**FIRST AMENDMENT TO REVOCABLE AND NONEXCLUSIVE LICENSE (CONFLUENCE EAST IMPROVEMENTS)**

**THIS FIRST AMENDMENT** is made and entered into by and between the CITY AND COUNTY OF DENVER, a home rule City and Colorado municipal corporation, whose address is 1437 Bannock, Denver, Colorado 80202 ("City"), and CONFLUENCE APARTMENTS, LLC, a Delaware limited liability company d/b/a Confluence Park Apartments, LLC, whose address is c/o PM Realty Group L.P., 1000 Main Street, Suite 2400, Houston, TX 77002-6359 ("Owner" or "Licensee" and together with the City, the Parties" or separately, a "Party").

## RECITALS

WHEREAS, the City granted to Licensee a Revocable License ("License"), dated July 15, 2016 ("Effective Date"), to construct certain off-site improvements within an open space parcel of land in Denver located generally on the south side of 15th Street along the east bank of the S. Platte River known as "Confluence East", which improvements are known as the "Confluence East Improvements"; and

WHEREAS, the City and the Licensee entered into a Development Agreement, dated March 2, 2016, found in City Clerk File Number 2016-0231, to define the Confluence East Improvements and to allow the Confluence East Improvements to be constructed; and

WHEREAS, the City and the Licensee desire the Licensee, at no cost to the City, to cause to be constructed and complete the Confluence East Improvements to be located within Confluence East and in conformance with the Site Development Plan and the Development Agreement; and

WHEREAS, a number of conflicts related to interpreting the term of the License have arisen, necessitating clarification thereof; and

WHEREAS, the Parties wish to clarify the term of the License with respect to warranty/guarantee periods of the Confluence East Improvements as required by the Denver Parks and Recreation: Confluence Park East Improvements – Technical Specifications ("Technical Specifications"), attached hereto as Exhibit F[1], and incorporated herein by reference, and including the General Contract Conditions; and

WHEREAS, the City and the Licensee desire to amend the License so that the Licensee, and/or Licensees contractor has access to, across and over Confluence East and to complete the construction and perform required maintenance of the Confluence East Improvements;

[1] The Technical Specifications include the City's General Contract Conditions which can be found at https://www.denvergov.org/content/denvergov/en/contract-administration/contractor-resources.html.

NOW, THEREFORE, the City and Licensee hereby amend the terms and conditions set forth for Licensee's access as follows:

1. Exhibit C is hereby stricken and replaced with Amended Exhibit C, attached to this First Amendment.

2. Paragraph 1 is amended to read as follows:

"1. LICENSED ACTIVITIES. The Licensee is hereby granted nonexclusive access to Confluence East, as described in Exhibit B, in order to construct, install, use, complete, and maintain the Confluence East Improvements ("Licensed Activities"). The Licensed Activities authorized hereunder with respect to Confluence East are described in Exhibit C and incorporated herein.

Licensee shall construct the Confluence East Improvements according to the specifications and timeframes detailed on Exhibit D attached hereto and incorporated herein and as set forth in the SDP; and in accordance with the construction plans and specifications approved by City's Manager of Parks and Recreation. Licensee shall comply with the requirements of all other utilities, including but not limited to Denver Water and Xcel Energy.

The Parties agree that this License is not a lease of Confluence East. The access granted herein is nonexclusive and is revocable by the City at the sole discretion and with the mutual agreement of the City's Managers of Public Works, Environmental Health and Parks and Recreation ("Managers"), as provided in paragraph 5. The Licensee agrees that all Licensed Activities conducted by Licensee shall comply with the City's Departments of Public Works technical specifications and standards, and the Technical Specifications; and shall be performed in accordance with the terms and conditions set forth herein, and the Amended Exhibits C and D. The Licensed Activities shall not unreasonably interfere with the public's use and enjoyment of Confluence East outside the area of said Licensed Activities."

3. Exhibit D is hereby replaced with Amended Exhibit D, attached to this First Amendment.

4. Paragraph 10 is amended to read as follows:

"10. During the term of this License, the Licensee shall furnish bonds to the City assuring 100% performance and labor and material payment of the Licensee's construction activity in an amount equal to 100% of the construction contract price for the Licensed Activities. Licensee shall provide a schedule of values itemizing costs of the Licensed Activities to City within seven (7) days of execution construction contract thereof. Such bonds shall guarantee prompt and faithful performance of Licensee's construction contract and prompt payment by Licensee's contractors to all persons supplying labor, materials, team hire, sustenance, provisions, provender, supplies, rental machinery, tools, and equipment used

directly or indirectly by such contractors, subcontractors, and suppliers in the prosecution of the work provided for in the Licensee's construction contract, and shall protect the City from any liability, losses, or damages related thereto. The payment bond and the performance bond shall name the Licensee as the obligee with the City named on a dual obligee rider. The Licensee shall furnish a copy of such bonds to the Managers. All bonds shall be issued by a surety company which is licensed to transact business in the State of Colorado and which is satisfactory to and approved by the City. If a bond is executed by an attorney-in-fact of the surety, a power of attorney must be attached to the bond."

