seat walls, entry features, etc. These elements can have a strong impact on the aesthetic quality and character of the site. Therefore, all walls included in the site design and construction shall include some type of architectural treatment. This treatment could include material selection such as stone, brick, or other veneers, colored concrete, formliners, wall caps, etc. The final wall treatment must be designed so that graffiti can be easily removed.

The concept plans for the 6th Ave. ramp include a retaining wall along most of the north side of Barnum Park East. This will have a significant visual presence on the park site.

Therefore it may be appropriate to visually link any new walls with the wall along 6th Ave. by utilizing a similar design vocabulary. This could include utilizing similar materials, similar colors, and/or similar architectural treatments such as wall caps or formliners, etc.

Heights of retaining wall should be kept to a maximum height of 9'. Where tall walls are required, terraced walls should be utilized to reduce the individual wall height as shown on the concept plans. This also provides opportunities to provide landscape screens to soften the appearance of the walls.

Graffiti has been an issue in Barnum Park in the past. Vertical elements in the park should be coated with a graffiti treatment approved by the Denver Parks Representative.

N. Landscaping

1. Seed and Sod

In general, bluegrass sod shall be installed only on areas that will be utilized for sports fields or for areas that are expected to receive substantial pedestrian traffic such as spectator viewing areas. All other landscape areas on the site shall either be planted with dryland seed or with shrub and perennial beds.

Some landscape areas on the site may require conversion from bluegrass to dryland grasses. This shall be accomplished by stripping the bluegrass sod and re-seeding the area with dryland seed.

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Concrete mowstrips with a minimum width of 1' shall be installed on site to ease maintenance. Mowstrips shall be installed centered along all fencing, at all locations where seed or sod areas are directly adjacent to walls or other vertical elements, and to delineate all planting beds.

2. Trees and Shrubs

The City realizes that many existing trees will have to be removed from the site due to the park construction. At the same time, the City would like to preserve as many healthy existing trees as possible on the site. Trees that will be preserved shall be protected in place per the specifications included in Book 2 – Section 17 Landscaping (Appendix A – Barnum Park East).

The landscape plans shall include trees, shrubs, and perennials, with the following minimum sizes:

- a. Deciduous trees: 2.5" cal.
- b. Evergreen trees: 8' ht.
- c. Shrubs: #5
- d. Perennials: #1

Plant selections shall be made based on existing site features such as soils, topography, and available space. All plants shall be drawn on the landscape plan shown at 80% of their expected mature size.

General goals of the landscape design include: specifying low maintenance and low water use species, screening the park from traffic along 6th Ave, Federal Blvd., and 5th Ave, screen the wall along the north side of the park as much as possible, improving the general aesthetics of the site, and providing shade for park users at locations such as spectator areas, plazas, the play area, and the parking lot.

The plan shall include sufficient plant material to meet the goals stated above. The minimum number of trees will be 210, as included in the Basic Configuration.

O. Site Furnishings

Site furnishings shall meet the Denver Parks standard for site furnishings. Site furniture could include picnic tables, benches, trash receptacles, bike racks, or other furnishings.

The site design will include one drinking fountain located at the restroom building.

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P. Restoration of Areas to Remain

Some portions of the existing site improvements are planned to remain in place. This includes the western parking lot, surrounding curb and gutter, and the adult baseball field. Portions of these items are currently in poor condition due to cracking and heaving of the concrete. The design should provide for the restoration of damaged portions of the park amenities to remain. For pavements and curb and gutter, this should include sawcutting and removing whole stones of concrete at the nearest joint, and replacing those damaged areas with a color and finish of pavement to match the adjacent work to remain.

Q. Irrigation System

The contractor shall provide complete irrigation design services for a fully automatic irrigation system including all irrigation planning, design and construction documentation services as set forth and specified below. The irrigation designer shall be a Certified Irrigation Designer with 10 years experience, and shall have completed 5 projects with Denver Parks.

1. Irrigation System Planning:

- A. Water pressure verification: The contractor shall coordinate and arrange for Denver Water Board personnel to place a data logger at the closest fire hydrant to the proposed point of connection for the renovated irrigation system to record static water pressure fluctuations in the existing municipal water main over a minimum period of seventy two hours.

The data logger read out shall be formatted as required and included in the irrigation renovation construction drawing / document package.

- B. Water budget preparation: The contractor shall calculate the square footage for each of the Denver Water Board water budgeting plant type classifications identified on the Denver Water Board water budget form and included in the landscape design. Using the area calculations above, the contractor shall prepare an annual water budget using the Denver Water Board water budgeting format showing both gallons and cubic feet of water required during the entire irrigation season. Water volumes shall be based on the historical evapotranspiration rates as calculated by Denver Water at Weather Region No.50 the Denver Water Administration Building.

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The water budget shall be formatted as required and included in the irrigation renovation construction drawing / document package.

- C. Tap sizing calculation: The contractor shall calculate the maximum potential irrigation system gallon per minute demand as required to apply the historical July E.T. precipitation rate across the entire square footage of each of the Denver Water Board water budgeting plant type classifications identified in the Denver Water Board water budget form and included in the landscape design. The cumulative total “worst case” gallon per minute demand shall be identified.

The tap sizing calculation table shall be formatted as required and included in the irrigation renovation construction drawing / document package.

- D. Friction loss analysis: The contractor shall prepare a friction loss calculation showing the total cumulative friction loss from the point of connection at the municipal water main through the water meter, the back flow assembly, the entire irrigation main line and secondary piping network (including all valves and fittings) to the last large area gear drive head on the zone located the maximum distance from the irrigation system point of connection. The friction loss analysis shall additionally calculate the net effect of cumulative head caused by elevation changes across the site.

The friction loss analysis shall identify the water pressure boost required at the point of connection assuming a minimum dynamic water pressure requirement of seventy five P.S.I. at the last large area gear drive head on the zone located the maximum distance from the point of connection.

The friction loss analysis shall be formatted as required and included in the irrigation renovation construction drawing / document package.

- E. Hydrozone and densogram preparation: The contractor shall prepare a hydrozone map of the entire site showing areas with different precipitation requirements including at a minimum areas of bluegrass sod, native seed and shrub and tree beds. The contractor shall prepare a densogram diagram for the entire irrigated area of the site using the Center for Irrigation Technology, (C.I.T.), Sprinkler Profile and Coverage Evaluation (SPACE) software or available equal.

2. Irrigation System Design

- A. Irrigation layout plans: The contractor shall prepare irrigation layout plans using Auto Cad release 2012 compatible design software in 22" by 34" format at a scale of 1" = 30'. Each sheet shall include a title block; a scale and north arrow and all sheets shall be oriented with north in the same direction. Each sheet shall include match lines indicating the number reference of all adjacent sheets. A reduced size sheet key shall be included on each of the irrigation layout sheets with the current sheet identified by shading.

Irrigation mainline piping, irrigation wire runs and irrigation secondary piping shall be represented by different line types. Mainline pipe shall be dashed, secondary pipe shall be continuous, and wire runs shall be represented by the letters (VCW) with an alternating dashed symbol pattern. Mainline pipe shall be represented by a heavier line weight. All irrigation line work shall be represented at 100% screening.

All other non-irrigation related line work (such as contours, pavement, fencing or plant material) shall be screened back to a gray scale between 35% and 40% screening.

Existing trees to remain shall be redrawn on the irrigation base map to indicate the physical limit of the drip line representing the extent of the critical root zone which is to be protected in conformance with all Denver Forestry standards and specifications which are made part of these requirements by reference.

The contractor shall prepare an irrigation equipment symbol legend showing the graphic symbol used for each irrigation component indicated on plan. A description of each component symbol shall be included in the legend indicating the manufacturer and model number of the irrigation component. A detail reference for the Denver Parks standard installation detail specific to each irrigation component shall be included in the symbol description. See the attached sample irrigation equipment symbol legend for the graphic representation of all irrigation components to be used on the irrigation system design drawings.

The contractor shall prepare an irrigation equipment schedule in tabular form showing each zone / electric control valve number, the electric control valve manufacturer, model and size, the sprinkler head manufacturer, model number and nozzle specification, the

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gallons per minute for the entire zone and the operating pressure required at the head.

- B. Packaged booster pump: The contractor shall specify and detail the installation of a packaged booster pump as manufactured by Rain Bird Corporation in conformance with all Denver Parks requirements. The packaged booster pump shall be sized as required to provide a dynamic / working pressure of 75 P.S.I. at the last large area gear drive head on the zone located the maximum distance from the irrigation system point of connection while flowing the maximum required G.P.M. based on the July E.T. tap sizing calculation.

Booster pump detailing shall be developed at a scale of $\frac{1}{4}'' = 1'-0''$ and be drawn to scale in both plan and section showing the location of the backflow assembly, all drains, isolation and quick coupler valves and the location of the master valve and flow sensor relative to the booster pump and the water supply point of connection.

- C. Electrical: The contractor shall provide all electrical engineering and local utility provider coordination required for a 120v 20a dedicated electrical service for the new irrigation controller the installation of a dedicated three phase booster pump and electrical service sized as required to energize the booster pump,.
- D. New irrigation water tap: The contractor shall provide all design services necessary for the approval and construction of a new irrigation only water tap including, but not limited to, the preparation of a complete water plan submittal package stamped by a civil engineer. Water plan submittal shall be in conformance with all Denver Water Board construction, design, and graphic standards and specifications and shall be submitted, reviewed and revised at the direction of Denver Water. The tap shall be sized as required to supply the maximum gallon per minute irrigation system demand identified in the tap sizing calculation under Section No.1, Item No.3 above within the recognized safe flow velocity of 5.5 feet per second. Additionally the water plan submittal shall show all required improvements necessary to abandon the existing irrigation water tap.
- E. Asbestos concrete pipe mitigation: The contractor shall provide all planning and design services necessary to coordinate and manage the removal and disposal of any asbestos concrete pipe encountered during construction. Asbestos concrete pipe

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encountered during construction shall be removed and disposed of by a licensed abatement contractor in conformance with all Denver Health and all Colorado Department of Public Health and Environment requirements.

- F. Existing irrigation equipment salvage: The contractor shall provide all design services necessary to develop an irrigation equipment salvage plan / schedule identifying all existing irrigation equipment to be salvaged and stipulating where and how the material is to be delivered to Denver Parks Southwest Maintenance District personnel, as well as the documentation process required to confirm the delivery.
- G. Minimum design standards: The contractor shall provide all design services necessary to completely layout and detail a fully operational and self-contained automatic irrigation system in conformance with all Denver Parks standards and specifications made fully part of these requirements by reference, including but not limited to the following:
- i. All gear drive head spacing shall provide a minimum of 5' of coverage beyond head to head in all directions.
 - ii. Zones shall be backed up along all grade breaks with one zone irrigating uphill of the grade break and another zone irrigating downhill of the grade break.
 - iii. Zones shall be backed up along each hydro zone interface between native seed and bluegrass turf with one zone irrigating native areas and another zone irrigating bluegrass turf areas.
 - iv. Pop-up sprays shall be located to trim out any pavement radius larger than 5'.
 - v. Zones shall be designed to water out from uphill to downhill across the athletic fields and the perimeter of the stripped infields shall be trimmed out with small area gear drive heads.
 - vi. New secondary piping shall be installed by directional boring to provide irrigation to existing trees to remain in parking islands and tree grates.

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- vii. Quick couplers shall be located near all improvements that may need to be washed down or hand watered. Examples would include but are not necessarily limited to; picnic areas, bleacher pads, restrooms, synthetic turf fields, play areas, other facilities that could be permitted for events and flower beds.
- viii. Isolation valves shall be located along the mainline as required to isolate the mainline into three roughly equal sections.
- ix. Vacuum / air relief valves shall be located at each high point and manual drains shall be located at each low point within each of the three isolated mainline sections.
- x. The irrigation system shall be designed with a system efficiency of: D.U. (distribution uniformity = .80) and S.C. (scheduling coefficient = 1.25).
- xi. All trees in native areas shall have pop-up tree maintenance sprays (two per tree located 5' from trunk) for long term maintenance.
- xii. All shrub beds shall be irrigated with pop-up spray heads.
- xiii. The irrigation mainline line shall be installed in a looped configuration around the perimeter of the site beginning at, and returning to, the point of connection. No main line is to be installed under any synthetic playing surface. No valve boxes are to be located inside the outfield and foul line fencing around the ball fields. Valve boxes are to be located at least 24" from any paved surface.
- xiv. Any mainline piping, secondary piping, valve control wire, flow sensor cable and master valve wire located under any paved surface and located within the drip line of any existing tree to remain is to be installed in sleeving. Piping installed under existing paving to remain and within the drip line of any existing tree to remain is to be installed by directional boring. Any sleeving installed under proposed pavement is to be installed by open trenching with additional compaction requirements.

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- F. Specification and detailing compliance: All irrigation improvements are to be designed and installed in conformance with Denver Parks standard irrigation specification Section 02810 and in conformance with all Denver Parks standard installation detailing which is made part of these requirements by reference and shall be included in the construction documents for the project.












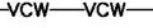







The contractor shall provide complete irrigation design services for a fully automatic irrigation system including all irrigation planning, design and construction documentation services as set forth and specified below:

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SAMPLE IRRIGATION EQUIPMENT SYMBOL LEGEND:	
Symbol:	Description:
	NEW WATER METER
	NEW BACK FLOW ASSEMBLY
	NEW DRAIN VALVE
	NEW ISOLATION VALVE
	NEW BACK QUICK COUPLER VALVE
	NEW MASTER VALVE
	NEW FLOW SENSOR
	NEW VACUUM / AIR RELEASE VALVE
	NEW RAIN SENSOR
	NEW IRRIGATION CONTROLLER
	NEW ELECTRIC ZONE CONTROL VALVE COUNT TO BE AS DESIGNED
	NEW LOW VOLTAGE VALVE CONTROL WIRE
	NEW MAIN LINE PIPE
	NEW SECONDARY PIPE
	NEW LARGE AREA GEAR DRIVE HEAD
	NEW SMALL AREA GEAR DRIVE HEAD
	NEW POP-UP SPRAY HEAD
	NEW PIPE OR WIRE SLEEVING
	NEW NETAFIM DRIPPER LINE FOR SHRUB BEDS

All components are per D.P.R. standard Irrigation Specification Section 02810 and all D.P.R. standard installation detailing

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SECTION 01010

SUMMARY OF WORK

PART 1 - GENERAL

1.1 DESCRIPTION

The Work specified herein consists of furnishing all services necessary for the design and construction of Barnum Park East as further described in the Basic Configuration of Book 2, Section 1.

1.2 SITE CONDITIONS

- A. The Contractor acknowledges satisfaction as to the nature and location of the Work, all of the general and local conditions, particularly those bearing upon availability of transportation, access to the Site, disposal, handling and storage of materials, availability of labor, water, power, roads, and uncertainties of weather, or similar physical conditions at the Site, the conformation and conditions of the ground, the character of equipment and facilities needed preliminary to and during Work, and all other matters that can in any way affect the Work.
- B. The Contractor further acknowledges satisfaction as to the character, quality and quantity of all surface and subsurface materials and all features on top of the surface or at worksites that would be encountered from inspection of the Site and from reviewing available records of exploratory work furnished by CDOT. Failure by the Contractor to become acquainted with the physical conditions of the sites and all the available information will not relieve the Contractor from responsibility for properly estimating the difficulty or cost of performing the Work.
- C. The Contractor warrants that as a result of examination and investigation of all the aforesaid data and the Site, that the Contractor can perform the Work in a good and workmanlike manner and to the satisfaction of CDOT. CDOT assumes no responsibility for any representations made by any of its officers or agents during or prior to the execution of the Work.

1.3 DESCRIPTION OF WORK

- A. The following work items are included in these specifications: earthwork; storm drainage; concrete walks and other flatwork; asphalt pavements; chain link fencing; irrigation; topsoil and soil preparation; seeding and sodding; synthetic turf; protection and retention of existing trees; and planting new trees. The materials and installation methods specified herein are to be considered standard for all Work ordered by and performed for CDOT in coordination with the City and County of Denver Department of Parks and Recreation in the construction of new facilities in Barnum Park East.

PART 2 - PRODUCTS (NOT USED)

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PART 3 - EXECUTION

3.1 CONTRACTOR'S DUTIES

- A. Except as otherwise specified, furnish the following to the full extent required by the Contract:
 - 1. Labor, superintendence, supervision and products.
 - 2. Construction equipment, tools, machinery and materials.
 - 3. Utilities required for construction and related activities.
 - 4. Other facilities and services necessary to properly execute and complete the Work, including security for worksite, testing and storage and protection of all materials awaiting incorporation into the Work, providing a safe working environment for workers, CDOT, City and County of Denver Department of Parks and Recreation representatives, and the public in accordance with all local, state and federal requirements.
- B. Prosecute the Work as specified and in a timely manner. Submit a schedule of Work that conforms to requirements of Book 2, Section 2. Work at night may be executed after the Contractor submits to CDOT, for review, a written program outlining special precautions to be taken to control the hazards presented by night work. That program shall include, but not be limited to, supplementary lighting of work areas, availability of medical facilities, security precautions and noise limitations.

3.2 COORDINATION

- A. Coordinate prosecution of the Work with those public utilities, governmental bodies, private utilities and other contractors performing work on and adjacent to the worksites. Eliminate or minimize delays in the Work and conflicts with those utilities, governmental bodies and contractors. Schedule governmental, private utility and public utility work that relies upon survey points, lines and grades established by the Contractor to occur immediately after those points, lines and grades have been established.
- B. In the coordination effort of work by others, the Contractor shall obtain and refer to equipment locations and other layouts, as available, to avoid interface problems.
- C. CDOT reserves the right to permit access to the Site of the Work for the performance of work by other contractors and persons at such times that CDOT deems proper. The exercise of such reserved right shall in no way or to any extent relieve the Contractor from liability for loss and damage to the Work due to or resulting from its operations or from responsibility for complete execution of the Contract. The Contractor shall cooperate with other contractors and persons in all matters requiring common effort.

3.3 CONTRACTOR USE OF WORKSITE

- A. Confine worksite operations to areas permitted by law, ordinances, permits and the Contract.

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- B. Consider the safety of the Work and that of the people and property on and adjacent to the worksite when determining amount, location, movement and use of materials and equipment on worksite.
- C. Do not load worksite with equipment and products that would interfere with the Work. Only equipment, tools or materials required for this Work may be stored at the worksite.
- D. Protect products, equipment and materials stored on worksite.
- E. Relocate stored products, equipment and materials which interfere with operations of government bodies, public and private utilities, and other contractors.

END OF SECTION 01010

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SECTION 01040

COORDINATION

PART 1 - GENERAL

1.1 SCOPE

This Section covers the procedures for project and construction coordination between CDOT, the Denver Parks Representative, and the Contractor.

1.1 SUMMARY:

A. Section includes: Requirements for coordination, supervision and administration for the Work, including but not necessarily limited to:

1. Coordination
2. Administrative and supervisory personnel
3. General installation provisions
4. Cleaning and protection
5. Utilities and site work

B. Related Work:

1. Section 01050 - Construction Surveying
2. Section 01105 - Administration, Procedures, Codes
3. Section 01200 - Project Meetings

1.2 GENERAL COORDINATION:

A. General:

1. The Contractor shall ensure that each entity involved in the performance of the Work shall cooperate in the overall coordination of the Work; promptly, when requested by the Contractor, furnish information concerning the entity's portion of the Work; and respond promptly and reasonably to the decisions and requests of persons designated with coordination, supervisory, administrative, or similar authority.
2. The Contractor shall, where necessary, prepare memoranda for distribution to each party involved outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings.
3. Prepare similar memoranda for the Owner and separate Contractors where coordination of their work is required.

B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction work. Such administrative activities include, but are not limited to, the following:

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1. Preparation of schedules
 2. Installation and removal of temporary facilities
 3. Delivery and processing of submittals
 4. Progress meetings
 5. Project close-out activities
- C. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water and materials. Salvage materials and equipment involved in performance of, but not actually incorporated in, the Work. Refer to other sections for disposition of salvaged materials that are designated as the CCD or City and County of Denver Department of Parks and Recreation property.
- D. Site Utilization: In addition to the site utilization limitations and requirements indicated by the Contract Documents, administer the allocation of available space equitably among entities needing access and space, so as to produce the best overall efficiency in the performance of the Work. Schedule deliveries so as to minimize the space and time requirements for storage of materials and equipment on the site; but do not unduly risk delays in the Work.
- E. Coordination Meetings: Include in scheduled meetings, coordination of various entities and activities as set forth in Section 01200 – Project Meetings. Where necessary, schedule additional coordination meetings for this purpose on an as-needed basis.
- F. Layout: It is recognized that the Contract Documents are diagrammatic in showing certain physical relationships of the various elements and systems and their interfacing with other elements and systems. Establishment and coordination of these relationships is the exclusive responsibility of the Contractor. Do not scale the Drawings. Layout and arrange all elements to contribute to safety, efficiency and to carry the harmony of design throughout the Work. In case of conflict or un-dimensioned locations, verify required positioning with the Denver Parks Representative. The Contractor shall provide surveying for the layout of all improvements including both horizontal and vertical control, in accordance with the requirements of Section 01050 – Layout of Work and Surveying.
- G. Substrate Examination: The Contractor shall ensure that the subcontractor of each element of the Work examines the conditions of the substrate to receive the Work, dimensions and spaces adjacent, tolerances, interfacing with other elements and services, and the conditions under which the Work will be performed. The Contractor shall require each subcontractor to notify the Contractor in writing of conditions detrimental to the proper or timely completion of the Work, and ensure that they do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to the subcontractor.
- 1.3 COMPLETE SYSTEMS: It is the intent of the Contract Documents that the system be complete and functional to provide the intended or specified performance. The Contractor shall provide all incidental items and parts necessary to achieve this requirement.

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- 1.4 COMPATIBILITY: Provide products and equipment which are compatible with other work requiring mechanical interface including connections, control devices, water, drain and other piping connections. Verify requirements and other interface requirements before ordering equipment and resolve conflicts that may arise.

PART 2 - PRODUCTS (Not applicable)

PART 3 – EXECUTION

3.1 GENERAL INSTALLATION PROCEDURES:

- A. Require the subcontractor of each major component to inspect both the substrate and conditions under which Work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.
- B. Inspect materials or equipment immediately upon delivery and again prior to installation. Reject damaged and defective items. Recheck measurements and dimensions before starting each installation.
- C. Manufacturer's Instructions: Comply with manufacturer's installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in the Contract Documents.
- D. Installation:
 - 1. Provide attachment and connection devices and methods necessary for securing Work. Secure work true to line and level. Allow for expansion and building movement.
 - 2. Install each component during weather conditions and the Work status that will ensure the best possible results. Isolate each part of the completed construction from incompatible materials as necessary to prevent deterioration.
 - 3. Coordinate Work with required inspections and tests, to minimize the necessity of uncovering completed construction for that purpose.
- E. Visual Effects: Provide uniform joint widths in exposed work. Arrange joints in exposed Work to obtain the best visual effect. Refer questionable choices to the Denver Parks Representative for final decision.
- F. Mounting Heights: Where mounting heights are not indicated, install individual components at standard mounting heights recognized within the industry for the particular application indicated. Refer questionable mounting height decisions to the Denver Parks Representative for final decision.

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3.2 CLEANING AND PROTECTION:

- A. During handling and installation, clean and protect construction in progress and adjoining materials in place. Apply protective covering where required to ensure protection from damage or deterioration prior to achieving Project Completion.
- B. Clean and maintain completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

END OF SECTION 01040

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SECTION 01050

LAYOUT OF WORK AND SURVEYS

PART 1 - GENERAL

1.1 SCOPE

This section covers the procedures and accuracy requirements for survey services for layout of Work and field measurement of Work quantities to be determined by surveys.

1.2 SUBMITTAL

- A. Refer to Technical Specifications Sections 01300 and 01340 for the submittal process.
 - 1. Copies of original pages of field notes.
 - 2. Original field notebooks when filled and at end of Contract.
 - 3. As-Built measurements.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONSTRUCTION LINES AND GRADES

- A. The Contractor shall make surveys and layouts as necessary to delineate the work. The Contractor shall make the surveys for the proper performance of the Work. As a part of such surveys, the Contractor shall furnish, establish and maintain in good order survey control points that may be required for the completion of the Work subject to the approval of the Project Manager as to their location, sufficiency and adequacy. However, such approval by the Project Manager shall not relieve the Contractor of his responsibility for the accuracy of his survey work.
- B. The Contractor shall furnish skilled labor, instrument platforms, ladders and such other temporary structures as may be necessary for making and maintaining points and lines in connection with the surveys required.
- C. CDOT may draw the Contractor's attention to errors or omissions in lines or grades, but the failure to point out such errors or omissions shall not give the Contractor any right or claim nor shall in any way relieve the Contractor of any obligations according to the terms of the Contract.
- D. The Contractor's instruments and other survey equipment shall be accurate, suitable for the surveys required in accordance with recognized professional standards and in proper condition and adjustment at all times. Surveys shall be performed under the direct supervision of a Colorado Registered Professional Land Surveyor.

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3.2 SURVEYING ACCURACY AND TOLERANCES IN SETTING SURVEY, LAYOUT AND QUANTITY CALCULATION STAKES

- A. The tolerances generally applicable in setting survey stakes shall be as set forth in the CDOT Survey Manual, latest edition. Such tolerances shall not supersede stricter tolerances required by the Contract requirements, and shall not otherwise relieve the Contractor of responsibility for measurements in compliance therewith.

3.3 AS-BUILT MEASUREMENTS

- A. As-Built measurement for items that will be hidden or visible including all civil, mechanical, electrical, control work and all utilities that are placed in concrete, earth or behind walls shall be made. Items located within or five feet beyond a building shall be referenced to building column lines and finish floor elevations. Special attention shall be paid to items requiring service, sensors, items with moving parts, access points and locations of junctions, elevation changes and directional changes.

END OF SECTION 01050

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SECTION 01060

REGULATORY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section identifies primary compliance with the State and City and County of Denver's regulatory requirements for Barnum Park East including:
 - 1. City and County of Denver Department of Public Works (including The Division of Wastewater Management)
- B. Construction shall be based on the latest edition of the referenced codes including additions and revisions thereto that are in effect at the time as defined in the Contract.

1.2 BUILDING CODE

- A. All design and construction work shall be governed by the Building Code for the City and County of Denver, latest edition. This is based upon the International Building Code of the International Code Council with Denver Amendments to this code.

1.3 DENVER BUILDING DEPARTMENT

- A. For review and approval of all construction documents for compliance to the Denver building code:
 - City and County of Denver
 - Community Planning and Development
 - Building Inspection Division
 - 201 West Colfax Avenue, Dept 205
 - Denver, Colorado 80202
 - Telephone 720-865-2720
 - Fax 720-865-2880

1.4 DENVER FIRE DEPARTMENT

- A. For review and approval of plans for compliance with the Denver Fire Department's requirements as they apply to projects for the Department of Public Works:
 - Denver Fire Department
 - 745 W. Colfax Ave.
 - Denver, Colorado 80204
 - Telephone 720-865-2833
- B. The Contractor is advised that the Denver Fire Department – Fire Prevention Bureau requires permitting for the following activities as they apply to the Work. The Contractor is responsible for obtaining the appropriate permits necessary to complete the work. All costs associated with this permitting and policy compliance shall be the responsibility of the Contractor. The policies all reference the International Fire Code (IFC).

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1. “Hot work”, which is defined as the operation of any equipment or tool that creates sparks, hot slag, or radiant or convective heat as a result of the Work. This includes, but is not limited to, welding, cutting, brazing, or soldering.
 2. Use and storage of compressed gas for both temporary storage and permanent facility installation. This includes, but is not limited to, flammable gas (excluding propane-LPG), oxidizer (including oxygen), and inert and/or simple asphyxiates.
 3. Tank installation, which includes above-ground storage tanks (AST) and underground storage tanks (UST) for both temporary tanks and permanent facility installations.
- C. In addition to the above permits, the Denver Fire Department may require other permits that are associated with the specific Work in the Contract Documents. Policies provided by the Denver Fire Department are meant to provide basic information for the most common conditions and situations. In any given occupancy, many other International Fire Code (IFC) requirements may be enforced. These should be addressed with the Denver Fire Department before construction begins and during construction with premise inspection(s). Any questions can be addressed to the Fire Prevention Bureau between 6:30 AM and 9:00 AM Monday-Friday at 720-913-8242 or -8237.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PERMITS AND CERTIFICATIONS

- A. The Contractor shall maintain records on Site of all permits acquired by federal, state, and local agencies. Posting of permits shall conform to requirements of the respective agencies.
- B. At the completion of any inspection by other agencies, the Contractor shall forward copies of the status of the inspection and copies of any approved or "signed-off" inspections by the respective agencies to CDOT.
- C. At the time of request for Project Completion, the Contractor shall forward to CDOT all permits approved by the respective agencies.

END OF SECTION 01060

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SECTION 01095

DEFINITIONS AND CONVENTIONS

PART 1 - GENERAL

1.1 SUMMARY

This section contains a list of definitions of words or phrases and grammatical or contextual conventions commonly used in these Barnum Park East contract documents. These definitions supplement, but do not supersede, those in Book 1 – Contract (Appendix A).

1.2 DEFINITIONS

A. Alphabetical Listing of Definitions

1. As indicated: Shown on the drawings by graphic indication, notes or schedules, or written in the specifications or elsewhere in the Contract Documents.
2. As directed, as approved, as requested: Unless otherwise indicated, these terms imply "by the Project Manager" and require that an instruction be obtained by the Contractor from the Project Manager.
3. Concealed: Embedded in masonry, concrete or other construction; installed in furred spaces; within double partitions or hung ceilings; in trenches; in crawl spaces or in enclosures.
4. Ensure: To make certain in a way that eliminates the possibility of error.
5. Exposed: Not installed underground or "concealed" as defined above.
6. Furnish or Provide: To supply, install and connect complete and ready for safe and regular operation of particular work unless specifically otherwise noted.
7. Indicated, Shown, or Noted: As depicted on drawings or specifications.
8. Install: To erect, mount and connect complete with related accessories.
9. Or equal, or approved equal: Refers to products which, in the opinion of the Project Manager, are similar in all respects to products specified by proprietary brand name. (Refer to Section 01630 for procedures for submittal of proposed substitutions.)
10. Rework: To repair existing items or work required to be removed and replaced in order to accomplish the Work in accordance with the Contract Documents.
11. Related Work: Includes, but not necessarily limited to, mentioned work associated with, or affected by, the work specified.
12. Reviewed, Satisfactory, Accepted, or Directed: Assumes by or to the Project Manager.
13. Similar, or Equal: Same in materials, weight, size, design, construction, capacity, performance and efficiency of specified product.
14. Supply: To purchase, procure, acquire and deliver complete with related accessories.

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15. Unless Otherwise Indicated and Unless Otherwise Noted: General note to perform work as indicated or shown on drawings or in specifications unless specifically directed otherwise elsewhere in the Contract Documents; may be abbreviated "U.O.N.", "U.O.I.", or "U.N.O."

1.3 CONVENTIONS

A. Specifications Format

1. In order to standardize the location of information in the Contract Documents, these specifications generally are organized in one or more of the following formats:
 - a. The 2004 edition of "MASTERFORMAT" published by the Construction Specifications Institute.

B. Organization of Drawings and Specifications

1. Organization of the specifications into divisions and sections, and arrangement or numbering of drawings is intended solely for the convenience of the Contractor for responsibilities to divide the Work among subcontractors or to establish the extent of Work to be performed by any trade.
2. Neither CDOT nor the City and County of Denver Department of Parks and Recreation assume any liability arising out of jurisdictional issues or claims advanced by trade organizations or other interested parties based on the arrangement or organization of drawings or specifications.

C. Singular vs. Plural

1. Materials, products, equipment or other items of work referred to in the singular shall be construed as plural where applicable by the intent of the contract documents and shall not limit quantities to be provided by the Contractor.

D. Imperative Mood

1. Specifications and notes on the drawings or elsewhere in the contract documents are generally written in the imperative mood as instructions to the Contractor, whether the Contractor is specifically addressed or not.

E. References to Subcontractors or Trades

1. References to subcontractors, trades or other entities which are not parties to the Contract shall be construed as meaning the Contractor whose responsibility it shall be to divide the Work among subcontractors or trades. Such references are used as a matter of convention, and are not intended to preclude or direct the Contractor's responsibility to divide the Work.

F. Abbreviations

1. Abbreviations are believed to be those in general use in the construction industry. Contact the Project Manager for clarification of abbreviations for which the meaning is not clear.

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PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 01095

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SECTION 01105

ADMINISTRATION, PROCEDURES, CODES

PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS: The Contract Documents, including those specific to Barnum Park East, apply to work of this section.
- 1.2 SUMMARY: This section includes general administrative requirements and procedures, and related applicable codes.
- 1.3 CODES:
- A. Obtain all permits and licenses in accordance with the Contract Documents.
 - B. Publication Dates: Comply with the most recent version in conformance with the Contract Documents.
- 1.4 EXISTING UTILITIES:
- A. Locate and protect existing utilities in accordance with the Contract Documents.
 - B. Although existing utilities may be shown on the drawings, their location is not guaranteed. Contractor is required to call Utility Notification Center of Colorado (UNCC) in accordance with the Contract Documents.
- 1.5 CONTRACTOR'S CONSTRUCTION SCHEDULE
- A. Furnish construction schedule, as required by requirements of the Contract Documents.
 - B. IMPORTANT: Prior to mobilizing on site on Barnum Park East, the Contractor shall give minimum 48 hour notification to CDOT.
- 1.6 DELIVERY, STOPRAGE AND HANDLING
- A. Properly carton, crate, cover, and protect materials, products and equipment for shipping, handling and storing. Use appropriate means for hoisting and loading which will prevent damage or overstress to items being handled or shipped. Store them under roof in controlled environment whenever feasible; otherwise store off the ground under suitable coverings properly secured against wind and weather. Protect all items from rain, snow, moisture, wind, cold, heat, frost, sun, staining, discoloration, deterioration and physical damage from any cause. Refer to individual sections for specific requirements.

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not applicable)

END OF SECTION 01105

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SECTION 01110

CONSTRUCTION SAFETY

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Work specified in this Section includes construction safety precautions and programs by the Contractor and the basis for reviews by the CDOT.

1.2 RESPONSIBILITY

- A. All safety precautions during the construction process are the responsibility of the Contractor. The Contractor is responsible for the health and safety of employees, agents, subcontractors and their employees, and other persons on the worksite; for the protection and preservation of the Work and all materials and equipment to be incorporated therein; and for the worksite and the area surrounding the worksite. The Contractor shall take all necessary and reasonable precautions and actions to protect all such persons and property.
- B. This section shall be interpreted in its broadest sense for the protection of persons and property by the Contractor and no action or omission by CDOT or its authorized representatives shall relieve the Contractor of any of its obligations and duties hereunder.

1.3 SUBMITTAL

- A. Refer to Technical Specifications Section 01300 and 01340 for the process. A safety plan shall be submitted by the Contractor prior to commencing any Work.

1.4 CONTRACTOR'S SAFETY PLAN SUBMITTAL

- A. The Contractor shall provide two (2) copies of its safety program to CDOT for review at least ten Days before on-site construction begins. The Contractor's program must meet as a minimum all applicable federal, state and local government requirements.
 - 1. The Contractor must, as part of the Contractor's safety program, submit one electronic file in the form of a security-free, fully bookmarked PDF file compatible with Adobe Acrobat 6.0 or newer and one body hard copy of the following information for acceptance by CDOT prior to construction:
 - a. Name of the Contractor's site safety representative.
 - b. If the Contractor is running multiple shifts or working more than forty (40) hours per week, the name of an assistant Contractor's safety representative who can act in the absence of the site safety representative.
 - c. Twenty-four hours per day emergency phone numbers of Contractor site management to be used in case of injury or accident. Provide at least four contacts.

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- d. The Contractor's method of ditching and trenching excavation to be used including how slopes will be stabilized with calculations showing the slope stability. The Contractor shall also show how material will be stored beside the excavation. Stored material will include the excavated and backfilled material.
 - e. How injuries or accidents will be handled including samples of the forms used to report injuries or accidents.
 - f. How employees will be handled who are unable to safely perform their duties, including how the Contractor will determine whether an employee is unable to safely perform his duties.
 - g. How and when equipment will be checked to see that it is safe, that all safety guards are in place and that the equipment is being used for its designed purpose and within its rated capacity.
 - h. How and when all electric devices will be checked for proper grounding and insulation. What system will be used to lock out electric systems that should not be energized.
 - i. How trash and human organic waste will be disposed.
 - j. How snow and ice will be removed by the Contractor within the Project area.
 - k. How concrete forms will be anchored to ensure their stability, including calculations showing that the forms will safely hold the maximum construction loads.
 - l. How flammable materials will be stored and handled, and how any spills will be cleaned up and removed for disposal.
 - m. What system will be used to prevent fires, and if fires do occur who will be trained to fight them. Also what fire fighting equipment will the Contractor have available and how will this equipment's condition be monitored.
 - n. How materials will be received, unloaded, stored, moved and disposed of.
 - o. How personnel working above ground level will be protected from falling.
 - p. How people working underneath work will be protected.
 - q. What will be done to protect personnel in case of severe weather.
 - r. How adequate lighting will be provided and monitored.
 - s. How the safety of work platforms, man lifts, material lifts, ladders, shoring, scaffolding, etc. will be ensured relating to load capacity and the protection of personnel using or working around them.
- B. Prior to the start of any Work by the Contractor or Subcontractor employee, the Contractor shall provide CDOT with a list of its employees, Subcontractor's employees and other personnel the Contractor has requested to work on site, who have signified in writing that they have been briefed on, or have read and understand, the Contractor's Safety Plan.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S SAFETY PLAN

- A. Provide a Contractor's Safety Program as described in Part 1 of Technical Specifications Section 01110.

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PART 3 - EXECUTION

3.1 IMPLEMENT CONTRACTOR'S SAFETY PLAN

- A. Implement the approved Contractor's Operational Safety Plan as described in Part 1 of this Technical Specifications Section 01110.

END OF SECTION 01110

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SECTION 01200

PROJECT MEETINGS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The Work specified in this Section requires the Contractor's Project Manager, Superintendent and Quality Control representative to attend meetings scheduled by CDOT for the collection and dissemination of information related to the Contract.
- B. The Project Manager will prepare the minutes of each meeting and distribute them to each of the participants.

1.2 OTHER MEETINGS

- A. The Contractor will be advised of times, dates and places of contract meetings.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PRECONSTRUCTION MEETING

- A. A Preconstruction Meeting will be scheduled by CDOT after the Contract has been signed by all parties. The purpose of this meeting is to introduce the Denver Parks Representative to their counterparts in the Contractor's organization and to establish lines of communication between these representatives and outline some Contract requirements. The Contractor's Superintendent, Contractors LEED manager and Quality Control Representative(s) shall attend this meeting.
- B. The Project Manager will distribute a notice of this meeting, along with an agenda of the subjects to be addressed.
- C. The Project Manager will explain and discuss the responsibilities and authorities of the designer, and the Project Manager's organization.
- D. The Contractor will introduce the Contractor's representatives and briefly describe each person's responsibilities. The Contractor will provide the following:
 - 1. A list of all subcontractors.
 - 2. Office, storage areas and construction area layouts, along with temporary easements.
 - 3. Safety, first aid, emergency actions and security procedures including the name of the Contractor's insurance company.
 - 4. Schedule.

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5. Sequence of Work.
 6. Construction methods and general worksite layout and haul plan.
 7. Housekeeping procedures.
 8. The Contractor's general erosion and sedimentation control plans, noise, hazardous material, air and water pollution control plans and Quality Control Plan.
 9. Coordination and notification for Utility Work.
 10. Deliveries and priorities of major equipment.
 11. Submittal requirements
- E. Explanations provided by CDOT and the City and County of Denver Department of Parks and Recreation will not amend, supersede or alter the terms or meaning of any Contract Document, and the Contractor shall not claim reliance on such explanations as a defense to any breach or failure by the Contractor to perform as specified in the contract.

3.2 CONSTRUCTION PROGRESS MEETINGS

- A. Progress meetings will be scheduled weekly and more often as necessary by the Project Manager to promote the competent and timely execution of the Contract.
- B. The meetings will be held at the worksite or at a location selected by the Denver Parks Representative. Meetings will be chaired by the Project Manager.
- C. The Contractor's personnel, as listed in Technical Specification Section 01200, 3.01.A, shall attend unless otherwise agreed by the Denver Parks Representative.
- D. The Project Manager will be responsible for publishing minutes of the meetings.
- E. At a minimum, the following items will be addressed at each meeting. The items addressed in the meeting do not waive notification or submittal requirements as required elsewhere in the Contract.
 1. Safety: Contractor shall report any safety issues
 2. Quality Control
 - a. The Contractor's Quality Control manager shall present and discuss the weekly test report and/or testing schedule.
 - b. The Contractor's Quality Control manager shall report on inspections by other agencies and any follow-up activity required.
 - c. The Project Manager will present and discuss issues regarding Quality Control.
 3. Quality Assurance
 - a. The Project Manager will present and discuss issues regarding Quality Assurance.
 4. Design activities: open discussion
 5. Shop drawings/submittals/material procurement

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- a. The Contractor shall provide and review the Contractor's submittal schedule and provide any updated information and/or changes to the schedule.
 - b. The Contractor shall provide information on the status of submittals requiring re-submittal.
 - c. The Contractor shall review any accepted submittals that the Contractor plans to resubmit with changes.
 - d. The Contractor shall provide the status of material procurement for long-lead items (long-lead items are materials and equipment that have a fabrication and/or delivery duration that exceeds 15 working days). This information shall be provided by the Contractor in a format satisfactory to CDOT and shall include, at a minimum: submittal/shop drawing preparation duration, review duration, fabrication duration and delivery duration. All long-lead items shall be identified with a separate activity on the approved Contract Schedule.
6. Construction activities: Open discussion to include coordination items with other Contractors and or agencies.
 7. Schedule
 - a. The Contractor shall provide to the Denver Parks Representative the Contractor's three week look-ahead schedule and review at the meeting the items on the schedule. The schedule shall be in bar chart format, and shall include dates of testing activities, items in progress, percentage of completion of items, responsible Subcontractor for the items.

END OF SECTION 01200

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SECTION 01300

SUBMITTALS

PART 1 - GENERAL

1.1 DESCRIPTION

The Work specified in this section summarizes the requirements for the submittal of documents to CDOT that are defined in these Specifications. It also describes the procedures for "supplemental" submittals.

PART 2 - PRODUCTS

2.1 SUBMITTAL SCHEDULE

- A. The Contractor shall provide a submittal schedule within fourteen (14) days after NTP2. The submittal schedule shall be directly related to the Schedule for the overall Project Work, shall identify all the submittals, and shall include the following information for each submittal item:

1. Specification section, contract article, or special condition
2. Specification subparagraph
3. Item description
4. Date the submittal shall be submitted
5. Name of Subcontractor or Supplier

The submittal schedule shall be updated every two weeks by the Contractor.

2.2 ELECTRONIC SUBMITTALS

- A. All submittals shall be delivered to CDOT in electronic format.
1. Acceptable electronic formats
 - a. Adobe Acrobat 8.0 or newer. All files shall be fully compatible with Adobe Acrobat 8.0. File shall have no security and bookmark every applicable submittal.
 2. Formats are acceptable only with written permission of the Denver Parks Representative or required by individual spec sections:
 - a. Microsoft Office 2003 (2007 preferred) or newer. All files shall be fully compatible with Microsoft Office 2003.
 - b. AutoDesk AutoCAD 2007 or newer. All files shall be fully compatible with AutoDesk AutoCAD 2007.
 - 1) AutoCAD files shall be self contained with no external x-references.
 - c. Other files pre-approved by the Denver Parks Representative.

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3. Electronic file names: Each electronic document shall have a unique file name. File name convention shall be as follows unless otherwise agreed to by Denver Parks Representative: -AAA-BBBBBB-CCC-RZ
 - a. AAA = sequential submittal number starting at 001.
 - b. BBBBBB = specification section containing submittal requirements
 - c. CCC = sequential specification submittal number starting at 001.
 - d. RZ = sequential revision number. RZ not required on initial submittals.
 - e. Example A:005-01370-002”, five submittals have been logged overall with two submittals made to specification section 01370.
 - f. Example B: 009-01370-002-R3, nine submittals made overall and three revisions to submittal 01370-002.

2.3 INITIAL SUBMITTAL

- A. Each submittal document shall include a title block showing the following information:
 1. Date of submittal and revision dates.
 2. Contract title and number.
 3. The names of Contractor, Subcontractor, Supplier, manufacturer and when applicable, the seal and signature of a landscape architect, engineer, or other design professional registered in the State of Colorado, for the involved discipline.
 4. Identification of product by either description, model number, style number or lot number.
 5. Subject identification by Contract Drawing or specification reference.
- B. On each submitted drawing, include a blank space on each sheet, three inches by four inches, in the lower right corner, just above the title block, in which CDOT or the designer of record may indicate the action taken.
- C. Make submissions sufficiently in advance so that the designer and CDOT review may be completed before any material procurement or Work represented by those submittals is scheduled to be performed.
- D. Allow a minimum cycle of ten (10) working days for review of each submittal by CDOT.
- E. The Contractor shall at the time of submission describe variations from the Contract Documents in writing, separate from the submittal document. If CDOT approves any such variations, an appropriate Contract Change Order shall be requested except that, if the variation is minor and does not involve a change in price or in time of performance, a modification need not be issued. If a submission contains variations and the variation column is not marked on the transmittal form, it will not be considered for review and acceptance. Along with marking the transmittal as a variation, a description must be included which outlines all the differences including maintenance and Utility services along with any cost savings from an item not containing the variation.

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- F. Changes in submittal documents will not be permitted unless those changes have been accepted, in writing, by the CDOT.
- G. The form and quality of submittal documents shall comply with Technical Specifications Section 01340.

2.4 SUPPLEMENTAL SUBMITTALS

- A. Supplemental submittal documents initiated by the Contractor for consideration of corrective procedures shall contain sufficient data for review. Make supplemental submittals in the same manner as initial submittals with the appropriate primary transmittal referenced.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. The Contractor shall review submittal documents, stamp and sign as reviewed and approved as complying with contract documents prior to submission to the City.