5. Paragraph 11 is amended to read as follows:

"11. TERM. This License shall commence on the Effective Date. Substantial Completion, as that term is used in the Technical Specifications, shall be granted by April 30, 2017. Should work be delayed for reasons beyond the control of Licensee, a thirty (30) day extension to comply with Substantial Completion may be authorized in writing, by the City's Manager of Parks and Recreation. Upon issuance of Substantial Completion, Licensee shall comply with the warranty/guarantee provisions of the Technical Specifications. This license shall terminate upon the expiration of the warranty/guarantee periods as required by the Technical Specifications, but in no event later than May 31, 2019 ("Expiration Date")."

6. Paragraph 24 is amended to read as follows:

"24. EFFECTIVE DATE. The Effective Date shall be the date of the City signature page."

*[The remainder of this page is intentionally blank.]*

**Contract Control Number:**

IN WITNESS WHEREOF, the parties have set their hands and affixed their seals at Denver, Colorado as of

SEAL

**CITY AND COUNTY OF DENVER**

ATTEST:

By_____

_____

APPROVED AS TO FORM:

REGISTERED AND COUNTERSIGNED:

By_____

By_____

By_____

**LICENSEE:**

**Confluence Apartments, LLC,**
a Delaware limited liability company

By: Denver Confluence, LLC,
a Delaware limited liability company
its Managing Member

By: PMRG Confluence, LLC,
a Texas limited liability company
its Managing Member

By: PM Realty Group, L.P.
a Delaware Membership
its Manager

By: Provident Investor GP, LLC,
a Texas limited liability company
its sole General Partner

By: _____ BW 5
Name: Wm. Roger Gregory
Its: Assistant Manager

# AMENDED EXHIBIT C

Confluence East Improvements

(Attached)

# CONFLUENCE PARK

## Denver, Colorado
## Issue for Construction

DECEMBER 21, 2016

PERMIT COMMENTS SET 10/12/2016
CONFLUENCE PARK EAST- SO PROJECT # 14047

## PROJECT TEAM


LANDSCAPE ARCHITECT
STUDIO OUTSIDE
CONTACT: BRIAN HALSELL
824 EXPOSITION AVE., SUITE 5
DALLAS, TX 75226
TEL: (214) 954-7160
FAX: (214) 954-7162

IRRIGATION
HINES IRRIGATION
CONTACT: NATE HINES
ADDRESS: 323 West Drake Road, Suite 204
Fort Collins, Colorado 80525
TEL: 970.282.1800

CIVIL
BOWMAN CONSULTING
CONTACT: CHUCK WEISS
ADDRESS: 603 Park Point Dr., Suite 100
Golden, CO 80401
TEL: 303.674.7355

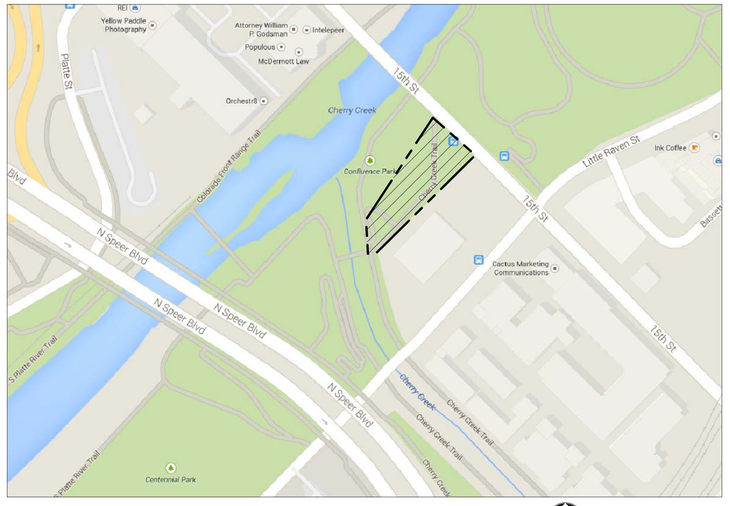
ELECTRICAL
BLUM CONSULTING ENGINEERS
CONTACT: CHRISTOPHER MICHAEL
ADDRESS: 8144 Walnut Hill Lane, Suite 200
Dallas, TX 75231
TEL: 214.373.8222

STRUCTURAL
BROCKETTE-DAVIS-DRAKE
CONTACT: JJ SNEED
ADDRESS: 4144 N. CENTRAL EXPY., STE 1100
DALLAS, TX 75204
TEL: 214.824.3647


## SHEET INDEX



## LOCATION MAP




N.T.S.

NORTH

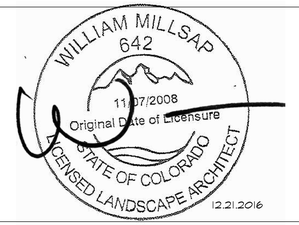
City and County of Denver
**Parks and Recreation Department**
Checked for General Compliance with applicable Denver Criteria, Rules, Regulations and Standards.

**APPROVED** (if validly signed)

Approved by: Executive Director of Parks and Recreation Date

(Note: Signature in Print)

APPROVED AS TO FORM.
**DRAWINGS AND DESIGN ADEQUACY ARE ACCEPTED BASED UPON THE PROJECT LANDSCAPE ARCHITECT'S ATTACHED SEAL OF REGISTRATION.**

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ASI 26-R5
12/22/2016

# GENERAL NOTES:

1. WRITTEN DIMENSIONS PREVAIL OVER SCALED DIMENSIONS. NOTIFY LANDSCAPE ARCHITECT OF ANY DISCREPANCIES.
2. THE CONTRACTOR BEARS ALL RESPONSIBILITY FOR VERIFYING ALL UNDERGROUND UTILITIES, PIPES, STRUCTURES, AND LINE RUNS IN THE FIELD PRIOR TO CONSTRUCTION. ANY DAMAGE TO UTILITIES THAT ARE TO REMAIN SHALL BE REPAIRED IMMEDIATELY AT NO EXPENSE TO THE OWNER. STUDIO OUTSIDE ASSUMES NO RESPONSIBILITY FOR ANY NOT SHOWN ON PLANS.
3. ALL PROPOSED AND FINISHED GRADES ARE BASED ON INFORMATION PROVIDED BY THE OWNER'S SURVEY AND/OR CIVIL ENGINEER. ANY DISCREPANCIES IN ACTUAL FIELD MEASUREMENTS ARE TO BE REPORTED TO THE LANDSCAPE ARCHITECT IMMEDIATELY.
4. PRIOR TO COMMENCEMENT OF HARDSCAPE CONSTRUCTION, ALL PIERS, FOOTINGS, AND WALLS ARE TO BE SURVEYED, LAID OUT, AND STAKED IN FIELD FOR REVIEW BY LANDSCAPE ARCHITECT. CONTRACTOR SHALL ASSUME RESPONSIBILITY FOR ANY DEMOLITION, ADJUSTMENTS, OR RECONSTRUCTION RESULTING FROM UNAUTHORIZED CONSTRUCTION ACTIVITIES.
5. CONTRACTOR IS RESPONSIBLE FOR ALL QUANTITIES PER DRAWINGS AND SPECIFICATIONS. ANY QUANTITIES PROVIDED BY STUDIO OUTSIDE ARE PROVIDED FOR CONVENIENCE ONLY CONTRACTORS ARE TO BID THEIR OWN VERIFIED QUANTITIES. NOTIFY LANDSCAPE ARCHITECT AT ANY DISCREPANCIES.
6. EASEMENTS SETBACKS, BUILDING, CURB AND GUTTER, UNDERGROUND UTILITIES HAVE BEEN SUPPLIED TO STUDIO OUTSIDE BY THE PROJECT CIVIL ENGINEER. REFER TO CIVIL ENGINEERS DRAWINGS FOR ADDITIONAL INFORMATION.