3.2 CITY REVIEW

- A. Submittal documents will be reviewed by the designer, the Denver Parks Representative, and CDOT for conformance to requirements of the Contract requirements. Review of a separate item will not constitute review of an assembly in which the item functions. The designer, Denver Parks Representative, or CDOT will withhold approval of submittals that depend on other submittals not yet submitted. Review and acceptance will not relieve the Contractor from responsibility for accuracy of submittals, for conformity of submittal document to requirements of the Contract, for compatibility of described product with contiguous products and the rest of the system, or for protection and completion of the Contract requirements.
- B. The designer, Denver Parks Representative, and CDOT will review the submittal documents for general conformance with the Contract Documents and mark the action code, sign and date the transmittal.
- C. The action codes have the following meanings:
 - 1. A - ACCEPTED is an approval, and means that the illustration and description appears to conform to the respective requirements of the Contract Documents.
 - 2. B - ACCEPTED AS NOTED is an approval, and means that the illustration and description will conform to the respective requirements of the Contract Documents after changes in recognition of the reviewer's comments. Submittals so marked need not be resubmitted.
 - 3. C - REVISE AND RESUBMIT means that the submittal is unacceptable and must be revised and resubmitted.
 - 4. E - NOT ACCEPTED means that the submittal is not approved and that a new submittal in accordance with the contract documents shall be made.

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5. F - RECEIPT ACKNOWLEDGED, means an item is received by the designer and Denver Parks Representative but no review was made. This mark is for use in re-submitting items that were previously accepted as noted and the Contractor has incorporated the notes and wants the designer, Denver Parks Representative, and CDOT to have the same material that the Contractor's field staff is using.

3.3 CONTRACTOR'S RESPONSIBILITIES

- A. Coordinate each submittal document with the requirements of the Work; place particular emphasis upon ensuring that each submittal of one trade is compatible with other submittals of that trade and submittals of other trades including producing as needed drawings showing the relationship of the work of different trades.
- B. Contractor's responsibility for errors and omissions in submittal documents and associated calculations is not relieved by CDOT's review, correction and acceptance of submittals.
- C. Contractor's liability to CDOT, in case of variations in the submittal document from the requirements of the Contract Documents, is not relieved by CDOT's review and acceptance of submittals containing variations unless CDOT expressly Approves the deviation in writing, in which CDOT describes the variation.
- D. The Contractor shall maintain a file of all approved submittal documents at the worksite. The complete file of approved submittal documents shall be turned over to CDOT with the As-Built Documents at Project Completion.
- E. Schedule impact due to resubmittal requirements is the responsibility of the Contractor.

END OF SECTION 01300

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SECTION 01340 SHOP AND WORKING DRAWINGS, PRODUCT DATA AND SAMPLES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The Work specified in this Section consists of preparing and submitting Shop and Working Drawings, product data, samples and record documents required by the Contract.
 - 1. The Contractor shall submit all Shop Drawings, Working Drawings, product data and samples, as defined in the Contract, to the designer, Denver Parks Representative, and CDOT in accordance with the requirements in the Contract. The designer, Denver Parks Representative and CDOT will return one copy of the Shop Drawings, Working Drawings and product data to the submitter with a written transmittal within the time periods noted in the Contract.

1.2 SUBMITTALS

- A. Refer to 01300 for submittal procedures.
- B. All submittals shall be delivered to the designer, Denver Parks Representative, and CDOT in electronic format. All submittals must be of a consistent format (all Acrobat or all Word, etc). No combination of electronic file types will be allowed unless required by a specific specification section.
 - 1. Acceptable electronic formats
 - a. Adobe Acrobat 8.0 or newer. All files shall be fully compatible with Adobe Acrobat 8.0
 - b. Formats are acceptable only with written permission of the Denver Parks Representative or required by individual spec sections:
 - 1) Microsoft Office 2003 (2007 preferred) or newer. All files shall be fully compatible with Microsoft Office 2003.
 - 2) AutoDesk AutoCAD 2007 or newer. All files shall be fully compatible with AutoDesk AutoCAD 2007.
 - a) AutoCAD files shall be self contained with no external x-references.
 - 3) Other files pre-approved by the Denver Parks Representative.
 - 2. Adobe Acrobat Requirements:
 - a. Drawings shall have security set to “No Security”. Commenting, printing, adding photos, form fields and document signing must be allowed.
 - b. PDF submittals shall be one continuous file. No external links are allowed.
 - c. All individual components of submittals shall be bookmarked inside the PDF file.
 - d. All original documents shall be directly converted from the original electronic format to PDF. Scanning of files shall only be allowed by the Project Manager when the original electronic information is not obtainable.
 - e. Failure to comply with these requirements will result in a return of file to the Contractor for immediate revision.

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3. Electronic file names: Each electronic document shall have a unique file name. File name convention shall be as follows unless otherwise agreed to by Denver Parks Representative: -AAA-BBBBBB-CCC-RZ
 - a. AAA = sequential submittal number starting at 001.
 - b. BBBBBB = specification section containing submittal requirements
 - c. CCC = sequential specification submittal number starting at 001.
 - d. RZ = sequential revision number. RZ not required on initial submittals.
 - e. Example A:005-01370-002”, five submittals have been logged overall with two submittals made to specification section 01370.
 - f. Example B: 009-01370-002-R3, nine submittals made overall and three revisions to submittal 01370-002.

C. Quantities

1. Post electronic submittals as PDF electronic files directly to designer’s FTP, Contractors FTP site or a site specifically established for the Project.
 - a. The Contractor should send an email for each submittal posted to all parties notifying them the submittal is available for review.
 - b. The Denver Parks Representative and CDOT or designer will send an email to the Contractor when the submittal review is complete.
2. Contractor can submit electronic submittals via email as PDF electronic files if approved by the Denver Parks Representative.
3. Four samples of each item specified in the various specification sections, unless otherwise specified.
4. Note: If manufacturer’s printed information is in color, all copies of submittals must be in color.
 - a. Printed information is only allowed when electronic copies are not possible.

D. Review

1. Submittal review comments by CDOT and the designer will be in electronic form and incorporated into the electronic submittal file.
2. Resubmittals of electronic documents shall modify the original electronic file with new information and include CDOT and the designer’s comments with appropriate responses and additional information.

1.3 CHANGES

- A. Changes in products for which Shop or Working Drawings, product data or samples have been submitted will not be permitted unless those changes have been accepted and approved in writing by CDOT.

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PART 2 - PRODUCTS

2.1 SHOP AND WORKING DRAWINGS

- A. Include the following as they apply to the subject:
1. Contract title, work order and number.
 2. Respective contract drawing numbers.
 3. Applicable specification section numbers.
 4. Relation to adjacent structure or materials.
 5. Field dimensions clearly identified as such.
 6. Applicable standards such as ASTM or federal specification number, and pertinent authority specifications or standards.
 7. Identification of deviations from the Contract requirements.
 8. Drawing name, number and revision.
 9. Contractor's stamp, initialed or signed, certifying:
 - a. Verification of field measurements.
 - b. Review of submittals for compliance with Contract requirements.
 - c. Compatibility of the Work shown thereon with that of affected trades.
 10. Blank space on each sheet per Technical Specifications Section 01300, paragraph 2.3.B.
- B. Drawings of equipment and other items that contain multiple parts shall include exploded views showing the relationship of parts and the description of the parts into the smallest units that may be purchased or serviced.

2.2 PRODUCT DATA

- A. Modify manufacturer's standard and/or schematic drawings to delete information which is not applicable to the Contract. Supplement standard information with additional information applicable to this Contract.
- B. Modify manufacturer's standard(s), diagrams, schedules, performance charts, illustrations, calculations and other descriptive data to delete information which is not applicable to the contract. Indicate dimensions, clearances, performance characteristics and capacities. Include with the submittal electrical, plumbing, HVAC and any other diagrams, as applicable.
- C. Modify erection, application and placing instructions to delete information that is not applicable to the contract or work order.
- D. Include the following:
1. Contract title, work order and number
 2. Respective contract drawing numbers

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3. Applicable Contract technical specification section numbers
 4. Applicable standards such as ASTM or Federal Specification number, and pertinent authority specification or standards
 5. Identification of deviations from the Contract Drawings and specifications
 6. Contractor's stamp, initialed or signed, certifying:
 - a. Dimensional compatibility of the product with the space in which it is intended to be used
 - b. Review of submittals for compliance with Contract requirements
 - c. Compatibility of the product with other products with which it is to perform or which will be next to it.
 - d. The products electrical, plumbing, control and HVAC requirements conform to Contract Documents and the necessary utilities are provided for in the Contract Documents.
- E. Certificates of compliance shall be submitted for all products. The certificates shall:
1. State that the product complies with the respective specification and Contract Document requirements
 2. Be accompanied by a certified copy of test results pertaining to the product
 3. Show the submittals date, Contractor's name and address, Contract title and number, product represented and its location in the Contract, producer's name, product trade name and catalog number, place of product origin, test date, testing organization's name and address, quantity of the product to be furnished and related contract drawing and specification section numbers
 4. Be signed by an officer or another authorized representative of the producer and notarized
 5. Submit one electronic copy.
 6. Be received by CDOT not later than 30 days before the acceptance is needed of the products for ordering.

2.3 SAMPLES

- A. Submit samples of sizes and quantities to clearly illustrate full color range and functional characteristics of products and materials including attachment devices.
- B. Erect field samples and mock ups at the worksite as specified in the several technical specifications sections and at locations acceptable to the Project Manager. All field samples shall be erected in a location that will be readily visible throughout the life of the Contract to allow comparison of the work as it progresses to the field sample.
- C. The Contractor shall verify, through appropriate inspections and tests, that the samples submitted meet the specifications and shall provide inspection and test data with the samples. The review and comments on the sample shall not relieve the Contractor of his responsibility for completion of the contract.

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- D. Show the following information:
1. Contract title and number
 2. Respective contract drawing numbers
 3. Applicable technical specification section numbers
 4. Applicable standards such as ASTM or Federal Specification number
 5. Identification of deviations from the contract drawings and specifications
 6. Contractor's stamp, initialed or signed, certifying:
 - a. Dimensional compatibility of the product with the space in which it is intended to be used
 - b. Review of submittals for compliance with contract requirements
 - c. Compatibility of the product with other products with which it is to perform or which will be next to it
 7. If multiple samples are submitted and the designer, Denver Parks Representative, and CDOT are requested to make a choice, each sample shall have a unique identification number attached to it so the returned transmittal can state the identification number of the accepted sample and the Contractor will know which one it is.

PART 3 - EXECUTION

3.1 CONTRACTOR RESPONSIBILITIES

- A. Verify field measurements, catalog numbers and similar data.
- B. The Contractor shall not start work for which submittals are required until a transmittal has been received by the Contractor showing acceptance or acceptance as noted by the Project Manager.
- C. Before making submittals ensure that products will be available in the quantities and at the times required by the contract.
- D. Submit final, corrected, electronic drawings of contract and shop and working drawings showing the Work as actually installed, placed, erected and applied. Refer to Technical Specification Section 01700 - Contract Closeout.

3.2 REVIEW BY CDOT

- A. One electronic copy of the marked-up shop and working drawing and one electronic copy of the product data will be returned to the Contractor by the designer, Denver Parks Representative, and CDOT. Only the transmittal form, appropriately marked, and two samples will be returned on sample submittals. Contractor shall maintain one approved sample on-site for the duration of the project.

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- B. Contractor's responsibility for errors and omissions in submittals for compatibility will not be reduced, waived or otherwise limited by the review and acceptance of submittals by CDOT.

END OF SECTION 01340

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SECTION 01630

SUBSTITUTIONS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The Work specified in this Section consists of submitting for the approval of a different material, equipment or process than is described in the Contract Documents.
- B. If the substitution changes the scope of Work, the Contractor shall adhere to requirements of Book 1 for such changes, including issuance of any related Change Orders. As-Built drawings and specifications must include all substitutions even if a Change Order is not issued.

1.2 QUALITY CONTROL

- A. The substitution must provide the same quality as what it is replacing. The level of quality is defined by:
 - 1. Maintenance and operating cost
 - 2. Reliability
 - 3. Durability
 - 4. Life expectancy
 - 5. Ease of cleaning
 - 6. Ability to be upgraded as needed
 - 7. Ease of interacting with other systems or components
 - 8. Ability to be repaired
 - 9. Availability of replacement parts
 - 10. Established history of use in similar environments
 - 11. Performance equal or superior to that which it is replacing.

1.3 SUBMITTAL

- A. Refer to Book 2, Technical Specifications Sections 01300 and 01340 for submittal procedures.
- B. A request for substitution must be submitted at least sixty (60) Days prior to when an order needs to be placed or a method needs to be changed.

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- C. The submittal shall contain, as appropriate, detailed product data sheets for the specified items and the substitution. Samples and shop drawings shall also be submitted of the substitution as applicable. The submittal shall contain all the data required to be submitted for acceptance of the originally specified item or process.
- D. The submittal shall contain all the applicable information required in this Section 01630, subparagraph 2.1 below.
- E. A signed statement as outlined in this Section 01630, paragraph 2.3.B below must accompany the request for substitution.

PART 2 - PRODUCTS

2.1 INFORMATION

- A. Provide the following information as applicable with the request for substitution on the item or process that is being requested to be substituted:
 - 1. A complete description of the item or process
 - 2. Utility connections including electrical, plumbing, HVAC, fire protection and controls
 - 3. The physical dimensions and clearances
 - 4. A parts list with prices
 - 5. Samples of color and texture
 - 6. Detailed cost comparisons of the substitution and the contract specified item or process
 - 7. Manufacturer warranties
 - 8. Energy consumption over a one-year period
 - 9. What local organization is certified to maintain the item
 - 10. Performance characteristics and production rates
 - 11. A list of any license fees or royalties that must be paid
 - 12. A list of all variations for the item or method specified
 - 13. A list of at least three other projects of similar nature to this contract where the products or methods have been in use for at least one year including telephone number and name of the person to contact at these other projects
 - 14. An analysis of the effect of the substitution on the schedule and contract cost and on the overall project as it relates to adjoining work.

2.2 SUBSTITUTION REQUEST

- A. The formal request for substitution will be evaluated by the Denver Parks Representative and the Designer of Record based on the following criteria:

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1. Compatibility with the rest of the Project
 2. Reliability, ease of use and maintenance
 3. Both initial and long term cost
 4. Schedule impact
 5. The ability of the item or process to meet all applicable governing regulations, rules and laws along with funding agency requirements
- B. Based upon the above evaluation CDOT will make a final determination and either Accept or deny the requested substitution.

PART 3 - EXECUTION (NOT USED)

END OF SECTION 01630

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SECTION 01700

CONTRACT CLOSEOUT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work specified in this Section includes procedures required prior to Final Acceptance of the Work for Barnum Park East, in addition to those specified in Section 01720.

1.2 PREPARATION FOR FINAL INSPECTION

- A. Before requesting inspection for Final Acceptance of the Work for Barnum Park East by the City, inspect, clean and repair the Work as required.

1.3 FINAL INSPECTION

- A. When the Contractor considers that the Work for Barnum Park East is complete, he shall submit written certification that:
1. All punch list items have been completed.
 2. All clean up at the Project Site has been accomplished.
 3. Work has been inspected by the Contractor for compliance with Contract Documents.
 4. Work has been completed in accordance with contract documents.
 5. Work is ready for final inspection by the City.
 6. All As-Built required Documents have been submitted and Accepted.
 7. All damaged or destroyed real, personal, public or private property has been repaired or replaced.
 8. All operation and maintenance manuals have been submitted and Accepted and all training has been completed.
- B. The Project Manager will inspect to verify the status of completion with reasonable promptness after receipt of such certifications. The inspection of the Work will be done in accordance with the Contract requirements.
- C. If CDOT finds incomplete or defective Work:
1. The CDOT may, at its sole discretion, either terminate the inspection or prepare a punch list and notify the Contractor in writing, listing incomplete or defective Work.
 2. The Contractor shall take immediate steps to remedy stated deficiencies and send a second written certification to CDOT that Work is complete.
 3. CDOT will then re-inspect the Work.

END OF SECTION 01700

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SECTION 01710

CLEANING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The Work specified in this Section consists of maintaining a clean, orderly, hazard free worksite during construction, and final cleaning for CDOT's Final Acceptance. Failure to maintain the worksite will be grounds for withholding monthly payments until corrected to the satisfaction of CDOT.

1.2 JOB CONDITIONS

A. Safety Requirements

1. Maintain the worksite in a neat, orderly and hazard-free manner in conformance with all federal, state and local rules, codes, regulations and orders, including all OSHA requirements, until Final Acceptance of the Work. Keep catwalks, underground structures, worksite walks, sidewalks, roadways and streets, along with public and private walkways adjacent to the worksite, free from hazards caused by construction activities. Inspect those facilities regularly for hazardous conditions caused by construction activities.

B. Hazards Control

1. Store volatile wastes in covered metal containers and remove those wastes from worksite daily.
2. Do not accumulate wastes which create hazardous conditions.
3. If volatile and noxious substances are being used in spaces that are not naturally ventilated, provide artificial ventilation.
4. Hazard controls shall conform to the applicable federal, state and local rules and regulations.
5. Provide appropriate waste receptacles in all areas in which employees are working. Waste receptacles shall be kept covered at all times. All materials on site shall be anchored and covered to prevent any objects from becoming wind-borne.

C. Access

1. Maintain the worksite to permit access by other CDOT and City contractors as required and to allow access by emergency personnel.

PART 2 - PRODUCTS

2.1 CLEANING MATERIALS

- A. Utilize the type of cleaning materials recommended by the manufacturer for the surfaces to be cleaned.

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- B. Maintain current Material Safety Data Sheets (MSDS) on site for all chemicals.
- C. Ensure proper disposal of all wastes generated from the use of these materials. Must ensure compliance with all environmental regulations.

PART 3 - EXECUTION

3.1 INTERIM CLEANING

- A. Clean the worksite every shift/workday for the duration of the Contract. Maintain structures, grounds, storage areas and other areas of worksite, including public and private properties immediately adjacent to worksite, free from accumulations of waste materials caused by construction operations. Place waste materials in covered metal containers. All hard concrete, steel, wood and finished walking surfaces shall be swept clean daily.
- B. Remove or secure loose material on open decks and on other exposed surfaces at the end of each workday or more often in a manner that will maintain the worksite hazard free. Secure material in a manner that will prevent dislodgment by wind and other forces.
- C. Sprinkle waste materials with water or acceptable chemical palliative to prevent blowing of dust.
- D. Promptly empty waste containers when they become full and legally dispose of the contents at dumping areas off the Project.
- E. Control the handling of waste materials. Do not permit materials to be dropped or thrown from structures.
- F. Immediately remove spillage of construction related materials from haul routes, work site, private property or public rights of way.
- G. Clean only when dust and other contaminants will not precipitate upon newly painted surfaces.
- H. Cleaning shall be done in accordance with manufacturer's recommendation.
- I. Cleaning shall be done in a manner and using such materials as to not damage the Work.
- J. Clean areas prior to painting or applying adhesive.
- K. Clean all heating and cooling systems prior to operations. If the contractor is allowed to use the heating and cooling system it shall be cleaned prior to testing.
- L. Clean all areas that will be concealed prior to concealment.

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3.2 FINAL CLEANING

- A. Inspect interior and exterior surfaces, including concealed spaces, in preparation for completion and acceptance.
- B. Remove dirt, dust, litter, corrosion, solvents, discursive paint, stains and extraneous markings.
- C. Remove surplus materials, except those materials intended for maintenance.
- D. Remove all tools, appliances, equipment and temporary facilities used in the construction.
- E. Remove detachable labels and tags. File them with the manufacturer's specifications for that specific material for CDOT and the City's records.
- F. Repair damaged materials to the specified finish or remove and replace.
- G. After all trades have completed their Work and just before Final Acceptance, all catch basins, manholes, drains, strainers and filters shall be cleaned; roadway, driveways, floors, steps and walks shall be swept. Interior building areas shall be vacuum cleaned and mopped.
- H. Final cleanup applies to all areas within and adjacent to the Site.

END OF SECTION 01710

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SECTION 01720

CONTRACT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The Work specified in this Section consists of maintaining, marking, recording and submitting Contract record documents for Barnum Park East which include shop drawings, warranties, contract documents and contractor records.
- B. Reference Specification Section 02810 – Irrigation Systems.

1.2 SUBMITTALS

- A. Each submittal of record documents shall contain the following information:
 - 1. Date
 - 2. Project title and numbers
 - 3. Contractor's name and address
 - 4. Title and number of each record document
 - 5. Certification that each document as submitted is complete and accurate
 - 6. Signature of the Contractor or his authorized representative.
- B. At the completion of this Contract, deliver all record documents including the following:
 - 1. As-Built shop drawings, diagrams, illustrations, schedules, charts, brochures and other similar data
 - 2. Warranties and guarantees
 - 3. Contract record documents
 - 4. Contractor records.

1.3 QUALITY CONTROL

- A. Record documents shall be prepared to a high standard of quality, such as that set forth in MIL STD 100, ANSI Standard Drafting Manual Y14 or other relevant lower tier specification defining equal drafting quality for microfilming, except for daily reports.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 MAINTENANCE OF DOCUMENTS

- A. The Contractor shall maintain at the worksite on a current basis one record copy of all drawings, specifications, addenda, change orders, approved shop drawings, working draw-

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ings, product data and samples in good order and marked currently to record all changes made during construction.

B. Maintain at the field office one copy of the following record documents:

1. Contract Documents

- a. Contract Drawings with all clarifications, requests for information, directives, changes and as-built conditions clearly posted.
- b. Contract specifications with all clarifications, requests for information, changes, directives and record of manufacturer actually used along with product trade name.
- c. One set of drawings to record the following:
 - 1) Horizontal and vertical location of underground utilities affected by the Work.
 - 2) Location of internal utilities; include valves, controls, conduit, duct work, switches, pressure reducers, size reducers, transitions, crosses, tees, filters, motors, heaters, dampers, regulators, safety devices, sensors, access doors and appurtenances that are concealed in the construction shall be shown with dimensions given from a visible and recognizable reference to the item being located in all three dimensions. The drawing shall also reference the applicable submittal for the item being located.
 - 3) Field changes of dimensions and details including as-built elevations and location (station and offset).
 - 4) Details not on original Contract Drawings but obtained through requests for information or by other communications with CDOT and the City.

3.2 RECORDING

A. Keep record documents current daily.

B. Legibly mark copies of the drawings to record actual construction.

C. Legibly mark up each Section of the technical specifications and drawings to record:

1. Changes made by Change Orders, requests for information, substitutions and variations approved by submittals.

3.3 DOCUMENT MAINTENANCE

A. Maintain documents in a clean, dry and legible condition, which shall be turned over to CDOT and the City prior to Final Acceptance.

B. Make documents available for inspection by the CDOT and any others having jurisdiction.

END OF SECTION 01720

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SECTION 01730

OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The Work specified in this Section consists of preparing and submitting Barnum Park East operation and maintenance data for mechanical, electrical and other specified equipment.

1.2 SUBMITTALS

- A. Refer to Technical Specifications Section 01300 and 01340 for submittal procedures.
- B. Submit one (1) electronic copy and two (2) bound hard copy of the proposed Operation and Maintenance Data Manual format including a table of contents not less than ninety (90) days prior to final inspection.
- C. Submit one (1) electronic copy and two (2) bound hard copy of Operation and Maintenance Data Manual within ten days after system startup is complete. These copies shall incorporate any comments made on the previous submittals, along with final readings on all settings and gauges taken while the system is in fully satisfactory operation.

1.3 CONTINUOUS UPDATING PROGRAM

- A. Furnish one electronic copy of the Contractor's letter indicating that suppliers have been notified to provide updated operation and maintenance data, service bulletins and other information pertinent to the equipment, as it becomes available.

PART 2 - PRODUCTS

- A. The following products are the requirements of hard copies:
- B. PAPER SIZE 8-½ inches x 11 inches.
- C. PAPER White bond, at least 20 pound weight.
- D. TEXT typewritten.
- E. PRINTED DATA Manufacturer's catalog cuts, brochures, operation and maintenance data. Clear reproductions thereof will be acceptable. If this data is in color, all final manuals must contain color data.
- F. DRAWINGS 8-½ inches x 11 inches, bound with the text. Larger drawings are acceptable provided they are folded to fit into a pocket inside the rear cover of the manual. Reinforce edges of large drawings.

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- G. PRINTS OF DRAWINGS black ink on white paper, sharp in detail and suitable for making reproductions.
- H. FLYSHEETS Separate each portion of the manual with colored, neatly prepared flysheets briefly describing the contents of the ensuing portion.
- I. COVERS Provide 40 to 50 mil, clear plastic, front and plain back covers for each manual. The front covers shall contain the information required in paragraph 3.02 below.
- J. BINDINGS Conceal the binding mechanism inside the manual; lockable 3 ring binders shall be provided.

PART 3 - EXECUTION

3.1 GENERAL

- A. Assemble each operation and maintenance manual using the manufacturer's latest standard commercial data.

3.2 COVER

- A. Include the following information on the front cover and on the inside cover sheet:
 - 1. OPERATION AND MAINTENANCE INSTRUCTIONS
 - 2. (TITLE OF STRUCTURE OR FACILITY)
 - 3. (TITLE AND NUMBER OF CONTRACT)
 - 4. (CONTRACTOR'S NAME AND ADDRESS)
 - 5. (GENERAL SUBJECT OF THE MANUAL)
 - 6. (Leave spaces for signatures of the City representatives and acceptance date)

3.3 CONTENTS OF THE MANUAL

- A. An index of all volumes in each volume of multiple volume systems.
- B. An index in front of each volume. List and combine the literature for each system in the sequence of operation.
- C. Name, address and telephone numbers of Contractor, suppliers and installers along with the manufacturer's order number and description of the order.
- D. Name, address and telephone numbers of manufacturer's nearest service representatives.
- E. Name, address and telephone number of nearest parts vendor and service agency.
- F. Copy of guaranties and warranties issued to, and executed in the name of, the City.

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- G. Anticipated date City assumes responsibility for maintenance.
- H. Description of system and component parts including theory of operation.
- I. Pre operation check or inspection list.
- J. Procedures for starting, operating and stopping equipment.
- K. Post operation check or shutdown list.
- L. Inspection and adjustment procedures.
- M. Troubleshooting and fault isolation procedures for on-site level of repair.
- N. Emergency operating instructions.
- O. Accepted test data.
- P. Maintenance schedules and procedures.
- Q. Test procedures to verify the adequacy of repairs.
- R. One copy of each wiring diagram.
- S. One copy of each piping diagram.
- T. Location where all measurements are to be made.
- U. One copy of each duct diagram.
- V. One copy of control diagram.
- W. One copy of each accepted shop drawing.
- X. One copy of software programs imputable or changeable on site.
- Y. Manufacturer's parts list with catalog names, numbers and illustrations.
- Z. A list of components which are replaceable by the City.
- AA. An exploded view of each piece of the equipment with part designations.
- BB. List of manufacturer's recommended spare parts, current prices and recommended quantities for two years of operation.
- CC. List of special tools and test equipment required for the operation, maintenance, adjustment, testing and repair of the equipment, instruments and components.
- DD. Scale and corrosion control procedures.

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- EE. Disassembly and re-assembly instructions.
- FF. Troubleshooting and repair instructions.
- GG. Calibration procedures.
- HH. Ordering information.
- II. Training course material used to train City staff, including slides and other presentation material.

END OF SECTION 01730

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SECTION 01740

WARRANTIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The Work specified in this Section consists of preparing and submitting Barnum Park East warranties required by these specifications.

1.2 SUBMITTALS

- A. Refer to Section 01300 for submittal procedures.
- B. Submit executed warranties.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 WARRANTIES

- A. Execute the warranties required by the Contract Documents. Prepare and submit a list of all warranties on the form provided by the City. Reference Technical Specifications Section 01999.
- B. Provide warranties for the materials, labor and time period set forth in the sections of these specifications requiring such documents. All warranties shall be in accordance with the Contract. Refer to the technical specifications for all specific items requiring longer warranty periods.
- C. Provide all warranties that the manufacturer or supplier furnishes at no additional cost in regular commercial trade. All warranties shall be in accordance with the Contract. Refer to the technical specifications for all specific items requiring longer warranty periods.

END OF SECTION 01740

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SECTION 01999

STANDARD FORMS

PART 1 - GENERAL

1.1 FORMS

- A. The forms listed below and appended to this Section will be used for performance of the Work, as indicated, for Barnum Park East. This is not a complete listing of all required forms. The Contractor may be permitted to re-create some of the forms so that they are compatible with the Contractors project management system. However, Contractor must achieve prior approval from CDOT before using modified forms. The Contractor shall properly complete all forms required by CDOT. CDOT shall review and Accept all submitted forms. If submitted forms are not acceptable the Contractor shall resubmit forms in an acceptable format.

1.2 APPENDICES

- B. Attached to this Technical Specifications Section are the following (Sample) forms:
1. Contractor Warranty (Reference the Contract General Conditions)
 2. Contractor/Subcontractor Warranty (Reference the Contract General Conditions)

PART 2 - PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 COMPLETING FORMS

- A. All documents are to be filled digitally by the Contractor using the format provided by the Denver Parks Representative or using Adobe Acrobat 8 or newer. It is at the discretion of CDOT if other forms or formats will be accepted.

3.2 SIGNING FORMS

- B. Original hand written signatures are acceptable for all documents. The Contractor is to fill out the document as indicated above prior to signing the hard copy. If the form is to be submitted digitally to CDOT the document shall be scanned and saved as an Adobe Acrobat file.
- C. Digital signatures are acceptable for all documents. The Contractor is to fill out the document digitally in the format provided by the Denver Parks Representative or using Adobe Acrobat 8 or newer. The file must be signed using Adobe Acrobat 8 or newer and submitted digitally to the Denver Parks Representative.
1. Digital signatures must contain the name of signer in plain text and the time and date the signature is executed.

END OF SECTION 01999

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SECTION 02050

DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS: The Book 1 Contract requirements apply to Work of this Section.

1.2 SUMMARY:

A. Work Includes: Demolition and removal of asphalt and concrete pavements and curbs, restroom building, press boxes, fencing, mow strips, bleachers, railings, irrigation system, landscaping, signs, abandoned utilities and miscellaneous site furnishings; salvaging designated items including light fixtures and site furnishings; preserving and protecting site improvements to remain including pavements, curbs, mowstrips, fencing, backstops, light fixtures, site furnishings and landscaping. The work also includes incidental filling and grading, and disposal of unsalvageable materials.

B. Related Work:

1. Tree Protection and Retention - Section 02150
2. Earthwork - Section 02200

1.3 QUALITY CONTROL: Comply with safety requirements for demolition, ANSI A10.6-83. Erect suitable barriers around open excavations. No blasting or burning will be permitted.

1.4 PROJECT CONDITIONS:

A. Keep dust to a minimum at removal areas. Use water trucks as necessary.

B. Ensure safety of persons in demolition area. Provide temporary barricades as required.

PART 2 - PRODUCTS

2.1 FILL MATERIALS: Native soils, free of debris, frozen materials, and roots and other organic matter. See Section 02200 – Earthwork.

PART 3 - EXECUTION

3.1 PREPARATION:

A. Protect structures, pavement, trails, utilities, and vegetation to remain.

B. Set up all barriers, including those for tree protection, in accordance with Section 02150 - Tree Protection and Retention, prior to proceeding with any demolition.

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3.2 DEMOLITION:

A. Pavement, Slabs and Miscellaneous Concrete Items:

1. Remove concrete slabs-on-grade, curbs, and miscellaneous concrete items as directed. Where concrete to be removed abuts concrete to remain, pavement shall be uniformly saw cut along an existing joint. Jagged or crooked edges will not be acceptable. Concrete shall be broken up, hauled and disposed off site. All recyclable materials shall be hauled to nearest recycling center and any non-recyclable materials shall be hauled per the Materials Management Plan.
2. Remove asphalt paved roads, parking lots, walks, curbs and miscellaneous asphalt as indicated on drawings. Cuts between pavement to be removed and pavement to remain shall be saw cut to full depth, straight, smooth and clean with no jagged edges. Asphalt shall be broken up, hauled and disposed off site. All recyclable materials shall be hauled to nearest recycling center and any non-recyclable materials shall be hauled per the Materials Management Plan.
3. Remove concrete pipe sections and miscellaneous concrete items as directed.
 - a. Where concrete pipe is to be removed it shall be uniformly saw cut along an existing joint or disassembled at the joints. Jagged or crooked edges will not be acceptable. Concrete shall be broken up, hauled and disposed off site. All recyclable materials shall be hauled to nearest recycling center and any non-recyclable materials shall be hauled per the Materials Management Plan.
4. Remove road base material that is exposed after removing the pavement. This material shall be hauled and disposed off site unless otherwise directed by the CDOT. All recyclable materials shall be hauled to nearest recycling center and any non-recyclable materials shall be hauled per the Materials Management Plan.

- B. Abandoned Utilities: Remove aboveground utilities and terminate as approved by the utility company and the Denver Parks Representative. Remove necessary portions of underground utilities to within twenty-four (24”) inches of excavation or final grade. Cap off conduits with minimum twenty-four (24”) inch long concrete plugs.

3.3 RESTORATION:

- A. Backfilling: Ensure that areas to be filled are free of standing water, frost, frozen material, vegetation, including roots and debris. Place fill materials in accordance with Section 02200 - Earthwork.

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- B. Grading:
1. Restored Areas: Grade surface to blend with original contours and provide free drainage flow. All ruts and depressions where any amount of standing water collets shall be re-graded to a smooth natural appearance to ensure positive drainage.
 2. New Construction Areas: Grade as indicated in Section 02200.

END OF SECTION 02050

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SECTION 02110

CLEARING AND GRUBBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS: The Book 1 Contract requirements apply to Work of this Section.

1.2 SUMMARY:

A. Work Includes: Stripping sod, and removing and disposing of vegetation and debris.

B. Related Work:

1. Tree Retention and Protection - Section 02150
2. Tree Transplanting – Section 02910

1.3 DEFINITIONS:

- A. The term “sod stripping” shall be used when the vegetative material to be removed is mowable and generally less than twelve inches (12”) tall.
- B. The term “tree removal” refers to individual woody plants with a caliper over four inches (4”). Any removals shall be performed by a tree contractor licensed through Denver Forestry.
- C. The term “clearing and grubbing” refers to all other plant removals.
- D. The term “diseased trees” refers to trees that have been diagnosed with ailments or infestations that are harmful or fatal to the tree and that may be spread to other living plant material.

PART 2 - PRODUCTS

2.1 BACKFILL MATERIAL: On-site soils, unless otherwise specified.

PART 3 - EXECUTION

3.1 PROTECTION OF TREES AND PLANTS TO REMAIN: Locate and suitably identify trees and improvements indicated to remain. See Section 02150 – Tree Retention and Protection.

3.2 TRANSPLANTING: See Section 02910- Tree Transplanting.

3.3 CLEARING: Remove brush and vegetation from areas designated to be cleared. As directed by the Denver Parks Representative, trim low hanging, unsound, or unsightly branches on trees and shrubs designated to remain. All cuts shall be in accordance with current industry standards.

3.4 GRUBBING: Remove all stumps, roots, and debris a minimum of twelve inches (12”) below finish grade in all areas as required. Use hand methods for grubbing inside drip line of trees to remain. Backfill and compact stump and root holes to a maximum of eight-five percent (85%) Standard Proctor in landscape areas and ninety-five (95%) Standard Proctor under hardscape.

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- 3.5 SOD STRIPPING: Strip sod in all areas to be re-graded, so that a relatively clean dirt surface remains.
- 3.6 TREE REMOVAL: In all proposed landscaped areas, stumps and surface roots shall be ground a minimum of twelve inches (12”) below finish grade. In proposed hardscape areas, all roots shall be removed entirely.
- 3.7 DISEASED TREE REMOVAL AND DISPOSAL: The removal of diseased and infested trees includes the requirement of offsite burial of all parts of the trees immediately following removal. This includes logs, stumps, roots, branches and composted and un-composted chips. Under no circumstances should diseased or infected wood be left or taken for firewood, mulch or taken to a wood processing mill.
- 3.8 DISPOSAL: Haul and dispose of all removed materials, trash, debris and waste materials per the Materials Management Plan.

END OF SECTION 02110

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SECTION 02150

TREE RETENTION AND PROTECTION

PART 1: GENERAL

- 1.1 RELATED DOCUMENTS: Book 1 Contract Documents apply to Work of this Section as well as specified requirements for Barnum Park East provided herein.
- 1.2 SUMMARY: The work of this section consists of retention and protection of trees during the construction of the project.
- 1.3 GENERAL REQUIREMENTS:
 - A. There should be daily supervision of field crews by the Denver Parks Representative during the critical phases of the project: for example, demolition of existing concrete; root pruning; construction of retaining walls and construction of new curb or sidewalk in tree protection areas. Denver Parks Representative may require a consulting arborist be hired to oversee the Work.
 - B. If it appears that the completion of the construction may cause damage to the branches of any tree, the Contractor shall contact the Denver Parks Representative. The Denver Parks Representative will make a determination as to whether such damage is eminent.
 - C. To prevent or minimize soil compaction, designated routes for equipment and foot traffic by work crews shall be determined prior to commencing construction activities, and shall be indicated in the tree protection plan to be submitted by Contractor. These routes shall be marked at the site, prior to commencement of construction, with tree protection fencing and signage as specified in Paragraphs 3.6 and 3.7 of this section. A Tree Protection Plan shall be submitted for approval by the Denver Parks Representative.
 - D. Motorized equipment and trailers, including tractors, bobcats, bulldozers, rubber tired excavators, tracked excavators, trucks, cars, and carts shall not be allowed access within tree protection areas. Should access be necessary within designated tree protection areas, the existing grade shall be covered with 12” of wood mulch with overlapping ¾” plywood on top to help distribute the weight of equipment and to minimize soil compaction and rutting. Plywood and/or mulch is not acceptable bridging material for driving over exposed tree roots. Exposed tree roots shall not be driven over. The Denver Parks Representative or Project Consulting Arborist shall be notified and shall approve of the access and driving surface prior to its use.
 - E. Materials and supplies shall not be stockpiled or stored within the tree protection area. Should temporary storage be necessary within designated tree protection areas, the existing grade shall be covered with double, overlapping sheets of ¾ inch thick plywood and 12” of wood mulch to help distribute the weight of materials or supplies and to minimize soil compaction.

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- F. Under no circumstances shall any objects or materials be leaned against or supported by a tree's trunk, branches, or exposed roots. The attachment or installation to trees of any sign, cable, wire, nail, swing, or any other material that is not needed to help support the natural structure of the tree is prohibited. Standard arboricultural techniques such as bracing or cabling that are performed by professional arborists are acceptable upon approval by the Denver Parks Representative or Project Consulting Arborist.
- G. Appropriate tree pruning and/or removal permits must be secured prior to beginning work.

1.4 DEFINITIONS:

- A. **TREE PROTECTION AREA:** The tree protection area should consist of the ground encompassing from 1.5 (minimum) to 2.0 times the distance between the trunk and dripline, or one linear foot away from the trunk base for every inch diameter of the trunk, whichever is greater. (See section below). Areas of ground covered by pavement, buildings, or other permanent structures where the presence of roots is minimal or negligible, are excluded. The area under or within the tree's dripline is also referred to as the "Critical Root Zone" (see below).
 - 1. With groups of trees or where an array effect is present, there may be discontinuous (non-overlapping) perimeters of tree protection areas, which result in difficult to maintain or ineffective tree protection fencing. In these cases, even though tree protection areas do not overlap, they should be treated as though they do if the distance between the perimeters of such areas is less than thirty (30) feet. In effect, this will artificially enlarge the area of tree protection, but will result in a more clearly defined, manageable area.
- B. **DRIPLINE:** The outermost edge of the tree's canopy or branch spread. The area within a tree's dripline is all the ground under the total branch spread.
- C. **CRITICAL ROOT ZONE:** Shall be defined as the tree protection area encompassing from 1.5 (minimum) to 2.0 times the distance between the trunk and dripline, or one linear foot away from the trunk base for every inch diameter of the trunk, whichever is greater.
- D. **DIAMETER (CALIPER):** The size (in inches) of a tree's trunk is measured at:

Trunk Size	Where Measured
< 4"	6" above grade
4" – 8"	12" above grade
> 8"	54" above grade

Note: All measurements should be rounded up to the nearest inch.

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- E. HIGH-VALUE SHRUB: Any specimen shrub with an appraised value of \$100.00 or more.
- F. PROJECT CONSULTING ARBORIST: An independent consultant with a degree in a horticulture ,arboriculture, and/or ISA Certified Arborist, and at least five years field experience in tree preservation or on-site monitoring of public works or construction projects involving tree retention and protection. The Consultant should be an active member in the American Society of Consulting Arborists and/or International Society of Arboriculture.

1.5 REFERENCE STANDARDS AND GUIDELINES:

- A. Contractor shall comply with applicable requirements and recommendations of the most current versions of the following standards and guidelines. Where these conflict with other specified requirements, the more restrictive requirements shall govern.
 - 1. ANSI Z133.1-2006: American National Standard for Tree Care Operations
 - 2. ANSI A300: Tree, Shrub, and Other Woody Plant Management – Standard Practices
 - 3. Guide for Plant Appraisal-Current Edition: Authored by the Council of Tree and Landscape Appraisers; published by the International Society of Arboriculture

PART 2: PRODUCTS - Not applicable

PART 3: EXECUTION

- 3.1 CONSTRUCTION REQUIREMENTS: This section provides standards and guidelines for the retention and protection of trees and high-value shrubs for the project.
- 3.2 DEMOLITION OF EXISTING CONCRETE: Caution should be used during removal of existing street, curb, gutter, sidewalk, drain inlets, and other concrete and asphalt demolition, to minimize injury to tree root systems. The following procedures should be used when removing existing concrete.
 - A. Breaking of the existing concrete and asphalt for removal should be done in a manner that will minimize ground disturbance and vibration.
 - B. Curbs and sidewalks within designated tree protection areas and critical root zones shall be removed by hand. When removing existing sidewalks and curbs, care should be taken to avoid injury to roots located under, over, or adjacent to paved surfaces.
 - C. Roots and root-trunk flares growing over curbs should not be injured during breaking of curbs and removal of debris. Wood and bark tissues shall not be injured by striking tissues with equipment.

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- D. During the removal of concrete, all root systems and soil areas exposed shall not be disturbed.
- E. Motorized equipment and trailers, including but not limited to tractors, skid steers, bulldozers, rubber tired excavators, tracked excavators, trucks, cars, and carts are to be limited to access on the existing paved street only. Access is not allowed behind the curb within tree protection areas.
- F. Should access be necessary within designated tree protection areas, the existing grade shall be covered with double, overlapping sheets of ¾” thick plywood and 12” of wood mulch to help distribute the weight of equipment and to minimize soil compaction and rutting. Plywood and/or mulch is not acceptable bridging material for driving over exposed tree roots. Exposed tree roots shall not be driven over. The Denver Parks Representative or Project Consulting Arborist shall be notified and shall approve of the access and driving surface prior to its use.

3.3 CONSTRUCTION OF SIDEWALKS, CURBS, CONCRETE, ASPHALT PAVING AND DRAINAGE INLETS: The following procedures shall be used when constructing sidewalks, curbs, concrete, asphalt paving, and drainage inlets.

- A. Keep all materials and equipment within the street bounded by existing curbs.
- B. Protect exposed roots from contamination by stabilization materials and concrete.
- C. Locate concrete washout areas away from roots and tree protection areas.
- D. When excavating for the construction of inlets, excavated soil shall be deposited in trucks and hauled off or deposited temporarily on ¾ inch thick plywood outside the critical root zone. Excavated and fill soil shall not be deposited, even temporarily, on unprotected natural grade.
- E. After proper pruning, as needed, cover exposed roots within 30 minutes to minimize desiccation. Roots may be covered with soil, mulch, or moistened burlap (7 ounce or equivalent), and shall be kept moist during the period until the final grade is established.
- F. Where possible, construction should be relocated to prevent damage to existing roots. Where relocation of walks is not possible, walks should be constructed in a manner with the least amount of impact/damage to roots including but not limited to raised, narrowed, curbed, ramped, bridged, cantilevered, use of pylons, root break out zones, root channeling, structural cells to prevent cutting and removing major roots (e.g. roots greater than two inches in diameter).

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- G. Place a sheet of 6 mil or thicker plastic over the grade within affected portions of tree protection areas prior to pouring concrete sidewalks, curbs, inlets, ramps, and driveway approaches. The plastic will assist in providing a non-leaching barrier between the concrete, soil and roots.
- H. Construct new sidewalks on, or above, the existing grade instead of excavating into root zones. The new grade shall not interfere with sheet-flow drainage.
- I. Grading within the critical root zone shall consist of the ground encompassing from 1.5 (minimum) to 2.0 times the distance between the trunk and dripline, or one linear foot away from the trunk base for every inch diameter of the trunk, whichever is greater. Grading within the critical root zone shall be performed by hand. Any fill material that needs to be placed in the critical root zone shall be limited to a maximum of 1” of fill material over the critical root zone area. Fill should consist of sandy loam topsoil. Clay soils shall not be used as fill. When using fill soil, the existing surface to receive fill should be scarified by hand to a maximum depth of 1” from the finished grade prior to placing fill material., to ensure proper incorporation of fill material. Any filling operation should not occur during water saturated soil conditions.
- J. Existing soil may be used as a form for back of curb and gutter, with or without the use of a thin masonite-type form, although a masonite form is preferred. This will minimize excavation in the critical root zone and prevent undue injury to the roots. This method is unnecessary in areas outside the critical root zone. Place a layer of Typar BioBarrier between the curb and tree roots to help inhibit root growth that may exploit small cracks in the curb. Where appropriate, use curbs with discontinuous footings to maintain natural grade near the base of trees adjacent to the curbing, and to minimize injury to roots and root flares.
- K. Provide for easy concrete removal and replacement where an obvious raised root may cause sidewalk cracking in the future. This can be accomplished by installing an expansion joint on either side of the root or by etching the concrete on either side of the root to allow that particular section to be broken out and replaced. Compaction rating for the replacement walkway should not exceed 80% Proctor density. Tree roots will continue to slowly add girth every year; therefore, the base material needs to be malleable (e.g. suitable subgrade aggregates, crushed granite, or compacted sand) to prevent a fulcrum or pressure point which can crack or heave the walkway.
- L. Where appropriate, and under the direction of the Denver Parks Representative, root restricting barriers can be installed with a minimal amount of disturbance away from sidewalks, curbs and streets. Materials include:
1. Stiff nylon woven fabric – Style 899 nylon fabric with extra firm finish as manufactured by Jason Mills, Westwood, NJ;
 2. 8 Mesh Copper (.028” or greater) wire screen;
 3. Typar BioBarrier as manufactured by Reemay, Inc. Old Hickory, TN; or
 4. approved equal.