## ENVIRONMENTAL

1) CONTRACTOR SHALL TAKE REASONABLE MEASURES TO PREVENT PARTICULATE MATTER FROM BECOMING AIRBORNE AND TO PREVENT THE VISIBLE DISCHARGE OF FUGITIVE PARTICULATE EMISSIONS BEYOND THE PROPERTY ON WHICH THE EMISSIONS ORIGINATE. THE MEASURES TAKEN MUST BE EFFECTIVE IN THE CONTROL OF FUGITIVE PARTICULATE EMISSIONS AT ALL TIMES ON THE SITE, INCLUDING PERIODS OF INACTIVITY SUCH AS EVENINGS, WEEKENDS, AND HOLIDAYS AS WELL AS ANY OTHER PERIOD OF INACTIVITY.
2) ANY FILL MATERIAL OR SOILS TO BE MOVED TO AND PLACED ON CCD-OWNED PROPERTY OR PLACED ON REAL PROPERTY TO BE TRANSFERRED TO THE CCD MUST BE FREE OF KNOWN CONTAMINATION (OBSERVED AND DOCUMENTED OR PREVIOUSLY DOCUMENTED) AND BE ACCEPTABLE FOR UNRESTRICTED RESIDENTIAL USE. CONTACT DAVE ERICKSON, DENVER ENVIRONMENTAL HEALTH (720-865-5433) FOR CLARIFICATION, IF NEEDED, REGARDING THIS CCD REQUIREMENT.
3) NOISE CONTROL. EXEMPTED HOURS FOR CONSTRUCTION IN THE CITY AND COUNTY OF DENVER ARE FROM 7 A.M. TO 9 P.M. MONDAY THROUGH FRIDAY AND 8 A.M. TO 5 P.M. ON SATURDAYS AND SUNDAYS PER SECTIONS 36-6.(B)(7) AND 36-7.(5)A., B. AND C. OF DENVER¿S NOISE ORDINANCE, CHAPTER 36, NOISE CONTROL, DENVER REVISED MUNICIPAL CODE (DRMC). IF THERE IS AN ANTICIPATED NEED TO WORK OUTSIDE OF THE EXEMPTED HOURS FOR CONSTRUCTION: 1) THE CONTRACTOR WILL NEED TO MAKE A REQUEST FOR A NIGHTTIME NOISE VARIANCE AS ALLOWED FOR IN SECTION 36-7.(5)C. OF THE DRMC AND 2) THE VARIANCE PROCESS NEEDS TO BE STARTED A MINIMUM OF THREE MONTHS PRIOR TO THE DESIRED START DATE OF ANY WORK NEEDING TO OCCUR OUTSIDE OF EXEMPTED ANY NOISE VARIANCE QUESTIONS SHOULD BE DIRECTED TO PAUL RIEDESEL, DEPARTMENT OF ENVIRONMENTAL HEALTH, DENVER COMMUNITY NOISE PROGRAM, (PHONE 720-865-5410; FAX (720-865-5532) A MINIMUM OF THREE MONTHS PRIOR TO THE START OF THE PROJECT.

## LIGHTING:

IMPORTANT! ALL LIGHTING SYMBOLS, CIRCUITS, LOCATIONS, AND CALL OUTS SHOWN ARE SHOWN FOR REFERENCE ONLY.

REFER TO LIGHTING AND ELECTRICAL PLANS FOR LIGHT SPECIFICATIONS AND SELECTIONS. ALL LIGHTS AND FINAL LOCATIONS TO BE APPROVED BY LIGHTING DESIGNER AND LANDSCAPE ARCHITECT PRIOR TO INSTALLATION.

# MATERIAL LEGEND

## CONCRETE

C-1 STANDARD CONCRETE
STANDARD GRAY
MEDIUM BROOM FINISH
PATTERN: SAW CUT JOINTS - REFER TO PLANS LAYOUT

C-2 CONCRETE W/ INTEGRAL COLOR
MANUFACTURER: DAVIS COLORS
COLOR: OUTBACK OR DUNE
FINISH: MEDIUM BROOM
PATTERN: REFER TO PLANS
(PROVIDE MOCKUP)

C-3 CONCRETE W/ INTEGRAL COLOR
MANUFACTURER: DAVIS COLORS
COLOR: OUTBACK OR DUNE
FINISH: SANDBLAST
PATTERN: REFER TO PLANS
(PROVIDE MOCKUP)

## STONE & GRAVEL

S-1 STONE SLAB, VENEER AND CAP
TYPE: BUFF SANDSTONE
PROVIDER: TBD
TEL: TBD
SIZE: REFER TO PLANS & DETAILS

S-2 CRUSHER FINES
COLOR: TBD
SIZE: 6" COMPACTED TYP.
SIZF: PER DPR SPECIFICATIONS

S-3 STONE VENEER & CAP
TYPE: COLORADO RED SANDSTONE
TO MATCH EXISTING STONE IN THE PARK
PROVIDER: TBD
TEL: TBD
SIZE: REFER TO DETAILS

# SYMBOLS LEGEND:

## GENERAL

CENTER LINE
LIMIT OF WORK
MATCHLINE
EXPANSION JOINT
CONTROL JOINT
P.O.B. POINT OF BEGINING
X / L3.00 ENLARGEMENT REFERENCE
DETAIL NUMBER C / L4.01 SHEET NUMBER DETAIL REFERENCE
X / L3.00 MATERIALCALLOUT ELEVATION REFERENCE
X / L3.00 SECTION REFERENCE
C-1 MATERIAL REFERENCE

## ABBREVIATIONS

| | |
|---|---|
| + 735.46 | PROPOSED LANDSCAPE SPOT GRADE |
| ⊕ 735.46 | PROPOSED CIVIL SPOT GRADE |
| TW | TOP OF WALL |
| BW | BOTTOM OF WALL |
| TF | TOP OF FOOTING |
| FL | FLOW LINE/ INVERT ELEVATION |
| EJ | EXPANSION JOINT |
| CJ | CONTROL/ CONSTRUCTION JOINT |
| CL | CENTER LINE |
| POB | POINT OF BEGINING |
| COL | TOP OF COLUMN |
| PA | PLANTING AREA |

# SHOP DRAWING, SAMPLES, MOCK-UPS:

| | PHOTOS | SHOP DRAWINGS | SAMPLES | MOCK UP |
|---|---|---|---|---|
| ALL PLANTS | X | | | |
| COLORED CONCRETE | | | | X |
| CRUSHED GRANITE | | | X | |
| STONE SLABS, CAPS, AND VENEERS | | | X | X |

CONTRACTOR SHALL PREPARE/PROVIDE SHOP DRAWINGS FOR REVIEW BY LANDSCAPE ARCHITECT FOR THE FOLLOWING ITEMS:

MOCK UPS MAY BE "IN PLACE" AND USED AS PART OF THE FINAL CONSTRUCTION IF APPROVED. REFER TO SPECIFICATIONS FOR FOR MOCK UP DESCRIPTIONS.


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824 Exposition Avenue, Ste. 5
Dallas, Texas 75226
o214.954.7160
f214.954.7162


Project Name

CONFLUENCE PARK EAST

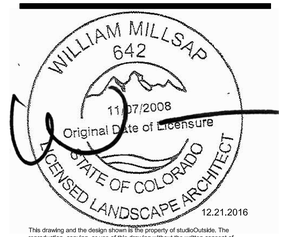
Issue Title

PERMIT

Issue / Addenda / Revisions

| | Date | Description |
|---|---|---|
| 1 | 7.26.16 | Permit Comments |
| 2 | 8.08.16 | Permit Comments |
| 3 | 9.01.16 | Permit Comments |
| 4 | 9.13.16 | Permit Comments |
| 5 | 9.20.16 | Permit Comments |
| 6 | 10.14.16 | Permit Comments |
| 7 | 11.28.16 | Permit Comments |
| 8 | 12.21.16 | Permit Comments |