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- M. In areas where roots have to be removed for construction of drain inlets, roots shall be severed prior to excavation to eliminate unnecessary tearing of roots by equipment, refer to Root Pruning in Paragraph 3.5. Excavate soil by hand at the construction cut limit to a depth of 30” or to the depth of the required root cut, whichever is less. Prune roots as specified in this section. Protect exposed roots as specified in this section.
- N. Concrete or chemicals spilled within tree protection areas should be completely removed. Contamination soil shall be completely removed at the time of the spill and removed by hand and/or air spade tool without disturbance to root systems. Appropriate soil should be added as necessary to restore the grade. Contact the Denver Parks Representative immediately in the event of a spill within a tree protection area.

3.4 IRRIGATION OR UTILITY INSTALLATION:

- A. **PROTECTION OF TREES AND HIGH-VALUE SHRUBS:** Contractor shall protect all trees and high-value shrubs from injury due to irrigation related work. All injuries to trees and high-value shrubs shall be mitigated to the satisfaction of the City of Denver, and, if appropriate in accordance with guidelines established in the "Guide for Plant Appraisal". All injuries to trees and high value shrubs will be assessed by the City Forester. The City Forester may assess a fine per the provisions of the Denver Parks Permit.
 - 1. All irrigation lines shall be indicated on construction plans and pre-approved by the Denver Parks Representative. No irrigation lines shall be located within 10’ of any existing tree trunk, without prior approval of Denver Parks Representative.
- B. **EXISTING TREES:** The Denver Parks Representative or Project Consulting Arborist shall be notified prior to any trenching or excavation known or suspected to disturb more than ten percent (10%) of the critical root zone.
- C. Where it is necessary to excavate within the critical root zone of existing trees, the Contractor shall use all possible care to avoid injury to trees and tree roots. Where more than 10% of the critical root zone area is to be disturbed the Contractor shall notify the Denver Parks Representative or Project Consulting Arborist to review the conditions. Final approval must be provided by Denver Parks Representative or Project Consulting Arborist prior to excavation work. In areas where tunneling or boring are to occur all exposed roots shall be covered with moistened burlap to prevent drying of roots.
- D. When trenching or excavation within the critical root zone is to occur care shall be taken not to disturb roots contained within the structural root plate of the tree. The structural root plate shall be determined based on the following guidelines:

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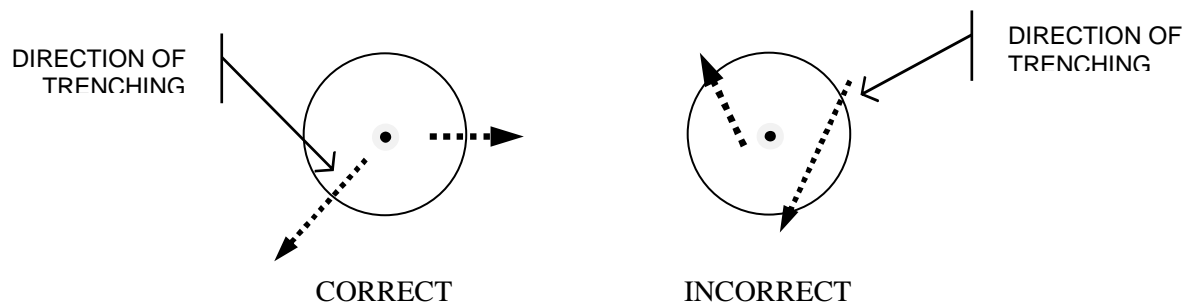
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Tree Diameter (in inches)	Structural Root Plate (in feet)
< 5	3
5	3.75
10	6
15	7.5
20	9
25	10
> 30	12

If trenching or excavation is to occur the following procedures shall apply:

1. If excavation, trenching or utility installation only occurs on one side of the tree or within a six (6") inch linear distance from the trunk base for every one (1") inch of trunk diameter, horizontal directional boring (auger tunneling), shall be used for irrigation or utility line installations.
 2. If excavation, trenching or utility installation will occur on two or more sides of a tree (e.g. N,S,E, or W) or is within one foot (1') foot linear distance from the trunk base for every One (1") inch of trunk diameter, then horizontal directional boring (auger tunneling) shall be used.
- E. All trenching or other work within the dripline of any tree shall be done by hand or other methods approved by the Denver Parks Representative, which will prevent breakage or other injury to branches and roots.
- F. Wherever a trenching machine exposes roots extending through the trench wall, those roots shall be hand pruned immediately, refer to Root Pruning, herein. All trenches within critical root zones shall be closed within twelve (12) hours; if this is not possible, the trench walls shall be covered with burlap and kept moistened. Prior to backfilling, the Contractor shall contact the Denver Parks Representative to inspect the condition and treatment of roots injured by trenching.
- G. Trenching within critical Root Zone shall be done perpendicular to the radial center of the tree and not through the critical root zone.



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3.5 ROOT PRUNING:

- A. Tree roots shall not be pruned or cut unless their removal is unavoidable or absolutely necessary. The Denver Parks Representative shall be notified prior to any operation known or suspected to involve cutting of more than:
1. The Denver Parks Representative or Project Consulting Arborist shall be notified immediately in the event that roots in excess of one-half ($\frac{1}{2}$) the diameter of the tree, as measured per this section, are cut, torn, ripped, or otherwise injured.
- B. Upon approval by the Denver Parks Representative, prior to any excavation, removal of sidewalk, or other activity that will result in removal of soil and tree roots, all tree roots within a designated area will be pruned to a depth of 14” inches. Pruning shall occur with a Dosko Root Pruner, or equivalent, in accessible areas, and by hand in areas inaccessible to the root pruning machine. All other root pruning shall be done by hand with approved tools.
- C. Removal of roots greater than one-half ($\frac{1}{2}$) the diameter of the tree, as measured per Section 1.4.D, or parts of roots that are injured or diseased should be performed as follows:
1. Preserve the root bark ridge (similar in structure and function to a branch bark ridge). Directional root pruning technique shall be used during hand excavation around tree roots. Roots are similar to branches in their response to pruning practices. With directional root pruning, objectionable and severely injured roots are properly cut to a lateral root $\frac{1}{3}$ the size of the root being cut, if possible, that is growing downward or in a favorable direction.
 2. All roots needing to be pruned or removed shall be cut cleanly with sharp hand tools, with oversight by the Denver Parks Representative or Project Consulting Arborist. No wound dressings shall be used.
 3. Recommended root pruning tools:
 - a. Scissor-type lopper.
 - b. Scissor-type pruner.
 - c. Large and small hand saws.
 - d. Wound scriber.
- D. Root Pruning Near Sidewalks
1. Root pruning should be done carefully, by hand, to achieve the objective of reducing future sidewalk problems as well as preserving the trees. Removing anchoring roots or causing injuries in anchoring roots and root flares can cause future decay and potential hazards. Indiscriminate cutting of vigorous roots results in their regeneration so that several more new roots may grow from the cut end, back under the sidewalk, thereby reducing the time between sidewalk repairs. Roots can be managed in the ground without significant harm to trees, if care is taken to avoid injuries that lead to root and trunk decay.

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2. Directional root pruning is recommended because it considers the tree's response to root pruning and decay. With directional root pruning, roots are cut to a lateral 1/3 the size of the root being cut, if possible, that is growing downward or in a more favorable direction. The pruned root ends will be less likely to regenerate, since a large lateral can assume the new terminal role of the root.
 3. Proper removal of selected roots or parts of roots can direct roots away from sidewalks in the future. Procedures for root pruning directly next to sidewalks are as follows:
 - a. Hand dig a trench six (6”) to eight (8”) inches in depth at the edge of the planting strip and sidewalk.
 - b. Remove all roots less than two (2”) inches in diameter in this trench back to a desirable lateral root, preserving the root bark ridge. If careful excavation does not reveal a desirable lateral root within twelve (12”) inches of the exposed root in question, then the exposed root shall be pruned properly so that a minimal amount of root is removed.
 - c. Small root bundles, the source of future sidewalk problems, should also be removed at this time.
- E. All roots one-half (½) the diameter of the tree caliper as measured per Section 1.4.D shall be examined by the Denver Parks Representative or Project Consulting Arborist in terms of their role in anchoring the tree.
1. All roots that contribute significantly to anchorage should be preserved. Remove all other roots in this size range to sound, downward growing lateral roots that are at least 1/3 the size of the root being removed.
 2. All roots larger than one-half (½) the diameter of the tree caliper as measured per Section 1.4.D diameter are to be preserved unless their removal is absolutely necessary and approved by the Denver Parks Representative. Preservation of large roots may require:
 - a. reducing the sidewalk width near the root flare; and/or
 - b. curving or relocating walk around root/root flare
 - c. ramping or bridging the sidewalk over the roots to allow for root growth
 - d. use of cantilever/pylon technology
 - e. establish root break out zones
 - f. root channeling
 - g. structural cells
- F. Tree guying subsequent to root pruning: Upon review of on-site root pruning and constructing grading limits, the Denver Parks Representative shall determine if existing trees subject to root pruning should be guyed or otherwise stabilized. Contractor shall retain a qualified tree service company to complete tree guying and stabilization in accordance with Tree Care Industry Association standards. Tree service company shall be licensed by the City and County of Denver, through the City Forester's Office.

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3.6 TREE PROTECTION FENCING:

- A. Tree protection fencing should be installed one (1') foot behind the existing curb in areas where the street surface will be removed and replaced. Tree protection areas shall be designated on construction documents, and fencing locations should be staked for approval by the Denver Parks Representative.
- B. Tree protection fences should be constructed of one of the following:
 - 1. Galvanized chain-link – 6' in height. Posts should be installed no less than 10' centers, at a depth of 36" minimum. Installation of post shall not result in injury to tree surface roots; root flares or branches.
 - 2. Colored (orange), molded plastic construction fencing-four 48" in height.
- C. Fencing should be installed to completely surround the limits of tree protection areas, and should extend at least 10' beyond the designated construction limits.
- D. Tree protection fencing shall be installed prior to any site activity and shall remain until its removal is authorized by the Denver Parks Representative.

3.7 TREE PROTECTION SIGNAGE: A standard Denver Forestry Tree Protection sign shall be mounted on tree protection fencing at 50' foot intervals warning construction personnel and the public to keep out of the tree protection areas. Signs may be picked up at the Denver Forestry office in the Webb Building at 201 W. Colfax Ave.

3.8 PROJECT SITE MONITORING: As determined by the Denver Parks Representative for projects of sufficient size to warrant such, a Project Consulting Arborist shall be retained to enforce and monitor the Tree Retention and Protection objectives. The Project site should be monitored a minimum of two (2) times weekly (more frequently at the start of the project) until all procedures and specifications are understood and properly executed by all parties. Specific monitoring schedules should be developed at preconstruction meetings and modified as deemed necessary by the appropriate parties. Schedules shall be relayed to the Denver Parks Representative along with reports of site visits.

3.9 INJURIES TO EXISTING PLANTS - FINES:

- A. Tree and High-Value Shrub Appraisal: All trees and high-value shrubs will be evaluated and appraised by the City Forester or Forestry Appointee, and a list of all tree values for the project will be on file in the Project Manager's office. Any tree or other plant requiring retention or protection that is not on the list shall be appraised by the City Forester or Project Consulting Arborist as necessary to comply with this damage fine.
- B. Documentation for appraisals will consist of :
 - 1. measurement of plant size;
 - 2. identification by common and botanical names;

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3. current condition (overall health, injuries, overt hazard status, etc.); and
 4. location factors as described in the most current addition of "Guide for Plant Appraisal". Photographs may be taken of certain trees and shrubs to document debilitating condition factors.
- C. The threshold level for plants to be appraised shall be \$100.00; only those trees and shrubs estimated to have a monetary value greater than \$100.00 shall be appraised.
- D. Trees and other plants designated as requiring retention or protection shall be identified and located on construction plans. Loss of, or partial injury to, any of these plants due to Contractor neglect or improper construction activities may result in a fine assessed by the City Forester per the provisions of the Denver Parks Permit.
- E. Trees determined as requiring “general protection” or “special protection” in the construction areas and in other key locations should be clearly identified by the Denver Parks Representative. Loss or partial injury to any of these trees due to Contractor neglect or improper construction activities may result in a fine assessed by the City Forester per the provisions of the Denver Parks Permit.
- F. A fine may be assessed by the City Forester per the provisions of the Denver Parks Permit for each incident of construction damage (including construction traffic) within designated tree protection areas. Any fine shall be independent of any applicable damages for the assessed value of the tree or tree part.
- G. Trees or roots visibly and unnecessarily injured may result in a fine assessed by the City Forester per the provisions of the Denver Parks Permit.

3.10 SUBMITTALS:

- A. Proposed methods and schedule for effectuating tree and other plant protection shall be submitted for approval. Contractor shall submit construction schedule which includes a time frame for work near existing plants. Approval of such shall be obtained from the Denver Parks Representative prior to commencement of construction near tree protection areas.
- B. Proposed methods, materials, and schedule for root pruning, branch pruning, and other tree maintenance shall be submitted for approval. The Denver Parks Representative shall mark the location of root pruning lines in the field prior to the operation. If possible, root pruning should occur between autumnal leaf fall and spring foliage. Root pruning during the growing season shall require approval of the Denver Parks Representative.

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- 3.11 TREE AND OTHER PLANT MAINTENANCE DURING AND AFTER COMPLETION OF CONSTRUCTION.
- A. Proper maintenance should include, but without limitation to: structural and remedial pruning; watering; mulching; remediating soil compaction; fertilization; insect and disease control; soil and tissue analysis; aeration; and wound treatment.
 - B. The timing duration and frequency of necessary maintenance practices should be determined and approved by the Denver Parks Representative, based on factors associated with the site and affected plants.
 - C. Submit maintenance schedule to Denver Parks Representative for approval prior to work beginning.

END OF SECTION 02150

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SECTION 02200

EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS: The Book 1 Contract requirements apply to Work of this Section.

1.2 SUMMARY:

- A. Work Included: Provide excavation, re-grading, stripping and stockpiling of topsoil, filling, backfilling, compaction, hauling, and legal off-site disposal of spoil materials to meet the required lines and grade as specified to complete the work.
- B. Related Work:
 - 1. Submittals – Section 01300
 - 2. Demolition - Section 02050.
 - 3. Tree Retention and Protection – Section 02150
 - 4. Clearing and Grubbing – Section 02110.
 - 5. Excavating and Backfilling of Trenches – Section 02220.
 - 6. Topsoil – Section 02925.

1.3 DEFINITIONS:

- A. Excavation consists of removal of material encountered to subgrade or over-excavation and subsequent disposal or placement of materials removed.
- B. Unclassified Excavation: The term "unclassified excavation", as used herein, includes the excavation of all materials required for the work obtained within construction limits of project, including bedrock, surface boulders, wasted sections of concrete, asphalt or other debris including historic landfills that may be encountered. All excavation will be considered unclassified regardless of the nature of material encountered.
- C. Unauthorized excavation consists of inadvertent or purposely removing materials beyond indicated subgrade elevations or dimensions without specific direction of the Denver Parks Representative. Unauthorized excavation, as well as remedial work resulting from unauthorized excavation shall be at Contractor's expense.
- D. Removal of unsuitable material and its replacement as directed will be paid on basis of Conditions of the Contract relative to changes in work.
- E. Subgrade: The undisturbed earth or the compacted soil layer immediately below proposed pavement topping materials.
- F. Structure: Walls, foundations, slabs, pavement or other man-made stationary features occurring above or below ground surface.
- G. Structural Fill: The term "structural fill", as used herein, includes soil materials used for general site filling under pavements or structures.

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1.4 QUALITY CONTROL:

- A. Codes and Standards: Comply with all applicable local, state and Federal rules, regulations and ordinances concerning sloping of excavation, trenching and safety of workers, including the latest version of OSHA requirement.
- B. Referenced Standards: Comply with the requirements of the reference standards noted herein, except where more stringent requirements are listed herein or otherwise required by the Contract Documents, to include specifications of local agencies exercising jurisdiction over this project.

1.5 PROJECT CONDITIONS:

- A. Existing Utilities: The Contractor shall contact all public utility companies and determine the location of all existing underground utilities, both public and private, prior to proceeding with construction. All work performed in the area of public utilities shall be performed according to the requirements of these agencies. The Contractor shall be responsible for locating any existing utility (including depth) which may conflict with the proposed construction. The Contractor shall contact Utility Notification Center of Colorado at 811 and other local utilities for existing utility locations. The Contractor shall protect, at his own expense, all existing utilities and be responsible for their repair if they are damaged during construction.
- B. Use of Explosives: Use of explosives is not permitted.
- C. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.
 - 1. Operate warning lights as recommended by authorities having jurisdiction.
 - 2. Protect structures, utilities, walkways, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- D. Environmental Requirements: Blasting is not permitted. Employ jack hammering and other loud noises and methods sparingly; comply with all applicable noise abatement ordinances or regulations. Onsite burning is not allowed.
- E. Existing Benchmarks: Carefully preserve and maintain existing benchmarks, vertical/horizontal control, monuments, property line pipes and pins, and other reference points. If disturbed or destroyed, restore or replace at no additional cost to CDOT.

1.6 SUBMITTALS:

- A. Provide one (1) cubic foot sample of imported material for approval by Denver Parks Representative and CDOT.

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- B. Contractor shall provide as part of the Submittals for imported materials at a minimum gradation tests, liquid limit, plasticity index and standard proctor density test. Depending on the use of the imported backfill materials the Denver Parks Representative and CDOT may request that a soils analysis be performed to determine percent organic content of the soils, and salt levels.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS:

- A. General: All fill material, regardless of intended use category, must be clean and free from organic matter, roots, brush or other vegetation, trash, debris or other detrimental substances, and rocks or unbroken lumps larger than three inch (3"). Denver Parks Representative to approve material prior to placement.
- B. Structural Fill: Existing soils obtained from on-site excavations, including granular or aggregate base course from removed pavements shall be free of organic matter or any other deleterious substances, including overly wet soils, bedrock, or high swell content soils. If sufficient materials meeting the above requirements are not available from on-site sources, provide additional material obtained from off-site sources and approved by the testing and inspections agency, at no additional cost to CDOT. The Contractor's geotechnical engineer will evaluate the suitability of proposed fill material prior to placement. The soil must be compactable and pass at minimum a proof roll prior to being accepted for supporting paving materials.
- C. On-Site Topsoil: The top four inches (4") of organic material in the excavation zone shall be stripped and stockpiled prior to other earthwork operations.
- D. Imported topsoil: Imported topsoil shall meet the requirements of section 02925 Topsoil.
- E. Infield Soil Mix: Infield soil mix shall be Razum Red Infield Mix with Stabilizer, available from Golf and Sport Solutions, 303-961-0141. Infield soil mix shall meet the following gradation and composition:

Sieve Size (mm)	% Retained		
#6/3.40	0.1		
#10/2.00	2.9		
#18/1.00	13.2		
#35/.050	15.7		
#60/0.25	10.7		
#140/0.15	6.4		
#270/0.05	14.2		

Stabilizer®	8#/s/ton		
USDA Texture	Sandy/loam		
Sand	65.9 %		
Silt	19.0 %		
Clay	15.1 %		

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PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Verification of Conditions: Examine areas and conditions under which the Work of this Section will be performed. Do not proceed with the Work until unsatisfactory conditions have been corrected. Commencement of work implies acceptance of all areas and conditions.

3.2 GENERAL PROCEDURES:

- A. Existing Public Utilities: Locate existing underground utilities in areas of the Work. If utilities are to remain in-place, provide protection during earthwork operations. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult CDOT immediately for direction. Cooperate with utility companies in keeping respective permanent and temporary utility services and facilities in operation. Repair damaged utilities to the satisfaction of the appropriate utility company.
- B. Existing Private Utilities: Contractor shall contact existing private utility owners to locate utilities. Contractor is responsible for providing written and graphical documentation from private utility owner. Documented “All Clear” needs to be provided in written format. Verbal “All Clears” will not be accepted.
- C. Protect of Persons and Property: Provide all necessary measures to protect workmen and passersby. Barricade open excavations occurring as part of the work, as required by municipal or other authorities having jurisdiction.

3.3 GROUND SURFACE PREPARATION:

- A. Complete clearing and grubbing operations in accordance with Section 02110. Where new material is to be placed on compacted subgrade, scarify ground surface until surface is free from ruts, hummocks or other uneven features, which would prevent uniform compaction and bond between old and new material.
- B. Prior to placing asphalt or concrete pavement, the entire subgrade shall be scarified to a depth of eight inches (8”). Adjust moisture content and compact as hereinafter specified.

3.4 STRIPPING AND STOCKPILING TOPSOIL:

- A. Strip all topsoil from the excavation zone for new facilities (four inch (4”) depth for all disturbed areas). Stockpile topsoil in locations indicated on the Drawings or as directed by the Denver Parks Representative.

3.5 EXCAVATION:

- A. All excavation shall be considered unclassified, including excavation to subgrade or trench elevations as indicated, regardless of character of materials and obstructions encountered.

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- B. Stability of excavations: Comply with local codes, ordinances, and requirements of agencies having jurisdiction to include the latest revision to OSHA standards.
- C. Excavation for Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus one-tenth foot (+/- 0.1'), and extending a sufficient distance to permit installation of services and other construction, and for inspection.
- D. Excavation for Pavements: Cut surface under pavements to comply with cross-sections, elevations and grades as indicated within a tolerance of plus or minus one-tenth foot (0.1').

3.6 DEWATERING:

- A. Wherever possible, prevent surface water and subsurface or groundwater from flowing into excavations and from flooding the project site and surrounding area.
- B. Contractor shall be required to dewater excavated areas by pumping, or otherwise control the water so that the project can be constructed in accordance with the plans. Any controlling of the water must be performed in such a manner that recently constructed portions of the project are not damaged. Repairs shall be at the Contractor's expense.
- C. Damage to adjacent property that results from the Contractor's alteration of any surface drainage, ground water flows or pumped water shall be repaired by the Contractor at no additional cost CDOT.

3.7 SPECIAL CONDITIONS:

- A. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than thirty-five degrees F (35°).
- B. Dust Control: Provide dust control to alleviate dust nuisance to the public, to adjacent properties and other work underway at the project site.
- C. Unanticipated Conditions: Notify the CDOT immediately upon finding subsurface or other conditions which are not shown or which cannot be reasonably assumed from existing surveys. Secure CDOT's instructions before proceeding with further work in such areas.
- D. Unsatisfactory Soils: Remove or otherwise correct unsanitary, sour, or otherwise unsatisfactory soil. Remove contaminated or unsuitable material from under paved areas.
- E. Additional Excavation: If unsuitable bearing materials are encountered at required subgrade elevations, carry excavations deeper and replace excavated material as directed by the Contractor's geotechnical engineer.

3.8 FILL AND BACKFILL:

- A. General: Place soil material in layers to required subgrade elevations, for each area classification listed below, using materials specified in this Section.

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1. Under grassed areas, use satisfactory excavated or borrow material.
2. Under walks and pavements, use satisfactory excavated or borrow materials, or a combination to meet structural fill requirements.

B. Backfill excavations as promptly as work permits, but not until completion of the following:

1. Inspection, testing, approval, and recording locations of underground utilities have been performed and recorded.
2. Removal of all trash and debris from excavation.

3.9 PLACEMENT AND COMPACTION:

A. Ground Surface Preparation: Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Ground surfaces that are steeper than four to one (4:1) (horizontal to vertical) shall be stripped of vegetation, scarified to a depth of six inches (6”) and create excavated benches to ensure that fill material will bond with the existing surface.

1. For any soils that do not meet the specified standard proctor density, contact the project Contractor’s geotechnical engineer for recommendations on improving the condition of the existing soils to meet required specifications.
2. Adjust moisture condition to Contractor’s geotechnical engineer recommendations regarding optimum moisture content, and re-compact to the densities specified in Section 3.9.J.

B. Place backfill and fill materials in layers not more than eight inches (8”) in loose depth for material compacted by heavy compaction equipment, and not more than four inches (4”) in loose depth for material compacted by hand-operated tampers, each layer to be compacted to meet requirements herein.

C. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

D. Compaction of Fill for Hardscape Areas:

1. Select fill material shall be placed and mixed in evenly spread layers. After each fill layer has been placed, it shall be uniformly compacted. Fill materials shall be placed such that the thickness of loose material does not exceed eight inches (8”) and the compacted lift thickness does not exceed six inches (6”).
2. Compaction shall be obtained by the use of sheepfoot rollers, multiple-wheel pneumatic-tired rollers, or other equipment approved by the Contractor’s geotechnical engineer. Granular fill shall be compacted using vibratory equipment or other equipment approved by the Contractor’s geotechnical engineer. Compaction of

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each layer shall be continuous over the entire area. Compaction equipment shall make sufficient passes to ensure that the required density is obtained. Refer to Paragraph 3.9 H and I for criteria.

3. Prior to placement of any base or surfacing materials, one-hundred percent (100%) of the subgrade shall be proof rolled with a fully loaded tandem-axle truck.

E. Compaction of Landscape Slope Areas:

1. Fill slopes shall be compacted by means of sheepsfoot rollers or other suitable equipment. Compaction operations shall be continued until slopes are stable, but not too dense for planting, and there is not appreciable amount of loose soils on the slopes. Permanent fill slopes shall not exceed four to one (4:1) (horizontal to vertical).
2. Where natural slopes are steeper than twenty percent (20%) in grade and the placement of fill is required, cut benches shall be provided at the rate of one bench for each five feet (5') in height (minimum of two benches). Benches shall be at least ten feet (10') in width. Fill shall be placed on completed benches as outlined within this specification.

F. Place backfill and fill materials evenly adjacent to structures, piping, or conduit to required elevations. Prevent wedging action of backfill against structures by carrying material uniformly around structure, piping, or conduit to approximately same elevation in each lift.

G. Control soil and fill compaction, providing minimum percentage of density specified. Correct improperly compacted areas or lifts as directed if soil density tests indicate inadequate compaction.

H. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade or layer of soil material. Apply water in minimum quantity as necessary to prevent free water from appearing on surface during or subsequent to compaction operations.

1. Moisture Content: The Contractor may be required to add moisture to the excavation materials in the stockpile area if, in the opinion of the Contractor's geotechnical engineer, it is not possible to obtain uniform moisture content by adding water on the fill surface. The Contractor may be required to rip or disc the fill soils to provide uniform moisture content through the soils.
2. The application of water to the embankment materials shall be made with any type of watering equipment approved by the Contractor's geotechnical engineer, which will give the desired results. Water jets from the spreader shall not be directed at the embankment with such force that fill materials are washed out.
3. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.
4. Stockpile or spread soil material that has been removed because it is too wet to permit compaction. Assist drying by disking, harrowing, or pulverizing until moisture content is reduced to a satisfactory value.

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- I. Density Tests: Field density tests shall be made by the Contractor at locations and depths selected by the Denver Parks Representative. Where sheeps foot rollers are used, the soil may be disturbed to a depth of several inches. Density tests shall be taken in compacted material below the disturbed surface. When density tests indicate that the density or moisture content of any layer of fill or portion thereof is below that required, the particular layer or portion shall be reworked until the required density or moisture content has been achieved. Criteria for acceptance are as follows:
 1. Under pavements and structures: Intervals and quantities of tests required shall be established by the Contractor's geotechnical engineer and approved by CDOT and the Denver Parks Representative. On-site or imported materials shall be compacted per the recommendations of the Contractor's geotechnical engineer.
 2. Under landscape areas (top twelve inches (12")): On-site or imported materials shall be compacted per the recommendations of the Contractor's geotechnical engineer.

3.10 GRADING:

- A. General: Uniformly grade areas within project limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations or contours are indicated or between such points and existing grades.
- B. Subgrade tolerances are as follows:
 1. Lawn or Unpaved Areas: Finish areas to receive topsoil to within not more than one-tenth foot (0.10') above or below required subgrade elevations.
 2. Pavements: Shape surface of areas under pavement to line, grade, and cross-section, with finish surface not more than two-hundreds feet (0.02') above or below required subgrade elevation.
- C. Under no circumstances shall variations from specified grade elevations create any ponding or retention of water on intermediate pavement levels, or finished surfaces.

3.11 PLACING STOCKPILED TOPSOIL:

- A. Refer to Section 02925.

3.12 MAINTENANCE:

- A. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades in settled, eroded, and rutted areas to specified tolerances.
- C. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.

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- D. Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn, or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.13 DISPOSAL OF EXCESS AND WASTE MATERIALS:

- A. Removal from City's Property: Remove waste materials, including materials not allowed for fill, backfill or site grading as specified within, trash, contaminated materials, and debris, and legally dispose of it per the Materials Management Plan.
- B. Remove any excess fill material from the site, unless otherwise directed by the Denver Parks Representative.
- C. Remove any materials determined to be hazardous or contaminated per the Materials Management Plan.

END OF SECTION 02200

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SECTION 02220

EXCAVATING AND BACKFILLING OF TRENCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS: The Book 1 Contract requirements apply to Work of this Section.

1.2 SUMMARY:

- A. Work Included: Excavate and backfill for all piping or other conduits and related appurtenances, as shown on the plans and as specified herein. All work shall be done in conformance with the Detail and Technical Specifications for Storm Drainage and Sanitary Sewer Construction - 4.0 Utility Trenching and Excavation and 5.0 Bedding and Backfilling, available from Denver Wastewater Management Division.

<http://www.denvergov.org/WMDDesign/StormDrainSantConstrDetailTechSpecs/tabid/395956/Default.aspx>

- B. Related Work: Contractor shall comply with the requirements of the following Sections when installing underground utilities.

1. Layout of Work and Surveying – Section 01050
2. Clearing and Grubbing - Section 02110.
3. Tree Retention and Protection - Section 02150
4. Soil Preparation - Section 02920
5. Topsoil - Section 02925
6. Turfgrass Seeding - Section 02932
7. Native Seeding - Section 02933
8. Sodding - Section 02935

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 02220

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SECTION 02505

CRUSHED STONE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS: The Book 1 Contract requirements apply to Work of this Section.

- A. Work Includes: Furnishing and placing crushed stone paving, bonded with fine aggregate, constructed on a prepared underlying base course in accordance with these specifications and in conformity with the dimensions, typical cross section, and the lines and grades shown on the Drawings.
- B. Related Work:
 - 1. Layout of Work and Surveying – Section 01050
 - 2. Submittals – Section 01300
 - 3. Earthwork – Section 02200.

1.2 SUMMARY: This work consists of furnishing and placement of crushed stone paving.

1.3 SUBMITTALS:

- A. Material Analysis: Contractor shall provide copies of the following test data required by ASTM:
 - 1. ASTM C136 - Sieve Analysis
 - 2. ASTM C127 - Specific Gravity and Absorption
 - 3. ASTM C131 - L.A. Abrasion
- B. Provide a one (1) pound sample of material for approval.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Granite Sand: Material shall be generated from quarries where granite is mined and shall comply with ASTM C 136. The following gradation is required:

Sieve size	% passing
3/8"	100
#4	70-100
#8	50-75
#16	30-65
#30	20-45
#50	10-30
#100	2-20
#200	0-15

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PART 3 - EXECUTION

3.1 PLACEMENT

- A. Cut earthwork to width of pavement and approximate depth for the five inch (5”) trail section as specified on the Drawings and Details. Remove, haul and dispose of excess material off site.
- B. Prior to placement of Crushed Stone Paving material, the sub-grade shall be proof rolled. Where soft spots are detected, scarify subgrade beneath Crushed Stone Paving to a minimum of six inch (6”) depth. Moisture treat and compact to a minimum ninety-five percent (95%) proctor density as determined by ASTM D698 or AASHTO T-99. Take moisture density tests every two-hundred-fifty linear feet (250 lf) of trail or proof roll. Treat and compact sub-grade, leaving it five inches (5”) below final grade for placement of Crushed Stone Paving. Compact material and retest by proof rolling.
- C. Spread Crushed Stone Paving. Rake the Crushed Stone Paving smooth, roll and compact to meet proposed grade. Establish cross-slope for drainage across the trail as specified in the Drawings. If ground is level, crown the paving to have positive drainage off both sides.
 - 1. If the paving is part of a cross slope it should drain in the direction of the slope no greater than two percent (2%). Ensure that no low spots exist so that ponding does not occur.
 - 2. Roll Crushed Stone Paving to ensure specified compaction density is achieved.

END OF SECTION

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SECTION 02510

ASPHALT PAVEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS: The Book 1 Contract requirements apply to Work of this section.

1.2 SUMMARY:

- A. The work of this section consists of constructing one or more surface courses composed of a mixture of aggregate, filler if required, and bituminous material, placed on a prepared base.
- B. Related work:
 - 1. Layout of Work and Surveying - Section 01050
 - 2. Submittals – Section 01300
 - 3. Earthwork – Section 02200.
 - 4. Excavating and Backfilling of trenches – Section 02220
 - 5. Concrete Walks, Curbs and Miscellaneous Flatwork – Section 02520

1.3 REFERENCES: As required for Work in Barnum Park East, plant mix pavements for this project shall be done in accordance the Metropolitan Government Pavement Engineers Council (MGPEC) Specification Item 9 for Hot Mix Asphalt Pavement (HMA) and Stone Matrix Asphalt (SMA). The latest issue, is available from Mgpec.org.

- A. The MGPEC specifications to be used for this Project are written as a stand-alone document. Included with the specifications Item 9 for mix identifying Asphalt Mixture criteria (grading, binder, %RAP and design level).

1.4 TESTING REQUIRMENTS

Testing requirements shall be as per Book 2 Section 3 – Quality Management

1.5 SUBMITTALS:

- A. Refer to the City and County of Denver Right of Way Services approved materials list of pre-approved concrete mixes at the following website:

<http://denvergov.org/rightofwayservices/RightofWayServices/ConstructionInspection/RightofWayConstructionInspection/ApprovedMaterials/tabid/442460/Default.aspx>

- B. Mix Designs:

- 1. Submit substantiating data for each Asphalt mix design per the requirements of Book 2 Section 7 – Quality Management.

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PART 2 - PRODUCTS

- 2.1 Refer to MGPEC Specification Item 9 for Hot Mix Asphalt Pavement (HMA) and Stone Matrix Asphalt (SMA). The latest issue, is available from Mgpec.org.

PART 3 - EXECUTION

- 3.1 Refer to MGPEC Specification Item 9 for Hot Mix Asphalt Pavement (HMA) and Stone Matrix Asphalt (SMA). The latest issue, is available from Mgpec.org.

- A. Pavement sections shall be installed in accordance to the following and the Contractor's geotechnical report:

1. Parking Lot Asphalt Pavement
 - a. Sub-grade shall be reconditioned to a minimum depth of eight inches (8") or as required per the geotechnical data, whichever is greater. The sub-grade shall be moisture conditioned and compacted to a ninety-five percent (95%) proctor density.
 - b. Base course shall be a minimum six inch (6") thickness, moisture conditioned and compacted to a ninety-five percent (95%) proctor density in accordance with Aggregate Base Course - Section 02232.
 - c. Parking areas shall have a minimum asphalt thickness of five inches (5").
 - d. Total thickness of pavement section is eleven inches (11").
2. Main drive isles Asphalt Pavement
 - a. Sub-grade shall be reconditioned to a minimum depth of eight inches (8") or as required per the geotechnical data, whichever is greater. The sub-grade shall be moisture conditioned and compacted to a ninety-five percent (95%) proctor density.
 - b. Base course shall be a minimum six inch (6") thickness, moisture conditioned and compacted to a ninety-five percent (95%) proctor density in accordance with Aggregate Base Course - Section 02232.
 - c. Main drive isles shall have a minimum asphalt thickness of six inches (6").
Total thickness of pavement section is twelve inches (12").

3.2 QUALITY CONTROL TESTING DURING CONSTRUCTION

- 1 All testing shall be completed according to requirements of Book 2 Section 3 – Quality Management.

END OF SECTION 02510

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SECTION 02520 CONCRETE WALKS, CURBS AND MISCELLANEOUS FLATWORK

PART 1: GENERAL

1.1 RELATED DOCUMENTS: Book 1 Contract requirements apply to Work of this section.

1.2 SUMMARY:

A. Work Includes: Constructing concrete The work in this section consists of furnishing, placing, shoring, bracing, and anchorage of formwork, concrete reinforcement, accessories, and placing concrete flatwork, including walks, curbs and gutters, ramps, and pans, including installation of control and expansion joints, concrete curing and concrete finishing.

B. Related Work:

1. Layout of Work and Surveying – Section 01050
2. Submittals – Section 01300
3. Earthwork – Section 02200
4. Cast In Place Concrete – Section 03300

1.3 REFERENCES:

Note: All references below shall be from the most current edition.

- A. ACI 117 - Standard Tolerances for Concrete Construction and Materials.
- B. ACI 301 - Specifications of Structural Concrete for Buildings.
- C. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
- D. ACI 305 and 306 - Hot and Cold Weather Protection for Concrete.
- E. ACI 315 - Details and Detailing of Concrete Reinforcement.
- F. ACI 318 - Building Code Requirements for Reinforced Concrete.
- G. ACI 347 - Recommended Practice for Concrete Formwork.
- H. ANSI/ASTM A82 - Cold Drawn Steel Wire for Concrete Reinforcement.
- I. ANSI/ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement.
- J. ASTM A615 - Deformed and Plain Billet-Steel for Concrete Reinforcement.

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- K. ASTM C33 - Concrete Aggregates.
- L. ASTM C94 - Ready-Mixed Concrete.
- M. ASTM C150 - Portland Cement.
- N. ASTM C260 - Air Entraining Admixtures for Concrete.
- O. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.
- P. ASTM C494 - Water Reducing Admixtures for Concrete.
- Q. ASTM C618 - Fly Ash Mineral Admixture for Concrete.
- R. ASTM C672 - Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals.
- S. ASTM-C800 - Curing Compound, Concrete, for New and Existing Surfaces.
- T. CRSI - Manual of Standard Practice.
- U. Colorado Department Of Transportation (CDOT) – Standard Specifications for Road and Bridge Construction

1.4 QUALITY ASSURANCE

- A. All concrete for flatwork shall be Class P (4200 PSI) unless otherwise requested by the Denver Parks Representative. Testing shall be in accordance with Book 2 Section 3 – Quality Management.
- B. Sample Panel: If requested by the Denver Parks Representative, prior to starting any concrete paving, provide a sample panel using materials indicated for Project Work. Build panel at the site of full thickness and approximately 10 feet by 10 feet, including expansion joints, control joint, scales, fillers, and one radial edge. Provide the workmanship proposed for the work. Correct and replace sample panel until Denver Parks Representative’s acceptance of the work. Retain panel during construction as a standard for completed paving work.
- C. The approved sample panel may be a portion of the work and remain in place. Locations as directed by the Denver Parks Representative.

1.5 SUBMITTALS:

- A. Mix Designs:

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1. Submit substantiating data for each concrete mix design specified for use to CDOT and Denver Parks Representative not less than four (4) weeks prior to first concrete placement. Data for each mix shall, as a minimum, include the following:
 - a. Mix identification designation (unique for each mix submitted).
 - b. Statement of intended use for mix.
 - c. Mix proportions.
 - d. Admixtures (must be approved by the CDOT and the Denver Parks Representative)
 - e. Wet and dry unit weight.
 - f. Entrained air content.
 - g. Design slump.
 - h. Strength qualification data.

1.6 DELIVERY, STORAGE AND HANDLING:

- A. General: Materials handling and batching shall conform to applicable provisions of ASTM C94.
- B. Reinforcing: Unload and store reinforcing bars so they are kept free of mud and damage.
- C. Hauling Time for Concrete: Deliver and discharge all concrete transmitted in a truck mixer, agitator, or other transportation device not later than one and one-half (1-1/2) hours, or three-hundred (300) revolutions of the drum after the mixing water has been added, whichever is earliest.
- D. Extra Water:
 1. Deliver concrete to site in exact quantities required by design mix.
 2. Should extra water be required for workability before depositing concrete, and the water/cement ratio of accepted mix design will not be exceeded, the Project Manager shall have the sole authority to authorize addition of water. Additional water shall not exceed one (1) gal/cu. yd. Any additional water added to mix after leaving batch plant shall be indicated on truck ticket and signed by person responsible.
 3. Where extra water is added to concrete it shall be mixed thoroughly for thirty (30) revolutions of drum before depositing.
 4. Water may be added at the site only once for each batch.
 5. A full set of tests shall be performed after addition of water. Excessive slump or other out of range tests will be cause for rejection.

1.7 PROJECT CONDITIONS:

- A. Environmental Requirements:

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1. Cold Weather Placement:
 - a. When for three successive days prior to concrete placement the average daily outdoor temperature drops below forty degrees (40°) F or when the average outdoor temperature is expected to drop below forty degrees (40°) F on the day of concrete placement, preparation, protection and curing of concrete shall comply with ACI 306R
 - b. Minimum temperature of concrete upon delivery shall conform to ACI 301 Table 7.6.1.1. Concrete at time of placement shall conform to minimum values of ACI 306R Table 1.4.1, and shall not exceed minimum values by more than twenty degrees (20°) F.
 - c. Subject to acceptance of the Denver Parks Representative an accelerating admixture may be used. Admixtures shall meet requirements of Part 2. Calcium Chloride and other chloride-type accelerating admixtures are not allowed.
 - d. Comply with concrete protection temperature requirements of ACI 306R. Record concrete temperatures during specified protection period at intervals not to exceed sixteen (16) hours and no less than twice during any twenty-four (24) hour period.

2. Hot Weather Placement:
 - a. When depositing concrete in hot weather, follow recommendations of ACI 305R.
 - b. Temperature of concrete at time of placement shall not exceed eighty-five degrees (85°) F.
 - c. When air temperatures on day of placement are expected to exceed ninety degrees (90°) F, mix ingredients shall be cooled before mixing. Flake ice or well-crushed ice of a size that will melt completely during mixing may be substituted for all or part of mix water.
 - d. Retarding admixture may be used subject to acceptance of the Denver Parks Representative. Admixtures shall meet requirements of Part 2.
 - e. Protect to prevent rapid drying. Start finishing and curing as soon as possible.

- B. Protection: Protect newly finished slabs from vandalism and all weather related damage. Protect finished slabs from mortar leakage from pouring of concrete above. Cover masonry walls, glazing, and other finish materials with polyethylene or otherwise protect from damage due to pouring of concrete.

PART 2: PRODUCTS

- 2.1 **SUBGRADE MATERIAL:** Dense, readily compactible material, free from organic matter, clay, and loose rock in excess of 1-1/2". Material excavated from on-site that meets this requirement may be used if approved by Denver Parks Representative.

- 2.2 **FORM MATERIALS:**

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- A. Hand Placed Steel Forms: Hand placed steel forms are only to be used for sections that are straight and have no bend, radii or curvature in the sections to be used.
- B. Plywood Forms: Are to be used on any section of concrete that have bends, radii or curvature. Forms shall be made of Douglas Fir or Spruce species; solid one side grade; sound, undamaged sheets with straight edges.
- C. Lumber: Douglas Fir or Spruce species; construction grade; with grade stamp clearly visible.
- D. Form Coatings: Provide commercial formulation form coating compounds that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.1 CONCRETE MATERIALS:

- A. Provide materials in accordance with ACI 301, unless amended or superseded by requirements of this section or general notes on structural drawings.
 - 1. General: Ready-mixed Concrete: ASTM C94. On-site mixed concrete not allowed.
 - 2. Cement: ASTM C150. Type II minimum of five-hundred-sixty-four pounds (564 lbs.) per cubic yard.
 - 3. Fly ash: ASTM C618 Class C or F. Fly ash shall not exceed fifteen percent (15%) of total cementitious material by weight.
 - 4. Aggregate: ASTM C33. Obtain from same source throughout project.
 - a. Fine Aggregate: Natural sand.
 - b. Coarse Aggregate: Gravel or crushed stone containing no deleterious substances which cause surface spalling.
 - 5. Water: Clean and not detrimental to concrete.

2.3 ADMIXTURES:

- A. General: Unless specified, no admixtures may be used without specific approval of CDOT and the Denver Parks Representative.
- B. Prohibited Products: Calcium chloride or admixtures containing more than half of one percent (0.05%) chloride ions or thiocyanates are not permitted.

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- C. Air-Entraining Admixture: ASTM C260. Subject to compliance with requirements, provide one of the following:
1. "Air Mix" - Euclid Chemical Co.
 2. Darex ARA" - W. R. Grace
 3. "Micro-Air" - Master Builders
- D. Water Reducing Admixture: ASTM C494, Type A. Subject to compliance with requirements, provide one of the following:
1. "Eucon WR-75" - Euclid Chemical Co.
 2. "Rheobuild 1000" - Master Builders
 3. "Plastocrete 106" - Sika Chemical Co.
- E. High Range Water Reducing Admixture (Superplasticizer): ASTM C494, Type F or G. Subject to compliance with requirements, provide one of the following:
1. "Eucon 37" - Euclid Chemical Co.
 2. "Pozzolith 400N" - Master Builders
 3. "Sikament" - Sika Chemical Co.
- F. Warm weather admixtures: ASTM C494. Use of admixtures will not relax warm weather placement requirements.
- G. Cold Weather Admixtures: ASTM C494. Use of admixtures will not relax cold weather placement requirements.

2.4 CONCRETE MIX

- A. Refer to the City and County of Denver Right of Way Services approved materials list of pre-approved concrete mixes at the following website:
- <http://denvergov.org/rightofwayservices/RightofWayServices/ConstructionInspection/RightofWayConstructionInspection/ApprovedMaterials/tabid/442460/Default.aspx>
- B. All Concrete mixes from the approved list or submitted for approval shall meet the following criteria.
1. Mix concrete in accordance with ASTM C94 and ACI 301 Chapter 3.
 2. Cement Content: Type II cement, minimum of five-hundred-sixty-four (564) pounds per cubic yard.
 3. Maximum water-cement ratio: 0.45.
 4. Slump: Four inches (4") maximum.