Seal





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Drawing Title

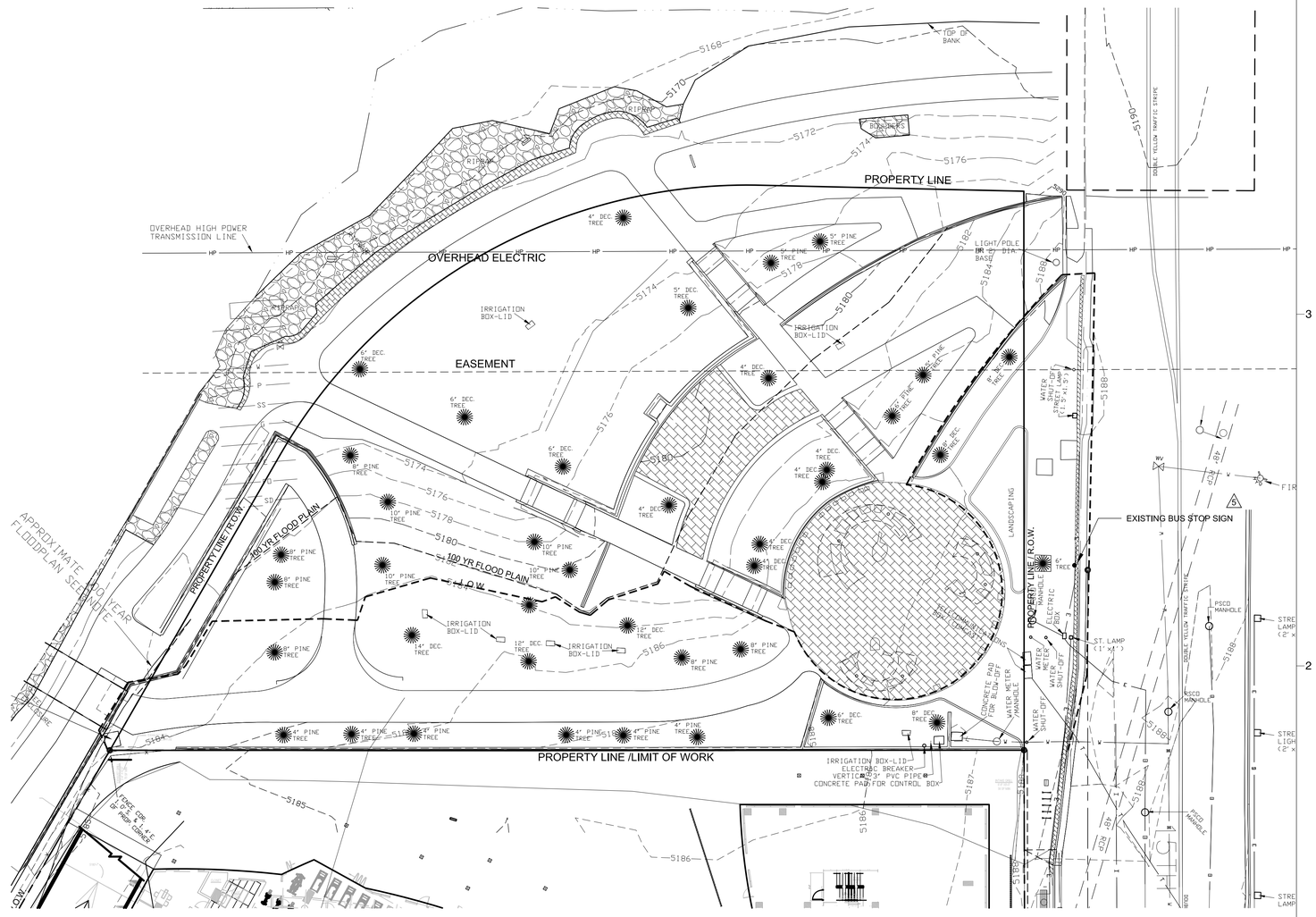
NOTES & LEGEND

Issue Date: 12.21.2016
Project No: 14047
Reviewed By: MF
Drawn By: BH

Sheet No.

L0.01

ASI 26-R5
12/22/2016

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Project Name

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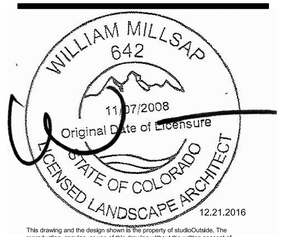
Seal

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Drawing Title

1 EXISTING CONDITIONS

| | |
|---|---|
| Issue Date: | 12.21.2016 |
| Project No: | 14047 |
| Reviewed By: | MF |
| Drawn By: | BH |

Sheet No.

# L1.00

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Project Name

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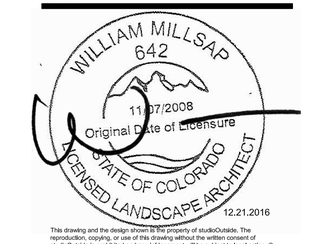
| 6 | 10.14.16 | Permit Comments |
| 7 | 11.28.16 | Permit Comments |
| 8 | 12.21.16 | Permit Comments |

Seal

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Drawing Title

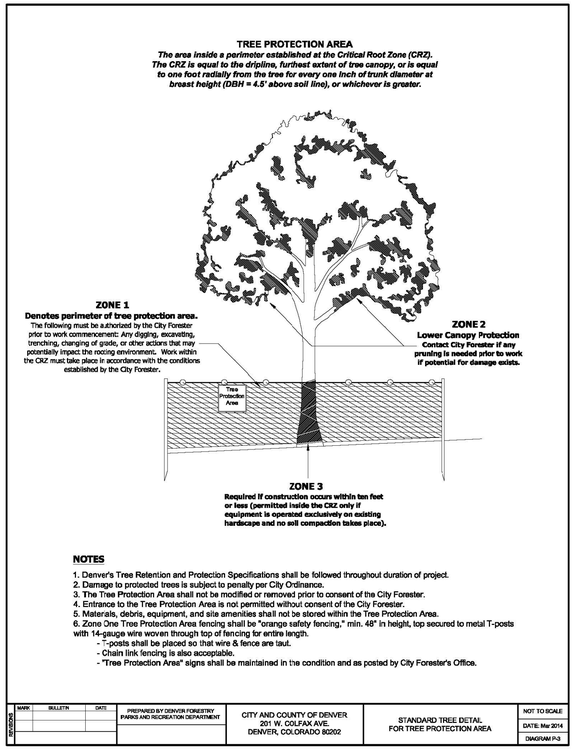
DEMOLITION PLAN

| | |
|---|---|
| Issue Date: | 12.21.2016 |
| Project No: | 14047 |
| Reviewed By: | MF |
| Drawn By: | BH |