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5. Air Entrainment: Five percent (5%) to eight percent (8%).
 6. Aggregate Size: three-quarter inch (3/4") maximum.
 7. Deliver concrete and discharge all concrete transmitted in a truck mixer, agitator, or other transportation device not later than one and one-half (1-1/2) hours, or three-hundred (300) revolutions of the drum after the mixing water has been added, whichever is earliest.
 8. During cold weather (below forty-five degrees (45°) F), use heated water and aggregates if necessary to maintain concrete temperature between sixty degrees (60°) F. and ninety degrees (90°) F.
 9. Concrete for Footings, Walls, and Interior Slabs-on-Grade shall be Class B, as approved by the Denver Parks Representative.
Concrete for Exterior Flatwork, including Pavement, Curb and Gutter, and Drainage Pans shall be Class P, as approved by the Denver Parks Representative.
 10. Fly Ash – Per CDOT Standard Specifications for Road and Bridge Construction Section 701.02.
- 2.5 FIBROUS CONCRETE REINFORCEMENT: Shall be 100% virgin polypropylene, fibrillated fibers containing no reprocessed olefin materials and specifically manufactured to an optimum gradation utilizing 25 individual fiber designs for use as concrete secondary reinforcement. Volume per cubic yard shall equal a minimum of 0.1% (1.5 pounds). Fiber manufacturer must document evidence of 5 year satisfactory performance history, compliance with applicable building codes and ASTM C1116 Type III 4.1.3 and ASTM C1116 Performance Level I. Acceptable manufacturer: Fibermesh Company, 4019 Industry Drive, Chattanooga, Tennessee, USA, 37416 or approved equal. Fibrous concrete reinforcement shall be utilized in all flatwork applications.
- 2.6 EXPANSION JOINT FILLERS: Pre-molded closed cell polyethylene foam, equal to "Sonoflex F" by BASF. Provide ½-inch thick by depth of the slab material, allow ½ thickness for joint sealer.
- 2.7 SLIP “SPEED” DOWLES: Provide Greenstreak two component Speed Dowel System, to accept 1/2” diameter x 18” long slip dowels. Slip Dowels may be used at the direction of the Denver Parks Representative.
- 2.8 EXPANSION JOINT SEALANT: Shall be a Sonolastic Sealant as manufactured by BASF or a silicone material that is on CDOT’s approved silicone sealant list. Where color additive is used, color to match.
- 2.9 CONTROL JOINTS: Shall be in conformance with current Public Works Traffic Engineering Standards and Details.
- <http://www.denvergov.org/Portals/487/documents/CCD%202010%20Trans%20Standards%20and%20Details%20-%20Complete.pdf>
- 2.10 CURING AND SEALING MATERIALS
- A. Curing and Sealing Compound – Exterior Concrete: Minimum thirty percent (30%) solids

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content, maximum moisture loss of three-hundredths grams (0.030) per square centimeter (three-hundred (300) square feet per gallon coverage): Subject to compliance with requirements, use one of the following:

1. Euclid Super Rex Seal or Super Pliocure
2. Master Builders Masterseal
3. Approved substitute in accordance with the General Conditions.

2.11 TRUNCATED DOME INSERTS FOR RAMPS: Shall be in conformance with current Public Works standards.

PART 3: EXECUTION

3.1 PREPARATION OF SUBGRADE: Excavate to required depth. Remove soft, yielding material and replace with select fill. Compact to min. 95% Standard Proctor within 2% of optimum moisture.

3.2 MAINTENANCE OF SUBGRADE: Maintain subgrade in a compacted condition until concrete is placed.

3.3 FORMS: Metal or uniform warp free lumber, coated with form release agent. Slope forms to give slabs positive drainage and stake securely. Obtain approval of Denver Parks Representative for alignment and grade before placing concrete. Radii shall be continuous and flowing to avoid angular intersections in the horizontal alignment, radial forming shall use bender board or approved equal as directed by Denver Parks Representative.

3.4 PLACING:

- A. Definitions: Refer to ACI 301 11.7 for definition of slab surface finishes.
- B. Concrete shall be formed, placed, vibrated and finished by hand using conventional methods. Concrete shall be placed at the line and grade shown on plans.
- C. Place concrete on moistened subgrade monolithically between construction joints. Deposit to full depth in one operation. Consolidate immediately. After depositing concrete, screed and darby or bullfloat.
- D. Provide a medium broom finish for all exterior concrete unless otherwise noted.
- E. Broom Finish: Immediately after float finishing and tooling control joints, roughen surface with fiber-bristle broom. Confirm direction or pattern of broom finish with the Denver Parks Representative prior to commencing slab placement.

F. Conform to ACI 301 and ACI 117 tolerance requirements.

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3.5 CONCRETE FINISHING:

- A. After darbying or bullfloating, stop finishing until bleeding has ceased and until concrete can support foot pressure with only about 1/8-inch indentation. During or after the first floating, check planeness of surface with a 10-foot straightedge applied at not less than two different angles, and then cut down all high spots and fill all low spots to achieve a true plane within 1/8 inch in 10 feet.
- B. Refloat slab immediately to a uniform sandy texture. Use steel trowel to densify surface, then apply medium broom finish to slab perpendicular to line of traffic.
- C. Handicap Ramps:
 - 1. Provide score joints in handicap ramps, tooled in a pattern in accordance with standard City of Denver detail.
 - 2. Install truncated dome inserts flush with the adjacent ramp surface, taking care to achieve a tight bond with the concrete, free of air pockets.

3.6 FORM REMOVAL: Remove forms after concrete surface is hard enough so as not to be damaged in any way. Reasonable care is to be used in removing forms. Repair minor defects with mortar. Plastering will not be permitted on exposed faces.

3.7 JOINTS: Construct joints true to line with faces perpendicular to surface.

- A. Expansion Joints: Expansion joint material shall be provided at the following locations and shall be in place prior to the placing of concrete:
 - 1. As shown on the plans; or
 - 2. At each end of curb return;
 - 3. between sidewalk and driveway slabs or service walks;
 - 4. between new concrete and existing concrete;
 - 5. between new concrete and fixed vertical objects;
 - 6. at maximum 120 foot spacing; and
 - 7. as directed by Denver Parks Representative.

Thoroughly clean all surfaces prior to installation of sealant material.

- B. Dowels:
 - 1. Attach bases to the face of concrete forms using a double-headed nail or self-tapping screw.
 - 2. Center of base shall be centered on form.
 - 3. Prior to pouring concrete, Speed Dowel sleeve shall be slipped over base.
 - 4. Pour concrete minimum 18" from Speed Dowel system and work concrete around the Speed Dowel System.
 - 5. Concrete forms shall be removed with bases still attached. Bases may be reused.

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6. Install slip dowels to the full depth of the embedded Speed Dowel sleeve and proceed with next concrete pour.
 7. Greasing of dowels is not required. Embedded Speed Dowel Sleeve accommodates expansion and shrinkage movements that may occur.
 8. Bent or badly sheared slip dowels shall not be used. Saw cut dowels recommended.
 9. Concrete shall not be poured directly over the Speed Dowel System.
 10. Place edge forms plumb. Out of plumb forms may result in misaligned dowels.
- C. Contraction (Control) Joints in Walks: Contraction joints shall be formed with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 3/8-inch-wide joints into concrete that has hardened sufficiently that cutting action will not tear, abrade, or otherwise damage surface, but before development of random contraction cracks. Saw cut joints shall be spaced at a distance equal to the width of the walk, but not over 10 feet unless approved by the Denver Parks Representative. Depth of joints shall be one-fourth the slab thickness.
1. Tooled joints will not be allowed on concrete trails, unless directed by the Denver Parks Representative.
- D. Curb and Gutter Contraction (Control) Joints: Space curb and gutter joints not more than 12 feet 6 inches on center, and align them with sidewalk joints. Contraction joints shall be tooled. Form plane of weakness by inserting and later removing a metal divider, finish with an edger or groover, or by saw cutting a previously tooled joint.

3.8 CONCRETE CURING, PROTECTION AND SURFACE TREATMENTS:

- A. General:
1. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Maintain concrete with minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of concrete.
 2. Curing shall commence as soon as free water has disappeared from the concrete surface after placing and finishing. The curing period shall be seven days for all concrete unless test cylinders, made and kept adjacent to the structure and cured by the same methods, are tested with the average compressive strength equal to seventy percent (70%) of the specified twenty-eight (28) day strength.
 3. Curing shall be in accordance with ACI 301 procedures. Avoid rapid drying at the end of the curing period. During hot and cold weather, cure concrete in accordance with ACI 305R and ACI 306R.
- B. Curing Methods: Perform curing of concrete by moisture curing, by moisture-retaining cover curing, by curing compound, and by combinations thereof, as herein specified. Coordinate with and choose a curing method that is compatible with the requirements for subsequent material usage on the concrete surface.

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1. Provide moisture curing by one of the following methods:
 - a. Keep concrete surface continuously wet by covering with water.
 - b. Continuous water-fog spray.
 - c. Covering concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping it continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with four inch (4") lap over adjacent absorptive covers.

2. Provide moisture retaining cover curing as follows: Cover concrete surfaces with a moisture-retaining cover for curing concrete, placed in widest practical width with sides and ends lapped at least three inch (3") and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3. Provide curing and sealing compound to exterior slabs, walks, curbs, etcetera as follows:
 - a. Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within thirty (30) minutes). Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions. Recoat areas subjected to rainfall within three hours after initial application.
 - b. Maintain continuity of coating and repair damage during period.

- C. Curing Formed Surfaces: Where wooden forms are used, cure formed concrete surfaces by moist curing with forms in place for full curing period or until forms are removed. When forms are removed, continue curing by methods specified above for specified curing time.

3.9 TOLERANCES:

- A. Surfaces shall not vary more than 1/8-inch when tested with a 10 foot straightedge.

3.10 QUALITY CONTROL TESTING DURING CONSTRUCTION

- A. All testing shall be completed according to requirements of Book 2, Section 3 - Quality Management.

- B. Sampling and testing for quality control during placement of concrete shall include the following.
 1. Slump: ASTM C143; at least one test at point of discharge for each day's pour of each type of concrete; additional tests at the Quality Control Inspector's discretion when concrete consistency seems to have changed. Test when taking samples for

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- compression tests.
2. Air Content: ASTM C173, volumetric method for normal weight concrete; ASTM C231 pressure method for normal weight concrete; at least one for each day's pour of each type of air-entrained concrete. Test when taking samples for compression tests.
 3. Concrete Temperature: Test hourly when air temperature is forty degrees (40°) F and below, and when eighty degrees (80°) F and above; and each time a set of compression test specimens is made.
 4. Compression Test Specimen: ASTM C31; one set of three (3) standard cylinders for each compression strength test unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required. If additional cylinders are required for any reason, they shall be done at the contractor's expense.
- C. Compressive Strength Tests: ASTM C39; one set for each day's pour exceeding five (5) cubic yards. Two specimens tested at seven (7) days, two specimens tested at twenty-eight (28) days, and one specimen retained in reserve for later testing if required.

END OF SECTION 02520

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SECTION 02710

SUBDRAINAGE SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS: The Book 1 Contract requirements apply to Work of this section.

1.2 SUMMARY:

- A. Work Includes: Furnishing and installing sub-drainage systems as shown on the Drawings or specified herein, or as required to complete the work.
- B. Related Work:
 - 1. Layout of Work and Surveying – Section 01050
 - 2. Submittals – Section 01300
 - 3. Tree Retention and Protection – Section 02150
 - 4. Excavating and Backfilling of Trenches – Section 02220
 - 5. Storm Sewerage – Section 02720
 - 6. Sodding – Section 02935

PART 2 - PRODUCTS

2.1 MATERIALS

- A. PVC under drain: ASTM D2729, minimum four inch (4”) diameter, plain or perforated type as indicated on the Drawings, with required fittings. Perforated pipe shall comply with requirements of ASTM 272a, with two (2) rows of evenly spaced three-eighths inch (3/8”) diameter perforations, one-hundred-twenty (120⁰) deg apart, providing a minimum number of holes of four (4) per foot.
- B. Geotextile Fabric: Non-woven fabric equal to Tencate- Mirafi 140N.
- C. Bedding Material: Solid pipe bedding material to be three- quarter inch (3/4”) crushed stone. Perforated pipe, refer to manufacturers specifications or drawings for required bedding material.
- D. Filter Material: Three-quarter inch (3/4”) crushed stone.

PART 3 -EXECUTION

3.1 INSTALLATION

- A. PVC under drain: Install pipe under drains as shown on the Drawings. Pitch shall be a minimum of one-half percent (0.5%) or as shown on drawings. Contractor is responsible

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to immediately notify the CDOT and the Denver Parks Representative of any discrepancies.

- B. Solid Pipe: Refer to the City and County of Denver Wastewater Storm Drainage and Sanitary Construction details and specifications document available at the following website:

<http://www.denvergov.org/wastewatermanagement/Wastewater/DesignEngineering/StandardsandDetails/tabid/438018/Default.aspx>

- C. Geotextile fabric used for the pipe under drains system shall be placed in the trench once pipe trench is prepared to receive pipe. The fabric shall be placed in full contact with the trench bottom and sides. The fabric shall be secured to the trench sides or top edge in a manner which does not damage the integrity of the fabric. The fabric shall be protected from damage during the placement of the pipe and granular fill. Install granular fill and pipe in trench to dimensions specified on Drawings. Contractor is responsible to ensure that no debris, sediment or foreign material enters the granular fill that inhibit drainage. Any installation that does not meet these standards shall be replaced at the direction of the Denver Parks Representative. Fabric edges shall overlap at least 6 inches for the full width of the trench.

3.2 CLEANING: Clean and flush out lines before covering. Remove and legally dispose of all waste material and debris offsite.

3.3 RESTORATION: Restore all fences, ditches, yards, lawns, and other structures or surfaces to condition equal to or better than before work began.

END OF SECTION 02710

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SECTION 02720

STORM SEWERAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS: The Book 1 Contract requirements apply to Work of this section.

1.2 SUMMARY:

- A. The work of this section consists of the construction of a complete storm sewerage system, including manholes, inlets, piping, and outfall structures. All work shall conform to the City and County of Denver Wastewater Storm Drainage and Sanitary Construction details and specifications document available at the following website:

<http://www.denvergov.org/wastewatermanagement/Wastewater/DesignEngineering/StandardsandDetails/tabid/438018/Default.aspx>

B. Related Work:

1. Layout of Work and Surveying – Section 01050
2. Tree Retention and Protection – Section 02150
3. Excavating and Backfilling of Trenches – Section 02220
4. Sodding – Section 02935

PART 2 - PRODUCTS (Not applicable)

PART 3 - EXECUTION (Not applicable)

END OF SECTION 02720

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SECTION 02810

IRRIGATION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS: The Book 1 Contract requirements apply to Work of this section.

1.2 SUMMARY:

A. Work of this Section consists of installation of an underground irrigation system including the following:

1. Trenching, stockpiling excavation materials, refilling and compacting trenches.
2. Complete irrigation system including but not limited to piping, valves, fittings, heads and wiring, and final adjustments to insure complete coverage.
3. Water connections.
4. Replacement of unsatisfactory materials.
5. Cleanup, inspections, and approval.
6. Tests.

B. Related Work:

1. Tree Retention and Protection - Section 02150
2. Excavating and Backfilling of Trenches – Section 02220
3. Concrete Walks, Curbs and Miscellaneous Flatwork - Section 02520
4. Soil Preparation - Section 02920
5. Turfgrass Seeding - Section 02932
6. Native Seeding - Section 02933
7. Sodding - Section 02935
8. Trees and Shrubs - Section 02950

1.3 REFERENCES

A. Conform to requirements of reference information listed below except where more stringent requirements are shown or specified in Contract Documents.

1. American Society for Testing and Materials (ASTM) - Specifications and Test Methods specifically referenced in this Section.
2. Underwriters Laboratories (UL) - UL Wires and Cables.
3. National Sanitation Foundation (NSF) – Piping and backflow prevention.
4. American Water Works Association – Piping and backflow prevention.

1.4 QUALITY CONTROL

A. Special Requirements.

1. Tolerances - Specified depths of mains and laterals and pitch of pipes shall be installed per the drawings and specifications.

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2. Compaction - Settlement of trenches is cause for removal of finish grade treatment, refilling, compaction, and repair of finish grade treatment.
3. Coordination With Other Contractors - Protect, maintain, and coordinate work with work under other Sections.
4. Damage to other improvements - Contractor shall replace or repair damage to grading, soil preparation, seeding, sodding, planting, done under other Sections during Work associated with installation of irrigation system at no additional cost to CDOT.
5. Damage or disturbance to the existing irrigation components – Damage to existing components as a result of work being performed by the Contractor will require the Contractor to replace the damaged components to the Cities current standards, at no additional cost to CDOT. This includes boxes, manifolds, valves, angle valves, risers, wire, heads, pipe and controllers.
6. Water Delivery Interruption – When working on an existing irrigation system, the Irrigation Contractor shall contact the Denver Parks Representative and inform him seventy-two (72) hours in advance of any water interruption that is required. The maximum irrigation system interruption is to be no more than seventy-two (72) hours during the growing season. The contractor shall make all necessary provisions including material, equipment, labor, delivery and scheduling as required to complete al point of connection upgrades and improvements within seventy-two (72) hours.
7. Watering – The Contractor is responsible for following all Denver Water rules and regulations for sod and seed establishment, available at <http://www.denverwater.org> . The Contractor shall post signage per Denver Water in a visible location(s) on site indicating “IRRIGATION TESTING AND MAINTENANCE IN PROGRESS” when Work (establishment, construction or warranty) requires irrigation system operation between the hours of 10AM to 6 PM. The signs are to be used are available from Denver Water.
8. Permits - Work involving plumbing for installation of copper piping, backflow preventer(s), and related Work shall be executed by licensed and bonded plumber(s). Secure a permit at least forty-eight (48) hours prior to start of installation. Work involving high voltage electrical wiring, grounding and related Work shall be executed by licensed and bonded electrician(s). Secure a permit at least forty- eight (48) hours prior to start of installation.

B. Pre-Construction Conferences and site meetings:

1. Contractor shall schedule and conduct a pre-construction conference to review in detailed construction requirements for equipment and materials used to perform the Work. Conference shall be scheduled not less than ten (10) days prior to commencement of Work. All parties required to be in attendance shall be notified no later than seven (7) days prior to date of conference. Contractor shall notify qualified representatives of each party concerned with that portion of Work to attend conference, including but not limited to the Denver Parks Representative, Denver Parks Representative, Contractor's Superintendent, and Installer.
2. Prior to commencement of Work, Contractor shall schedule an on-site conference with Denver Parks Representative, Parks Forestry and any other parties

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designated by Denver Parks Representative to discuss tree protection requirements, marshalling locations, traffic control, and equipment access. Provide a minimum of seven (7) days notice prior to date of conference.

3. Denver Parks Representative shall record minutes of each conference and distribute to all parties in attendance within three (3) days of conference.

1.5 SUBMITTALS - Prepare and make submittals in accordance with conditions of the Contract prior to installation of any irrigation equipment:

A. Material List: Submit a complete list of materials, and cut sheets indicating manufacturer, model number and description of all materials and equipment to be used. Show appropriate dimensions and adequate detail to accurately portray intent of construction.

B. Shop Drawings: If applicable, submit shop drawings for pumps, fertigation, backflows and controllers indicating electrical wiring design, and assembly. Plumbing and foundation/support systems if the installation differs from the manufacturer's recommended installation.

C. Samples:

1. Valve clusters: Provide a completely built electrical valve cluster. This mock-up, to include three electric valves, angle valve, manifold, unions and riser, the mock up may be incorporated into the work toward the end of the project.
2. Swing joints: Provide a pre-manufactured or constructed swing joint assemblies for each per detail shown (quick coupler, rotors) or as directed by the Denver Parks Representative.
3. Drain valves: Provide a mock up including the service tee, and required fittings, and drain valve.

D. Operation and Maintenance Data: Coordinate scheduling/precipitation instructions with the City's maintenance personnel. Submit three (3) bound brochures and one (1) digital copy to the Denver Parks Representative including:

1. Winterization and spring start-up procedures.
2. Cut sheets of products.
3. Manufacturer's maintenance and checking instruction for irrigation controller.
4. Manufacturer's maintenance and operation instruction for weather station and any other water conservation equipment.
5. Manufacturer's maintenance and checking instruction for backflow preventer (if applicable).
6. Manufacturer's maintenance and operation instruction for pump station (if applicable).
7. Manufacturer's maintenance and operation instruction for fertigation system (if applicable).

E. Warranty: Submit one year written warranty, in accordance with the contract documents.

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- F. Record Drawings (As-Built):
1. At onset of irrigation installation, Contractor will secure copies of original irrigation design from the Denver Parks Representative. Contractor to revise hard copy drawings in red ink as Work progresses to show any deviations from the design. Record Drawings shall be brought up-to-date at the close of the working day every Friday by a qualified draftsman. A print of Record Drawings shall be available at Project Site for review. Updated Record Drawings shall be available for review at all times.
 2. Record Drawings shall encompass entire scope of work including any altered existing equipment and altered zones. For systems that are altered less than fifty percent (50 %) of entire site size, the record drawing shall encompass the scope of work, and notate the controller zone number, type of irrigation, GPM, operating PSI for any altered or added zone.
 3. Preparation of Record Drawings (As-Built): Dimension from two permanent points of reference (building corners, sidewalk, road intersections or permanent structures) the location of the following items:
 - a. Point of connection.
 - b. Routing of sprinkler pressure lines. Provide dimensions for each one-hundred linear feet (100 L.F.) (maximum) along each routing and for each change of direction.
 - c. Routing of non-pressure lateral lines, layout and size.
 - d. Sprinkler control valves.
 - e. Quick coupling valves.
 - f. Drain valves
 - g. Master valves
 - h. Flow sensors
 - i. Rain sensors/weather station
 - j. Wire splice boxes
 - k. Control wire routing if not with pressure mainline.
 - l. Gate valves.
 - m. Air relief valves.
 - n. Sleeves.
 - o. Flush valves.
 - p. Power service drop.
 - q. Other related equipment as directed.
 4. Make dimensions accurately at the same scale used in the original drawings, or larger. Notes and dimension lettering must be legible.
 5. The irrigation legend must be changed to accurately reflect the irrigation equipment installed, if such equipment is not the same as originally specified on the contract documents. This includes flow rates, effective spray diameter/radius and operating pressure of all sprinkler heads.
 6. Final Submittal: Upon completion of Project, prior to final acceptance, secure digital copy of irrigation design from the Denver Parks Representative and record As-Built information that reflects all changes made over the course of the construction project, prepared by a qualified draftsman. As-Built Drawings shall include details, including any revisions as per actual installation. Deliver and submit to the Denver Parks Representative for review the following items:

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- a. One (1) set of three (3) mil. Mylar prints of As-Built.
 - b. Digital as built drawings in both PDF and CAD format (include any related X-ref files, plot files and pen settings.) Make any additional changes to the file as directed by the Denver Parks Representative prior to final submittal and approval.
 7. Request for final payment will not be certified or processed until all As-Built prints and digital files have been received and approved.
- G. Controller Zone Maps and Programming Schedule:
 1. Do not prepare zone maps or irrigation controller charts until record drawings have been reviewed and approved by the Denver Parks Representative. The Denver Parks Representative shall provide an example of Controller Charts and zone map required.
 2. Provide one controller zone map for each automatic controller installed.
 - a. Zone Map shall be reproduction of record drawing, one page sized eleven inch by seventeen inch (11" X 17").
 - b. Zone Map shall be print of actual record drawing of the system, showing the entire area covered by that controller on one sheet.
 - c. Identify controller, all remote valves and lateral lines of each remote control valve, using a distinctly different color for each zone. Include the entire area of the controller's coverage. Provide a legend showing equipment being used.
 - d. Submit digital copies in the original program format as well as PDF format to the Denver Parks Representative
 3. Provide one zone map for the entire project.
 - a. Zone Map shall be reproduction of record drawing, one page maximum twenty-four by thirty-six inch (24" X 36"), photo reduced to maximum size and legibility.
 - b. Identify all controllers, remote valves and lateral lines using different colors to distinguish adjacent zones.
 - c. Submit digital copies in the original program format as well as PDF format to the Denver Parks Representative
 4. The contractor is responsible for following all Denver Water restrictions and establishment rules for new landscapes per Denver Water, rules and regulations at: <http://www.denverwater.org>
 5. The Contractor shall be responsible for providing an Establishment Watering Schedule, Transition Watering Schedule and a Maintenance Watering Schedule to the Denver Parks Representative, Operation Supervisor and the Toro Factory Representative (when applicable). All irrigation schedules and zone controller charts shall ensure that there will be no ponding or runoff of water during any of the scheduled times. Prior to any plant material being installed all schedules shall be provided to the Denver Parks Representative and Operations Supervisor. The water schedule templates are available from Water Conservation and the Denver Parks Representative. Contractor shall make any modifications to the

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programming as requested by Denver Parks Representative or Operations Supervisor.

- a. Establishment Irrigation (Days 1-21) - Plants shall be adequately watered for the first twenty-one (21) days after installation or until seeds have germinated and emerged or sod has become firmly rooted. Exact timing of irrigation cycles will depend on weather conditions, soil conditions, and speed of emergence of grass seed. Short, frequent irrigation cycles shall be used. Split cycles or the 'cycle and soak' feature must be employed to reduce erosion or run off in seeded areas. Do not exceed three inches (3") of total water per week. Coordinate with irrigation system schedule and programming with the Denver Parks Representative, City staff, and local Toro Field Representative. Contractor shall submit a meter reading before and after establishment to verify water use.
 - b. Transition Irrigation (Days 21-56) - Less frequent, but longer watering cycles will provide moisture at depths that will encourage seedlings to continue to develop and sod to develop deeper roots. Allow the surface soils to dry slightly between watering to encourage deeper rooting. Watering shall be done utilizing historic evapotranspiration rates for the current watering month(s).
 - c. Maintenance Irrigation - Irrigate as needed to maintain an optimum stand of turf while minimizing water use. Irrigation frequency shall be adjusted at a minimum, based on monthly historical evapotranspiration rates and plant (turf and tree) water requirements. It is the responsibility of the Contractor to coordinate with Denver Parks Representative, Operations Staff, and local Toro Field Representative the programming of irrigation controllers, to properly irrigate plant materials and turfgrass.
6. Once sod has been laid, begin watering to build up the sub-soil moisture. This will be the most critical time to apply water. Water up to one and one-half inches (1-1/2") of water per day for the first two to three (2-3) days. Probe the soil to determine if the moisture has penetrated down to a minimum of four inches (4"). During the next three (3) weeks the amount of water needed will be similar to that of the historical evapotranspiration rates for the season per day. Each day may require more than one application depending on wind and temperature in order to keep the root zone and blades moist.
 7. Provide one Controller Programming Schedule for each automatic controller installed, one page maximum, eight and one-half inch by eleven inch (8-1/2" X 11"). Denver Parks Representative shall provide an example of Controller Programming Schedule required and the scheduling templates.
 8. Following review of Zone Maps and Schedules by the Denver Parks Representative, provide two (2) additional color duplicates of Zone Maps and Schedules. One set of Zone Maps and Schedules shall be laminated between two (2) layers of three (3) mil. plastic sheet. Provide digital copies of Zone Maps and Schedules in PDF format.

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9. Zone Maps and Schedules shall be completed and reviewed prior to final review of irrigation system.
10. Request for final payment will not be certified or processed until all prints and files for Zone Maps and Schedules have been received and approved.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping:

1. Deliver all components to job site in original unopened packaging containers prominently displaying manufacturer's name, volume, quantity, contents, instructions, and conformance to local, state, and federal law. Remove and replace cracked, broken, or contaminated items or elements prematurely exposed to moisture, inclement weather, snow, ice, temperature extremes, fire, or jobsite damage.
2. Handling, storage and delivery of PVC pipe:
 - a. Exercise care in handling, loading and storage of PVC pipe.
 - b. Provide forty-eight (48) hours advance notice of delivery to the Denver Parks Representative for observation of unloading and handling of PVC materials during delivery.
 - c. All PVC pipe shall be transported in a vehicle which allows length of pipe to lie flat so as not to subject it to undue bending or concentrated external loads. All sections of pipe that have been dented or damaged shall be discarded, and shall be replaced with new piping.

B. Storage and Protection:

1. Deliver, unload, store, and handle materials, packaging and bundling products in dry, weatherproof condition in manner to prevent damage, breakage, deterioration, intrusion, ignition, and vandalism.

1.7 JOBSITE CONDITIONS:

A. Existing Conditions:

1. Soil Conditions: Investigate the type of soil and conditions in which lines are to be installed and allow for same type of soil in the proposal. No extra payment will be allowed due to difficulty in trenching.
2. Contractor is responsible for understanding the scope of related operations as specified and indicated in the Drawings and Specifications before beginning Work under this Section.
3. Report unsatisfactory conditions in writing to the CDOT within twenty-four (24) hours of discovery. Commencement of installation means acceptance of existing conditions by the Contractor.

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- B. Protection of Property:
1. Protect buildings, walks, walls, and other property from damage. Erect and maintain barricades, warning signs and lights, and provide guards as necessary or required to protect all persons on the site. Damage caused to asphalt, concrete, monuments, structures or other building material surfaces shall be repaired or replaced at no cost to CDOT. Restore disturbed areas to original condition.
 2. Preserve and protect all trees and plants as shown on plans or as directed by the Denver Parks Representative or the City Forester. In the event damage does occur, all damage to plant material shall be brought to the attention of the Denver Parks Representative immediately for review by the City Forester. All damage to plant material shall be repaired or replaced per the direction of the City Forester at no cost to CDOT.
- C. Protection of Existing Trees:
1. Refer to Tree Retention and Protection – Section 02150
 2. Consult with the City Forester as requested by the Denver Parks Representative prior to trenching or boring within tree drip-lines. All trenching or work under drip line of any tree shall be dug by hand or by other methods as directed by the Forester or the Denver Parks Representative so as to prevent damage to limbs or branches and root system.
 3. Directional boring that is permitted within tree protection area must occur at thirty-six (36”) inches below grade and may not take place anywhere within four (4’) feet of the drip line. Any exception must be agreed upon by the City Forester or the Denver Parks Representative.
- D. Protection and Repair of Underground Lines:
1. Contact Utility Notification Center of Colorado per the contract documents.
 2. The Contractor is required to contact all private utility companies including City Departments to locate all private utilities. The request for locates shall be a minimum of seventy-two (72) hours prior to proceeding with any excavation. If, after such requests private utilities are encountered and damaged by the Contractor these shall be repaired by the no cost to the City. If the Contractor damages staked or located private utilities, they shall be repaired by the Utility Owner at the Contractor's expense.
- E. Replacement of Paving and Curbs:
1. Any damage do to work that occurs adjacent to or crosses existing roadways, paths, trails, curbing, sidewalks, etc. shall be restored to original condition at the contractors expense, and the satisfaction of CDOT and the Denver Parks Representative.

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1.7 WARRANTY/GUARANTY:

- A. Provide a one year written warranty for material and installation per the contract documents.
- B. Expenses due to vandalism before Final Acceptance shall be the contractors responsibility.
- C. Any settling of backfilled trenches that occurs during warranty period shall be repaired at no expense to the City, including complete restoration of damaged property.
- D. The City Parks staff reserves the right to make temporary repairs during the warranty period as necessary to keep systems in operating condition without voiding the Contractor's warranty, nor relieving the Contractor of his responsibilities.
- E. Contractor shall make repairs and replacements within three days of notification. If Contractor fails to make repairs within three days, the City will make such repairs at Contractor's expense.

1.8 MAINTENANCE:

- A. Where applicable, furnish the following maintenance items to City prior to Final Acceptance:
 - 1. Two sprinkler heads for each size and type specified. Two nozzles for each type of head.
 - 2. Two head adjustment tools for each type of head installed.
 - 3. Two valve keys for operating each type of manual valve. (Manuel drain valves, isolation valves)
 - 4. Two valve keys and hose swivels for each type of quick coupling valve.
 - 5. Four controller cabinet keys. (If applicable)
 - 6. One remote control device for each project. (If applicable).

1.9 Maintenance During Project Construction:

- A. Within Limits of Construction - Contractor shall fence, water, and keep weed free any turf, trees and any plantings within the limits of construction. Contractor is responsible for maintenance which includes picking up trash, weed control and mowing of turf and native areas within the limits of construction. Contractor is responsible for watering existing landscape within limits of construction. Turf and plants affected by mainline work or irrigation water service shutdown during irrigation season shall receive watering per Parks' schedule, with no interruption of watering greater than seventy-two (72) hours. Contractor is responsible for maintenance until final acceptance is granted.
- B. Outside Limits of Construction - Coordinate controller scheduling and maintenance operations with Parks maintenance staff and Denver Parks Representative for portions of Park property unaffected by construction.
- C. Additional Maintenance During Warranty Period:
 - a. Make repairs and replacements needed due to defective workmanship and materials.
 - b. Winterization – include winterizing complete system at conclusion of irrigation season (during which system received Final Acceptance) within three (3) days of notification by the City. System shall be voided of water using compressed air or similar method accepted by the Denver Parks Representative. Coordinate with

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the Denver Parks Representative to be present during the winterization procedures. The Contractor shall notify all person that are to be present at the winterization a minimum of forty-eight (48) hours prior to the winterization of the system.

- c. Spring Start Up - Reopen, operate, adjust system malfunctions and make any necessary system repairs, the following season within three (3) days of notification by the City. Coordinate with the Denver Parks Representative to be present during the spring start up procedures. The Contractor shall notify all person that are to be present at the spring start up a minimum of forty-eight (48) hours prior to starting of the system.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. Equipment must have performance characteristics to operate per the design conditions indicated. If any discrepancy or conflict exists between the quantities of equipment listed in the schedule and quantities shown on the drawings, the greater quantity shall govern.
- B. All material shall be of the highest grade possible and where applicable, shall be marked accordingly and shall be new.

2.2 PIPE AND PIPE FITTINGS:

A. Main and Lateral Lines:

1. Main Lines (pressurized, downstream of backflow prevention units):
 - a. Class 200 PVC BE size one inch through two and one half inch (1" - 2-1/2")
 - b. Class 200 PVC RT size three inch and larger (3" +).
 - c. Velocities in PVC mainline shall not exceed five feet per second (5 FPS).
 - d. All PVC pipe shall conform to the requirements of the United States Department of Commerce commercial standard Type 1-ASTM-D-2241.
 - e. HDPE pipe, pressure rating DR 9 (200 PSI) may be used by approval of Denver Parks Representative for portions of mainline that require boring such as below trees and paving. HDPE requires fusion butt weld transition to PVC mainline using ISCO Industries IPS Bell MJ Adapter with kit, model #ISMFMJ03IPSBELL.
2. Lateral Lines: One hundred 100 PSI High Density NSF Polyethylene Piping – one inch (1") minimum diameter.
 - a. Velocity of water flow in polyethylene pipe shall not exceed seven and one-half feet per second (7-1/2 FPS).
3. Main line water flow velocity shall not exceed five (5) FPS.

B. Sleeving:

1. Horizontal sleeves under paved surfaces: Class 200 PVC.

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2. Vertical sleeves for access to drains and valves: Class 200 PVC.
 3. Horizontal sleeving for boring applications: HDPE
- C. Brass Pipe and Fittings:
1. Brass Pipe – Eighty-five percent (85%) red brass, ANSI Schedule 40 screwed pipe.
 2. Fittings - Medium brass, screwed 125 pound class.
- D. Plastic Pipe and Fittings:
1. Identification Markings:
Identify all pipe with following indelible markings:
 - a. Manufacturer's name.
 - b. Nominal pipe size.
 - c. Schedule of class.
 - d. Pressure rating.
 - e. NSF (National Sanitation Foundation) seal of approval.
 - f. Date of extrusion.
 2. Gasketed End Pipe (Pressurized main line three (3”) and larger) – Manufactured from virgin Polyvinyl Chloride compound in accordance with ASTM D2241 and ASTM D1784; cell classification 1254-B, Type 1, Grade 1.
 - a. All fittings and service tees (3” and larger) – Harco or Leemco ductile iron, grade 70-55-05 in accordance with ASTM A-536. Fittings shall have deep bell push-on joints with factory installed gaskets meeting ASTM F-477.
 - b. Lubricant – As recommended by manufacturer of pipe fittings.
 - c. Pipe Restraints on all fittings and service tees and pipe to pipe restraints: Harco or Leemco, installation as recommended by the manufacturer. Each fitting bell shall be restrained to the pipe inserted in it per manufacturer’s recommendations. See Manufacturer catalog for appropriate selection or chart supplied on plans.
 3. Class 200 PVC pipe (Pressurized main line two and one-half inch (2-1/2”) and under).
 - a. Pipe will be assembled with Schedule 80 PVC fittings using ASTM-F-656 purple primer followed with heavy bodied ASTM-D-2564 glue.
 - b. Fittings shall be installed with thrust blocks as per Detail.
 4. Flexible Plastic Pipe (non-pressure lateral lines):
 - a. Manufactured from virgin polyethylene in accordance with ASTM D2239, designated as PE 3408. Maximum size 2”; minimum size 1”.
 - b. Fittings - Manufactured in accordance with ASTM D2609; PVC Type 1 cell classification 12454-B.
 - c. Clamps - All stainless steel worm gear screw clamps. Use 2 clamps per joint on all insert fittings.
 - d. Risers for Pop-up Heads - Shall be swing pipe, 0.49 ID, operating pressure of 80 PSI, manufactured by Rainbird or approved equal.

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2.3 VALVES:

A. Gate Valve or Isolation Valve:

1. Valve for three inch (3”) and larger mainline: Shall be cast iron body, push-on, left-hand opening, square nut operated, rubber resilient seated, mechanical joint AWWA gate valve with clear waterway equal to full diameter of pipe. Able to withstand continuous working pressure of 150 PSI. Wheel type handle is unacceptable.
2. Valve for two and one-half inch (2-1/2”) and smaller mainline (solvent-weld): Shall be Matco-Norca 518 brass gate valve with threaded ends and non-rising stem.

B. Automatic Control Valve:

1. Automatic Valve for Potable Water System: Rain Bird PEB Series Valve having manual flow adjustment and manual bleed nut. PRS-D shall be used if pressure at the heads is greater than ten pounds over the optimal pressure as stated on the plans or measured in the field.
2. Automatic Valve for Non-Potable Water System: Rain Bird PESB Series Valve. PRS-D shall be used if pressure at the heads is greater than ten pounds (10 lbs) over the optimal pressure as stated per the manufactures catalog, plans or measured in the field.
3. Manifold: Manifold to be constructed out of Schedule 80 PVC pipe, fittings, and nipples. Use ductile iron riser nipple and Champion angle valve brass body 200RS angle valve with brass unions as per details and plans.

C. Manual Drain Valve:

1. Drain Valve: Mueller Oriseal #H-10283 or MacDonald AY one inch (1”) 3061 with brass swing joint assembly.

D. Quick Coupling Valves:

1. Buckner “Wing Thing” Q44LCAR10 brass two-piece body with winged stabilizer, designed for working pressure of 150 PSI; one inch (1”) FIP. Equip quick coupler with locking rubber cover, key and brass swivel. Size as shown on drawing.
2. The Quick Coupling Valves immediately after the backflow shall be used for winterization and shall be constructed of all brass swing joint and fittings. All other Quick Coupling Valve swing joints shall be constructed as shown on the details.

E. Master Valve:

1. Mainline two inch (2”) and larger Master Valve shall be Bermad 410 normally open valve.
2. Mainline smaller than two inch (2”) Master Valve shall be Superior 3100 normally open valve.

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F. Flow Sensor Assembly:

1. Mainline one and one-half inch through four inch (1-1/2” – 4”), flow sensor shall be Data Industrial 228-PV, sized according to mainline size.
2. Mainline larger than four inch (4”), flow sensor shall be Data Industrial 220-B mounted with Harco tapping saddle sized according to mainline size.
3. Mainline one inch (1”), flow sensor shall be Data Industrial 4000.

G. Valve Boxes:

1. All valve boxes will have a stainless steel hex bolt locking system.
2. Isolation Valves, Quick Coupling Valves, Drain Valves, Wire Splices and Ground Rods - Carson Brooks model #910-4, ten inch (10”) round box,
 - a. Brand Lids as follows:
 - 1) Isolation/Gate Valve - “GV”
 - 2) Quick Coupler Valve - “QC”
 - 3) Manual Drain Valve - “DV”
 - 4) Air Relief Valve - “AR”
 - 5) Master Valve - “MV”
 - 6) Flow Sensor - “FS”
 - 7) Wire Splice Box - “SB”
3. Electric Control Valve Box: Shall have locking cover branded with the zone numbers.
 - a. Single valve location only, three-quarters of an inch (3/4”) through two inch (2”): Carson Brooks model #1220 jumbo box with bolt down T-cover.
 - b. Multiple valve clusters, max. three (3) control valves per box: Carson Brooks model #1730-18 box with bolt down T-cover or Rain Bird VB Max.
4. Box Color for valves shall be green for potable systems, purple for non-potable systems.
5. Gravel Leveling Bed and Drainage Sump in Valve Boxes: three-quarters of an inch (3/4”) crushed gravel lined in geo-textile, as indicated on Drawings.

H. Backflow Preventer:

1. High hazard, reduced pressure type, approved by University of Southern California (USC) or other approved testing laboratory; fully ported, ball-type gate valves on units two inch (2”) or smaller, as manufactured by Febco 825YA or approved equal. Resilient gate valves on units larger than two inch (2”); as manufactured by Febco 880V or approved equal.
2. Backflow Preventer Cover: Guardshack enclosure of appropriate size, equipped with Lock Shield Brackets, manufactured by BPDI, phone: 800-266-5411. Color: forest green.
3. For devices two inches (2”) and smaller, install Sentry SC75-200 locking device.
4. Concrete Pad: Comply with Section 02520.

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- I. Air Relief Valve:
 - 1. On mainlines three inches (3”) or larger, as per plan: Bermad 4415 (all cast iron) two inch (2”) double purpose vacuum air release valve or approved equal.
- J. Pressure Reducing Valve:
 - 1. Watts commercial grade or equal required where system pressures exceed 100PSI.

2.4 SPRINKLER HEADS:

- A. Heads: Provide fabricated riser units of the type and size as indicated on the Drawings. Heads of a specific type or function in the system shall be of the same manufacturer and shall be marked with the manufacturer’s name and identification in such a position that they can be identified without being removed from the system.
 - 1. Pop-Up Sprinkler Heads in turf areas: 1806 SAM-PRS.
 - 2. Pop-Up Sprinkler Heads in native grass areas and flower bed areas: Rain Bird 1812 SAM-PRS.
 - 3. Pop-Up Sprinkler Nozzles shall be Rain Bird U-Series nozzle. Strip series, rotary, MPR and VAN nozzles may be used for specific approved applications at the direction of the Denver Parks Representative.
 - 4. Gear Driven Heads: Hunter I-20, I-25, I-40 or Rain Bird 5000 Plus, 5500, or 8005 series with stainless steel risers, SAM, PRS and MPR as specified per drawings.
- B. Flexible Connectors to Lateral Pipe:
 - 1. Pop-up Heads: Shall be one-half inch (1/2”) swing pipe, connected to lateral pipe with male x insert spiral barbed ell PVC insert fittings.
 - 2. Gear Driven Heads: Shall be field constructed swing joints as per detail, connected to lateral pipe with PVC insert fittings.

2.5 LOW VOLUME IRRIGATION

- A. Valve – Rain Bird XCZ B Com for reuse water and XCZ Com for potable water, size per drawings. Valves shall be installed in Carson Brooks #1220 jumbo box or approved equal with bolt down T-cover. Brand lid with zone numbers.
 - 1. All low volume irrigation shall be zoned independently from turf, and product applications may not be mixed within zone.
- B. Lateral pipe – Flexible polyethylene pipe as per specifications 2.2.D.4. All lateral piping shall be installed at an eighteen inch (18”) depth, or as directed by the Denver Parks Representative.

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- C. Sub-surface irrigation – Netafim Techline emitter spacing and flow as per drawings. All sub surface laterals to be buried at a four inch (4”) depth minimum or as directed by the Denver Parks Representative.
 - 1. Requires Netafim 120 mesh filter in Carson 1419-12 valve box with corner hex bolt down cover. Brand lid with “FIL”. (need to look at the type of valve to use and the valve box)
 - 2. Flush valve in Carson round 10” valve box with bolt down T-cover as per Drawings. Brand lid with “FV”.

- D. Tree/Shrub Bubblers – Pop up sprinkler heads shall be used for all tree and shrub applications including medians, size and nozzle type as per the drawings or as directed by Parks Manager or Forestry.
 - 1. Discharge rate must not exceed soil infiltration rate.

2.6 AUTOMATIC CONTROL SYSTEM:

- A. Automatic Controller:
 - 1. Central Control systems shall be Toro Sentinel special build central control with wireless output boards. Update to Sentinel central control is required on all projects unless a variance is granted by Denver Parks Water Conservation.
 - a. Sentinel satellite controller in prefabricated enclosure with pedestal is available exclusively through C.P.S. Distributors. Contractor shall purchase fully assembled enclosure including back panel, terminal strips, power supply unit, interior fused disconnect with 120 volt GFI duplex outlet, heavy duty transient surge protection boards, antenna(s) with cable, louvers and fan kit. Enclosure and pedestal shall be stainless steel with factory applied powder coating finish, color #6005 Tiger Drylack color chart. Enclosure shall have a heavy duty hasp for locking. Model number is per plan as specified by Toro.
 - b. Provide one hand-held remote control unit for each project specified or as specified per plan.
 - c. 450 MHz radio communication shall be fully compatible with Denver Parks and Recreation frequency required by the Operations District.
 - 2. If variance is granted, Controller must have the following minimum characteristics:
 - a. Solid state, fourteen (14) day clocks, with multiple programming capabilities.
 - b. Capable of opening normally closed electric solenoid type valve.
 - c. Automatic Timing: Capable of incremental units from three (3) to at least sixty (60) minutes per station.
 - d. Water Budgeting: Capable of global program run time changes in percentage increments.
 - e. Ability to provide repeat and/or syringe cycle capabilities and ability to eliminate or isolate one station without disturbing remaining controller features.
 - f. Flow sensing capability with automatic shut-down or alarm signal.

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- g. Minimum 40 VA transformer rating.
 - h. Controller cabinets shall be stainless steel Strongbox or Hoffman enclosure with factory-applied Federal Green powder-coat finish and heavy duty locking hasp. Size cabinet per specification from manufacturer.
 - i. Controller and cabinet require grounding per manufacturer recommendations, outside disconnect, inside fused disconnect, interior duplex GFI outlet.
- 3. Controller and remote control equipment: Manufacturer and Model shall be noted on Drawing.
 - 4. Contractor shall provide concrete pad, 120V electrical power, conduits, grounding and control wire connections to terminal surge strips.
 - 5. Concrete Pad: Comply with plan detail and Section 02520.
- B. Electrical Control Wiring:
- 1. Low Voltage:
 - a. Electrical Control Wire for 24VAC solenoid – Golf Course Sprinkler Wire - #14 to #10 AWG UL approved direct burial solid conductor copper wiring with polyethylene insulation .045” thickness.
 - b. Electrical Common Wire – Golf Course Sprinkler Wire - #12 AWG UL approved direct burial solid conductor copper wiring with polyethylene insulation .045” thickness.
 - c. Data Wires – Paige 7171D-A direct burial shielded and armored signal cable with polyethylene jacket.
 - d. Wire Colors: Consistent color system throughout.
 - 1) Control Wires – Black.
 - 2) Common Wires – White.
 - 3) Spare Control Wires – Red.
 - 4) Spare Common Wires – Purple.
 - 5) Data Wires – Green and Blue
 - 6) Tracer Wire – Yellow
 - e. Control Wire connections and splices shall be made with 3M DBM direct bury splice, or similar UL listed dry splice methods.
 - f. Data Wire connections and splices shall be made with Ranger Servi-Seal
 - g. Spare Wire and wire ends shall be capped with 3M DBY or DBR direct bury splice, or similar UL listed dry splice methods to prevent wire corrosion.
 - 2. Splice Box: Carson Brooks ten (10”) inch round box, branded “SB.”
 - 3. Mainline Tracer Wire – Install one continuous AWG UL No. 10 tracer wire as detailed above all mainline. Loop wire into control box. Color shall be yellow.
 - 4. High Voltage – Type required by local codes and ordinances, of proper size to accommodate needs of equipment serviced.

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2.7 MISCELLANEOUS MATERIALS:

- A. Rain Sensor: Hunter wireless Rain Klik with by-pass or Mini-Klik (wired) with Sensor Guard or approved equal. Rain sensor shall be installed per manufacturer's recommendations.

PART 3 – EXECUTION

3.1 PREPARATION:

- A. Utility Locates: Contact Utility Notification Center of Colorado in accordance with the contract documents. Route trenches to avoid existing utilities. Verify with the Denver Parks Representative any required relocation prior to installation.
- B. Landscape Plan Review and Coordination: Contractor will be held responsible for coordination between landscape and irrigation system installation. Landscape material locations shown on the Landscape Plan shall take precedence over the irrigation system equipment locations. If irrigation equipment is installed in conflict with the landscape material locations shown on the landscape plan, the Contractor will be required to relocate the irrigation equipment, as necessary, at Contractor's expense.
- C. Pressure Verification: Contractor shall field verify the tap size, static pressure and verify Gallons Per Minute flow at the project site, prior to commencing Work or ordering irrigation materials, and submit findings in writing to the Denver Parks Representative. If Contractor fails to verify tap size, static water pressure and flow prior to commencing Work or ordering irrigation materials, Contractor shall assume responsibility for all costs required to make system operational and the costs required to replace any damaged landscape material. Damage shall include all required material costs, design costs, labor costs and plant replacement costs.
- D. Inspection: Examine areas and conditions under which Work of this Section is to be performed. Do not proceed with Work until unsatisfactory conditions have been corrected.
 - 1. Grading operations, with the exception of fine grading, shall be completed and approved by Denver Parks Representative before staking or installation of any irrigation system begins.
- E. Layout: Layout and stake system before beginning installation. Staking shall occur as follows:
 - 1. Mark, with paint, routing of pressure supply line and flag heads for all new zones. Contact the Denver Parks Representative forty-eight (48) hours in advance and request review of staking. Denver Parks Representative will advise installer as to the amount of staking to be prepared. The Denver Parks Representative will review staking and direct changes if required. Review does not relieve installer from coverage problems due to improper placement of heads after staking.
 - 2. Valve boxes and mainline will not be located in ball fields, and multi-use sport fields, recovery zones, or below playground equipment.

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3. If project has significant topography, free form planting beds, or other amenities which could require alteration of irrigation equipment layout as deemed necessary by the Denver Parks Representative, do not install irrigation equipment in these areas until the Denver Parks Representative has reviewed equipment staking.
4. The Denver Parks Representative may request the City Foresters approval of proposed trenching prior to start of trenching.
5. Review backflow prevention device location and operation with the Denver Parks Representative prior to mainline installation.

3.2 EXCAVATION AND BACKFILL:

- A. Install mainline pipe and wire sleeving under existing asphalt paving, concrete walks and critical root zones by directional boring. Pot-hole existing utilities for location and depth in advance of boring operations. When pot-holing in cross streets: include all permits, traffic control, backfill, compaction and surface restoration as required by the City and County of Denver Transportation Engineering Standards and Specifications. Compact backfill around end of sleeves to ninety-five percent (95%) compaction in landscape areas.
- B. Excavation:
 1. Trenching:
 - a. Trench excavation shall follow, as much as possible, layout shown on Drawing. Dig trenches straight and support pipe continuously on bottom of trench. Trench bottom shall be clean and smooth with all rock and organic debris removed. Comply with OSHA standards for all trenching and excavation.
 - b. Trenching under limb spread of existing trees: Accomplish by hand or other method that will not damage limbs or branches. Keep trenches at least ten (10) feet from trunk of existing trees. Refer to Section 02150 - Tree Retention and Protection for additional precautions.
 2. Clearances and Depths:
 - a. Main pressure line: Make trenches of sufficient width to properly assemble and position pipe in trench. Clearances:
 - 1) Piping three inch (3”) and larger: Minimum clearance of piping three inch (3”) or larger shall be five inches (5”) inches horizontally on both sides of the trench.
 - 2.) Piping two and one-half inch (2-1/2”) and Smaller: Trenches shall have a minimum width of four inches (4”) inches.
 - 3.) Line Clearance: Provide min. six inches (6”) of clearance between each line, and min. twelve inches (12”) of clearance between lines of other trades.
 - 4.) Lateral pipe: Trenches shall have a minimum width of four inches (4”).
 - 5.) Line Clearance: Provide not less than six inches (6”) of clearance between each line, and not less than twelve inches (12”) of clearance between lines of other trades.

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- b. Pipe and Wire Depth to finish grade:
 - 1.) Pressure Supply Piping within Parks – Thirty inches (30”) from the top of pipe, maximum variation two inches (2”).
 - 2.) Pressure Supply Piping within Right-of-Way – twenty- four inches (24”) from the top of pipe, maximum variation two inches (2”).
 - 3.) PVC Sleeving – at specified pipe or wire depth.
 - 4.) Non-pressure Piping (gear driven heads) – Eighteen inches (18”) from top of pipe, maximum variation two inches (2”).
 - 5.) Non-pressure Piping (pop-up heads) – Eighteen inches (18”) inches from top of pipe, maximum variation two inches (2”).
 - 6.) Control Wiring – Side of pressure main when installed in the same trench; twenty-four inches (24”) from the top of wire bundle where installed separately from mainline trench.
 3. Boring will be permitted only where pipe must pass under obstruction(s) which cannot be removed. In backfilling bore, final density of backfill shall match that of surrounding soil. It is acceptable to use sleeves of suitable diameter installed first by jacking or boring, and pipe laid through sleeves. Observe same precautions as though pipe were installed in open trench.
 4. Vibratory Plow: Not permitted without written authorization of the Denver Parks Representative.
- 3.3 INSTALLATION OF IRRIGATION EQUIPMENT: Locate all equipment as near as possible to locations designated. Deviations shall be reviewed and approved by the Denver Parks Representative prior to installation.

A. Sleeving:

1. Install sleeving under any hard surface prior to surface being installed to accommodate piping and wiring.
2. Minimum depth to top of pipe shall be determined by depth of mainline and lateral lines.
3. Provide for a minimum cover of twenty-four inches (24”) between the top of the sleeve and the bottom of the aggregate base for all pressure and non-pressure piping installed under asphaltic concrete or concrete paving.
4. Sleeving located under areas where asphalt or concrete paving will be installed shall be bedded with a sand layer six inches (6") below the pipe and six inches (6") above the pipe.
5. Sleeving under existing walks or concrete pavement shall be done by jacking, boring or hydraulic driving, but where cutting of asphalt and/or concrete is necessary, it shall be done and replaced at no cost to the City. Where cutting of concrete is necessary remove the entire concrete section or “stone”. Obtain permission to cut walks from the Denver Parks Representative
6. Lay sleeve to drain at minimum grade of three inches (3”) per one-hundred feet (100’).

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7. Compact backfill material in three uniform lifts at ninety-five percent (95%) determined in accordance with ASTM D698 using mechanical tamping devices under pavement.
8. Do not allow sleeves to become filled with soil or other undesirable material. Tape ends of sleeves until commencement of pipe installation.
9. Set in place, cap and pressure test all piping under paving, in presence of the Denver Parks Representative prior to backfilling and paving operations.
10. Mark sleeves on hard surfaces with a three inch by three inch (3" x 3") "X" as per plans in a manner to ensure easy location in the future.
11. Sleeve size requirements for wire and pipe, control wire shall be placed in sleeving separate from pipe sleeving:
 - a. 1" to 1-1/4" Pipe: 2" PVC (1)
 - b. 1-1/2" to 2" Pipe: 4" PVC (1)
 - c. 2-1/2" to 3" Pipe: 6" PVC (1)
 - d. 4" Pipe: 8" PVC (1)
 - e. 1 to 25 Control Wires: 2" PVC (1)
 - f. 26 to 50 Control Wires: 3" PVC (1)
12. HDPE pipe shall be used for sleeving purposes when directional boring takes place under any existing hard surfaces, walks, roadways or trees, etc. HDPE pipe may be used as the irrigation mainline under existing hard surfaces, walks, roadways or trees in lieu of sleeving.
 - a. Install HDPE pipe to ensure that the end section of the HDPE pipe is a minimum of two feet (2') beyond any hard surface or tree dripline.
 - b. All connections to the HDPE pipe are to be made with fusion welded fittings per the manufactures recommendations. All connection fittings between HDPE and PVC or any other pipe material being used are to be made a minimum of two feet (2') away from any hard surface or tree drip line.
 - c. HDPE pipe will be paid based on the amount of pipe installed for actual sleeving or mainline use and not for any pipe
 - d. Fittings to be used as couplings between HDPE and PVC shall be fusion welded and shall be installed as specified per the Drawings, Specifications and Manufactures recommendations. The following are pipe size requirements and coupling types:
 - 1.) Pipe sizes three inches and up (3" +) shall utilize a HDPE flange to PVC pipe transition with coupling and restraints. The fitting shall be fusion welded on the HDPE pipe and utilize joint restraints on the PVC side, Harco or approved equal.
 - 2.) Pipe sizes 2 and one-half inches and less (2-1/2" -) shall utilize a HDPE to PVC pipe transition. The fittings shall be fusion welded on the HDPE side and be solvent welded on the PVC side, Poly-Cam Inc, Model #730 or approved equal.

B. Installation of Piping:

1. PVC Mainlines:
 - a. Ensure that pipe is placed at a consistent depth and on a level base free of rocks and stones. Place manual drain valves at low points and dead ends

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of pressure supply piping to insure complete drainage of system. When pipe laying is not in progress, or at end of each day, close pipe ends with tight plug or cap. Perform Work in accordance with good practices prevailing in piping trades.

- b. Slope pipe at minimum three inches per one hundred feet (3" per 100') to manual drain valve and drainage sump. Field adjust as needed.
 - c. Install mainlines a minimum of twenty-four inches (24") off of any hard surface.
 - d. Solvent Weld PVC Pipe (required on all pipes two and one-half inches or less (2-1/2" -). Lay pipe and make all plastic to plastic joints in accordance with manufacturer's recommendations. Do not install pipe when air temperature is below forty degrees (40°) Fahrenheit (F).
 - e. Gasketed End Pipes: Lay pipe and make pipe-to-fitting or pipe-to-pipe joint, following the manufactures installation recommendations. Install Harco or Leemco fittings and pipe restraints on all fittings and adjacent pipe runs per manufacturer's recommendations and per approved plan.
- C. Thrust Blocks on all PVC mainline two and one-half inch and smaller (2-1/2"-): Construct thrust blocks per plans.
- 1. Concrete thrust blocks shall be a minimum of one (1) CF of cast in place concrete in compliance with section 03300. Contact Denver Parks Representative prior to placing thrust blocks, for observation of thrust block excavation and initial placement. Install a bond breaker made of a minimum six (6) mil plastic between the thrust block and fittings being restrained. Size thrust blocks per soil type table below:
 - 2.

Soil Type	lbs./SF
a. Mulch, Peat, etc.	0
b. Soft Clay	500
c. Sand	1,000
d. Sand and Gravel	1,500
e. Sand and Gravel with Clay	2,000
f. Sand and Gravel Cemented with Clay	4,000
g. Hard Pan	5,000
- D. Joint restraints on all gasketed PVC mainline pipe three inches and larger (3"+): Install joint restraints per the plans and or manufactures recommendations.
- 1. Joint restraints shall be installed as shown on the plans or per the manufactures recommendations. Prior to backfilling any joint restraints the Denver Parks Representative or Parks Operations Staff shall be present to verify that the restraints were installed in the proper locations and that all bolts have been tightened to the manufactures specifications. Any restraints that are buried prior to inspection shall be excavated to allow for review and inspection at no additional cost to the City.

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- E. Flexible Plastic (Polyethylene) Pipe –
 - 1. Lay pipe and assemble fittings according to manufacturer’s recommendations and per drawings and details.

- F. Control Wiring - Low Voltage Wiring:
 - 1. Bury control wiring between controller and electric valves in pressure supply line trenches, strung as close as possible to main pipe lines with such wires to be consistently located below and to one side of pipe, or in separate trenches.
 - a. Bundle all twenty-four (24) volt wires at ten foot (10’) intervals and lay with pressure supply line pipe to one side of the trench.
 - 2. Install tracer wire as per plan detail.
 - 3. Provide an expansion loop at every pressure pipe angle fitting, every electric control valve location (in valve box), and every five-hundred feet (500’). Form expansion loop by wrapping twenty-four inches (24”) of wire around a three-quarter inch (3/4”) inch pipe and withdrawing pipe.
 - 4. Make all splices and electric control valve connections using 3M DBY & DBR connectors or similar UL listed dry splice method.
 - 5. Install all control wire splices not occurring at control valve in a separate Carson Industries Model #910-10 body with 910-4 bolt down T-cover wire splice valve box with branded with WS in one inch (1”) high letters minimum.
 - 6. Install one control wire for each control valve.
 - 7. Run five (5) spare #14 AWG UFUL control wires and one (1) spare common wire from controller pedestal to the end of each and every leg of mainline. Label spare wires at controller and wire stub box.

- G. High Voltage Wiring for Automatic Controller:
 - 1. Provide 120 volt power connection to automatic controller.
 - 2. All electric work shall conform to local codes, ordinances, and authorities having jurisdiction. All high voltage electrical work shall be performed by licensed electrician.

- H. Installation of Valves:
 - 1. Electric Control Valves: Install electric control valves as detailed on the Drawings.
 - 2. Quick Coupling Valves: Install quick coupling valves as detailed on the Drawings.
 - 3. Drain Valves: Install manual drain valves as detailed on the Drawings.
 - a. Install manual drain valves at all low points in pressure supply line, whether indicated on the drawing or necessitated by actual conditions, to ensure proper drainage of the mainline.
 - 4. Isolation/Gate Valves: Install as detailed in locations shown on Drawings.
 - 5. Valve Boxes: Install one valve box for each type of valve or manifold as detailed. Install gravel compaction and leveling bed after compaction of subgrade and prior to setting of valve box.

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- a. Install valve boxes flush with finish grade and square to adjacent surface features.
 - b. When valve boxes are grouped together, allow at least twenty-four (24”) inches between valve box sides.
 - c. Install valve boxes a minimum of eighteen inches (18”) off of any hard surface.
 - d. Cutting of valve box to give clearance for piping or valves will not be allowed.
6. Backflow Prevention Device: Contractor must meet all applicable laws, rules and codes, including but not limited to Uniform Building codes, Plumbing Codes and State Water Regulations. Assemblies must be installed per the manufacturer’s specifications. Backflow devices shall not be installed within the public right-of-way.
- a. Install in strict accordance with current requirements of Denver Water. Connections to the Denver Water System are to have an approved assembly for the type of protection they provide, either isolation or containment.
 - b. Successful Testing of backflow assembly by a certified Backflow Prevention Assembly Tester is Contractor’s responsibility and any cost shall be considered incidental. Test reports shall be forwarded to Denver Water in accordance with the State of Colorado regulations. Copies of the report, the tester’s certification and the certification of the testing equipment used are to be forwarded to the Denver Parks Representative.
 - c. Request for final payment will not be certified or processed until certification reports have been filed with Denver Water and received by the Denver Parks Representative.
- I. Installation of Sprinkler Heads:
1. Install sprinkler heads where designated after the Denver Parks Representative has approved staking. Set to finish grade as detailed.
 2. Spacing of heads shall not exceed the maximum indicated on Drawing(s) unless re-staked or as directed by the Denver Parks Representative. In no case shall the spacing exceed maximum recommended by manufacturer.
 3. Install gear driven heads on swing-joint risers as detailed. Swing joints to non-pressure lines shall be set at no more than 45 degrees or less than 10 degrees.
 4. Install pop-up heads on swing pipe as detailed.
 5. Adjust part circle heads for proper coverage. Adjust heads to correct height after sod is installed. Plant placement shall not interfere with intended sprinkler head coverage, piping, or other equipment. The Denver Parks Representative may request nozzle changes or adjustments without additional cost to CDOT.
- J. Backfilling:
1. Do not begin backfilling operations unless authorized by the Denver Parks Representative and all required systems tests have been completed. Backfilling shall not be done in freezing weather unless authorized by the Denver Parks Representative. Leave trenches slightly mounded to allow for settlement after

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backfilling is completed. Trenches shall be finish graded and sodded or seeded prior to walk-through of system by the Denver Parks Representative.

2. Materials - Excavated material is generally considered satisfactory for backfill purposes. Backfill material shall be free of trash, organic matter, frozen materials, and stones larger than two inches (2”) in maximum dimension. Do not mix subsoil with topsoil. Material not suitable for backfill shall be hauled away. Contractor shall be responsible for providing suitable backfill if excavated material is unacceptable or not sufficient to meet backfill, compaction, and final grade requirements.
3. Do not leave trenches open for a period of more than forty-eight (48) hours. Open excavations shall be protected in accordance with OSHA regulations.
4. Compact backfill to ninety-five percent (95%), determined in accordance with ASTM D698 utilizing the following methods in landscape areas:
 - a. Mainline Pipe: Backfill and mechanically compact in three uniform lifts to a ninety-five percent (95%) compaction, utilizing optimum moisture content for the soil type. Hydraulic settling of mainline trenches will not be allowed.
 - b. Secondary Pipe: Backfill in two uniform lifts and hydraulically or mechanically compact each.
 - c. Puddling or ponding and/or jetting is prohibited within twenty feet (20') feet of building or foundation walls.

K. Automatic Control System:

1. Sentinel Central Control:
 - a. Contractor is to arrange and pay for C.P.S. Distributors to conduct a signal test and survey to maximize signal quality of any antenna and each Sentinel controller installed, and maximize layout for flow sensing. Contact Brandon Gully, with C.P.S Distributors at (303)394-6040 or gulyb@cpsdistributors.com. Signal test and survey is to be conducted or verified prior to construction during full tree leaf-out when possible. Location of the controller shall be based on the field test. Contractor is responsible to coordinate optimization of central control with the Toro Factory Representative, Water Conservation, Parks Operations Supervisor and the Denver Parks Representative
 - b. All irrigation schedules during establishment period and warranty period are to be submitted via email to the Toro Factory Representative, Water Conservation, Parks Operations Supervisor and Denver Parks Representative. Upon approval of the schedule the Toro Factory Representative will input schedules and make all changes, corrections or updates within forty eight (48) hours.
2. Install controller and enclosure in accordance with the Drawings and per the manufacturer's instructions. All work including but not limited to concrete pad, 120v electrical power, conduits, grounding and control wire connections to terminal surge strips shall be by the contractor.

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3. Provide controller to earth ground as per manufacturer recommendations.
Central Control Satellite: Provide controller to earth ground in accordance with Article 250 of the National Electrical Code (NEC). Earth ground shall be 10 OHMS or less as measured by a Megger® or similar instrument, or as per manufacturer recommendation. Contractor shall arrange with the Toro Factory Representative and perform testing in presence of Parks Operations Staff and Denver Parks Representative.
 - a. Ground rods are to have a minimum diameter of five-eighths of an inch (5/8") and a minimum length of eight feet (8').
 - b. Copper wire shall be six (6) gauge bare copper wire connected to the ground rod using a Cadweld GR1161GPLUS "Plus One Shot" welding kit.
 4. Install above ground wiring in rigid conduit in accordance with applicable codes.
- L. Coordinate installation with electrical work to insure electrical power supply line(s) are provided to controller location(s).
1. Permanently engrave date of installation and Xcel service pole number inside controller enclosure.
- M. Wire control valves in a logical zone sequence or as shown on Drawings.
- N. Rain Sensor: Install in accordance with manufacturer's instructions, and as shown on the Drawings.
1. Install rain sensor(s) prior to starting any irrigation schedules for new sod or seed programs.
 2. Install rain sensor(s) a minimum of fifteen feet (15') above grade, mount to a light pole, building or approved structure that is not shielded by tree canopies or structures and not effected by irrigation overspray.
 3. All rain sensor(s) to be set at one-eighth of an inch (1/8") prior to being installed or irrigation begins.
- 3.4 FIELD QUALITY CONTROL:
- A. Flushing: After piping, risers, and valves are in place and connected, but prior to installation of sprinkler heads, quick coupler assemblies, and hose valves, thoroughly flush piping system under full head of water pressure from dead end fittings. Maintain flushing for five (5) minutes through furthest valves. Cap risers after flushing.
- B. Testing pressurized mainline: Prior to installing any plant materials (sod, seed, trees, shrubs, perennials) arrange and conduct pressure test(s) in the presence of Parks Operation Supervisor, the Denver Parks Representative and Designer of Record. Arrange for testing a minimum of forty-eight (48) hours in advance. The contractor is responsible to supply the hydrostatic test pump and all other equipment required to complete the test.
1. Set in place, cap and pressure test all piping under paving, in presence of the Denver Parks Representative prior to backfilling and paving operations.

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2. After backfilling and installation of all control valves, fill pressure supply line with water, and pressurize to forty (40) PSI over the designated static pressure or one hundred and twenty(120) PSI, whichever is greater, for a test period of two (2) hours.
 3. All isolation valves, angle valves, ball valves and zone valve flow controls are to remain open during testing.
 4. Leakage, Pressure Loss:
 - a. Solvent welded PVC Pipe - Test is acceptable if zero (0) pounds of pressure is evident during the test period.
 - b. Ring Tight Pipe – Test is acceptable if two (2) pounds of pressure or less is evident during the test period.
 5. Leaks: Detect and repair leaks. Replace defective PVC pipe with new full length pipe section. No pipe splices will be accepted within pipe sleeve. No PVC pressure couplings or slip-fix repair couplings will be allowed.
 6. Retest system until test pressure can be maintained for duration of test.
- C. Testing Controller Operations:
1. Functional test of the control system shall be performed and demonstrate that all parts of the control system function as specified or intended, as per Parks **Central Control Certification Checklist**. The functional test for each system shall consist of not less than thirty (30) days of continuous, satisfactory operation of the complete system serviced by a controller.
 - a. Contractor to coordinate with the Denver Parks Representative to arrange Central Control Certification meeting.
 - b. Required attendees are the Toro Factory Representative, Water Conservation, Parks Operations Supervisor and the Denver Parks Representative.
 2. Any materials determined to be faulty as part of the installation shall be replaced or corrected by the Contractor at his expense in a manner respective to the Plans, Details and other sections of this Specification. In the event of a system failure due to faulty installation, programming or workmanship, the thirty (30) day period will be repeated until testing is complete.
- D. System Operations Orientation:
1. System Operation Training Session: A training and orientation session for Parks staff shall be required.
 - a. The Contractor, the irrigation subcontractor, a representative of the manufacturer or distributor, and representatives of Parks maintenance and Water Conservation shall be present. The date and time of the session and attendees present shall be subject to approval by the Denver Parks Representative.
 - b. The completed Record Drawings, Controller Zone Maps and Controller Program Schedule shall be reviewed for approval by Water Conservation .

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- c. Controller features, flow sensing, alarms and programming shall be reviewed.
- d. Hand held operation of field units shall be demonstrated.

E. Walk-Through for Final Acceptance:

1. Arrange for Parks Operations Supervisor, the Denver Parks Representative and Designer of Record to be present provide a minimum of forty-eight (48) hours notice in advance of walk-through.
2. Entire system shall be completely installed and operational and trenches shall be finish graded and sod and seed in place prior to scheduling of walk-through.
3. Electrically operate each zone in its entirety for the Denver Parks Representative and Operation Supervisor at the time of walk-through.
4. A project inspection walk through shall include but is not limited to the following:
 - a. Contractor shall adjust, straighten and nozzle all heads prior to walk through. Review operation, coverage, head/nozzle adjustment, and system adjustment per specifications.
 - b. Contractor shall have all valves boxes unlocked prior to walk through. Open valve boxes to confirm materials, gravel bedding, compaction, elevation, workspace access within boxes, clearance from lid and bedding, locking mechanisms, and zone branding. Interior of boxes should be free of foreign material, only filter fabric shall be visible in the bottom of boxes. All valves must be tagged with zone identification and valve box lids must be branded with zone valve identification. Verify connections in all valve and wire splice boxes.
 - c. Contractor shall provide documentation that resistance tests for all spare common and hot wires has been performed and the results for each OHMS reading on each wire tested.
 - d. Confirm irrigation heads are at specified elevation and distance(s) from paved surfaces and curbs, plumb and soil compacted.
 - e. Inspect concrete size and elevation of pads for backflow assemblies, master valves, and enclosure pads. Confirm quality of concrete, finishes access to the controller and spare conduit/sleeving as required for wiring.
 - f. Confirm quality of controller enclosure and mounting (there must be no gap between controller and concrete), grounding, high voltage installation, low voltage wiring, ID tagging of wires in controller, and communication set up. Each controller must have a color-coded zone chart and programming chart as per specifications.
 - g. Contractor shall submit to the Owner written certification of testing that proper grounding for all controllers has been installed per the manufactures recommendations.
 - h. Review trench and related excavation repair including backfill, compaction, fine grade, seed and sod installation.
 - i. Review appropriate use of purple valve lids and other product as required for reuse water applications.
 - j. Generate a punch list of items to be corrected prior to Final Completion.
 - k. Furnish all materials and perform all work required to correct all inadequacies of coverage due to deviations from Contract Documents.

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5. Certify Central Control Operation: Central control operation will be verified by Parks Certification of Central Control Checklist.

F. Walk-Through for Final Completion:

1. Arrange for Park Operations Supervisor, the Denver Parks Representative and Designer of Record to be present a minimum of seventy-two (72) hours in advance of walk-through.
2. Show evidence to the Denver Parks Representative that the City has received all maintenance items and accessories, charts, record drawings, equipment, backflow certification reports and controller grounding assembly certificates as required before Final Completion walk-through is scheduled.
3. Operate each zone, in its entirety for the Denver Parks Representative at time of walk-through to insure correction of all incomplete items.
4. Items deemed not acceptable by the Denver Parks Representative shall be reworked to complete satisfaction of the Denver Parks Representative.

3.5 ADJUSTING:

- A. Upon completion of installation, "fine-tune" entire system by regulating valves, adjusting arcs and radius, and setting pressure reducing valves at proper and similar pressure to provide optimum and efficient coverage. Flush and adjust all sprinkler heads for optimum performance and to prevent overspray onto walks, roadways, and buildings as much as possible. Heads of same type shall be operating at same pressure within plus or minus ten percent (+/- 10%).
- B. If it is determined by the Denver Parks Representative or Designer of Record that irrigation adjustments will provide improved coverage and water distribution, the Contractor shall make such adjustments prior to Final Acceptance. Adjustments may include but not limited to changes in nozzle sizes, degrees of arc, and control valve flow control regulations. Adjustments shall be completed at no additional costs to the City.
- C. All sprinkler heads shall be set perpendicular to finish grade or within allowable limits shown on Drawings.
- D. Areas that do not conform to designated operation requirements, due to unauthorized changes or poor installation practices, shall be immediately corrected at no additional cost to the City.

- 3.6 CLEANING - Maintain continuous cleaning operation throughout duration of Work. Dispose of, all trash, waste materials, debris and excess soil generated by installation of irrigation system off-site at no additional cost to the City,

END OF SECTION 02810

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SECTION 02831

FENCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS: The Book 1 Contract requirements apply to Work of this section.

1.2 SUMMARY:

- A. Work Includes: Furnishing and installing entire fence system, including fence framework, fabric and accessories, manual gates and all related hardware.
- B. Related Work:
 - 1. Layout of Work and Surveying – Section 01050
 - 2. Submittals – Section 01300
 - 3. Tree Retention and Protection – Section 02150
 - 4. Earthwork – Section 02200
 - 5. Concrete Walks, Curbs and Miscellaneous Flatwork - Section 02520
 - 6. Sodding – Section 02935
 - 7. Cast-In-Place Concrete - Section 03300

1.3 REFERENCES:

- A. Comply with the following standards unless noted otherwise. If conflict between specifications occur, the most stringent shall apply.
 - 1. ASTM A116 – Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric
 - 2. ASTM A53/A53M – Pipe, steel, Black and Hot-Dipped Zinc Coated (Galvanized) Welded and Seamless, for Ordinary Use.
 - 3. ASTM A123 – Zinc (Hot Dipped Galvanized) Coatings on Iron and Steel Products.
 - 4. ASTM A153 – Zinc-Coated (Hot-Dip) on Iron and Steel Hardware.
 - 5. ASTM A392 – Zinc-Coated Steel Chain-Link Fence Fabric.
 - 6. ASTM A392-11a – Top and Bottom Knuckled Selvage Chain Link Fabric.
 - 7. ASTM F668 – PVC Coated Steel Chain Link Fence Fabric.
 - 8. ASTM F934 – Colors for PVC Fence Coatings

1.4 SUBMITTALS

- A. Submit manufacturer’s specifications and literature for approval prior to installation.
- B. Contractor shall submit product sheets on materials to be used including but not limited to fittings, hardware, fabric, colors, coatings, paints and concrete as specified.

1.5 QUALITY CONTROL

- A. The contractor shall provide laborers and supervisors who are thoroughly familiar with the type of construction involved and materials and techniques specified.

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1.6 PRODUCT HANDLING AND STORAGE

- A. Upon receipt at the job site, all materials shall be checked to ensure that no damage occurred during shipping or handling.
- B. Materials shall be stored in such a manner to ensure proper ventilation and drainage and to protect against damage, weather, vandalism and theft.

1.7 SITE CONDITIONS

- A. Protection of Monuments: Locate, protect and maintain benchmarks, monuments, control points and project engineering reference points.
- B. Site Drainage and Dust: The Contractor shall maintain positive drainage into all existing drainage ways. The project area shall be graded to smooth all uneven areas prior to installation of fencing materials and at the completion of fence installation. Control dust caused by the work. Dampen surfaces as required.
- C. Site Access: The Contractor shall access each project site at locations designated by the Project Manager. No heavy trucks are allowed on turf areas. Should the work be for the installation of a ball field fence access for fence installation will only be allowed from outside the ball field area.

PART 2 - PRODUCTS

2.1 GENERAL

All fence materials shall meet the minimum requirements established by the Chain Link Fence Manufacturers Institute.

2.2 FENCE FABRIC

- A. Vinyl Coated Fabric: Nine gauge (9) gauge wire, two inch (2”) mesh. Knuckled selvage top and bottom. Polyvinyl Chloride (PVC) coating to be Class 2B (thermally fused and bonded to metallic coated steel wire). Color in accordance with ASTM F934, to be selected by the Denver Parks Representative.

2.3 FENCE FRAMEWORK

- A. Polyester Powder Coated Posts and Rails: For use in conjunction with vinyl coated fabric. Min. thickness of finish polyester powder coat shall be two to three mils (2-3) over two mil (2) mil zinc epoxy. Color to match fabric.

2.4 GATES

- A. Materials for gates shall match fence materials.

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2.5 FENCE FITTINGS

- A. The material for fence fittings shall be manufactured to meet the requirements of ASTM F626. The coating for all fittings shall be the same as that required for the framework.

2.6 SAFETY TUBE

- A. Safety tubing shall be installed on top of all outfield fencing or any fencing surrounding play fields. Safety tubing shall be a product specifically manufactured as a safety cap for fencing. The tubing shall be 4 1/2” diameter made of polyethylene, and shall be weather and fade resistant. Color to be selected by Denver Parks Representative.

PART 3 - EXECUTION

3.1 SITE CONDITIONS

A. Existing Conditions:

1. Soil Conditions: Investigate the type of soil and conditions in which lines are to be installed and allow for same in proposal.
2. Contractor is responsible for understanding the scope of related operations as specified before beginning Work under this Section.
3. Report unsatisfactory conditions to CDOT.

B. Protection of Property:

1. Preserve and protect all trees, plants, monuments, structures, and paved areas from damage due to Work of this Section. In the event damage does occur, all damage to inanimate items shall be completely repaired or replaced to satisfaction of CDOT and the Denver Parks Representative, and all injury to living plants shall be repaired or replaced by the Contractor.
2. Protect buildings, walks, walls, and other property from damage. Erect and maintain barricades, warning signs and lights, and provide guards as necessary or required to protect all persons on the site. Damage caused to asphalt, concrete, or other building material surfaces shall be repaired or replaced at no cost to the City. Restore disturbed areas to original condition.

C. Protection of Existing Trees:

1. Consult with Parks’ Forestry as requested by Denver Parks Representative prior to digging within critical root zones. All digging or work within critical root zones of any tree shall be dug by hand or by other methods as directed by the Denver Parks Representative so as to prevent damage to limbs or branches and root system. Refer to Tree Retention and Protection – Section 02150.

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3.2 INSTALLATION

- A. Install framework, fabric, accessories and gates in accordance with recommendations of the Chain Link Fence Manufacturers Institute.
- B. Workmanship: The complete fence shall be plumb, both in line and transverse to the fence, straight and rigid with fabric tightly stretched and held firmly in place. Install fencing with bottom of fabric flush with grade. Details of construction, not specified shall be performed in keeping with good standard fencing practice.
- C. Concrete: Set all posts in concrete, designed to have a minimum compressive strength of three-thousand PSI (3000) at twenty-eight days (28). Allow all posts to set at least forty-eight hours (48) before top rails, center rails, wire fabric and fittings are installed.
- D. Posts: Space posts not more than ten feet (10') apart. Set posts in concrete as shown on drawings or per manufacturer's specifications. Install mow strip per Cast in Place Concrete – Section 03300 (when applicable) where required, with control joints centered on posts.
- E. Rails: Set rails as nearly parallel to finish grade as possible and at the specified height shown on the Drawings.
- F. Fabric: Fabric shall be full height as shown on details. Where applicable, all fabric shall be attached to the ball field side of the fence with the ties spaced at one foot (1') intervals (maximum) on all posts and two foot (2') foot intervals (maximum) on all rails, with no sharp ends projecting. Selvages shall be knuckled top and bottom throughout. Fabric shall be tightly stretched and securely fastened with fittings and accessories provided by the manufacturer. Minimum width of fabric on fences over six feet (6') in height shall be eight feet (8'). Fabric on high fences shall lap or splice only at intermediate rails. All fabric shall be in contact with top of mowing strips – no gaps allowed.
- G. Fasten fabric to top rail, line post, braces and bottom tension wire/bottom rail with tie wire at maximum twelve inches (12") on center.
- H. Attach fabric to end, corner and gate posts with tension bars and tension bar clips. The tension bars shall be of lengths two inches (2") less than the full height of the fabric with which they are to be used. Bars shall be attached to the fabric by threading through the fabric, by bands or other mechanical means, and installed at all terminal or corner posts and gate posts.
- I. Install gate with fabric to match fence.

3.3 TOLERANCES:

- A. Variation from plumb: One-quarter inch (1/4") in six feet (6') (one-half inch (1/2") maximum overall).

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- B. Variation in line of posts: One-quarter inch ($\frac{1}{4}$ ") in twenty feet (20') horizontal (one-half inch ($\frac{1}{2}$ ") maximum overall).

3.4 CLEAN UP

- A. Maintain a neat and orderly work site at all times.
- B. Upon completion of site work, clean up area, remove tools, equipment, materials and debris.

END OF SECTION 02831

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SECTION 02841

MODULAR BLOCK RETAINING WALL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS: The Book 1 Contract requirements apply to Work of this section.

1.2 SUMMARY:

A. Work Includes: Installation of Modular Block Retaining Wall no greater than 30” in height. The work covered under this section includes all necessary design criteria, materials, and construction requirements for providing walls in accordance with these specifications and in conformity with the details and dimensions shown on the plans.

B. Related Work:

1. Layout of Work and Surveying – Section 01050
2. Submittals – Section 01300
3. Tree Retention and Protection – Section 02150
4. Earthwork – Section 02200
5. Excavating and Backfilling of Trenches – Section 02220
6. Subdrainage Systems – Section 02710

1.3 SUBMITTALS:

A. Samples of specified modular block product, showing range of color if appropriate.

B. Manufacturer's data and testing results for wall units and soil reinforcement.

1.4 STORAGE AND HANDLING:

A. Protect concrete block from damage during storage. Store all materials off ground on palettes under protective covering.

PART 2 - PRODUCTS

2.1 GENERAL: The Contractor shall provide all materials and incidentals to construct a complete wall system in place. The modular block retaining wall system shall include the precast wall units, aggregate base course, and drainage system as indicated on the plans.

2.2 MATERIALS:

A. Precast Concrete Modular Block Wall Units

1. Precast wall units shall have a minimum twenty-eight days (28) compressive strength of three-thousand PSI (3000). The concrete shall have adequate freeze thaw protection with a maximum moisture absorption rate of eight percent (8%).

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2. Exterior dimensions shall not differ more than one-eighth inch (1/8") from manufacturers specifications.
 3. All units shall be sound and free of cracks or other defects that would interfere with the proper placing of the unit or significantly impair the strength or permanence of the construction. The exposed surfaces of units shall be free of chips, cracks or other imperfections.
 4. All exposed sides, except for top of cap units, shall be split face.
 5. Acceptable manufacturers: Versa-lok, Keystone, Mesa or approved equal.
- B. Perforated Drain: Refer to Subdrainage Systems - Section 02710.
- C. Filter Material: Class C filter material per CDOT 703.09.
- D. Base Material: Class 6 aggregate per CDOT 703.03.

PART 3 - EXECUTION:

3.1 PREPARATION:

- A. Prepare sub grade per block manufactures or suppliers recommendations.
- B. The foundation for the walls shall be graded level. Compact subgrade to a minimum ninety-five percent (95%) of maximum standard proctor dry density per ASTM D 698 at plus or minus two percent (+/-2%) optimum moisture content. Any foundation soils found to be unsuitable shall be removed and replaced.
- C. Place a minimum of six inches (6") of aggregate base material in the trench, compacted to minimum Ninety-five percent (95%) of maximum modified proctor dry density per ASTM D 1557 at plus or minus two percent (+/-2%) optimum moisture content.

3.2 INSTALLATION:

- A. Install per block manufactures or suppliers recommendations.
- B. Precast modular block wall units shall be placed true to line and level as indicated on the Drawings and as directed by the manufacturer's installation instructions.
- C. Bottom course shall be buried a full depth of block below finish grade.
- D. Cap stones shall be secured with an approved adhesive material, as recommended by the manufacturer.

END OF SECTION 02841

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SECTION 02850

SYNTHETIC TURF

PART 1 - GENERAL

1.1 RELATED DOCUMENTS: The Book 1 Contract requirements apply to Work of this Section.

1.2 SUMMARY:

- A. Work Included: Provide and install synthetic turf field system suitable for soccer, football, and ultimate frisbee.
- B. Related Work:
 - 1. Submittals – Section 01300
 - 2. Earthwork – Section 02200
 - 3. Subdrainage Systems – Section 02710

1.3 INSTALLER QUALIFICATIONS

- A. The turf installer must have installed a minimum of 5 fields using the infill system to be used at Barnum Park East. The turf installer must hold, in good standing, a Certification with the Synthetic Turf Council this is acceptable for Synthetic Surfaces. A letter on the manufacturer's letter head shall be submitted affirming the turf installer as a competent in the installation of the material, including seaming methods, in-laid markings, termination and proper installation of the product.

1.4 SUBMITTALS

- A. Synthetic Turf – One (1) sample –approximately 18" square
- B. Sample of knitted in 4" white line
- C. Sample of knitted in 2" light blue line
- D. 1 cubic foot sample of infill material
- E. Seaming material samples and manufacturer's product data
- F. Seaming diagram
- G. Striping diagram
- H. Plan showing the layout of the synthetic turf rolls and proposed seam locations.
- I. Manufacturer's data certifying compliance with these specifications.
- J. Certified list of existing installations, including Owner representative and telephone number, attesting compliance with quality assurance information.
- K. Sieve analysis of base rock and crusher fines
- L. Manufacturer's data for drainage system.
- M. Certified results from an independent testing laboratory indicating results for the tests listed in 2.1.C.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packing and Shipping: Deliver products in original unopened packaging with legible manufacturers' identification. All materials shall be stored in a dry place out of direct sunlight.

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- B. Bulk Materials: Deliver materials in clean, washed and covered trucks to eliminate contamination during transportation. On site stockpiling locations to be coordinated with the Project Manager. Stockpile only in areas free of debris and away from drainage routes. Cover all materials with plastic or geotextile if materials are to be stockpiled more than 48 hours.

1.6 HOLD OWER HARMLESS

- A. The Contractor shall hold CDOT and the City and County of Denver harmless from infringement of any current or future patent issued for the synthetic turf system, fibers, backings, installation methods, drainage characteristics, etc. The successful bidder will be required to submit a letter of consent from their surety. The surety shall indemnify the requirements.

PART 2 - GENERAL

2.1 SYNTHETIC TURF:

- A. Synthetic turf shall be a permeable, vertically draining, infilled synthetic grass that provides the look, the feel, and the playability of natural grass with respect to ball speed and bounce and maximum safety to the athletes.
 - 1. The pile fibers shall be monofilament fiber.
 - 2. The entire system shall be resistant to weather, insects, rot, mildew, fungus growth and shall be non-toxic.
 - 3. The surface shall provides superior traction in all types of weather with the use of conventional athletic shoes and composition molded-soles.
 - 4. The infill materials specified shall provide the shock attenuation characteristics of the system. The system shall maintain a G-Max reading as described in ASTM F 1936-98 *Shock Absorbing Properties of North American Football Field Playing Systems* as measured in the field.
 - 5. Pile fibers shall resemble freshly grown grass in appearance, texture, and color (except for striping). Streaks, discoloration, or different dye lots shall not be accepted.
 - 6. The combined grass and infill system shall drain vertically at a minimum rate for 6 inches of precipitation per hour for 24 hours continuously.
- B. Field Markings: Field of play stripes shall be knitted in. Painted lines will not be accepted. All markings shall be uniform in color, providing sharp contrast to the background turf color and shall have sharp, distinct edges.
- C. Carpet Fiber: shall be a low friction blended polyethelene fiber, nominal 2-2 ½" long poly fiber tufted into a permeable double-layered primary backing with a secondary backing. The tufts shall be fanned (or unfolded) at installation. It shall have the following properties:

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<u>Property</u>		<u>Units</u>	<u>ASTM</u>
Pile Yarn Type:	UV-resistant poly		
Yarn Denier:	8000 nominal		D1577
Yarn Breaking Strength:	Min. 1.2	gms/denier	D2256
Yarn Melting Point:	250	degree F	D789
Minimum Pile Height	2	inches	D418
Maximum Pile Height	2 ½	inches	D418
Pile Weight	33	oz/sq.yd.	D418
Machine Gauge	¾ inch centers max.		D418
Tuft Bind (without infill)	11	lbs.	D1335
Grab Tear Strength	170	lbs.	D1682
Pill Burn Test	Pass		D2859
Permeability	10-40	inches/hour	D4491

1. Primary backing: shall be a UV-treated woven polypropylene, weighing approximately 8 oz./sq. yd.
2. Secondary backing: shall be a permeable application of high quality latex or polyurethane, heat activated to lock the fiber tufts into the primary backing materials.

D. Seams

1. If sewn, all seams shall be constructed of reinforced backing material or sewn with high strength polyester fiber cord. Sewn seams shall be a “bagger” type seam with a double sewn line.
2. All Glued seams shall have a 12” wide seaming tape of nylon or mylar, fully coated with adhesive. No seams shall have any adhesive applied to the exposed fibers.
3. All seams shall lay flat after infill installation.

E. Infill: Shall consist of ground rubber, or a blend of graded dust free sand and ground rubber.

1. Rubber shall be free of all metal and produced of 100% recycled automobile tires. The material shall not exceed 14 mesh nor be smaller than 20 mesh. Fine particles shall not exceed 10% by volume. Bulk density of the rubber shall not be less than 29.75 lbs/cubic foot.
2. All rubber materials shall be treated with an anti-static material before installation. Anti-static material shall be as manufactured by Bristol Meyer, Lever Brothers, or approved equal.
3. All materials shall be approved by the turf manufacturer.

2.2 ADHESIVE MATERIAL

- A. Adhesive material meant to adhere to synthetic turf shall be a polyurethane 34G adhesive as manufactured by Synthetic Surfaces Inc., or approved equal. The adhesive shall be applied per the manufacturer’s recommendations.
- B. Adhesive material shall not be thinned in any way.
- C. The adhesive shall have the same warranty period as the synthetic turf.
- D. If a hot melt welding method is used, the glue shall have an application temperature of 325 degrees F. with a melting point of 180 degrees F. Material shall be National Adhesive #34-5372 or approved equal.
- E. Adhesive materials shall be approved by the turf manufacturer.