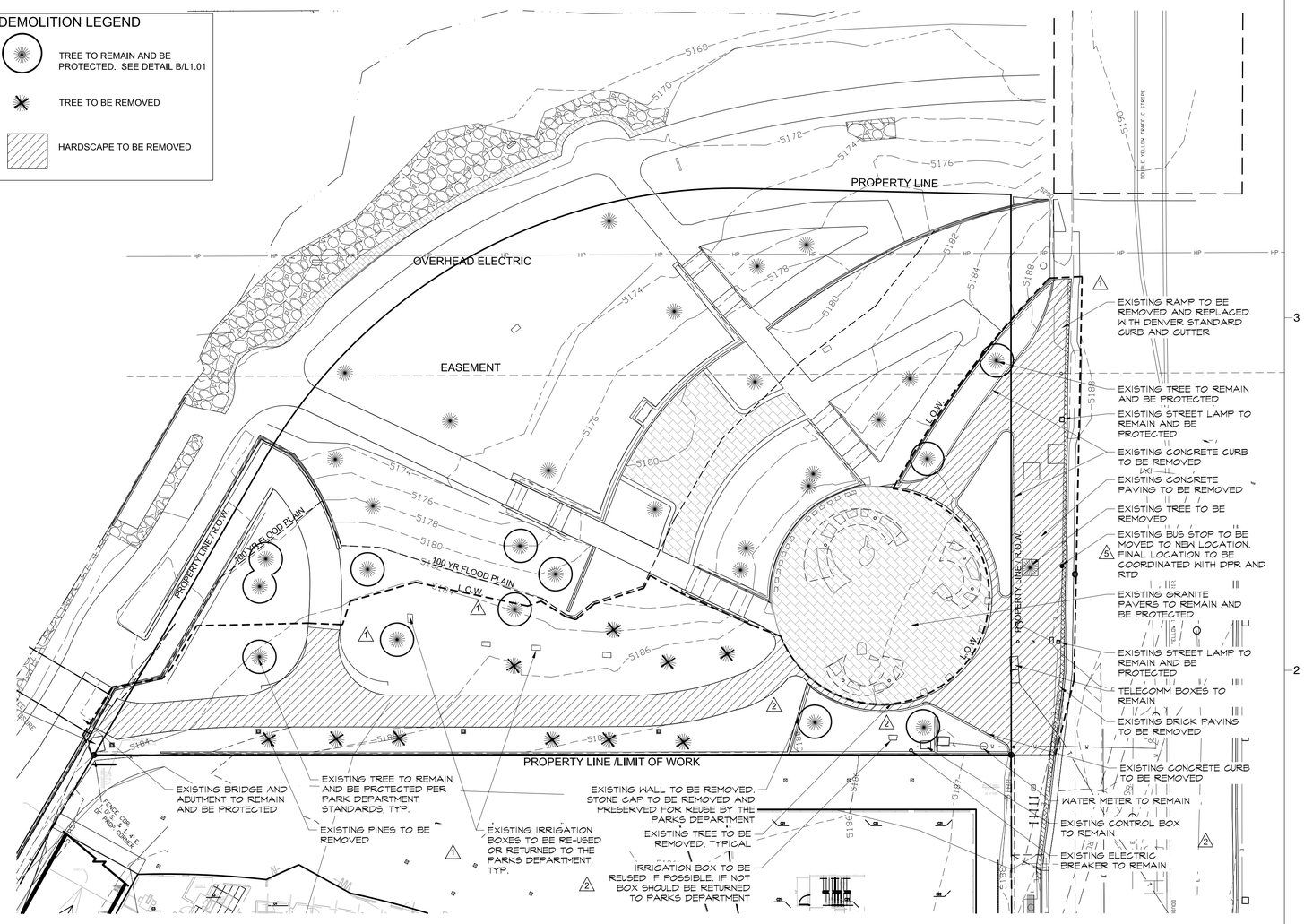
Sheet No.