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2.3 BASE MATERIAL

- A. The Base shall be constructed of crushed stone aggregate per the details provided or as required by the Manufacturer’s specifications. The base layer shall be a minimum of 4", topped by a 2" finishing layer of finer crushed stone. The thickness of the base layer will be dictated by the permeability of the selected base stone, the rainfall Intensity-Duration-Frequency (IDF) data for the site, and the stability and load-bearing capacity of the sub-base.

2.4 DRAIN PIPE

- A. The collector drainage pipes can be rigid corrugated plastic wall smooth bore pipe, laid with a minimum slope of 0.5%. The individual field drain shall be 12" EnkaDrain material. The Contractor shall carry the collector pipe to its exit outside the field. The trench in which the pipe is set shall be filled with permeable granular material, such as ½" or ¾" drain rock or any similar free draining material as approved by the designer of record.

2.5 EDGING

- A. The edging around the fields shall be concrete per the details on the drawings.

PART 3 - EXECUTION

3.1 GENERAL

- A. Prior to the installation of the turf, the Contractor shall have surveyed the area to be covered and the longitudinal and lateral center lines and perimeter edge lines shall be located, marked, and staked 5 feet outside of the actual limits of the turf surface.
- B. The bristles of any brooms used, either during the original installation, or in subsequent maintenance, shall be of nylon only, shall under no circumstances include any metal, and must be approved by the manufacturer.

3.2 INSTALLATION LIMITATIONS

- A. Installation shall not proceed when:
 - 1. Ambient air temperature is below 50 degrees F.
 - 2. Material temperature is below 50 degrees F.
 - 3. Rain is falling or pending, unless acceptable to qualified installers.
 - 4. Other conditions exist, or are pending, that will be unsuitable for the installation of the system.

3.3 DELIVERY AND INSPECTION OF MATERIALS

- A. Prior to installation of any materials and immediately upon delivery of the synthetic turf components to the Project Site, the Contractor shall inspect material as follows:
 - 1. For damaged or defective items
 - 2. Measure turf pile height and roll lengths
 - 3. Inspect the perforations and uniformity
 - 4. Adhesives shall arrive in sealed dry containers
 - 5. Rubber in-fill shall arrive in large sacks or bags without tears and loose material about

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6. Rubber in-fill shall arrive dry and loose. No rubber shall be accepted that is bulked or solid.
7. Rubber in-fill shall be free of metal particles

3.4 TESTING

- A. CDOT reserves the right to submit any materials, either before or after installation to any testing it deems necessary to satisfy the conditions of the Contract.
- B. Any materials tested and found not in compliance with the Contract will be rejected and replaced with material conforming to the specifications. This will be done at the sole expense of the Contractor.

3.5 DRAIN SYSTEM

- A. Drains shall always be set as close as possible to the periphery of the turf-covered area in order to evacuate the water coming through the permeable granular base, and to capture any water coming toward the Base from outlying areas.
- B. The base shall be designed to slope away from the longitudinal centerline of the playing area. The diameter of the drainage pipes at the two long edges shall be a minimum of 8-inches in diameter.
- C. The drain shall be set so that the crown of the drainpipe is below any frost penetration and at least 6 inches below the bottom of the permeable granular base.
- D. There must be no drainage system exposed to the surface of the field, in order to eliminate any risk of accidents to users of the field.

3.6 BASE

- A. Contractor shall install base rock material. Both the base rock layer and the finishing rock layer shall be compacted and finished to provide slopes per the drawings.
- B. The finished grade shall not vary from the specified by more than ¼" in 10 ft. in any direction. It is strongly recommended that only laser grading equipment be used to meet these requirements.
- C. Prior to turf installation, the base rock shall be reviewed and accepted by the design of record and the Denver Parks Representative. In addition, the turf installer shall review the installation of the base rock and drainage system to comment on any problems that may be discovered. Prior to installation of the turf, the turf installer shall submit a letter confirming his review of the base and drainage installation, noting any discrepancies, problems, or conflicts, discussing how those issues were rectified, and finally, accepting the installation of the base and drainage system as suitable for turf installation.

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3.7 TURF

- A. After acceptance of the constructed base, the synthetic turf shall be laid out on the site and consecutive panels glued together at the seams using the latest state of the art procedures approved by the manufacturer.
- B. Seams will be sewn only with thread or glued only with adhesive approved by the manufacturer.
- C. Striping for fields shall be straight, consistent lines layed out to the size shown on the plans. The field sidelines and end lines shall be straight and square and shall not vary from the specified location by more than ½”.

3.8 INFILL

- A. The sand and rubber infill shall be inserted into the turf by experienced personnel who shall also brush and fibrillate the turf at the same time.

3.9 WARRANTY

- A. The turf installer and the manufacturer shall provide CDOT and the City and County of Denver with a written warranty to guarantee the materials and installation for a period of eight (8) years from the date of acceptance against all defects in workmanship and materials and premature wear and tear, provided that the product is properly maintained and used per the maintenance manual, and for a period of eight (8) years from ultraviolet degradation due to normal exposure to the sun. This warranty shall include all components of the synthetic turf system.

3.10 MAINTENANCE

- A. Turf installer shall supply The City and County of Denver with a written maintenance manual for proper care of the finished product. Provide descriptions of all equipment recommended for the maintenance and repair of the system, and activities not recommended relative to the warranty. Include maintenance recommendations such as coverings for special events, small repair procedures, minor seam repair, discussion of the precautions to be practiced, general maintenance, and uses to avoid to protect the grass system.

END OF SECTION 02850

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SECTION 02865

PLAYGROUND SURFACING MATERIALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS: The Book 1 Contract requirements apply to Work of this section.

1.2 SUMMARY:

A. Work Included: Furnishing and installing miscellaneous soft surface materials.

B. Related Work:

1. Layout of Work and Surveying – Section 01050
2. Submittals – Section 01300
3. Materials and Equipment – Section 01600
4. Tree Retention and Protection – Section 02150
5. Earthwork – Section 02200
6. Concrete Walks, Curbs and Miscellaneous Flatwork – Section 02520
7. Cast in Place Concrete – Section 03300

1.3 SUBMITTALS

- A. Submit one (1) 12”x12”x(thickness required at highest fall height) of rubberized surfacing
- B. Samples of each color being poured on the project
- C. Product data including manufacturer’s installation details for approval by Denver Parks Representative and Designer of record.
- D. A copy of manufacturer's test reports indicating compliance with the latest U.S. Consumer Product Safety Commission's Technical Guidelines for Public Playground Safety with regard to thickness of product beneath various equipment height ranges. IPEMA certification required – 1292-99 impact testing. In order to determine performance and longevity, the following test reports shall be required and tested by a certified laboratory.

The tests must certify that each material item has been tested for the following physical properties.

ASTM F-1292, Shock attenuation and HIC

ASTM E-108, Flame Spread

ASTM E-303, Skid Resistance

ASTM D-412, Tensile Strength

ASTM D-6241/86, Tear Resistance

Permeability

Proof that the product has been manufactured for at least 5 years.

Material safety data sheets.

Copy of a list of recommended maintenance procedures.

- E. Qualifications/References. The Contractor or subcontractor must have proven successful experience in the construction installation of poured in place resilient matting within the last three (3) years. The Contractor or their subcontractor designated to perform this

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work, shall be required to submit three (3) references, 2 of which are in similar climates, for projects which demonstrate successful experience with similar work. These projects must have been installed for a minimum of one (1) year. **The installation must be completed by certified factory installers from the location of the manufacturer.**

PART 2 - PRODUCTS

2.1 RUBBERIZED SURFACING

- A. Manufacturer: Surface America – “Playbound” poured in place, or approved equal.
- B. Product: Rubber surface shall have 1-3/4” minimum combined thickness of wearing course and base mat. Thickness may be greater if required by fall height of equipment. Minimum thickness for wear course shall be 1/2”. Color to be determined by Denver Parks Representative.
- C. An aliphatic binder shall be used.
- D. Contractor shall provide one year warranty for the rubber surface against any defects.

PART 3 - EXECUTION

3.1 INSTALLATION OF RUBBERIZED SURFACING

- A. Cushion Course: Contractor shall install thick cushion course (thickness as required by manufacturer) over the concrete base. The total thickness shall be recommended per ASTM 1292-99.

The Contractor shall adhere to the following installation procedure:

- 1. Determine manageable batch size.
 - 2. Thoroughly mix ingredients by mechanical drum mixer to ensure all granules are coated. Rubber granules, binder and mixing additives must be mixed at least 2 minutes to ensure a complete coating of particles.
 - 3. Establish reference points using screed strips to establish proper depth of Poured-in-Place cushion course. The cushion course shall be Poured-in-Place by means of screeding and hand troweled to maintain a seamless application.
 - 4. Prior to placement of the cushion course, the Contractor shall prime the vertical edges of all existing concrete to ensure matting does not pull away from edges.
 - 5. Allow the cushion course to cure completely before installing the top wearing course surface.
- B. Top Wearing Course: The poured cap material, minimum 1/2” thick, shall be composed of EPDM granular rubber and polyurethane resin. The wearing course shall be screed, troweled, and compacted onto the cushion course. To maintain a seamless application, the top-wearing course must be completed within one working day. All rubber shall remain consistent in gradation and size. Color tinted binder will not be allowed.

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The wearing course must be compacted manually by using hand trowels and light rollers.

All mixing shall be done by means of the mixmatic M 1200 D. Rubber granules, polyurethane binder and mixing additives must be mixed at least 2 minutes to ensure a complete coating of the particles.

- C. Curing Time: Curing time in between the cushion course and top wearing course shall be approximately 12 hours or per manufacturer's recommendation. **Curing time before use must be at least 48 hours after completion of wearing surface.**
- D. Weather Limitations: The matting shall not be applied during adverse weather conditions, such as rain, sleet or snowstorms. Based on specific manufacturer's recommendations, resilient matting shall not be installed if temperature is below 50°F. Should any additional cold weather curing ingredients be needed, it shall be at the Contractor's expense.
- E. Protection: The Contractor shall be responsible for the protection of the resilient matting during the installation process. The Contractor shall also be responsible for the protection of the surface during curing period following the completion of the installation. It is required that a temporary 6' high chain link security fence be installed around the perimeter of the playground from the start of construction through Final Acceptance.

3.2 MAINTENANCE AND CLEANUP

- A. Upon completion of work, the Contractor shall remove all containers and surplus materials leaving the site in a clean and orderly condition acceptable to CDOT and the Denver Parks Representative.
- B. Contractor shall provide the Owner with a certificate of satisfactory workmanship and warranty application to Surfacing Manufacturer.
- C. Contractor shall supply the City and County of Denver with surfacing maintenance guidelines at the completion of the project.
- D. Contractor shall supply the City and County of Denver with two (2) fifty (50) pound bags of the identical color of EPDM granular rubber used for the project and a five (5) gallon pail of resin.

END OF SECTION 02831.

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SECTION 02871

RESTROOM BUILDING MATERIALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS: The Book 1 Contract requirements apply to Work of this section.

1.2 SUMMARY:

- A. Work Included: Furnishing and installing miscellaneous materials for the restroom building.
- B. The design and construction of the restroom building shall integrate the materials described herein as parts of whole functioning systems that meet the applicable codes, City requirements, and the requirements of the Contract.

1.3 SUBMITTALS

- A. Submit product data for all restroom materials including manufacturer's installation details for approval by Denver Parks Representative and Designer of record.

PART 2 - PRODUCTS

2.1 CONCRETE SEALER

- A. Install Consolideck LS by Prosoco on concrete floors. Install per manufacturer's recommendations.

2.2 MASONRY

- A. 8x8x16 ground face block color #1; 4x8x16 split face block color #2.
- B. Inside face of CMU to align. Extend exterior face of split face block ½" beyond face of split face block.
- C. Remove interior face shells as required to allow for continuous reinforcing

2.3 INSULATION

- A. Install foam insulation or polystyrene insulation units.
- B. Foam insulation shall be installed in accordance with manufacture's recommendations.
- C. Molded polystyrene insulation units shall be Korfil by Concrete Block Insulation Systems, Omni Core by Shelter Enterprises Inc., or approved equal.

2.4 ROOFING

- A. Heavyweight Three-Tab Strip Shingles: Granule-surfaced, self sealing, fiberglass based strip asphalt shingles with architectural laminate styling to simulate wood shake appearance.

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- B. Product shall be: Model # GAF-Elk Timberline Weathered Wood by GAF.

2.5 DOOR HARDWARE

- A. Exterior restroom and chase doors
 - 1. Lock and Lever: Model # 93k-7R15DS3626 – (class room function) by BEST. Finish to be US26D.
 - 2. Deadbolt: Model # 83T-7SS3 STD Exterior keyed, interior thumb turned release-only safety feature - (class room function) by BEST. Finish to be US26D.
- B. Interior stall doors:
 - 1. Latch set: Model # 93kOL15DS3626 (passage function) by BEST. Finish to be US26D.

2.6 INTERIOR PARTITIONS

- A. Partitions Doors: Hollow metal door (3' wide by 4'-8" high) with 6' high hollow metal frame with no top. Hold bottom of door up 1'-4" so top aligns with top of frame.

2.7 SKYLIGHTS

- A. Tubular day lighting system shall be Brighten Up Series Model 290 DS, 14 inch diameter by Solatube or approved equal. The skylight shall be a transparent roof-mounted skylight dome with self-flashing curb, reflective tube and ceiling level diffuser assembly transferring sunlight to interior spaces.

2.8 PAINT

- A. Interior CMU Wall, Ceilings and exterior wood, soffits etc: high quality acrylic latex, semi gloss
- B. Colors:
 - 1. Interior all surfaces except floors and exterior soffits, eaves and ceilings: Kwal Blaeberry # CLW 1007W (very light gray) or approved equal.
 - 2. Exterior components: doors, frames, screens, vents and roof fascia, etc. Kwal Federal Green #14056 or approved equal.

2.9 GRAFFITI BLOCK

- A. Block Guard and Graffiti Control II by Prosoco. Install per manufacturer's recommendations.

2.10 SIGNAGE

- A. Men and women's sign: standard ADA bronze with symbol (6" X 8")
- B. Informational sign: Sign shall include the address and message to call 311 as noted below. The sign shall have dark letters on white back ground. Dimensions are 4" X 10". Sign locations should be noted on the drawings, and coordinated by Denver Parks Representative.

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John Doe Park Restroom · XXXX So. Restroom Way

**Report damage, graffiti, repair needs and non-functioning lights to Phone No. 311
Thank you for your cooperation in helping us keep this restroom clean and safe.**

2.11 HAND DRYER

- A. Model # HD-03 by Fastaire. Mounting: recessed behind restroom wall, touch button operated with timed power cut-off switch.
- B. Provide one unit for each restroom.

2.12 PLUMBING FIXTURES

- A. All Plumbing Fixtures shall be prison grade, stainless steel fixtures manufactured by Bradley.
- B. Lavatory: Model # LAV6185 by Bradley. The fixture shall be chase mounted, barrier free, stainless steel with open grid strainer. Mounted on stainless steel back plate with thru-bolts and concealed drain. Install stops in pipe chase. Provide P-trap, drain and integral faucet with hot and cold water valve.
 - 1. Waste piping from restroom lavatories shall be 1-1/2" no hub elbow waste.
- C. Lavatory faucets: Model No. DMSP S45-2156 by Bradley.
- D. Urinal: Model # UR18100 by Bradley. Fixture shall be a chase mounted, stainless steel, wash-out urinal, 1.5-1.6 gallons per flush. Concealed back supply, mounted on stainless steel back plate with thru-bolts. Flush valve shall be Model 609-1 concealed flush valve with vacuum breaker by Sloan. Installation shall meet all building code and ADA requirements
- E. Water Closets: Model # WC7245 by Bradley. Supply with integral seat. The fixture shall be chase mounted, siphon jet, stainless steel, 1.6 gallons per flush. Concealed supply, hinged seat, mounted on stainless steel back plate with thru-bolts. Installation shall meet all building code and ADA requirements. Flush controls shall be model # 601-1.6 concealed push button flush controls by Sloan. Flush valves shall be Prison Flushometer by Sloan.

2.13 HEATING SYSTEM

- A. A Heating system is not required for the restroom since it will be open for seasonal use only.
- B. The restroom and building systems shall be designed and built with the capacity to be retrofitted to provide heat in the future.

2.14 WATER HEATER

- A. Water heater: An electric, on demand water heater to provide tempered water for hand washing is required unless a variance is provided by the City and County of Denver. Mount the heater in chase as required.

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2.15 VENTILATION

- A. Provide code required mechanical ventilation.

2.16 ELECTRICAL

- A. Designer to determine service required. Minimum service shall be 100 amps. Service.
- B. Transformer: May be required, locate in a discrete location and away from drainage swales, irrigation etc. Coordinate with Denver Parks Representative for location.
- C. Time clocks: Utilize capacitor type battery so that clocks continue running for several days without power.
- D. Light Fixture Type ‘C’ (the recessed exterior down light) shall be Fail-Safe Model # FRR-142-UNV-80/86, ¼” polycarbonate lens, low temp ballast, 42W TRT, 3500K, 82 CRI, 0-Degrees by Fail-Safe.
- E. Light controls The operating sequence is the following:
 - 1. Exterior lights controlled by photocell only. Lights shall turn on at dusk and off at dawn.
 - 2. Interior lights controlled by occupancy sensor with photocell override. Lights shall switch on during occupancy, but only after dusk and before dawn.
 - 3. Exhaust fans controlled by time clock set to hours of park opening or staff planned times.

PART 3 – EXECUTION – NOT USED

END OF SECTION 02871

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SECTION 02910

TREE TRANSPLANTING

PART 1: GENERAL

1.1 RELATED DOCUMENTS: The Book 1 Contract requirements apply to Work of this section.

1.2 SUMMARY:

- A. Work Included: Furnish all labor, equipment and materials required to transplant trees from the site to new locations on the site, and restore tree excavation area as directed by the Denver Parks Representative.
- B. Related Work:
 - 1. Tree Retention and Protection – Section 02150
 - 2. Soil Preparation and Fine Grading – Section 02920
 - 3. Turfgrass Seeding – Section 02932
 - 4. Native Seeding – Section 02933
 - 5. Sodding – Section 02935

1.3 QUALITY ASSURANCE:

- A. Trees must be transplanted by an experienced tree transplanting company. Pruning work must be determined and completed by a licensed arborist according to standards established by the National Arborists Association: ANSI A300, part 1.

1.4 SITE CONDITIONS:

- A. Transplanting operations shall be conducted under favorable weather conditions and during the tree's dormant period (November. 1 to March 31), unless otherwise approved the Denver Parks Representative.
- B. At least 72 hours prior to beginning transplanting work, the Contractor shall contact UNCC per the contract and Denver Parks and Recreation for location of irrigation system. No transplanting shall occur until all utilities have been located.

1.5 DAMAGE TO SITE CONDITIONS:

- A. Damage to lawns, natural areas, pavements, irrigation systems, underground utilities and other improvements shall be repaired by the Contractor.

PART 2: PRODUCTS

2.1 TREES TO BE TRANSPLANTED: Trees to be transplanted shall be indicated on the drawings and as directed by the Denver Parks Representative.

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- 2.2 WATER: Water shall be supplied by Contractor at planting time and as necessary until irrigation system is operational. Water shall contain no substances harmful to plant life.
- 2.3 MULCH: Organic mulch, free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of chipped bark and/or wood material not larger than four inches (4”) in length. Submit 1.0 CF sample for approval.

PART 3 - EXECUTION

3.1 GENERAL:

- A. Proposed locations for trees to be transplanted shall be staked and approved by the Denver Parks Representative prior to beginning planting operations. New locations shall be on site if possible.
- B. Prior to transplanting any trees, the City Forester shall determine if the tree is suitable for transplanting. Unsuitable trees shall be cleared and grubbed in accordance with Section 02110.

3.2 PLANTING SITE PREPARATION:

- A. Dig pits immediately prior to moving plants to their respective locations for planting to ensure that they will not be unnecessarily exposed to drying elements or to physical damage. Circular pits with vertical sides hard-trimmed shall be excavated with tree spade to a depth such that tree, when planted, will sit 2-4" above surrounding grade. Sides of pit shall be scarified so as to not have a slick surface.
- B. It is not anticipated that planting shall be done where the depth of soil over rock or other underground obstructions is insufficient to accommodate the roots or where pockets in rock or impervious soil will require drainage. If such conditions are encountered in the excavation of planting areas, and if the stone, boulders or other underground obstructions cannot be broken and removed by hand methods in the course of digging plant pits of the usual size, other locations for the planting may be designated. Removal of rock or other underground obstructions and relocation of plant materials shall be done only as directed by the Denver Parks Representative. If changes in the location of the work or if the removal of rock or other obstructions, other than existing underground utilities, involves additional work, the Contractor shall notify the Denver Parks Representative for approval of extra payment.
- C. The Contractor shall dispose of excess excavated planting pit material by filling and compacting the holes created by moving the trees.

3.3 SIZE OF TREE SPADE:

- A. The size of the mechanical tree spade to be used for transplanting shall be 10” (minimum) in size for every 1” of tree caliper. Minimum size spade shall be 48”.

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3.4 SETTING TREES:

- A. Relocate trees to be transplanted to locations as directed by the Denver Parks Representative.
- B. Trees shall be planted in pits to such a depth that the finished grade level at the plant after settlement will be 2 inches above that at which the plant is currently growing. Trees shall be planted upright with trunks plumb and faced to give the best appearance or relationship to adjacent areas.
- C. A saucer shall be formed at the perimeter of the pit and filled with 4 inches of specified mulch for water retention.
- D. Trees shall be guyed for stability. Trees shall be thoroughly watered immediately after planting.

3.5 MAINTENANCE OF TRANSPLANTED TREES:

- A. Tree plantings shall be protected and maintained by the Contractor until Final Completion, after which the City will assume responsibility for the maintenance.
- B. Maintenance shall include watering, weeding, cultivating, mulching, removal of dead branches, resetting plants to proper grade or upright position and restoration of tree planting saucers and other necessary operations.
- C. Pruning work shall be completed according to standards established by the National Arborist's Association and ANSI A300.

END OF SECTION 02910

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SECTION 02920

SOIL PREPARATION

PART 1: GENERAL

1.1 RELATED DOCUMENTS: The Book 1 Contract requirements apply to Work of this section.

1.2 SUMMARY:

A. Work Included: Preparation of soil for the purpose of seeding, sodding or planting operations. Soil preparation consists of ripping, fertilizing, soil conditioning and fine grading the topsoil. Soil preparation as specified herein MUST precede all seeding, sodding and planting.

B. Related Work:

1. Submittals – Section 01300
2. Clearing and Grubbing – Section 02110
3. Topsoil – Section 02925
4. Turfgrass Seeding – Section 02932
5. Native Seeding – Section 02933
6. Sodding – Section 02935
7. Trees and Shrubs – Section 02950

1.3 SUBMITTALS:

A. Quality Control Submittals:

1. Certificates: State, Federal and other inspection certificates shall accompany invoice for materials showing source or origin. Submit to Project Manager prior to acceptance of material.
2. Material Analysis: Provide soil conditioner analysis performed no more than three (3) months prior to delivery to site.

1.4 DELIVERY, STORAGE AND HANDLING:

A. Fertilizer: Deliver inorganic or chemical fertilizer to site in original unopened containers bearing manufacturer's guaranteed chemical analysis, chemical name, trade name, trademark and conformance to state law, bearing name and warranty of producer.

B. Notify Project Manager of delivery schedule in advance so material can be inspected upon arrival at project site. Immediately remove unacceptable material from project site.

1.5 PROJECT/SITE CONDITIONS:

A. General: Do not perform work when climate and existing site conditions will not provide satisfactory results.

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- B. Vehicular site access shall be limited to the area(s) indicated on the drawings or as defined by CDOT.
- C. Damage to lawns, natural areas, pavements, irrigation systems, underground utilities, and other improvements shall be repaired by the contractor at no additional cost.

PART 2: PRODUCTS

2.1 SOIL MATERIALS:

- A. Topsoil: Shall be as specified under Section 02925 - Topsoil.
- B. Soil Conditioner:
 - 1. Composted material shall consist of aged organic matter, free of weed or other noxious plant seeds, lumps, stones, or other foreign contaminants harmful to plant life, and having the following characteristics based on a nutrient test performed no longer than three (3) months prior to its incorporation into the project:
 - a. Organic matter: twenty-five percent (25%) maximum;
 - b. Salt content: five (5.0) mmhos/cm maximum;
 - c. PH: Seven and one-half (7.5) maximum;
 - d. Carbon to nitrogen ratio shall be less than twenty to one (20:1);
 - 2. Mountain peat, aspen humus, gypsum and sand will not be accepted.
 - 3. Acceptable product: Class I compost, such as Ecogro or Bio-comp, as produced by A1 Organics, Eaton, CO, or approved equal.
 - 4. If a site is unable to be tilled as determined by the Parks Project Manager, then the following products shall be used as a soil conditioner:
 - a. Organic slow release fertilizer (6-1-1), acceptable product: Biosol or approved equal.
 - b. Granular Humic Acid soil conditioner, acceptable product: Menefee Humate Soil Conditioner
 - c. Mycorrhizal Granular Inoculum, acceptable product: MycoApply Endo Granular

2.2 FERTILIZER:

- A. General:
 - 1. Fertilizer shall conform to applicable State fertilizer laws. It shall be uniform in composition, dry, and free flowing, and shall be delivered to the site in the original, unopened containers, each bearing the manufacturer's guaranteed analysis. Fertilizer that has become caked or damaged will not be accepted.

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B. Turf Grass Lawns:

1. Diamonium phosphate (18-46-0). Nitrogen shall be composed of sulphur-coated Urea only. Provide in sufficient quantity to apply at the rate of one-hundred (100) pounds nitrogen per acre, unless otherwise indicated by the soils tests.

C. Native Grass Areas:

1. No fertilizer shall be applied to native grass areas.

2.3 HERBICIDE:

- A. Post Emergent Herbicide: Roundup (Glyphosate) or approved equal as manufactured by Monsanto Company or approved equal.

PART 3: EXECUTION

3.1 EXAMINATION:

- A. General: Verify that existing site conditions are as specified and indicated on drawings before beginning work under this Section.
 1. Grades: Inspect to verify rough grading is within plus or minus one-tenth of a foot (+/- 0.1') of grades indicated and specified.
 2. Damaged Earth: Inspect to verify that soil rendered unfit to support planting due to concrete, water, mortar, limewater or any other contaminant dumped on it has been removed and replaced with clean soil from a source approved by the Project Manager.
- B. Unsatisfactory Conditions: Report in writing to Project Manager with copy to Denver Parks Representative.
- C. Acceptance: Beginning of installation means acceptance of existing conditions by installer.

3.2 PREPARATION

- A. Areas of Newly Placed or Existing Topsoil:
 1. Protection:
 - a. Locate sewer, water, irrigation, gas, electric, phone and other pipelines or conduits and equipment prior to commencing work.
 - b. Contractor shall be responsible for proper repair to landscape, utilities, walls, pavements and other site improvements damaged by operations under this section.

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2. Weed Control: Remove annual weeds by tilling. Remove perennial weeds by applying herbicide one (1) week before soil preparation and as needed, but no sooner than (3) months before beginning work.
3. Surface Grade: Remove weeds, debris, clods and rocks larger than one inch (1"). Remove and dispose of accumulated materials at direction of Denver Parks Representative.
4. Soil Testing: Soil amendments shall meet the minimum amounts as specified in Section 3.3. The Contractor shall be responsible for performing horticultural soil tests on a minimum of four (4) current soil samples for each source of topsoil to be used in the project. Reference Section 02925 – Topsoil, Section 1.3, for soil analysis report information. Soil test will be used to determine the type and amount of soil organic amendment and fertilizer to be applied prior to seeding, sodding and planting. Locations for testing shall be approved by the Denver Parks Representative.
5. Timing: Perform soil preparation just prior to planting operations and in accordance with final planting schedule. Coordinate with irrigation system installation to avoid damage.

B. Areas of Compacted Topsoil:

1. Areas within the work limits or as defined on Drawings or by the Denver Parks Representative that have vegetation that is sparse, stunted, anemic, weedy or was used as a construction staging, parking area and/or subjected to heavy use will require ripping to prepare the soil for revegetation. Scarify compacted soil to a six inch (6") depth minimum to loosen topsoil.

C. Areas of Disturbed Topsoil:

1. Areas disturbed but not severely compacted as determined by the Denver Parks Representative, shall be deep tine aerated or shattered to prepare the soil for revegetation.

D. Areas of Undisturbed Natural Topsoil:

1. Undisturbed sites that are or were supporting healthy plant growth need only surface seedbed preparation prior to sowing seed.

3.3 INSTALLATION

A. Soil Preparation in Turf Grass Areas:

1. Apply amendments at the following rates:
 - a. Soil conditioner: Four (4) cubic yards per thousand (1000) square feet, or per soil test recommendations. If a granular soil conditioner is being utilized the product shall be applied per the manufactures

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recommendations.

- b. Diamonium phosphate: Two (2) lbs. of nitrogen per thousand (1000) square feet.
2. After applying soil conditioner and fertilizer, thoroughly till area to depth of six inches (6") minimum by plowing, rototilling, harrowing, or disking until soil is well pulverized and thoroughly mixed.

B. Soil Preparation in Native Grass Areas:

1. Apply soil conditioner only as directed by per soils tests performed for the areas to be seeded.
2. Thoroughly till the area to depth of six inches (6") minimum by plowing, rototilling, harrowing, or disking until soil is well pulverized and thoroughly mixed. If a soil conditioner is to be applied ensure that the product is spread evenly across the area to be seeded and mixed thoroughly into the soil.

C. Fine Grading in all Landscape Areas:

1. Complete fine grading for all areas prior to seeding or planting. Allow for natural settlement.
2. For ground surface areas surrounding buildings to be landscaped, maintain required positive drainage away from buildings.
3. Establish finish grades to within plus or minus one-tenth of a foot (0.1') of grades indicated, in order to prevent "bird-baths" or ponding.
4. Finish grade shall be below edge of pavement prior to sodding, seeding or planting.
 - a. Sodded Areas: Allow one-and one-half inch (1-1/2 ") for sod;
 - b. Seeding Areas: Allow one inch (1") for seed;
 - c. Shrub Beds: Allow four inches (4") for mulch.
5. Noxious weeds or parts thereof shall not be present in the surface grade prior to seeding.
6. Compaction of Surface Grade Prior to Landscape Installation: Firm, but not hard (eighty-five percent (85%) standard Proctor density within two percent (2%) optimum moisture).
7. Hand Raking:
 - a. Turfgrass Lawn Areas: Prior to acceptance of grades, hand rake to smooth, even surface, free of debris, clods, rocks and organic matter greater than one inch (1").
 - b. Native Seed Areas: Area shall not be raked smooth but left in a uniform condition after tilling. Rough raking may occur parallel to the contours only.
8. Restore planting areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.

3.4 NOTIFICATION AND INSPECTION

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- A. Inspection: Provide notice to the Denver Parks Representative requesting inspection at least seven (7) days prior to anticipated date of completion. **ALL AREAS SHALL BE REVIEWED AND ACCEPTED BY THE DENVER PARKS REPRESENTATIVE PRIOR TO ANY LANDSCAPE INSTALLATION.**
- B. Contractor shall be responsible for coordinating soil preparation inspections with Denver Water, call (303) 628-6682 at least seventy-two (72) hours prior to installing sod, seed or plantings.
- C. Deficiencies: The Denver Parks Representative will specify deficiencies to Contractor who shall make satisfactory adjustments and shall again notify Denver Parks Representative for final inspection.

3.5 CLEANING

- A. General: Remove debris and excess materials from site. Clean out drainage inlet structures. Clean paved and finished surfaces soiled as a result of work under this Section, in accordance with Section 208 of the General Specifications or as directed by the Denver Parks Representative.

3.6 PROTECTION

- A. General: Provide and install barriers as required and as directed by CDOT or Denver Parks Representative to protect completed areas against damage from pedestrian and vehicular traffic until acceptance by CDOT.

END OF SECTION 02920

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SECTION 02925

TOPSOIL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS: The Book 1 Contract requirements apply to Work of this section.

1.2 SUMMARY:

A. Work Includes: Furnishing, stockpiling and placing topsoil on a previously prepared subgrade.

B. Related Work:

1. Submittals – Section 01300
2. Soil Preparation -Section 02920
3. Turfgrass Seeding - Section 02932
4. Native Seeding - Section 02933
5. Sodding - Section 02935
6. Trees and Shrubs - Section 02950

1.3 QUALITY CONTROL: Submit soil analysis report for imported topsoil from the State University Agricultural Extension Service or other approved soil testing laboratory. Report shall cover soil textural classification (percentages of sand, silt, and clay), pH, percentage organic matter, and soluble salts (electric conductivity in millimos/centimeter), and shall include additive recommendations. Testing will be at the expense of the Contractor.

1.4 DELIVERY, STORAGE AND HANDLING: Do not deliver or place topsoil in a frozen, wet, or muddy condition.

PART 2 - PRODUCTS

2.1 ON-SITE TOPSOIL: Topsoil previously stripped and stockpiled prior to earthwork operations.

2.2 IMPORTED TOPSOIL: All topsoil shall be a loam or sandy loam. At least ten (10) days prior to topsoil delivery, notify Denver Parks Representative of the source(s) from which topsoil is to be furnished. Topsoil shall be furnished by the Contractor and shall be a natural, friable soil representative of productive soils and shall meet the following conditions;

A. It shall be obtained from the top twelve inches (12") of well drained areas.

B. Fertile, friable, loamy soil, reasonably free from subsoil, refuse, roots, heavy or stiff clay, stones larger than one inch (1”), coarse sand, noxious seeds, sticks, brush, litter, and other deleterious substances; suitable for the germination of seeds and the support of vegetative growth. The PH value shall be between seven and eight (7.0 and 8.0).

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- C. Soil Texture: Sand, thirty to fifty percent (30% - 50%); silt, thirty to fifty percent (30% - 50%) percent; clay, five to thirty percent (5% - 30%).
- D. Additives: As determined by soil fertility tests.
- E. Percent Organic Content: two point nine percent (2.9%) minimum.
- F. Soluble Salts: Electric conductivity shall be less than three point three (3.3) mmhos/cm for dryland areas and less than five (5.0) mmhos/cm for irrigated lands.

PART 3 - EXECUTION

3.1 PLACING TOPSOIL:

- A. Scarify compacted subgrade to a six inch (6”) depth to bond topsoil to subsoil. Place topsoil to a minimum depth of four inches (4”) inches after settlement. Topsoil shall be free from weeds, sod, and material larger than one inch (1”), toxic substances, litter or other deleterious material. Spread evenly and grade to elevations and slopes shown on drawings. Hand rake areas inaccessible to machine grading.
- B. Utilize salvaged topsoil as the top layer to the extent available. If sufficient on-site material is not available, the Contractor shall furnish and install imported topsoil in the manner described above. Topsoil shall mixed thoroughly with the salvaged topsoil prior to placement.

END OF SECTION 02925

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SECTION 02932

TURFGRASS SEEDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS: The Book 1 Contract requirements apply to Work of this section.

1.2 SUMMARY:

A. Work Included: Installation of turfgrass lawns, hydromulch, and maintenance of the seeded areas as outlined herein until Final Completion.

B. Related Work:

1. Submittals – Section 01050
2. Irrigation System - Section 02810
3. Soil Preparation - Section 02920
4. Topsoil - Section 02925
5. Trees and Shrubs - Section 02950

1.3 REFERENCES:

A. Reference Standards: Comply with U.S. Department of Agriculture Rules and Regulations under the Federal Seed Act and be equal to or better in quality than the standards for Certified Seed.

B. Colorado Department of Transportation (CDOT) – Standards Specifications for Road and Bridge Construction.

1.4 SUBMITTALS:

A. Submit seed vendors certification(s) a minimum of ten (10) working days prior to anticipated date of installation for required seed mixture. Indicate percentage by weight, percentages of purity, germination, weed seed for each grass species and source or origin.

B. Contract Closeout Submittals:

1. Operating and Maintenance Data: At completion of work, submit one (1) digital copy and two (2) hard copies to the CDOT and the Denver Parks Representative. Include directions for irrigation, aeration, mowing, fertilizing and spraying as required for continued and proper maintenance through full growing season and dormant period.
2. Warranty for Turfgrass Seed Areas: At completion of work, furnish written warranty to CDOT based upon specified requirements.

C. CDOT reserves the right to reject the seed at anytime prior to acceptance and that fails to meet specification requirements. Promptly remove rejected seed from site.

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1.5 DELIVERY, STORAGE AND HANDLING

- A. Seed: Deliver seed materials in original unopened containers bearing weight, analysis and name of supplier. Store in a manner to prevent the materials from becoming wet and deteriorating.
- B. Fertilizer: Deliver inorganic or chemical fertilizer to site in original unopened container bearing manufacturer's guaranteed chemical analysis, name, trade name, trademark and conformance to state law, and bearing name and warranty of producer.
- C. Material will be inspected upon arrival at project site. CDOT will reject any opened or unacceptable materials as described above.
- D. Immediately remove unacceptable material from job site.

1.6 PROJECT/SITE CONDITIONS

- A. Vehicular accessibility on site shall be as directed by Parks Project Manager. Repair damage to prepared topsoil and existing surfaces, caused by vehicular access and movement during work under this section, to original condition at no additional cost to the City.
- B. Do not drill or sow seed during windy, rainy weather or when ground is frozen or otherwise unable to be tilled.

1.7 WARRANTY:

- A. Warranty for Turfseed Areas: Warrant areas in seed to be in a healthy, vigorous growing condition, and for consistency and completion of coverage for a period of one year from the completion of the landscape establishment period as a full stand of grass. After seed germination, re-seed any spots where seed has not germinated within the total seeded area. Continue this procedure until a successful stand of grass is growing and accepted by CDOT.
 - 1. During the original warranty period, reseed at once with comparable blend/mix, those areas that have failed to achieve a stand of grass or which in CDOT's and the Denver Parks Representative's opinion are unhealthy.
 - 2. Reseeding will not be allowed in any season considerable unfavorable for seeding by CDOT.
 - 3. Reseed in a manner to achieve quality as originally specified.

1.8 MAINTENANCE:

- A. General: The maintenance period shall begin as described in CDOT Standard Specification for Section 214.04(b) Final Acceptance of seeded areas will not be given until CDOT is

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satisfied with germination and a full stand of grass, in a vigorous growing condition, with consistent and complete coverage. During this time, Contractor shall be responsible for watering, mowing, spraying, weeding, fertilizing and all related work as necessary to ensure that seeded areas are in a vigorous growing condition. Provide all supervision, labor, material and equipment to develop and maintain seeded areas.

- B. The seeded areas shall be accepted on the basis of having a uniform plant growth over the entire seeded area. Two (2) months after seeding, the seeded areas shall be reviewed by CDOT, the Denver Parks Representative, and the Contractor. Any areas as determined by CDOT where the seed has failed to germinate shall be reseeded and raked to cover the seed. In any area where the seed has failed to grow, reseeding shall be at the Contractor's expense until grass is established and accepted. Acceptable uniform plant growth shall be defined as scattered bare spots, not greater than one (1) square foot, and do not exceed two percent (2%) of the seeded area.
- C. Mowing and Trimming: When turfgrasses reach three and one-half inches (3-1/2") height, begin weekly mowing program to maintain turf at two and one-half inches (2-1/2") to three inches (3") height. Do not remove more than one-third (1/3) the height of the grass leaf in single mowing. Do not mow when grass is wet. All clippings from adjacent paved areas shall be removed and clippings from mowed turf areas shall be removed at the direction of CDOT and the Denver Parks Representative.
- D. Fertilizing: Within sixty (60) days of seeding and every sixty (60) days thereafter until final acceptance, apply specified fertilizer to maintain optimal turf vigor.
- E. Weed Control: Control annual weeds by mowing. Do not use herbicides unless approved by CDOT and the Denver Parks Representative.
- F. Insect and Disease Control: As needed, apply insecticide and fungicide approved by CDOT and the Denver Parks Representative.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. Turf Seed:
 - 1. Seed shall be fresh, clean and new crop mixture mixed by an approved method.
 - 2. Blend: Kentucky bluegrass minimum ninety percent (90%) and Perennial ryegrass maximum ten percent (10%):
 - a. Include at least three (3) improved Kentucky bluegrass cultivars, each of a different type classification. At least one cultivar shall be an aggressive type. Submit list of proposed varieties to CDOT and Denver Parks Representative a minimum of ten (10) days prior to seeding.
 - b. Application rate:
 - i. Mechanical Seeding: Four (4) pounds. pure live seed (PLS) per one-

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thousand (1,000) square feet.

- ii. Hand Broadcast Seeding: Eight (8) pounds pure live seed (PLS) per one-thousand (1,000) square feet.
- b) Mulch: Wood cellulose fiber suitable for hydromulching, in compliance with CDOT 213.02
- c) Fertilizer: Inorganic mixture with following chemical composition: (20-5-10) with fifty percent (50%) sulfur coated urea (no iron), or as recommended by testing lab based on soil sample results.
- d) Water: Contractor to utilize the existing irrigation system and or quick coupler(s) when available. If irrigation or quick coupler(s) are not available then the contractor is responsible for watering. Water shall be free of substances that may be harmful to seed growth. Hoses and other watering equipment necessary to water the seed to be furnished by Contractor.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. Examine finish surfaces, grades and depth to verify that grades that grades are within one-tenth (0.10) of a foot of grades indicated on the Drawings. Do not start seeding work until unsatisfactory conditions are corrected and approved by the Denver Parks Representative. Perform seeding work only after planting and other work affecting ground surface has been completed.
- B. Acceptance: Beginning of installation means acceptance of existing conditions by the Contractor.

3.2 PREPARATION:

- A. Work notification: Notify CDOT and the Denver Parks Representative at least seven (7) working days prior to start of seeding operations.
- B. Limit preparation to areas that can be seeded within twenty-four (24) hours of preparation.
- C. The Contractor shall prepare the soil of all areas to be seeded in accordance with the requirements of Soil Preparation - Section 02920.
- D. When completed, the soil shall be firmed by float dragging, followed by steel raking, to provide for the proper seeded surface. The seed bed shall be totally free from rock or clay clods over one-half inch (1/2") in diameter.

3.3 INSTALLATION:

- A. Seed within twenty-four (24) hours after preparation of bed. Seed shall be sown between April 15 and June 1, or between August 15 and October 1. Seeding at other

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times may only be done if approved by CDOT.

- B. Areas outside Contract Limits disturbed as a result of construction operations shall be seeded at Contractor's expense.
- C. Seed shall be uniformly applied, (half in one direction and the other half at right angles to the first application). The direction of the final application shall always be at right angle to the slope or running in the direction of the contour. Seed shall be installed at a depth between one-quarter inch (1/4") and one-half inch (1/2").
- D. Areas that are too small or steep for mechanical seeding may be hand seeded. Seed shall be uniformly applied utilizing a broadcast spreader and then hand rake in to a depth of no more than one-half inch (1/2"), then roll seed bed to ensure proper contact to the soil.

3.4 MULCHING:

- A. Mulch Application: Utilize an approved hydromulcher to apply cellulose fiber at a rate of two-thousand (2000) pounds per acre. Apply tackifier to comply with CDOT Standard Specification for Section 213.02 – Mulching. Contractor shall provide verification of application rates in the form of ship tickets.
- B. Mulching shall not be installed when surface water is present resulting from rains, melting snow irrigation or other causes.
- C. Areas not properly mulched, or any damage that may occur during construction is the responsibility of the Contractor and shall be repaired and re-mulched in an acceptable manner at the Contractor's expense. Mulching removed by wind, rain or other causes prior to acceptance shall be re-established by the Contractor at his own expense.
- D. The seeded area shall be mulched within eight (8) hours of seeding. Areas not mulched within twenty-four (24) hours after seeding must be re-prepped and re-seeded with the specified seed mix at the Contractor's expense.
- E. Contractor shall remove all hydromulch from and surface area not specified for seeding, including but not limited to plant materials, fences, paved areas, signs, mulch beds, irrigation components and all other objects as directed by the Denver Parks Representative.

3.5 FERTILIZING:

- A. Distribute fertilizer uniformly at the rate of five (5) pounds of material per one-thousand (1,000) square feet, one (1) pound of actual nitrogen per one-thousand (1,000) square feet or sixty (60) days after initial seeding operations and every sixty (60) days thereafter until Final Acceptance of the Project.

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3.6 PROTECTION:

- A. Protect existing utilities, paving and other facilities from damage caused by seeding operations, Contractor shall repair any damage at no additional cost.
- B. Restrict vehicular and pedestrian traffic from seeded areas until grass is established. Erect signs and barriers as required or directed by the Denver Parks Representative at no additional cost.
- C. Locate, protect and maintain the irrigation system during seeding operations. Irrigation system components damaged during seeding operations shall be replaced or repaired to current City irrigation standards at Contractor's expense.
- D. Erosion Control: Take measures and furnish equipment and labor necessary to control and prevent soil erosion, blowing soil and accumulation of wind-deposited materials on the site throughout the duration of Work.

3.7 CLEANING:

- A. Perform cleaning during installation of the work and upon completion of the work. Remove from all excess materials, debris and equipment from site. Repair any damage resulting from seeding operations.

END OF SECTION 02932

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SECTION 02933

NATIVE SEEDING

PART 1: GENERAL

1.1 RELATED DOCUMENTS: The Book 1 Contract requirements apply to Work of this section.

1.2 SUMMARY:

A. Work Included: Installation of native grass seed and specified mulch, straw matting if applicable, and maintenance of the seeded areas is achieved as outlined within.

B. Related Sections:

1. Submittals – Section 1300
2. Tree Retention and Protection – Section 02150
3. Irrigation System - Section 02810
4. Soil Preparation - Section 02920
5. Topsoil – Section 02925
6. Trees and Shrubs - Section 02950

1.3 REFERENCES:

A. Reference Standards: Comply with U.S. Department of Agriculture Rules and Regulations under the Federal Seed Act and be equal to or better in quality than the standards for Certified Seed.

1.4 SUBMITTALS:

A. Submit seed vendors certification(s) a minimum of ten (10) working days prior to anticipated date of installation for required seed mixture. Indicate percentage by weight, percentages of purity, germination, weed seed for each grass species and source or origin

B. Contract Closeout Submittals:

1. Operating and Maintenance Data: At completion of work, submit one (1) digital copy and two (2) hard copies to the Parks Project Manager in accordance with Book 2 Section 3 – Quality Management. Include directions for irrigation, aeration, mowing, fertilizing and spraying as required for continued and proper maintenance through full growing season and dormant period.
2. Warranty for Native Seed Areas: At completion of work, furnish written warranty to CDOT based upon specified requirements.

C. CDOT reserves the right to reject the seed at anytime prior to acceptance and that fails to meet specification requirements. Promptly remove rejected seed from the site.

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1.5 DELIVERY, STORAGE, AND HANDLING

- A. Seed: Deliver seed materials in original unopened containers bearing weight, analysis and name of supplier. Store in a manner to prevent the materials from becoming wet and deteriorating.
- B. Fertilizer: Deliver organic or chemical fertilizer to site in original unopened container bearing manufacturer's guaranteed chemical analysis, name, trade name, trademark and conformance to state law, and bearing name and warranty of producer.
- C. Material will be inspected upon arrival at project site. CDOT will reject any opened or unacceptable materials as described above.
- D. Immediately remove unacceptable material from job site.

1.6 PROJECT/SITE CONDITIONS

- A. Vehicular accessibility on site shall be as directed by the Project Manager. Repair damage to prepared topsoil and existing surfaces, caused by vehicular access and movement during work under this section, to original condition at no additional cost.
- B. Do not drill or sow seed during windy, rainy weather or when ground is frozen or otherwise unable to be tilled.

1.7 WARRANTY:

- A. Warranty for Native Seed Areas: Warrant areas in seed to be in a healthy, vigorous growing condition, and for consistency and completion of coverage for a period of one year from date of Project Completion as a full stand of grass. After seed germination, re-seed any spots where seed has not germinated within the total seeded area. Continue this procedure until a successful stand of grass is growing and accepted by the CDOT.
 - 1. During the original warranty period, reseed at once with comparable blend/mix, those areas that have failed to achieve a stand of grass as accepted by CDOT.
 - 2. Reseeding shall be timed per 3.4E of this section.
 - 3. Reseed in a manner to achieve quality as originally specified

1.8 MAINTENANCE:

- A. General: The maintenance period shall begin as described in CDOT Standard Specification for Section 214.04(b) Final Acceptance of seeded areas will not be given until CDOT is satisfied with germination and a full stand of grass, in a vigorous growing condition, with consistent and complete coverage. During this time, be responsible for watering, mowing, spraying, weeding, fertilizing and all related Work as necessary to ensure that seeded areas are in a vigorous growing condition. Provide all supervision, labor, material and equipment to develop and maintain seeded areas.

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- B. Irrigated Areas: The seeded areas shall be accepted on the basis of having a uniform plant growth over the entire seeded area. Two (2) months after seeding, the seeded areas shall be reviewed by CDOT, the Denver Parks Representative, and the Contractor. Any areas (as determined by CDOT and the Denver Parks Representative) where the seed has failed to germinate shall be reseeded and raked to cover the seed. In any area where the seed has failed to grow, reseeding shall be at the Contractor’s expense until grass is established and accepted. Acceptable uniform plant growth shall be defined as when scattered bare spots, not greater than 1 square foot, do not exceed 5% of the seeded area.
- C. Non-irrigated Areas: The seeded areas shall be accepted on the basis of showing evidence of growth of specified seed material over the entire seeded area within three (3) months of seeding during weather conditions that are favorable for seed germination and growth.
- D. Mowing and Trimming: Mow native grasses after the grass has gone to seed, cutting back to not less than 4” height. Remove clippings from adjacent pavement or irrigated turf areas.
- E. Fertilizing: Within forty –five (45) days of seeding and every sixty (60) days thereafter until final acceptance, apply specified fertilizer to maintain optimal turf vigor or per the direction of the Parks Project Manager.
- F. Weed Control: Control annual weeds by mowing prior to seed development. Control perennial weeds through use of selective herbicides approved by the Denver Parks Representative and CDOT only after grass stand has matured sufficiently that it will not be harmed by application of herbicides. Any plant material that is harmed do to over spraying, wind drift or improper application shall be replaced by the Contractor.
- G. Insect and Disease Control: As needed, apply insecticide and fungicide approved by CDOT and the Denver Parks Representative.

PART 2: PRODUCTS

2.1 MATERIALS:

- A. General:
 - 1. The selected seed mix must be approved by the Denver Parks Representative and CDOT prior to its incorporation into the project.
 - 2. All seed shall be furnished in bags or containers clearly labeled to show the name and address of the supplier, the seed name, the lot number, net weight, origin, the percent of weed seed content, the guaranteed percentage of purity and germination, pounds of pure live seed (PLS) of each seed species, and the total pounds of PLS in the container. All brands shall be free from Colorado prohibited noxious weed seeds as Russian or Canadian Thistle, European Bindweed, Johnson Grass, and Leafy Spurge. The Contractor shall furnish to the Parks Project Manager a signed statement certifying that the seed is from a lot that has been tested by a recognized

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laboratory for seed testing within six months prior to the date of delivery. Seed that has become wet, moldy or damaged in transit or in storage will not be acceptable.

3. Computation for quantity of seed required on the project is based on Pure Live Seed (PLS). The formula used for determining the quantity of PLS shall be: $Pounds\ of\ Seed \times (Purity \times Germination) = Pounds\ of\ PLS$. If seed available on the market does not meet the minimum purity and germination specified, the Contractor must compensate for a lesser percentage of purity or germination by furnishing sufficient additional seed to equal the specified product. Product comparison shall be made on the basis of PLS in pounds, stated on each seed bag.

B. Seed Mixes:

1. Short Grass Mix

Common Name	Scientific Name	PLS Full Seed Rate	%	PLS lbs/Acre
Blue Grama	Bouteloua gracilis	3.0	25	0.75
Bottlebrush Squirreltail	Elymus elymoides	15.0	5	0.75
Buffalograss	Buchloe dactyloides	16.0	25	4
Green Needlegrass	Nassella viridula	10.0	5	0.5
Prairie Junegrass	Koeleria cristata	4.0	5	0.2
Sand Dropseed	Sporobulus cryptandrus	0.6	5	0.03
Sideoats Grama	Bouteloua curtipendula	9.0	20	1.8
Western wheatgrass	Pascopyrum smithii	16.0	10	1.6
			100	9.63

Drill Seeded Rate: 9.63 PLS#/Acre
Mechanical Broadcast Rate: 19.26 PLS#/Acre
Hand Broadcast Areas Rate: 38.52 PLS#/Acre

2. Mid Grass Mix

Common Name	Scientific Name	PLS Full Seed Rate	%	PLS lbs/Acre
Blue Grama	Bouteloua gracilis	3.0	25	0.75
Little Bluestem	Schizachyrium scoparium	7.0	20	1.4
Needle and Thread	Stipa comata	14.0	5	0.7
Prairie Junegrass	Koeleria cristata	4.0	5	0.2
Indian Ricegrass	Achnatherum hymenoides	10.0	5	0.5
Sand Dropseed	Sporobulus cryptandrus	0.6	5	0.03
Sideoats Grama	Bouteloua curtipendula	9.0	25	2.25
Switchgrass	Panicum virgatum	5.0	5	0.25
Western Wheatgrass	Pascopyrum smithii	16.0	5	0.8
			100	6.88

Drill Seeded Rate: 6.88 PLS#/Acre
Mechanical Broadcast Rate: 13.76 PLS#/Acre
Hand Broadcast Areas Rate: 27.52 PLS#/Acre

3. Sandhill Prairie Mix

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Common Name	Scientific Name	PLS Full Seed Rate	%	PLS lbs/Acre
Big Bluestem	Andropogon gerardii	11.0	20	2.2
Indiangrass	Sorghastrum nutans	10.0	20	2.0
Little Bluestem	Schizachyrium scoparium	7.0	20	1.4
Needle and Thread	Stipa comata	14.0	5	0.7
Prairie Sandreed	Calamovilfa longifolia	7.0	20	1.4
Indian Ricegrass	Achnatherum hymenoides	10.0	5	0.5
Sand Bluestem	Andropogon hallii	16.0	5	0.8
Switchgrass	Panicum virgatum	5.0	5	0.25
			100	9.25

Drill Seeded Rate: 9.25 PLS#/Acre
 Mechanical Broadcast Rate: 18.5 PLS#/Acre
 Hand Broadcast Areas Rate: 37.0 PLS#/Acre

4. Riparian Prairie Mix

Common Name	Scientific Name	PLS Full Seed Rate	%	PLS lbs/Acre
Big Bluestem	Andropogon gerardii	11.0	5	0.55
Prairie Cordgrass	Spartina pectinata	10.0	25	2.5
Prairie Sandreed	Calamovilfa longifolia	7.0	25	1.75
Slender Wheatgrass	Elymus trachycaulus	11.0	5	0.55
Western Wheatgrass	Pascopyrum smithii	16.0	10	1.6
Switchgrass	Panicum virgatum	5.0	5	0.25
Canada Wildrye	Elymus canadensis	15.0	25	3.75
			100	10.95

Drill Seeded Rate: 10.95 PLS#/Acre
 Mechanical Broadcast Rate: 21.9 PLS#/Acre
 Hand Broadcast Areas Rate: 43.8 PLS#/Acre

5. Wetland Mix

Common Name	Scientific Name	PLS Full Seed Rate	%	PLS lbs/Acre
American Sloughgrass	Beckmannia syzigachne	1.6	15	0.24
Nebraska Sedge	Carex nebraskensis	2.8	10	0.38
Creeping Spikerush	Eleocharis palustris	5.6	5	0.28
Hardstem Bullrush	Schoenoplectus acutus	5.0	10	0.5
Alkali Bullrush	Phragmites communis	4.2	10	0.42
Switchgrass	Panicum virgatum	5.0	10	0.5
Western Wheatgrass	Pascopyrum smithii	16.0	15	2.4
Prairie Cordgrass	Spartina pectinata	10.0	10	1.0
Canada Wildrye	Elymus canadensis	10.0	15	1.0
			100	6.72

Drill Seeded Rate: 6.72 PLS#/Acre
 Mechanical Broadcast Rate: 13.44 PLS#/Acre
 Hand Broadcast Areas Rate: 26.88 PLS#/Acre

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6. Native Wildflower Mix

Common Name	Scientific Name	PLS Full Seed Rate	%	PLS lbs/Acre
Purple Prairie Clover	Petalostemon purpurea	6	20%	1.2
Narrowleaf Penstemon	Penstemon angustifolius	6.5	5%	0.325
Perennial Gaillardia	Gaillardia aristata	11	10%	1.1
Prairie Coneflower	Ratibida columnifera	2	15%	0.3
Rocky Mountain Beeplant	Cleome serrulata	28	10%	2.8
Golden Crownbeard	Verbesine encelioides	13	10%	1.3
Western Yarrow	Achillea lanulosa	0.5	5%	0.025
American Vetch	Vicia americana	23	20%	4.6
Fringed Sage	Artemesia frigida	0.5	5%	0.025

11.675

Drill Seeded Rate: 11.675 PLS#/Acre

Mechanical Broadcast Rate: 23.35 PLS#/Acre

Hand Broadcast Areas Rate: 46.7 PLS#/Acre

- C. Mulch: Comply with Section 213 – Mulching of the CDOT Standards and Specifications for Road and Bridge Construction.
- D. Fertilizer: None required unless otherwise specified by soils test.
- E. Water: Contractor to utilize the existing irrigation system and or quick coupler(s) when available. If irrigation or quick coupler(s) are not available then the contractor is responsible for watering. Water shall be free of substances that may be harmful to seed growth. Hoses and other watering equipment necessary to water the seed to be furnished by Contractor..
- F. Tackifier: Comply with Section 213 – Mulching of the CDOT Standards and Specifications for Road and Bridge Construction.
- G. Erosion Control Blanket: As specified under Section 01565, Erosion and Sedimentation Control.

PART 3: EXECUTION

3.1 INSPECTION:

- A. Examine finish surfaces, grades and depth. Do not start seeding work until unsatisfactory conditions are corrected and approved by the Denver Parks Representative. Perform seeding work only after planting and other work affecting ground surface has been completed.
- B. Acceptance: Beginning of installation means acceptance of existing conditions by the Contractor.

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3.2 PROTECTION

- A. Protect existing utilities, paving and other facilities from damage caused by seeding operations, Contractor shall repair any damage at no additional cost.
- B. Restrict vehicular and pedestrian traffic from seeded areas until grass is established. Erect signs and barriers as required or directed by the Denver Parks Representative at no additional cost.
- C. Locate, protect and maintain the irrigation system during seeding operations. Repair irrigation system components damaged during seeding operations shall be replaced or repaired to current City irrigation standards at Contractor's expense.
- D. Erosion Control: Take measures and furnish equipment and labor necessary to control and prevent soil erosion, blowing soil and accumulation of wind-deposited materials on the site throughout the duration of work.

3.3 PREPERATION

- A. Work notification: Notify the Denver Parks Representative at least seven (7) working days prior to start of seeding operations.
- B. Limit preparation to areas that can be seeded within twenty four (24) hours of preparation.
- C. The Contractor shall prepare the soil of all areas to be seeded in accordance with the requirements of Soil Preparation - Section 02920. When completed, the soil shall be firmed by float dragging, followed by steel raking, to provide for the proper seeded surface. The seed bed shall be totally free from rock or clay clods over one (1") inch in diameter.
- D. Fine Grading: Perform as required per Section 02920 – Soil Preparation to maintain positive drainage, prevent ponding and direct run-off into catch basins, drainage structures, etc., and to provide well-contoured surface prior to proceeding. A firm weed-free seed bed is required.

3.4 INSTALLATION:

- A. Seed within twenty-four (24) hours after preparation of seed bed. Seeding at other times may only be done if approved by the CDOT.
- B. Areas outside Project limits disturbed as a result of construction operations shall be seeded at Contractor's expense.
- C. Seed shall be uniformly applied, (half in one direction and the other half at right angles to the first application). The direction of the final application shall always be at right angle to the slope or running in the direction of the contour. Seed shall be installed at a depth between one-quarter (1/4") inch and one-half (1/2") inch. Accomplish seeding by a rangeland grass drill with double disk openers and depth bands.

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- D. Areas that are too small or steep for mechanical seeding may be hand seeded. Seed shall be uniformly applied utilizing a broadcast spreader and then hand rake in to a depth of no more than one-half (1/2”) inch, then roll seed bed to ensure proper contact to the soil.
- E. Seeding Seasons
 - 1. Irrigated Areas:
 - a. Spring Seeding: Spring thaw to May 31.
 - b. Summer Seeding: July 15 to August 20.
 - c. Fall Seeding (dormant): October 15 to March 31.
 - 2. Non-irrigated Areas:
 - a. Spring Seeding: Spring thaw to May 31
 - b. Fall Seeding (dormant): October 15 to March 31.
- F. Dormant Seeding: Upon approval of CDOT, dormant seeding may be accomplished between October 15 and March 31. No seeding shall be done when the ground is frozen, muddy, covered with snow, or otherwise in a condition unsuitable for seeding. Dormant seeding will not relieve the Contractor from the warranty or the acceptance requirements specified elsewhere in this section.

3.5 MULCHING:

- A. Straw Mulch Application: Comply with Section 213 – Mulching of the CDOT Standards and Specifications for Road and Bridge Construction.
- B. Mulching shall not be installed when surface water is present resulting from rains, melting snow irrigation or other causes.
- C. Areas not properly mulched, or any damage that may occur during construction is the responsibility of the Contractor and shall be repaired and re-mulched in an acceptable manner at the Contractor’s expense. Mulching removed by wind, rain or other causes prior to acceptance shall be re-established by the Contractor at his own expense.
- D. The seeded area shall be mulched within eight (8) hours of seeding. Areas not mulched within twenty-four (24) hours after seeding must be re-prepped and re-seeded with the specified seed mix at the Contractor’s expense.
- E. Contractor shall remove all hydromulch from and surface area not specified for seeding, including but not limited to plant materials, fences, paved areas, signs, mulch beds, irrigation components and all other objects as directed by the Denver Parks Representative.

3.6 EROSION CONTROL BLANKET:

- A. Install erosion control blanket on slopes exceeding four to one (4:1) and in swales or other areas of concentrated runoff. Install in accordance with manufacturer’s instructions.

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3.7 PROTECTION:

- A. Protect existing utilities, paving and other facilities from damage caused by seeding operations, Contractor shall repair any damage at no additional cost.
- B. Restrict vehicular and pedestrian traffic from seeded areas until grass is established. Erect signs and barriers as required or directed by the CDOT at no additional cost.
- C. Locate, protect and maintain the irrigation system during seeding operations. Repair irrigation system components damaged during seeding operations shall be replaced or repaired to current City irrigation standards at Contractor's expense.
- D. Erosion Control: Take measures and furnish equipment and labor necessary to control and prevent soil erosion, blowing soil and accumulation of wind-deposited materials on the site throughout the duration of work.

3.8 CLEANING:

- A. Perform cleaning during installation of the work and upon completion of the work. Remove from all excess materials, debris and equipment from site. Repair any damage resulting from seeding operations.

END OF SECTION 02933

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SECTION 02935

SODDING

PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS: Book 1 Contract requirements apply to Work of this section.
- 1.2 SUMMARY:
- A. Work Included: Furnish and install bluegrass sod, and maintain sodded areas as outlined in within.
 - B. Related Work:
 - 1. Submittals – Section 01300
 - 2. Irrigation System - Section 02810
 - 3. Soil Preparation - Section 02920
 - 4. Topsoil – Section 02925
 - 5. Trees and Shrubs - Section 02950
- 1.3 SUBMITTALS
- A. Quality Control Submittals:
 - 1. Certificates: State, Federal and other inspection certificates shall be provided to the Denver Parks Representative a minimum of ten (10) working days prior to anticipated date of sod delivery.
 - 2. Submit a list of varieties contained in the sod, and include the source and origin for approval by the Denver Parks Representative.
 - B. Contract Closeout Submittals:
 - 1. Operating and Maintenance Data: At completion of work, submit one (1) digital copy and two (2) hard copies to CDOT and the Denver Parks Representative in accordance with Section 01700 – Contract Closeout. Include directions for irrigation, aeration, mowing, fertilizing and spraying as required for continued and proper maintenance through full growing season and dormant period.
 - 2. Warranty for Turfgrass Sod Areas: At completion of work, furnish written warranty to CDOT and Denver Parks Representative based upon specified requirements.
 - C. CDOT reserves the right to reject the sod at anytime prior to acceptance and that fails to meet specification requirements.

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1.4 QUALITY CONTROL

A. Source Quality Control:

1. Sod Materials: Subject to inspection and acceptance. CDOT reserves the right to reject at any time or place prior to acceptance, any work and sod which fails to meet these specification requirements.
2. Inspection will be made periodically during sodding, at completion and at end of warranty period by the Denver Parks Representative. Primarily for quality; however, other requirements are not waived even though visual inspection results in acceptance.
3. Promptly remove rejected sod from site.

B. Sod Standards:

1. Sod shall consist of healthy, thick turf having undergone a program of regular fertilization, mowing and weed control; free of weeds; uniform in green color, leaf texture and density; healthy, vigorous root system; inspected and found free of disease, nematodes, pests and pest larvae by the State Department of Agriculture.
2. Each piece of Sod shall consist of a sandy-loam soil base that will not break, crumble or tear during sod installation.
3. Sod thickness shall be a minimum three-quarter inch (3/4") thick, excluding top growth and thatch.
4. Thatch layer shall not exceed one-half inch (1/2") uncompressed.
5. Sod shall be delivered and installed within twenty-four (24) hours of being cut.

1.5 DELIVERY, STORAGE AND HANDLING

A. Sod: Deliver on pallets properly loaded on vehicles with root system protected from exposure to sun, wind, and heat in accordance with standard practice. Sod that has been damaged by poor handling or improper storage is subject to rejection by the Denver Parks Representative.

1. Protect from dehydration, contamination, freezing and heating at all times. Keep stored sod moist and under shade or covered with moistened burlap.
2. Do not drop sod rolls from carts, trucks or pallets.
3. Do not deliver more sod than can be installed within twenty-four (24) hours.

B. Fertilizer: Deliver inorganic or chemical fertilizer to site in original unopened container bearing manufacturer's guaranteed chemical analysis, name, trade name, trademark, warranty and conformance to state law.

C. Material will be inspected upon arrival at Project Site. Denver Parks Representative will reject any opened or unacceptable materials as described above.

D. Immediately remove unacceptable material from job site.

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1.6 PROJECT/SITE CONDITIONS

- A. Vehicular accessibility on site shall be as directed by the Project Manager. Repair damage to prepared topsoil and existing surfaces, caused by vehicular access and movement during work under this section, to original condition at no additional cost.
- B. Install sod between April 15 and October 1 or when irrigation is available for twenty-one (21) days per Denver Water’s guidelines for sod and seed establishment.
- C. Schedule work for periods of favorable weather. Do not install sod on saturated or frozen soil. CDOT reserves the right to deny sod installation on days that are deemed to be unfavorable for installation.

1.7 WARRANTY:

- A. Warranty for Sod Areas: Warrant areas in sod to be in a healthy, vigorous growing condition, and for consistency and completion of coverage for a period of one year from date of Final Acceptance as a full stand of grass. After sod germination, re-seed any spots where seed has not germinated within the total seeded area. Continue this procedure until a successful stand of grass is growing and accepted by the Denver Parks Representative.
 - 1. During the original warranty period, re-sod at once with comparable blend/mix, those areas that have failed to achieve a stand of grass or which in the Denver Parks Representative’s opinion are unhealthy.
 - 2. Re-sodding will not be allowed in any season considerable unfavorable for sodding by CDOT.
- B. Re-sod in a manner to achieve quality as originally specified

1.8 MAINTENANCE

- A. General: The maintenance period shall begin as described in CDOT Standard Specification for Section 214.04(b). Final Acceptance of sodded areas will not be given until CDOT is satisfied with establishment and a full stand of grass, in a vigorous growing condition, and thoroughly rooted to the soil and absence of visible joints. During this time, the Contractor is responsible for watering, mowing, spraying, weeding, fertilizing and all related work as necessary to ensure that sodded areas are in a vigorous growing condition. Provide all supervision, labor, material and equipment to develop and maintain sodded areas for a minimum of forty-five (45) days from the time of installation. After Final Acceptance, maintenance shall become the responsibility of the City.
- B. The sodded areas shall be accepted on the basis of having a healthy, uniform stand of turf over the entire sodded area. Forty-Five days (45) after sodding the sodded areas shall be reviewed by CDOT, the Denver Parks Representative, and the Contractor. Any areas as determined by CDOT and the Denver Parks Representative where the sod has failed to

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establish shall be re-sodded. Acceptable sod establishment shall be defined healthy uniform turf that does not contain any stressed or bare spots greater than one (1) square foot.

- C. Mowing and Trimming: When turfgrasses reach three and one-half inches (3-1/2”) height, begin weekly mowing program to maintain turf at two and one-half inches (2-1/2”) to three inches (3”) height. Do not remove more than one-third (1/3) the height of the grass blade in single mowing. Do not mow when grass is wet. All clippings from adjacent paved areas shall be removed and clippings from mowed turf areas shall be removed at the direction of CDOT and Denver Parks Representative.
- D. Fertilizing: Within thirty (30) days of sodding and every sixty (60) days thereafter until Final Acceptance, apply specified fertilizer to maintain optimal turf vigor or per the direction of the Denver Parks Representative.
- E. Weed Control: Control annual weeds by mowing. Do not use herbicides unless approved by the Denver Parks Representative.
- F. Insect and Disease Control: As needed, apply insecticide and fungicide approved by the Denver Parks Representative.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. Sod: Colorado grown Kentucky Bluegrass blend having a healthy, vigorous root system. Blend shall contain a minimum of three (3) improved varieties, of which at least one variety is an aggressive type.
- B. Fertilizer: Inorganic mixture with following chemical composition: (20-5-10) with fifty percent (50%) sulfur coated urea (no iron), or as recommended by testing lab based on soil sample results.
- C. Water: Contractor to utilize the existing irrigation system and or quick coupler(s) when available. If irrigation or quick coupler(s) are not available then the contractor is responsible for watering. Water shall be free of substances that may be harmful to sod growth. Hoses and other watering equipment necessary to water the sod to be furnished by Contractor.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Examine finish surfaces, grades and depth to verify that grades are within one-tenth (0.10) of a foot of grades indicated on the Drawings. Do not start work until unsatisfactory conditions are corrected and approved by the Denver Parks Representative. Perform sodding work only after planting and other work affecting ground surface has been completed.

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- B. Acceptance: Beginning of installation means acceptance of existing conditions by the Contractor.

3.2 PREPARATION:

- A. Work notification: Notify the Denver Parks Representative at least seven (7) working days prior to start of sodding operations.
- B. Limit preparation to areas that can be sodded within twenty-four (24) hours of preparation.
- C. The Contractor shall prepare the soil of all areas to be sodded in accordance with the requirements of Soil Preparation - Section 02920.
- D. When completed, the soil shall be firmed by float dragging, followed by steel raking, to provide for the proper sodded subgrade. The sod bed shall be totally free from rock or clay clods over one-half inch (1/2”) in diameter.
- E. Repair: Re-establish grade and specified conditions to damaged sod areas prior to placing sod.
- F. Adjustment: Adjust irrigation heads to proper watering height according to depth of sod material but lower than compacted blade height to enable lawn mowers to cut grass freely without damage to the sprinkler system.

3.3 INSTALLATION:

- A. Sodding:
 - 1. Subgrade on which sod is laid shall be slightly moist during installation.
 - 2. Lay sod with longest dimension parallel to contours and in continuous rows.
 - 3. Tightly butt ends and sides of sod together. Stagger and compact vertical joints between sod strips.
 - 4. Sod shall not be overlapped or stretched during placement. Exposed joints due to shrinkage will require replacement of sod in affected areas.
- B. Topsoil: Where new sod abuts an existing turf area topsoil shall be placed along seams and or joints to provide a smooth transition.
- C. Rolling: Sod shall be rolled after installation to ensure proper contact with the subgrade, , and to ensure tight joints between adjacent pieces. Sod shall be moist prior to rolling. Once rolling is complete additional watering shall occur. Roller shall weigh one-hundred (100) to one-hundred-sixty (160) pounds per foot of roller.
- D. Drainage: Contractor shall ensure that finished areas are graded so that positive drainage of storm and irrigation water is achieved.

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3.4 FERTILIZING:

- A. Distribute (20-5-10) fertilizer uniformly at the rate of five (5) pounds of material per one-thousand (1,000) square feet, one (1) pound of actual nitrogen per one-thousand (1,000) square feet or sixty (60) days after initial seeding operations and every sixty (60) days thereafter until Final Acceptance of project by the Denver Parks Representative.

3.5 PROTECTION:

- A. Protect existing utilities, paving and other facilities from damage caused by sodding operations, Contractor shall repair any damage at no additional cost.
- B. Restrict vehicular and pedestrian traffic from sodded areas until grass is established. Erect signs and barriers as required or directed by the Denver Parks Representative at no additional cost.
- C. Locate, protect and maintain the irrigation system during seeding operations. Repair irrigation system components damaged during sodding operations shall be replaced or repaired to current City irrigation standards at Contractor's expense.
- D. Erosion Control: Take measures and furnish equipment and labor necessary to control and prevent soil erosion, blowing soil and accumulation of wind-deposited materials on the site throughout the duration of work.

3.6 CLEANING:

- A. General: Provide and install barriers as required and as directed by Denver Parks Representative to protect sodded areas against damage from pedestrian and vehicular traffic until Final Acceptance.

END OF SECTION 02935

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SECTION 02950

TREES, PLANTS AND GROWDCOVERS

PART 1 - GENERAL

1.1 DOCUMENTS: Book 1 Contract requirements apply to Work of this section.

1.2 SUMMARY:

A. Work Includes: Furnishing, installing, and maintaining live woody plant material.

B. Related Work:

1. Clearing and Grubbing – Section 02110
2. Tree Retention & Protection - Section 02150
3. Irrigation System - Section 02810
4. Soil Preparation - Section 02920
5. Topsoil - Section 02925

1.3 GLOSSARY:

- A. **ANSI.** American National Standards Institute. Z60.1 is the national standard for nursery stock.
- B. **Caliper.** Trunk diameter is measured 6 inches (15 cm) from the ground; if the caliper is greater than 4 inches (10 cm), the measurement is taken at 12 inches (30 cm) from the ground.
- C. **Cane,** a cane shall be considered a primary stem which starts from the ground or at a point close to the ground at a point not higher than one-fourth the height of the plant, and which reaches the minimum height stated in the plant size specification.
- D. **Central leader,** also referred to as **leader** or the **dominant leader.** A continuation of the main trunk located more or less in the center of the crown, beginning at the lowest main scaffold branch and extending to the top of the tree.
- E. **Circling root(s).** One or more roots whose diameter is greater than 10% of the trunk caliper circling more than one-third of the trunk. Circling roots are unacceptable.
- F. **Clear trunk.** The portion of the trunk below the main crown which may include shortened temporary branches.
- G. **Co-dominant.** Two or more vigorous, upright branches or stems of relatively equal diameter that originate from a common point, usually where the leader was lost or removed. Co-dominant stems are unacceptable.
- H. **Container-grown**—grown to a specified size in a container.
- I. **Crown.** The portion of a tree beginning at the lowest main scaffold branch extending to the top of the tree. On younger trees, the crown may be comprised of temporary branches.
- J. **Cultivar.** A named plant selection from which identical or nearly identical plants can be produced, usually by vegetative propagation or cloning.
- K. **Included bark.** Bark embedded in the union between a branch and the trunk or between two or more stems that prevents the formation of a normal branch bark ridge. Included bark is unacceptable.
- L. **Kinked root.** A main root that is sharply bent. Kinked roots are unacceptable.

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- M. **Root collar**, also referred to as the **root flare**. The base of a tree where the main roots and trunk meet.
- N. **Scaffold branches**. Large main branches that form the main structure of the crown.
- O. **Stem-girdling root**. A circling, bent, or straight root that touches or rests on the trunk or root flare that can become a permanent root.
- P. **Temporary branch**. A small branch that is temporarily retained along the lower trunk of young trees.
- Q. **Trunk**. The main stem of a tree, beginning at the root collar and ending at the lowest main scaffold branch.
- R. **Taper**. The thickening of a trunk or branch toward its base.

1.2 SUBMITTALS

- A. Proper Identification: All trees shall be true to name as ordered or shown on planting plans and shall be labeled individually or in groups by species and cultivar (as appropriate).
- B. Contractor shall provide a complete list of all plant material for approval by the Denver Parks Representative a minimum of ten (10) days prior to delivery. Any substitutions of plant material, including but not limited to size, type, species and variety shall be listed and submitted to the Denver Parks Representative for approval.
- C. Samples: At a minimum provide the following samples for approval by the Denver Parks Representative, additional product samples may be required at the direction of the Denver Parks Representative.
 - 1. Mulch (1 gallon bag minimum)
 - 2. Tree Stakes (1 of each type)
 - 3. Tree Straps (1 Each)
 - 4. Guy Material (1 linear foot)
 - 5. Guy Signal (1 linear foot)
 - 6. Tree Wrap (1 linear foot)
- D. Contractor shall provide the following certificates:
 - 1. State Inspection Certificate from the origin nursery
 - 2. Japanese Beetle Certificate from origin state
 - 3. Japanese Beetle Quarantine Certificate from origin state
 - 4. Any Certificates required by the Colorado Nursery Act and accompanying Rules and Regulations.
- E. Analysis of existing soil shall be per Section 02925 –Topsoil, 1.3 Quality Assurance.

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- F. Contract Close Out Submittals:
 - 1. Operating and Maintenance Data: At completion of work, submit one (1) digital copy and two (2) hard copies to CDOT and the Denver Parks Representative in accordance with Section 01700 – Contract Closeout. Include recommended procedures for continued and proper maintenance during a full calendar year.
 - 2. Warranty for Trees, Plants and Groundcovers: At completion of work, furnish written warranty to the Denver Parks Representative based upon specified requirements.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed landscaping work similar in material, design, and extent to that indicated for this Project and with a record of successful landscape establishment.
 - 1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on the Project site at all times.
- B. Provide quantity, size, genus, species, and variety of trees indicated, complying with current applicable requirements of ANSI Z60.1 "American Standard for Nursery Stock", and all applicable state and local rules and regulations.
- C. Inspection: Contractor shall arrange for CDOT and the Denver Parks Representative to select and or inspect plant material prior to delivery at the nursery(s) or upon delivery to the site, for compliance with requirements for genus, species, variety, cultivar, size, and quality. Selection and approval of plant material shall be at the discretion of the Denver Parks Representative.
 - 1. The Denver Parks Representative reserves the right to reject, at any time or place prior to final acceptance, all plant materials that fail to meet these specifications in the Park Denver Parks Representative's opinion. Inspection of materials is primarily for quality, size, and variety, but other requirements are not waived even though visual inspection results in approval. Plants are to be inspected where available; however, inspection at the places of supply shall not preclude the right of rejection at the site or at a later time prior to final acceptance. Rejected material shall be removed from the site within 24 hours.
 - 2. The Contractor shall schedule inspection of the plants, at either the supplier or on-site, to be completed in one visit. Any further inspection required due to plants being unavailable, rejected, and or not meeting specifications shall be charged to the Contractor at the current hourly rate for the City personnel performing the inspection.
- D. Measurements: Measure trees according to the requirements of the Colorado Nursery Act, with branches and trunks in their normal position. Do not prune to obtain required sizes. Take caliper measurements six-inches (6") above ground for trees up to four-inch (4") caliper size, and twelve-inches (12") above ground for larger sizes. Measure main body of tree for height and spread; do not measure branches or roots tip-to-tip.

DELIVERY, STORAGE, AND HANDLING

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1.4 DELIVERY, STORAGE, AND HANDLING

- A. Materials: Deliver materials in original containers with tags showing genus, species and size.. Protect materials from damage during delivery and while stored at site. The Denver Parks Representative reserves the right to inspect containers before or after installation to verify compliance with Specifications.

- B. Trees: Nursery stock shall be harvested and planted during the same growing season. Do not prune, except as approved by the Denver Parks Representative. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or tie trees in such a manner as to destroy natural shape. Provide protective covering during delivery. Plant materials delivered without protective covering may be rejected. Do not drop trees during delivery. All trees shall be labeled with a securely attached waterproof tag bearing a legible plant name. Remove all tags and flagging as directed by the Denver Parks Representative.

- C. Handle balled and burlapped stock by the root ball only.

- D. Deliver trees after preparations for planting have been completed and install immediately. If planting is delayed more than 6 hours after delivery, set planting materials in shade, protect from weather and mechanical damage, and keep roots moist.
 - 1. Set balled stock on ground and cover ball with wood chips, or other acceptable material.
 - 2. Do not remove container-grown stock from containers before planting.
 - 3. Water root systems of trees stored on site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.

1.5 PROJECT/SITE CONDITIONS

- A. Vehicular accessibility on site shall be as directed by Project Manger. Repair damage to prepared topsoil and existing surfaces, caused by vehicular access and movement during work under this section, to original condition at no additional cost.

- B. Utilities: Contractor shall be responsible locating utilities and , repair of utilities damaged during the work. Determine location of overhead and underground utilities and perform work in a manner that will avoid damage. Hand excavate, as required. Maintain markings until their removal is mutually agreed upon by the Contractor and Denver Parks Representative.

- C. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify the Denver Parks Representative before planting.

- D. Protection: Erect and maintain barricades, warning signs and lights, and provide guards as necessary or required to protect all persons on the site from exposed excavations.

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1.6 COORDINATION AND SCHEDULING

- A. Coordinate installation of planting materials during normal planting seasons for each type of plant material required. Planting materials should be planted between April 15 and October 1, or at the direction of the Denver Parks Representative. If irrigation is not available at the time of planting then the Contractor is responsible for watering of all plant material and no additional cost.
- B. Plant trees after final grades have been accepted and prior to seeding or sodding, unless otherwise authorized by Denver Parks Representative.

1.7 WARRANTY

- A. Warranty: The warranty specified in this Article shall not deprive CDOT of other rights CDOT may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Trees, Plants and Groundcovers shall be warranted for a period of one year after date of Project Completion, against defects including death and unsatisfactory growth as determined by CDOT. Warranty shall not cover defects resulting from lack of adequate maintenance, neglect or abuse by City staff, hail, or incidents that are beyond Contractor's control.
- C. Inadequate or improper maintenance by the City shall not be cause for replacement, provided the Contractor shall have submitted a letter or report to the City on improper or inadequate maintenance practices and recommended remedial actions.
- D. The warranty shall not be enforced should any plant die due to vandalism after Final Acceptance.
- E. Replace any plant materials that may be excessively pruned, more than 20 percent dead, or in an unhealthy or declining condition immediately upon notice from the Denver Parks Representative during warranty period.
- F. All plants shall be true to name and meet all conditions of these specifications. Any plant that is not true to name as indicated by form, leaf, flower, or fruiting characteristics shall be replaced at the Contractor's expense.

1.8 TREE MAINTENANCE DURING CONSTRUCTION PERIOD:

- A. Maintain trees by pruning, cultivating, watering, mulching, winter watering, weeding, wrapping, unwrapping, restoring planting saucers, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Control as required to keep trees free of insects and disease. Restore or replace damaged tree wrappings, stakes, guying. Trees shall be maintained by the Contractor through the Warranty period of the project.

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PART 2 - PRODUCTS

2.1 PLANT MATERIALS

- A. General: Furnish nursery-grown trees and shrubs conforming to the requirements of the Colorado Nursery Act, with healthy root systems developed by transplanting or root pruning. Provide well shaped, symmetrical, fully branched, healthy, and vigorous stock free of disease, insects, eggs, larvae, girdling, and defects such as sun scald, injuries, abrasions, and disfigurement. Trees of a larger size than that specified in the plant list may be used with a proportionate increase in size of roots and balls, if acceptable to the Denver Parks Representative. The use of larger plants shall be covered by the Contractor at no additional cost to the City.
- B. Label all plants of each size, caliper and variety and caliper with a securely attached waterproof tag bearing legible designation of botanical and common name.
- C. All plants shall be the species designated on the Design Documents. No substitutions will be accepted without the prior written approval of the Denver Parks Representative. Contractor must provide proof of non-availability.

2.2 TREES - These specifications shall apply to deciduous, broadleaf evergreen, and coniferous species. Note that leaf characteristics will not be evident on deciduous trees during the dormant season.

- A. Crown: The form and density of the crown shall be typical for a young specimen of the species/cultivar. Changes in form caused by wind, pruning practices, pests, or other factors shall not substantially alter the form for the species/cultivar. These crown specifications do not apply to plants that have been specifically trained in the nursery to be: topiary, espalier, multi-stem, or clump; or unique selections such as contorted or weeping cultivars.
 - 1. Trees shall have a single, relatively straight trunk, and central leader. They shall be free of co-dominant stems and vigorous, upright branches that compete with the central leader. If the original leader has been headed, a new leader at least one-half of the diameter of the original leader shall be present.
 - 2. Main branches shall be well-distributed along the central leader, not clustered together. They shall form a balanced crown appropriate for the age of the species/cultivar.
 - 3. Branch diameter shall be no larger than two-thirds (one-half is preferred) the diameter of the central leader measured 1 inch (2.5 cm) above where the branch is attached.
 - 4. The attachment of the largest scaffold branches shall be free of included bark.
 - 5. Temporary branches, unless otherwise specified, should be present along the lower trunk below the lowest scaffold branch, particularly for trees less than 1 inch (2.5 cm) in caliper. These branches should be no greater than 3/8 inch (1 centimeter) diameter. Clear trunk shall be no more than 30% of the total height of the tree.
- B. Trunk: The tree trunk shall be relatively straight, vertical, and free of wounds, except properly made pruning cuts, which shall be closed over or less than 3/4 inch (2 cm) diameter open, sunburned areas, conks (fungal fruiting bodies), wood cracks, bleeding areas, signs of boring insects, galls, cankers, stem-girdling ties, or lesions (mechanical injury).

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1. Trunk caliper and taper shall be sufficient so that the tree will remain vertical without a stake. Trunk caliper at 6 inches (15 centimeters) above the soil media (substrate) surface shall be within the diameter range shown for each container size below and as specified in current edition of ANSI Z60.1.
 2. The cut made when re-growing the top should be just above the major structural roots. The "shank" that results from this procedure should be at a consistent height above the structural roots and no longer than 5 inches (12 cm), to ensure that the trees are consistently planted at the correct depth. The base of the trunk should not have a large pruning cut from re-growing the top.
- C. Roots: The root system shall be substantially free of injury from biotic (e. g., insects and pathogens) and abiotic (e. g., herbicide toxicity and salt injury) agents.
1. The uppermost roots or root collar shall be within the upper 2 inches (5 cm) of the soil media (substrate). Depth of the root-ball shall be measured from the top of the ball, which in all cases shall begin at the root flare. Soil above the root flare shall not be included in the root-ball depth measurement, and shall be removed.
 2. The root collar and the inside portion of the root-ball shall be free of defects, including circling, kinked, and stem-girdling roots. Soil removal or root washing near the root collar may be necessary to inspect for the aforementioned root defects.
 3. Roots on the periphery and bottom of the root-ball shall be less than 1/4 inch (.65 cm) in diameter while 1/8 inch (.3 cm) is preferred.
 4. The tree shall be well rooted in the soil media (substrate). Root distribution shall be uniform throughout the soil or media. Structure and growth shall be appropriate for the species/cultivar. When the burlap or container is removed, the root-ball shall remain intact. When the trunk is lifted both the trunk and root system shall move as one.
 5. Trees should have several lateral roots or many fibrous roots spaced evenly around the trunk to provide support so the trees are stable when planted. Trees should have as many small roots as possible. These roots are key to the uptake of sufficient water and nutrients. Fibrous roots can be achieved by root-pruning, using air-pruning containers, or under-cutting or root pruning and transplanting at any stage of production.
 6. As a general rule for young nursery-grown trees, there should be two or more structural roots within 1 - 3 inches (2.5 - 7.5 cm) of the soil surface. "First order lateral roots" is another term that has been used for these roots. If the roots are deeper than 3 inches (7.5 cm), the stock shall be rejected if the root-ball is undersized as specified in current edition of ANSI Z60.1.
 7. Field grown trees for balled and burlap delivery shall have the roots pruned at least six inches inside the final root-ball size performed within adequate time for the tree to develop fibrous roots at the outer edge of the root-ball prior to harvest and delivery.
- D. Leaves: The size, color, and appearance of leaves shall be typical for the time of year and stage of growth of the species or cultivar. Trees shall not show signs of prolonged moisture stress or extended drought as indicated by wilted, shriveled, or dead leaves.

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- E. Branches: Shoot growth (length and diameter) throughout the crown shall be appropriate for the age and size of the species/cultivar. Trees shall not have dead, diseased, broken, distorted, or otherwise injured branches.
- F. All deciduous trees of one species used in formal rows or groupings shall exhibit cultural uniformity, i.e. “matched” in height, crown width and shape, height to first branch, and trunk taper. For this reason it is desired that these trees be produced by a single grower.

2.3 SHRUBS

- A. Container Grown Shrubs: All specifications for container grown plants shall include both plant size and container size. Plant size intervals and reference to height or spread shall be in accordance with the guidelines for the appropriate plant type set forth in ANSI Z60.1; Section 2.2 Types of Deciduous Shrubs.
- B. Container size shall be by container classification (i.e., not by container volume) as set forth in the ANSI Z60.1 Container Class Table.
- C. In all cases, container grown nursery stock shall meet the following general requirement:
 - 1. All container grown nursery stock shall be healthy, vigorous, well rooted, and established in the container in which it is growing. Container grown nursery stock shall have a well-established root system reaching the sides of the container to maintain a firm ball when the container is removed, but shall not have excessive root growth encircling the inside of the container.
- D. The container shall be sufficiently rigid to hold the ball shape and to protect the root mass during shipping.
- E. Minimum shrub sizes shall conform to the following standards:
 - 1. Tender shrubs (Type 0) that do not produce top growth that is winter hardy :

Height or Spread	Minimum number of canes	Minimum spread of roots
15 inches	3 canes	9 inches

- 2. Small shrubs (Type 1) that grow to a mature height of not more than three feet (3’):

Height or Spread	Minimum number of canes	Minimum spread of roots
15 inches	4 canes	9 inches

- 3. Intermediate shrubs (Type 2) that grow to a mature height between three feet (3’) and seven feet (7’):

Height or Spread	Minimum number of canes	Minimum spread of roots
2 feet	4 canes	12 inches

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4. Large shrubs (Type 3) that grow to a mature height exceeding seven feet (7').

Height or Spread	Minimum number of canes	Minimum spread of roots
4 feet	6 canes	20 inches

2.4 PERENNIALS, GRASSES, GROUNDCOVERS, AND VINES

- A. All container grown plants shall be healthy, vigorous, well rooted, and established in the container in which they are growing. A container grown plant shall have a well established root system reaching the sides of the container to maintain a firm root ball, but shall not have excessive root growth encircling the inside of the container.

2.5 STAKING AND GUYING MATERIALS

- A. Deciduous Tree Stakes: 6' steel T-posts, color green, or 2" diameter wood posts, min. 6' long.
- B. Evergreen Tree Stakes: 2' steel T-posts, color green.
- C. Tree Straps: 12" metal grommet nylon straps, 1-1/2" wide, or Arbor Tie.
- D. Guying Material: 14 gauge galvanized steel wire, double strand twisted, or Arbor Tie.
- E. Guy Signal: 1/2" diam. white PVC pipes, length as indicated on the drawings.
- F. Trunk-Wrap Tape: Two layers of crinkled paper cemented together with bituminous material, four inches (4") wide minimum, with stretch factor of thirty-three 33 percent (33%).

2.6 MULCH

- A. Organic Mulch: Organic mulch, free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of chipped wood material not larger than four inches (4") in length. Submit a one (1) gallon bag sample for approval.

2.7 PLANT PIT BACKFILL MATERIAL

- A. Unless otherwise directed by the Denver Parks Representative, the plant pit backfill material shall consist of the following, thoroughly mixed:
1. Soil originally excavated from the pit (two thirds proportion of total mix)
 2. Compost material as specified in Section 02920 - Soil Preparation, 2.1, B Soil Conditioner (one-third (1/3) proportion of total mix)
- B. If imported topsoil is required, it shall meet the requirements specified in Section 02925 Topsoil, 2.2.

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2.8 WATER

- A. During the irrigation season (generally May through September), water will be available from on-site quick couplers. When the system is not charged, it shall be the Contractor's responsibility to supply adequate amounts of water (10 gallons per caliper inch) from a water truck or other approved source. Hoses and other watering equipment shall be supplied by Contractor.
- B. Watering: Refer to Section 02233 – Watering.

2.9 MISCELLANEOUS MATERIALS

- A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees, as approved by the City Forester and the Denver Parks Representative. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's instructions.
- B. Pre-Emergent Herbicide: Treflan as manufactured by Elanco Company, or an approved equal, and as approved by the City Forester and the Denver Parks Representative.
- C. Herbicides and Pesticides: EPA registered and approved, and as approved by the City Forester and the Denver Parks Representative.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive landscaping for compliance with requirements and for conditions affecting performance of work of this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Cooperate with any other contractors and trades, who may be working in and adjacent to the landscape work areas. Examine drawings which show the development of the entire site and become familiar with the scope of all work required.

3.2 FINISH AND FINE GRADING

- A. Mechanically rip or disk subsoil in all areas to be planted to minimum depth of six inches (6") prior to placing top soil and soil amendments.
- B. Place topsoil to a depth of four inches (4") over all areas to be landscaped, excluding planting beds.
- C. Finish and fine grade the project area to establish an even and well matched gradient over the entire surface. Provide positive surface drainage, with no depressions, settling, or irregularities in the finished grade.

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- D. At any transitional point or line where one plane intersects another, such as from a sloping area or berm to a level area, a smooth and gentle transition shall be made. There shall be no abrupt changes in grade unless specifically noted otherwise. Match the grades of new work with existing areas outside the project area. Grading shall be completed in accordance with the Design Documents.
- E. The finish grade elevation shall not vary above or below the proposed grade more than one-tenth (0.10) of a foot.

3.3 PREPARATION:

- A. Layout, stake and label all individual tree locations for approval by the Denver Parks Representative prior to installing trees
- B. Outline planting beds and mark plant locations within the bed(s) for approval by the Denver Parks Representative prior to installing any plant material or mow bands. Make adjustments as directed at no additional cost to the City.

3.4 WEED CONTROL

- A. In areas that have been regraded and/or have existing weed growth, weed control measures appropriate to the amount of growth and/or species shall be provided. Submit weed control plan to the Denver Parks Representative for approval.
- B. Clear and grub, apply pre-emergent herbicide, and/or apply post emergent herbicide as necessary to eliminate weeds. Do not proceed with landscape work until weed growth has been controlled and eliminated

3.5 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits: Excavate by hand or with a backhoe. Scarify sides of tree pit. Tree spade may not be used to dig tree pits.
 - 1. Balled and Burlapped Trees: Excavate a minimum two times (2X) as wide as ball diameter at base of pit. The base of the root collar shall be three inches (3") higher than the grade at which the tree originally grew and finished grade. Slope sides of the pit as shown on the detail.
 - 2. Container-Grown Trees and Shrubs: Excavate approximately two times (2X) times as wide as container diameter. Plants shall be set one inch (1") higher than finished grade.
- B. Obstructions: Notify the Denver Parks Representative if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavation.
- C. Drainage: Notify the Denver Parks Representative if subsoil conditions show evidence of water seepage or retention in tree or shrub pits.
 - 1. Fill the pit with water and allow it to completely drain before planting occurs.

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2. If water does not drain out of pit within 24 hours, notify Denver Parks Representative.

3.6 PLANTING TREES AND SHRUBS

A. Balled and Burlapped Stock:

1. Set balled and burlapped stock plumb and in center of pit with top of ball raised above adjacent finish grades as indicated. Root collar shall be set 3” above the grade at which the tree originally grew and finished grade.
2. Remove burlap from tops of balls and partially from sides, but do not remove from under balls. Remove wire baskets entirely. Remove pallets, if any, before setting. Do not use planting stock if ball is cracked or broken before or during planting operation.
3. Place backfill around ball in layers, tamping to settle backfill and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing and tamping final layer of backfill.

B. Container Grown Stock:

1. Carefully remove containers so as not to damage root balls.
2. Lightly scratch sides of exposed root ball to loosen surface roots.
3. Set plants plumb and in center of pit with top of ball raised above adjacent finish grades as indicated.
4. Place backfill around ball in layers, tamping to settle backfill and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing and tamping final layer of backfill.

C. Tree Staking: Stake trees as shown on the details.

D. Wrapping tree trunks: Wrap trees with trunk-wrap tape. Start at base of trunk and spiral cover trunk to height of first branches. Overlap wrap, exposing half the width, and securely attach without causing girdling. Do not use staples. Inspect tree trunks for injury, improper pruning, and insect infestation and take corrective measures required before wrapping.

1. All deciduous trees shall be wrapped between November 1st and November 15th. All tree wrap shall be removed by May 15.
2. Contractor shall be responsible for wrapping and unwrapping trees during the warranty period.

3.7 PRUNING OF PLANTS: Prune only damaged or dead branches as directed by the Denver Parks Representative.

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3.8 MULCHING

- A. Mulch backfilled surfaces of pits, planting beds areas, and other areas indicated or as directed by the Denver Parks Representative. Create a forty-eight inch (48”) diameter saucer around tree and fill with four inch (4”) deep specified wood mulch. Mulch shall be kept six inches (6”) away from tree trunk.
- B. Pre-Emergent Herbicide: Apply pre-emergent herbicide to all shrub beds at the rate recommended by the manufacturer. Do not apply to annual, perennial, or ground cover areas.
- C. Mulch in shrub bed areas: Apply four inches (4”) thick layer of mulch and finish level with adjacent finish grades. Do not place mulch against trunks or stems.

3.9 INSTALLATION OF MISCELLANEOUS MATERIALS

- A. Apply antidesiccant using power spray to provide an adequate film over trunks, branches, stems, twigs, and foliage.
 - 1. When deciduous plants are moved in full-leaf, Denver Parks Representative may direct the use of an antidesiccant at nursery before moving and again 2 weeks after planting.

3.10 PROTECTION:

- A. Protect existing utilities, paving and other facilities from damage caused by seeding operations, Contractor shall repair any damage at no additional cost to the City.
- B. Restrict vehicular and pedestrian traffic from seeded areas until grass is established. Erect signs and barriers as required or directed by the Denver Parks Representative at no additional cost to the City.
- C. Locate, protect and maintain the irrigation system during seeding operations. Repair irrigation system components damaged during seeding operations shall be replaced or repaired to current City irrigation standards at Contractor’s expense.
- D. Erosion Control: Take measures and furnish equipment and labor necessary to control and prevent soil erosion, blowing soil and accumulation of wind-deposited materials on the site throughout the duration of work.

3.11 CLEANING:

- A. General: Provide and install barriers as required and as directed by Denver Parks Representative to protect sodded areas against damage from pedestrian and vehicular traffic until Final Acceptance.

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3.12 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus soil including excess subsoil and unsuitable soil, waste material, including, trash, and debris generated during installation off site at no additional cost to the City.

END OF SECTION 02950

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SECTION 02970

PROJECT MAINTENANCE AND GUARANTEE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS: Book 1 Contract requirements apply to Work of this section.

1.2 SUMMARY

A. Work Included: Furnish all supervision, labor, materials, equipment and transportation required to maintain the landscape areas during the Landscape Establishment period. The work includes but is not limited to: weed control, re-seeding, re-sodding, mowing, weed control, watering of plant material and pruning, irrigation system repair and maintenance, fence installation and maintenance, maintenance of erosion control measures (BMP's) including storm water features and coordination with City staff.

B. Related Work:

1. Submittals – Section 01050
2. Irrigation System - Section 02810
3. Turfgrass Seeding – Section 02932
4. Native Seeding – Section 02933
5. Sodding – Section 02935
6. Trees and Shrubs - Section 02950

1.3 INSPECTION AND ACCEPTANCE

A. Formal Inspections: The project will be inspected during the Landscape Establishment period at the following points:

1. Substantial Landscape Completion Inspection
2. Establishment Inspection
3. Monthly Inspections
4. Final Inspection

B. Additional inspections and observations to monitor maintenance and landscape conditions will be done throughout the Landscape Establishment period by the CDOT and the Denver Parks Representative.

C. Substantial Landscape Completion Inspection: Will occur per CDOT Standard Specifications section 214.04. At the time of this inspection, the Contractor shall have all planted and landscape areas complete and irrigation system operational. All fencing and protection shall be in place. All debris and litter shall be cleaned up and all walkways and curbs shall be cleaned of soil and debris left from installation operations. The inspection will not occur until these conditions are met.

D. Establishment Inspection: Shall occur approximately ninety (90) days after Substantial Landscape Completion. The review will consist of a review of sodded and seeded areas

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and plant material. The inspection will be to review proper rooting of sod, germination of seed areas and to check for signs of stress in plant materials.

- E. Monthly Inspections: Shall occur monthly from the date of Substantial Landscape Completion. The review will consist of a review of all maintenance contract responsibilities. The contractor shall keep a monthly report to be turned in at inspections to review work done to date, including any subcontracting, frequency of schedule, notifications made, materials list, equipment list etc.
- F. Final Inspection and Acceptance: The Contractor must give forty eight (48) hours notice to the CDOT and the Denver Parks Representative requesting a Final Inspection at the completion of the Landscape Establishment period. During the inspection the Project Manager shall prepare a list of any defects discovered during such final inspection ("punch list") and submit the punch list to CDOT and the Denver Parks Representative. If in the opinion of CDOT and the Denver Parks Representative that all work has been completed or performed per the contract documents CDOT will provide the Contractor with written notice of Final Acceptance. Final acceptance by CDOT will not be given until all deficiencies are corrected.

1.4 SUBMITTALS

- A. Submit detailed maintenance monthly reports and schedules for the Landscape Establishment period for review and approval by CDOT and the Denver Parks Representative.
- B. Material List: Submit a detailed list of materials, to be used for seeding, fertilization, herbicides, pesticides that are to be used for seeding, weed control, plant health and mulching.
- C. Equipment List: submit a detailed list of equipment and chemical controls to be used for weed control, seeding and mulching operations. Include brand and model number of all equipment to be used for soil preparation and seeding activities.
- D. Work Examples: submit list of three projects completed in the last two years of similar complexity to this project with name and location of project, Project Manager's name and telephone number, name of project landscape architect and telephone number. Include certifications held by contractor and subcontractor employees who will oversee the work during the maintenance period.

PART 2 - CONTRACTUAL REQUIREMENTS

2.1 LIMITS OF WORK AREA

- A. All improvements and maintenance within the project work area are included unless agreed to by the Denver Parks Representative. Areas outside the defined areas will be maintained by the City and County of Denver.

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2.2 SCHEDULING/PROGRESS REPORTS

- A. Notification: Contractor shall be required to notify the Denver Parks Representative a minimum forty-eight (48) hours in advance of all major work so the Denver Parks Representative have the option of being present at the time of the work. Examples of such work are: clean cultivation, mowing, spraying, seeding, mulching or other activities relating to the repair of landscape items. In the event that proper notification is not given by the Contractor, the Denver Parks Representative shall have the right to require the Contractor to reschedule any such work until such time that the Denver Parks Representative is available. The above provision applies only to work which could be perceived as normal or regularly scheduled maintenance, emergency repairs do not apply.
- B. Progress Reports: The Contractor shall submit monthly progress reports during the growing season and quarterly progress reports through the winter. The written progress reports shall be sent to the CDOT and the Denver Parks Representative outlining work completed, damage incurred, and problems encountered. Progress reports shall contain digital photo documentation of work.
- C. After Hours Contact: Contractor shall provide an afterhours contact and telephone number.

2.3 MAINTENANCE COORDINATION

- A. Contractor shall coordinate maintenance operations and activities with City and County of Denver operations personnel. Maintenance activities between Contractor and Parks and Recreation staff may overlap.

2.4 FAILURE TO PERFORM

- A. In the event that, in the Denver Parks Representative's opinion, action has not been taken on the part of the Contractor to properly maintain the project, the Denver Parks Representative may take whatever action that is deemed necessary to affect such repairs.

2.5 LICENSES, TAXES AND INSURANCE

- A. Licenses: Contractor agrees to obtain and pay for all licenses required by the City, State and Federal governments that are necessary for legally conducting business. Contractor shall maintain all licenses and permits required for maintenance activities (e.g. herbicide application).
- B. Taxes: Contractor shall pay all applicable taxes, including sales taxes on materials supplied.
- C. Insurance: Contractor shall maintain all insurance policies in accordance with the Contract of the contract through the entire term of the Landscape Establishment period.

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PART 3 - EXECUTION

3.1 IRRIGATED TURF CARE (Bluegrass Sod and Seed)

- A. Watering: All watering shall be done in such a way as to encourage establishment, deep root growth and drought tolerance. See Irrigation & Water Management section 3.5 below.
- B. Fertilization: Turf areas shall be fertilized with accepted material (20-5-10) two (2) times per growing season at a rate of 1 pound of nitrogen per 1,000 square feet, once between April 15 and June 1 and once again between August 1st and September 15th.
- C. IPM (Integrated Pest Management): Apply approved herbicides as needed to control establishment and growth of annual and perennial weeds. Spot applications shall be required in areas of excessive growth. Contractor is responsible for ensuring turf establishment and that turf is not adversely affected by herbicide applications. No herbicides will be allowed until seedlings are at least three (3) months old. After establishment, herbicide applications shall be done as required and directed by the Denver Parks Representative during the Landscape Establishment period.
- D. Insect and Disease Control: Insects and disease treatment shall be by application of necessary insecticides and fungicides as plant condition require.
- E. Topdressing. Soil used as topdressing material is to be consistent with existing soil texture where it is to be applied. Organic materials used are to meet DPR's organic material specifications. Topdressing is to be used in non-athletic fields when soil tests or leveling needs determine the application. Fill low spots with matching existing soil when filling noticeable depressions or holes. Compact to meet surrounding soil compaction.
- F. Reseed / resod all bare areas or dead areas of grass greater than one (1) square foot. Reseeding / sodding shall occur within five (5) calendar days of notice to repair the condition. Upon the Denver Parks Representative written approval, the Contractor may reseed / resod at a later date mutually agreed upon. Replacement products and installation shall comply with specifications for original seeding.
- G. Mowing, Trimming and Edging: The contractor shall be responsible for mowing of all areas defined by the Contract until final acceptance. When turfgrasses reach three and one-half inch (3-1/2") height, begin weekly mowing and trimming program to maintain turf at three inch (3") height. Do not remove more than thirty-three percent (33%) of grass leaf in single mowing. Do not mow when soil is wet. Remove clippings from adjacent paved areas. Mower blades are to be sharp to avoid tearing grass blades. Areas not accessible to riding mowers shall be string line trimmed each mowing if necessary to match the mowing height. Limit string line trimming as much as possible around trees and objects (i.e., posts, utility boxes), by using Roundup and/or pre-emergent herbicides six to twelve inch (6" - 12") radius kept clear, and base of shrubs and trees require twenty-four inch (24") minimum radius clear of turf (bare soil/mulch) Turf along concrete edges will be removed in cool season turf areas to the edge of the concrete curb or walkway using the appropriate edging equipment. The edge of the concrete surface should be visible after edging..

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3.2 NATIVE SEEDING AREAS

- A. Watering: Watering: All watering shall be done in such a way as to encourage establishment, deep root growth and drought tolerance. See Irrigation & Water Management section 3.5 below.
1. Non Irrigated Native: Irrigation in non irrigated native areas shall consist of watering of all existing trees and shrubs as well as any new trees or shrubs that are to be watered for establishment.
- B. Weed Control:
1. Weed Control Prior to Initial Installation per Section 02920 – Soil Preperation - Weed control shall be done for the duration of the Landscape Establishment period and when weed density meets or exceeds twelve (12) plants per square yard. Weed control shall be completed by one of the following methods:
- a. Clean Cultivation: Prior to finish grading and final soil preparation work all areas to be seeded areas shall be clean cultivated with approved equipment. Clean cultivate using a rod weeder or other approved equipment tilling the ground no more than two inches (2”) deep. Contractor shall coordinate timing of clean cultivations with the vegetative conditions on the site. Exact timing of cultivations shall be adjusted to control weed germination on the site. It is the responsibility of the Contractor to clean cultivate as necessary to prevent excessive growth of vegetation. Undesirable species shall not be allowed to seed on the site. Bindweed shall not be clean cultivated but removed by herbicide spot applications.
 - b. Mowing: Mowing of annual undesirable species shall be done as a weed control method. Undesirable species shall not be allowed to seed on the site. Existing grass stands to remain shall not be mowed until late fall or early spring to encourage seed drop.
 - c. Chemical Control: Apply approved herbicides as needed to control establishment of annual and perennial weeds. Spot applications may be required. Contractor is responsible for ensuring seed establishment and that seed is not adversely affected by herbicide applications. Contractor shall use herbicides for specific species as recommended by CSU Agricultural Extension Service or City Naturalist.
 - d. Spot Application Chemical Control: Apply Milestone or approved equal, as manufactured by Dow AgroSciences. Apply Milestone by hand applicator directly to invasive annual and perennial weeds. Allow a minimum two weeks between application and any seeding activities.
2. After Initial Seeding - Weed control shall be done for the duration of the Landscape Establishment period. Weed control during the Landscape

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Establishment period shall be completed by one or more of the following methods:

- a. **Clean Cultivation:** After the initial growing season clean cultivation may be done in small areas that have few or no viable native plants. Clean cultivate using a rod weeder or other approved equipment tilling the ground no more than two inches (2") deep. Contractor shall coordinate timing of clean cultivations with the Denver Parks Representative based on vegetative conditions on site. Exact timing of cultivations shall be adjusted to control weed germination on the site. Undesirable species shall not be allowed to seed on the site. Bindweed shall not be clean cultivated.
 - b. **Mowing:** Mowing of annual undesirable species shall be done as a weed control method. Undesirable species shall not be allowed to seed on the site. Existing grass stands to remain shall not be mowed until late fall to encourage seed drop. All Native Seeding areas shall be mowed to a six inch (6") height, do not allow grasses to exceed twelve inches (12") in height. Mow grasses before non specified or invading grasses/weeds are able to seed.
 - c. **Chemical Control:** Apply approved herbicides as needed to control establishment of annual and perennial weeds. Spot applications may be required. Contractor is responsible for ensuring seeding establishment and that seed is not adversely affected by herbicide applications.
 - d. **Spot Application Control:** Small areas of weeds may be addressed initially by hand labor removal or second by herbicide spot applications. Apply Milestone or approved equal as recommended by CSU Agricultural Extension Service or City Naturalist. Apply Milestone or approved equal by hand applicator directly to invasive annual and perennial weeds. Allow a minimum two weeks between application and any seeding activities.
- C. **Reseeding:**
1. After initial seeding has been completed, reseeding evaluation and seeding shall be done a minimum of two times during the Landscape Establishment Period. Replacement seeding, soil preparation and mulching shall comply with Specification Sections 02932-Turfgrass Seeding and 02920-Soil Preparation. Seed mixes may be revised (% of species) to better suit site conditions. If requested by Denver Parks Representative, mix shall be revised at no additional cost to the Contract. Where drill seeding is not feasible hand broadcast seed and rake into the soil to achieve one-quarter inch (1/4") to one-half inch (1/2") coverage of soil. The seed application rate shall be doubled in all areas where it is mechanically broadcast and quadrupled in areas requiring hand broad casting. Hydroseeding is not allowed.
 2. Determination of areas to be reseeded will be based on field conditions and will follow these specifications. Reseed all areas that meet the following conditions:
 - a. Areas of bare or dead grass greater than twenty-four inches by twenty-four inches (24" x 24") square.

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- b. Areas of weed density greater than twelve (12) plants per square foot.
- c. Areas with general density of specified grasses less than twelve (12) plants per square foot.

- 3. Timing of reseeded shall be as specified herein. Upon the Denver Parks Representative's written approval, the Contractor may reseed at a later date mutually agreed upon.

3.4 TREE, SHRUB AND PLANT CARE

- A. Pruning: Refer to Section 02950 – Trees and Shrubs for maintenance requirements.
- B. Replacement of Plants: Per CDOT Standard Specification Section 214.04 (a).
- D. Transplanted Material: Refer to Section 02910.
- E. Non Irrigated Plant Material (trees): all plant material that not served by an automatic underground irrigation system shall be watered by Contractor for the duration of the Landscape Establishment period. Water all plant material at a rate of 10 gallons per inch of tree caliper (e.g. 2” tree requires 20 gallons) to maintain optimum growth. Watering frequency shall be adjusted based on rainfall, season and plant performance. Maintain a large enough water basin around plants so that enough water can be applied to establish moisture through the major root zone. When hand watering; use a water wand to break the water force. Winter watering is the responsibility of the Contractor throughout the maintenance period as many times as required to prevent the plant material from desiccation. Watering may be done by water truck.

3.5 IRRIGATION SYSTEM AND WATER MANAGEMENT

- A. Contractor shall check all irrigation systems for proper operation after each mowing, and any deficiencies or adjustments shall be repaired prior to the next watering cycle. Any damage to system caused by Contractor's operations shall be repaired without charge.
- B. The contractor is responsible for following all Denver Water restrictions and establishment rules for new landscapes per Denver Water, rules and regulations at: <http://www.denverwater.org>
- C. The Contractor shall be responsible for providing an Establishment Watering Schedule, Transition Watering Schedule and a Maintenance Watering Schedule to the Denver Parks Representative, Operation Supervisor and the Toro Factory Representative (when applicable). All irrigation schedules and zone controller charts shall ensure that there will be no ponding or runoff of water during any of the scheduled times. Prior to any plant material being installed all schedules shall be provided to the Denver Parks Representative. The water schedule templates are available from Water Conservation and the Denver Parks Representative. Contractor shall make any modifications to the programming as requested by Denver Parks Representative.

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- a. Establishment Irrigation (Days 1-21) - Plants shall be adequately watered for the first twenty-one (21) days after installation or until seeds have germinated and emerged or sod has become firmly rooted. Exact timing of irrigation cycles will depend on weather conditions, soil conditions, and speed of emergence of grass seed. Short, frequent irrigation cycles shall be used. Split cycles or the 'cycle and soak' feature must be employed to reduce erosion or run off in seeded areas. Do not exceed three inches (3") of total water per week. Coordinate with irrigation system schedule and programming with the Denver Parks Representative and local Toro Field Representative. Contractor shall submit a meter reading before and after establishment to verify water use.
 - b. Transition Irrigation (Days 21-56) - Less frequent, but longer watering cycles will provide moisture at depths that will encourage seedlings to continue to develop and sod to develop deeper roots. Allow the surface soils to dry slightly between watering to encourage deeper rooting. Watering shall be done utilizing historic evapotranspiration rates for the current watering month(s).
 - c. Maintenance Irrigation - Irrigate as needed to maintain an optimum stand of turf while minimizing water use. Irrigation frequency shall be adjusted at a minimum, based on monthly historical evapotranspiration rates and plant (turf and tree) water requirements. It is the responsibility of the Contractor to coordinate with Denver Parks Representative and local Toro Field Representative the programming of irrigation controllers, to properly irrigate plant materials and turfgrass.
6. Once sod has been laid, begin watering to build up the sub-soil moisture. This will be the most critical time to apply water. Water up to one and one-half inches (1-1/2") of water per day for the first two to three (2-3) days. Probe the soil to determine if the moisture has penetrated down to a minimum of four inches (4"). During the next three (3) weeks the amount of water needed will be similar to that of the historical evapotranspiration rates for the season per day. Each day may require more than one application depending on wind and temperature in order to keep the root zone and blades moist.
- D. All damage to irrigation system during the landscape and irrigation maintenance period shall be repaired by the Contractor with identical materials.
 - E. Time of Irrigation: Watering shall be done during the approved Denver Parks and Denver Water allowed water window. Coordinate times with the Denver Parks Representative.
 - F. Winterization of Irrigation System: Under the maintenance period, the Contractor shall be responsible for winterizing irrigation pumps, if applicable, and draining irrigation system

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for the full maintenance period. The Contractor shall remove water from system by use of compressed air. Remove water from drip lines by opening flushing plugs. Contractor shall submit a meter reading after winterization of the system has occurred to Parks Water Conservation. Winterization shall occur no later than October 15th unless a variance has been granted from the Denver Parks Representative.

- G. Spring Start-Up: The Contractor shall be responsible for starting up the irrigation system in the spring (April 15). Contractor shall fully activate the system including controller start-up, in order to demonstrate that it is in full working order. Any repairs that are needed as a result of improper winterization shall be corrected by the Contractor at no additional cost to the City. Contractor shall correct all deficiencies and make any adjustments to ensure proper system function. Contractor shall submit a meter reading prior to spring start-up to the Denver Parks Representative.
- H. It shall be the responsibility of the Contractor to ensure the satisfactory operation of the entire irrigation system and workmanship within the project area. The entire system, including materials, shall be maintained to be complete and remain operable in every detail by the Contractor throughout the maintenance period, and the Contractor agrees to make any adjustments or repair any defects occurring within the maintenance period within seven (7) calendar days of notification by the Denver Parks Representative. Contractor shall replace any materials with manufacturer's defects at no additional cost. Replacement of any equipment shall match that installed and designed on the irrigation plans unless a variance is granted from Denver Parks Representative. Problems resulting in leakage or water waste shall be repaired within twelve (12) hours of notification. Contractor is responsible for emergency repairs and or shut downs.

Any settling of irrigation trenches/backfill material during the maintenance period shall be repaired by Contractor's at no additional cost. Contract documents shall govern irrigation replacement during maintenance period the same as new work. Replacements are to be made at no additional cost.

Any vandalism to the irrigation system prior to final acceptance shall be repaired and/or replaced at Contractor's expense.

END OF SECTION

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SECTION 03300

CAST IN PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS: Book 1 Contract requirements apply to Work of this section..

1.2 SUMMARY:

A. The work in this section consists of furnishing, placing, shoring, bracing, and anchorage of formwork, concrete reinforcement, accessories, and placing concrete in connection with cast-in-place concrete installation including installation of control and expansion joints, concrete curing and concrete finishing.

B. Related Work:

1. Construction Surveying – Section 01050
2. Submittals – Section 01300
3. Quality Control – Section 01400
4. Erosion and Sedimentation Control – Section 01565
5. Earthwork – Section 02200
6. Aggregate Base Course – Section 02232
7. Concrete Walks, Curbs, and Miscellaneous Flatwork - Section - 02520

1.3 REFERENCES:

Note: All references below shall be from the most current edition.

- A. ACI 117 - Standard Tolerances for Concrete Construction and Materials.
- B. ACI 301 - Specifications of Structural Concrete for Buildings.
- C. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
- D. ACI 305 and 306 - Hot and Cold Weather Protection for Concrete.
- E. ACI 315 - Details and Detailing of Concrete Reinforcement.
- F. ACI 318 - Building Code Requirements for Reinforced Concrete.
- G. ACI 347 - Recommended Practice for Concrete Formwork.
- H. ANSI/ASTM A82 - Cold Drawn Steel Wire for Concrete Reinforcement.
- I. ANSI/ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement.
- J. ASTM A615 - Deformed and Plain Billet-Steel for Concrete Reinforcement.

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- K. ASTM C33 - Concrete Aggregates.
- L. ASTM C94 - Ready-Mixed Concrete.
- M. ASTM C150 - Portland Cement.
- N. ASTM C260 - Air Entraining Admixtures for Concrete.
- O. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.
- P. ASTM C494 - Water Reducing Admixtures for Concrete.
- Q. ASTM C618 - Fly Ash Mineral Admixture for Concrete.
- R. ASTM C672 - Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals.
- S. ASTM-C800 - Curing Compound, Concrete, for New and Existing Surfaces.
- T. CRSI - Manual of Standard Practice.
- U. Colorado Department Of Transportation (CDOT) – Standard Specifications for Road and Bridge Construction

1.4 QUALITY CONTROL:

- A. Requirements of Regulatory Agencies: Comply with all applicable provisions of the state and local building and safety codes.
- B. Reference Standards: Comply with following standards except where more stringent requirements are shown or specified:
 - 1. ACI 301, "Specification for Structural Concrete for Buildings." Contractor shall make a copy of ACI 301 available at the project field office for the duration of the project.
- C. The Contractor is responsible for quality control, including workmanship and materials furnished by his subcontractors and suppliers.
 - 1. Inspection or testing does not relieve the Contractor of his responsibility to perform the Work in accordance with the Contract Documents.
- D. Testing: The Contractor shall be responsible for all concrete testing unless otherwise indicated.

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1. The contractor shall provide and pay for additional testing due to non specification compliant test results.
- E. Record of Work: A record shall be kept by the General Contractor listing the time and date of placement of all concrete for the structure. Such record shall be kept until the completion of the project and shall be available to the CDOT and the Denver Parks Representative for examination at any time.
- 1.5 SUBMITTALS:
- A. Mix Designs:
1. Submit substantiating data for each concrete mix design specified for use to CDOT and the Denver Parks Representative not less than four (4) weeks prior to first concrete placement. Data for each mix shall, as a minimum, include the following:
 - a. Mix identification designation (unique for each mix submitted).
 - b. Statement of intended use for mix.
 - c. Mix proportions.
 - d. Admixtures (must be approved by the CDOT and the Denver Parks Representative)
 - e. Wet and dry unit weight.
 - f. Entrained air content.
 - g. Design slump.
 - h. Strength qualification data.
- B. Submit shop drawings for fabrication, bending and placement of concrete reinforcement. Comply with ACI Detailing Manual SP 66. Include all accessories specified and required to support reinforcement.
- 1.6 DELIVERY, STORAGE AND HANDLING:
- A. General: Materials handling and batching shall conform to applicable provisions of ASTM C94.
- B. Reinforcing: Unload and store reinforcing bars so they are kept free of mud and damage.
- C. Hauling Time for Concrete: Deliver and discharge all concrete transmitted in a truck mixer, agitator, or other transportation device not later than one and one-half (1-1/2) hours, or three-hundred (300) revolutions of the drum after the mixing water has been added, whichever is earliest.
- D. Extra Water:
1. Deliver concrete to site in exact quantities required by design mix.
 2. Should extra water be required for workability before depositing concrete, and the water/cement ratio of accepted mix design will not be exceeded, the General

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Contractor's superintendent shall have the sole authority to authorize addition of water. Additional water shall not exceed one (1) gal/cu. yd. Any additional water added to mix after leaving batch plant shall be indicated on truck ticket and signed by person responsible.

3. Where extra water is added to concrete it shall be mixed thoroughly for thirty (30) revolutions of drum before depositing.
4. Water may be added at the site only once for each batch.
5. A full set of tests shall be performed after addition of water. Excessive slump or other out of range tests will be cause for rejection.

1.7 PROJECT CONDITIONS:

A. Environmental Requirements:

1. Cold Weather Placement:

- a. When for three successive days prior to concrete placement the average daily outdoor temperature drops below forty degrees (40°) F or when the average outdoor temperature is expected to drop below forty degrees (40°) F on the day of concrete placement, preparation, protection and curing of concrete shall comply with ACI 306R
- b. Minimum temperature of concrete upon delivery shall conform to ACI 301 Table 7.6.1.1. Concrete at time of placement shall conform to minimum values of ACI 306R Table 1.4.1, and shall not exceed minimum values by more than twenty degrees (20°) F.
- c. Subject to acceptance of the CDOT and Denver Parks Representative an accelerating admixture may be used. Admixtures shall meet requirements of Part 2. Calcium Chloride and other chloride-type accelerating admixtures are not allowed.
- d. Comply with concrete protection temperature requirements of ACI 306R. Record concrete temperatures during specified protection period at intervals not to exceed sixteen (16) hours and no less than twice during any twenty-four (24) hour period.

2. Hot Weather Placement:

- a. When depositing concrete in hot weather, follow recommendations of ACI 305R.
- b. Temperature of concrete at time of placement shall not exceed eighty-five degrees (85°) F.
- c. When air temperatures on day of placement are expected to exceed ninety degrees (90°) F, mix ingredients shall be cooled before mixing. Flake ice or well-crushed ice of a size that will melt completely during mixing may be substituted for all or part of mix water.
- d. Retarding admixture may be used subject to acceptance of CDOT and the Denver Parks Representative. Admixtures shall meet requirements of Part 2.
- e. Protect to prevent rapid drying. Start finishing and curing as soon as possible.

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- B. Protection: Protect newly finished slabs from vandalism and all weather related damage. Protect finished slabs from mortar leakage from pouring of concrete above. Cover masonry walls, glazing, and other finish materials with polyethylene or otherwise protect from damage due to pouring of concrete.

PART 2 - PRODUCTS

2.1 FORM MATERIALS:

- A. Hand Placed Steel Forms: Hand placed steel forms are only to be used for sections that are straight and have no bend, radii or curvature in the sections to be used.
- B. Plywood Forms: Are to be used on any section of concrete that have bends, radii or curvature. Forms shall be made of Douglas Fir or Spruce species; solid one side grade; sound, undamaged sheets with straight edges.
- C. Lumber: Douglas Fir or Spruce species; construction grade; with grade stamp clearly visible.
- D. Form Coatings: Provide commercial formulation form coating compounds that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.2 REINFORCING STEEL:

- A. Reinforcing Steel: ASTM A615, grade forty (40) for, ties and stirrups; grade sixty (60) for all other bar; billet-steel deformed bars, uncoated finish.
- B. Welded Steel Wire Fabric: ANSI/ASTM A185 plain type; in flat sheets or coiled rolls; uncoated finish.
- C. Tie Wire: ASTM A82, minimum sixteen (16) gauge annealed type.
- D. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during installation and placement of concrete. Wood, brick or other unacceptable material is not permitted.

2.3 CONCRETE MATERIALS:

- A. Provide materials in accordance with ACI 301, unless amended or superseded by requirements of this section or general notes on structural drawings.
 - 1. General: Ready-mixed Concrete: ASTM C94. On-site mixed concrete not allowed.

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2. Cement: ASTM C150. Type II minimum of five-hundred-sixty-four pounds (564 lbs.) per cubic yard.
3. Fly ash: ASTM C618 Class C or F. Fly ash shall not exceed fifteen percent (15%) of total cementitious material by weight.
4. Aggregate: ASTM C33. Obtain from same source throughout project.
 - a. Fine Aggregate: Natural sand.
 - b. Coarse Aggregate: Gravel or crushed stone containing no deleterious substances which cause surface spalling.
5. Water: Clean and not detrimental to concrete.

2.4 ADMIXTURES:

- A. General: Unless specified, no admixtures may be used without specific approval of CDOT and the Denver Parks Representative.
- B. Prohibited Products: Calcium chloride or admixtures containing more than half of one percent (0.05%) chloride ions or thiocyanates are not permitted.
- C. Air-Entraining Admixture: ASTM C260. Subject to compliance with requirements, provide one of the following:
 1. "Air Mix" - Euclid Chemical Co.
 2. Darex ARA" - W. R. Grace
 3. "Micro-Air" - Master Builders
- D. Water Reducing Admixture: ASTM C494, Type A. Subject to compliance with requirements, provide one of the following:
 1. "Eucon WR-75" - Euclid Chemical Co.
 2. "Rheobuild 1000" - Master Builders
 3. "Plastocrete 106" - Sika Chemical Co.
- E. High Range Water Reducing Admixture (Superplasticizer): ASTM C494, Type F or G. Subject to compliance with requirements, provide one of the following:
 1. "Eucon 37" - Euclid Chemical Co.
 2. "Pozzolith 400N" - Master Builders
 3. "Sikament" - Sika Chemical Co.
- F. Warm weather admixtures: ASTM C494. Use of admixtures will not relax warm weather placement requirements.

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- G. Cold Weather Admixtures: ASTM C494. Use of admixtures will not relax cold weather placement requirements.

2.5 ACCESSORIES:

- A. Form Release Agent: Colorless material which will not stain concrete, absorb moisture, contain oils or waxes, or impair natural bonding or color characteristics of coating intended for use on concrete. Subject to compliance with requirements, use one of the following:

1. "Pro-Cote" - Protex
2. "Cast Off" - Sonneborn or
3. "Debond" - L&M Construction Chemicals

- B. Epoxy Adhesive: ASTM C881; two-component material suitable for use on dry or damp surfaces. Subject to compliance with requirements, use one of the following:

1. "Sikadur Hi-Mod LV" - Sika Chemical Corp.
2. "Patch and Bond Epoxy" - Burke
3. "Epoxite" - A.C. Horn
4. "Sure-Poxy" - Kaufman Products, Inc., or
5. "Euco Epoxy 463 or 615" - Euclid Chemical Co.

- C. Expansion Joints:

1. Interior Use or Exterior Use Where Sealants Are Specified: Bituminous saturated fiber conforming to ASTM D1751, one-half inch (1/2") thickness. Provide manufacturer's certification of compatibility with specified sealants where required.
2. Exterior Use Where Sealants Are Not Specified: Premolded asphalt and fiber conforming to ASTM D994, one-half inch (1/2") thickness.

2.6 CURING AND SEALING MATERIALS

- A. Curing and Sealing Compound - Interior Slabs to Remain Exposed and Exterior Concrete: Minimum thirty percent (30%) solids content, maximum moisture loss of three-hundredths grams (0.030) per square centimeter (three-hundred (300) square feet per gallon coverage): Subject to compliance with requirements, use one of the following:

1. Euclid Super Rex Seal or Super Pliocure
2. Master Builders Masterseal
3. Approved substitute in accordance with the General Conditions.

2.7 CONCRETE MIX

- A. Refer to the City and County of Denver Right of Way Services approved materials list of pre-approved concrete mixes at the following website:

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<http://denvergov.org/rightofwayservices/RightofWayServices/ConstructionInspection/RightofWayConstructionInspection/ApprovedMaterials/tabid/442460/Default.aspx>

- B. All Concrete mixes from the approved list or submitted for approval shall meet the following criteria.
1. Mix concrete in accordance with ASTM C94 and ACI 301 Chapter 3.
 2. Cement Content: Type II cement, minimum of five-hundred-sixty-four (564) pounds per cubic yard.
 3. Maximum water-cement ratio: 0.45.
 4. Slump: Four inches (4") maximum.
 5. Air Entrainment: Five percent (5%) to eight percent (8%).
 6. Aggregate Size: three-quarter inch (3/4") maximum.
 7. Deliver concrete and discharge all concrete transmitted in a truck mixer, agitator, or other transportation device not later than one and one-half (1-1/2) hours, or three-hundred (300) revolutions of the drum after the mixing water has been added, whichever is earliest.
 8. During cold weather (below forty-five degrees (45°) F), use heated water and aggregates if necessary to maintain concrete temperature between sixty degrees (60°) F. and ninety degrees (90°) F.
 9. Concrete for Footings, Walls, and Interior Slabs-on-Grade shall be Class B, as approved by the CDOT and the Denver Parks Representative.
Concrete for Exterior Flatwork, including Pavement, Curb and Gutter, and Drainage Pans shall be Class P, as approved by the CDOT and the Denver Parks Representative.
 10. Fly Ash – Per CDOT Standard Specifications for Road and Bridge Construction Section 701.02.

PART 3 - EXECUTION

3.1 FORMWORK ERECTION:

- A. Construct formwork to maintain tolerances in accordance with ACI 301.
- B. Verify lines, levels, and measurement before proceeding with formwork.
- C. Contractor shall notify CDOT and the Denver Parks Representative a minimum of forty-eight (48) hours in advance of placing concrete for review of formwork. Contractor shall make correction within twenty-four (24) hours of review.
- D. Minimize form joints. Symmetrically align form joints and make watertight to prevent leakage of mortar.
- E. Provide chamfer strips on all exposed corners.
- F. Do not apply form release agent other than specified materials where concrete surfaces receive special finishes or applied coatings which may be affected by agent. Soak

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contact surfaces of untreated forms with clean water. Keep surfaces wet prior to placing concrete.

- G. Coordinate work of other Sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, dowels, anchors, and other inserts and embedded materials.
- H. Do not remove forms, shoring and bracing until concrete has sufficient strength to support its own weight, and construction and design loads which may be imposed upon it.
- I. During cold weather, remove ice and snow from forms. **Do not** use deicing salts. Do not use water to clean out completed forms unless formwork and construction proceed within heated enclosure. Use compressed air to remove foreign matter.

3.2 REINFORCEMENT:

- A. Place, support, and secure reinforcement against displacement.
- B. Locate reinforcing splices per ACI 318 unless indicated otherwise on the Drawings.

3.3 PLACING CONCRETE

- A. Contractor's Review: Contractor shall inspect forms and reinforcing prior to concrete placement to assure accurate placement of embedded items and overall acceptability.
- B. Review: Contractor shall provide minimum of forty eight (48) hours notice to CDOT and the Denver Parks Representative to allow review of forms and reinforcement before concrete is placed and to observe placing of concrete.
- C. Place concrete in accordance with ACI 301 and ACI 304.
- D. Hot Weather Placement: ACI 301 and ACI 305R.
- E. Cold Weather Placement: ACI 301 and ACI 306R.
- F. Ensure reinforcement, inserts, embedded parts and formed joints are not disturbed during concrete placement.

3.4 FINISHING:

- A. Rough Form Finish: All texture imparted by form facing material, including tie holes and defective areas, shall be repaired and patched, and all fins and other projections exceeding one-quarter inch (1/4") shall be removed.
- B. Smooth Form Finish: Use form material to impart smooth, hard, uniform texture, and arrange form panels in orderly and symmetrical pattern with minimum seams. Repair and patch defective areas and completely remove and smooth all fins and other projections.

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3.5 SLAB FINISHING:

- A. Definitions: Refer to ACI 301 11.7 for definition of slab surface finishes.
- B. Provide trowel finish slab surface on all slabs scheduled to receive floor finish. Provide a medium broom finish for all exterior concrete unless otherwise noted.
- C. Trowel Finish: Consolidate surface by final hand or power-driven troweling operation, free of trowel marks, uniform in texture and appearance. Tolerance to be Class AX, one-eighth inch (1/8") in ten feet (10').
- D. Broom Finish: Immediately after float finishing and tooling control joints, roughen surface with fiber-bristle broom. Confirm direction or pattern of broom finish with the Denver Parks Representative prior to commencing slab placement.
- E. Conform to ACI 301 and ACI 117 tolerance requirements.

3.6 CONCRETE CURING, PROTECTION AND SURFACE TREATMENTS:

- A. General:
 - 1. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Maintain concrete with minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of concrete.
 - 2. Curing shall commence as soon as free water has disappeared from the concrete surface after placing and finishing. The curing period shall be seven days for all concrete unless test cylinders, made and kept adjacent to the structure and cured by the same methods, are tested with the average compressive strength equal to seventy percent (70%) of the specified twenty-eight (28) day strength.
 - 3. Curing shall be in accordance with ACI 301 procedures. Avoid rapid drying at the end of the curing period. During hot and cold weather, cure concrete in accordance with ACI 305R and ACI 306R.
- B. Curing Methods: Perform curing of concrete by moisture curing, by moisture-retaining cover curing, by curing compound, and by combinations thereof, as herein specified. Coordinate with and choose a curing method that is compatible with the requirements for subsequent material usage on the concrete surface.
 - 1. Provide moisture curing by one of the following methods:
 - a. Keep concrete surface continuously wet by covering with water.
 - b. Continuous water-fog spray.
 - c. Covering concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping it continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with four inch (4") lap over adjacent absorptive covers.

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2. Provide moisture retaining cover curing as follows: Cover concrete surfaces with a moisture-retaining cover for curing concrete, placed in widest practical width with sides and ends lapped at least three inch (3") and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 3. Provide curing and sealing compound to interior slabs left exposed, and to exterior slabs, walks and curbs as follows:
 - a. Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within thirty (30) minutes). Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions. Recoat areas subjected to rainfall within three hours after initial application.
 - b. Maintain continuity of coating and repair damage during period.
 - c. Do not use membrane curing compounds on surfaces which are to be covered with materials applied directly to concrete: liquid floor hardener, waterproofing, dampproofing, painting, and other coating and finish materials.
- C. Curing Formed Surfaces: Where wooden forms are used, cure formed concrete surfaces by moist curing with forms in place for full curing period or until forms are removed. When forms are removed, continue curing by methods specified above for specified curing time.
- D. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by application of appropriate curing method.
- 3.7 FORM REMOVAL:
- A. Removal of Forms: Supplement and Modify ACI 301 as follows:
1. ACI 301 4.5.4: Formwork not supporting weight of concrete such as sides of grade beams, walls, and similar parts of the work, may be removed after cumulatively curing at not less than fifty degrees (50°) F for twenty-four (24) hours after placing the concrete provided:
 - a. The concrete is sufficiently cured to be undamaged by form removal.
 - b. Required shores and supports are so arranged that they will not be loosened or disturbed during form removal.
 - c. Supplemental curing and protection is provided for exposed concrete surfaces.
- 3.8 TOLERANCES:
- A. Formed Surfaces and Building Lines: Conform to ACI 301 4.3.

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- B. Slab Finishing Tolerances: See Concrete Walks, Curbs and Miscellaneous Flatwork - Section 02520.
- C. Embedded Items: Unless noted otherwise on drawings, tolerances shall be as follows:
 - 1. Anchor Bolts
 - a. Adjacent anchor bolts in a group receiving a single fabricated setting piece: Plus or minus one-eighth inch (+/- 1/8").
 - b. Location and alignment of anchor bolt groups from designated location and alignment: Plus or minus one-eighth inch (+/- 1/8").

3.9 QUALITY CONTROL TESTING DURING CONSTRUCTION

- A. All testing shall be completed by the contractor at their expense unless otherwise specified by the contract.
- B. Sampling and testing for quality control during placement of concrete shall include the following.
 - 1. Slump: ASTM C143; at least one test at point of discharge for each day's pour of each type of concrete; additional tests at the Quality Control Inspector's discretion when concrete consistency seems to have changed. Test when taking samples for compression tests.
 - 2. Air Content: ASTM C173, volumetric method for normal weight concrete; ASTM C231 pressure method for normal weight concrete; at least one for each day's pour of each type of air-entrained concrete. Test when taking samples for compression tests.
 - 3. Concrete Temperature: Test hourly when air temperature is forty degrees (40°) F and below, and when eighty degrees (80°) F and above; and each time a set of compression test specimens is made.
 - 4. Compression Test Specimen: ASTM C31; one set of three (3) standard cylinders for each compression strength test unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required. If additional cylinders are required for any reason, they shall be done at the contractor's expense.
- C. Compressive Strength Tests: ASTM C39; one set for each day's pour exceeding five (5) cubic yards. Two specimens tested at seven (7) days, two specimens tested at twenty-eight (28) days, and one specimen retained in reserve for later testing if required.

END OF SECTION 03300