L1.01

ASI 26-R5
12/22/2016



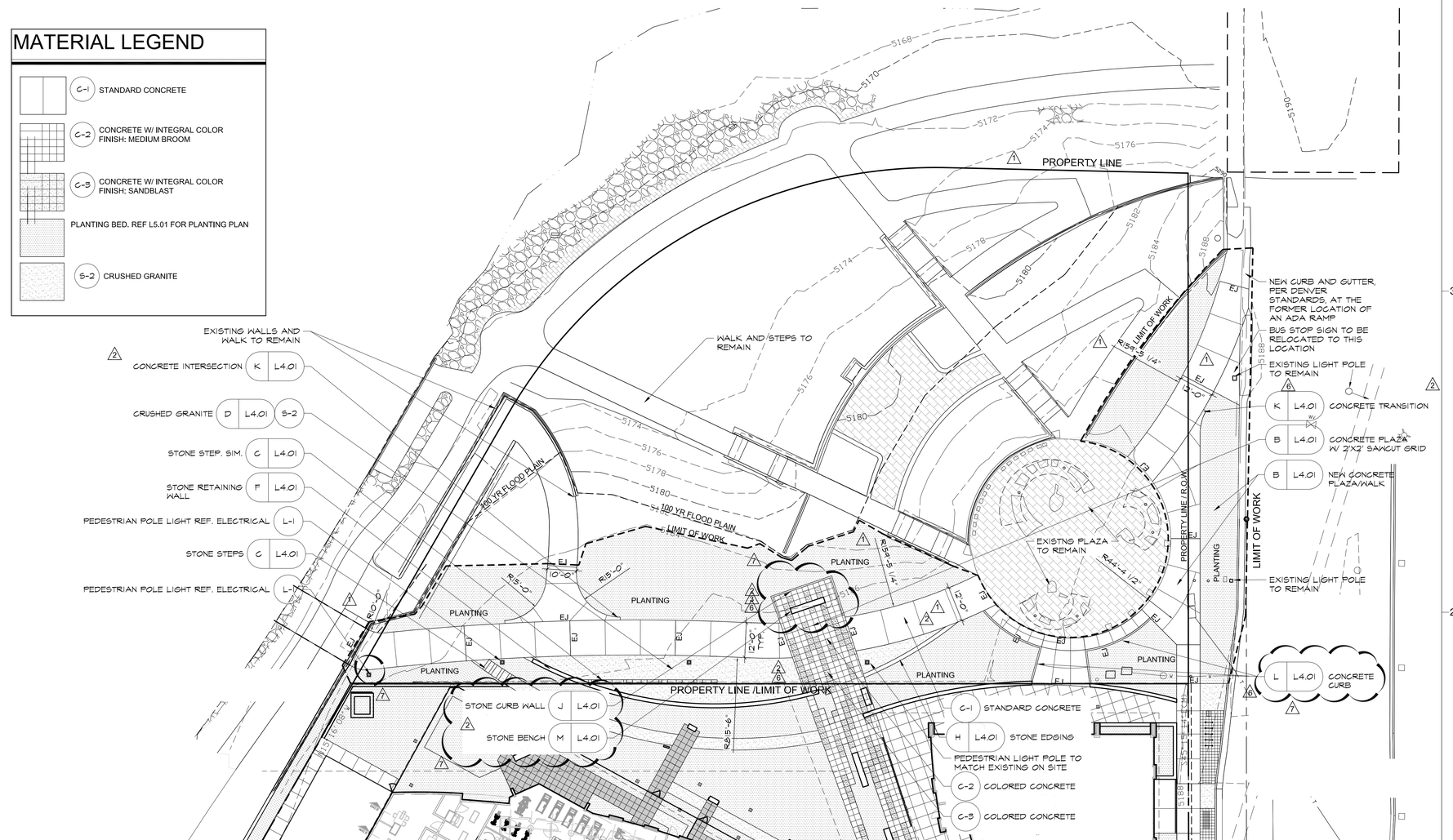

Tree Protection Detail | B | Scale: 1" = 20'-0" | L1.01




Demolition | A | Scale: 1" = 20'-0" | L1.01

## MATERIAL LEGEND

- C-1 STANDARD CONCRETE
- C-2 CONCRETE W/ INTEGRAL COLOR FINISH: MEDIUM BROOM
- C-3 CONCRETE W/ INTEGRAL COLOR FINISH: SANDBLAST
- PLANTING BED. REF L5.01 FOR PLANTING PLAN
- S-2 CRUSHED GRANITE




Hardscape Plan | A

Scale: 1" = 20'-0" | L2.01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Project Name

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Issue Title

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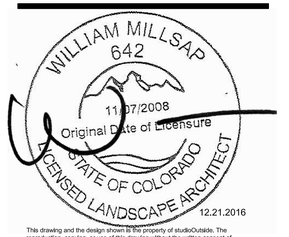
Seal





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Drawing Title

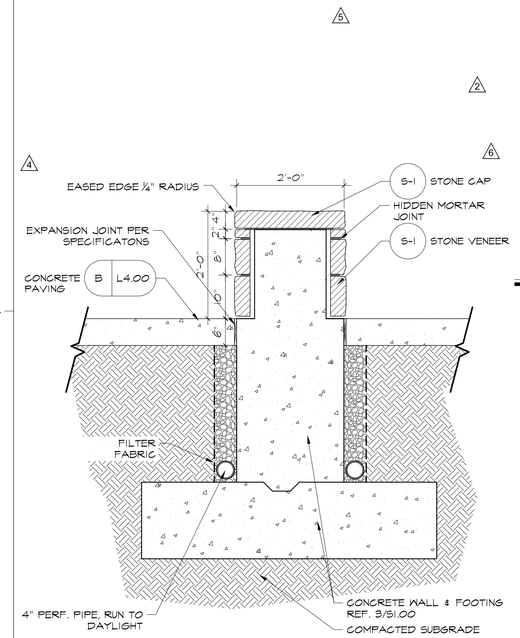
HARDSCAPE PLAN

| | |
|---|---|
| Issue Date: | 12.21.2016 |
| Project No: | 14047 |
| Reviewed By: | MF |
| Drawn By: | BH |

Sheet No.

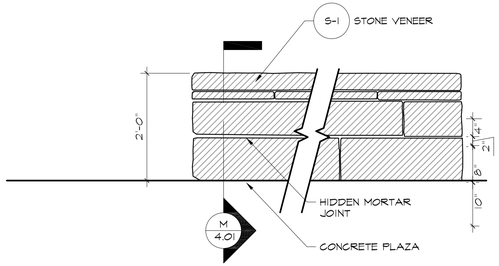
L2.01

ASI 26-R5
12/22/2016



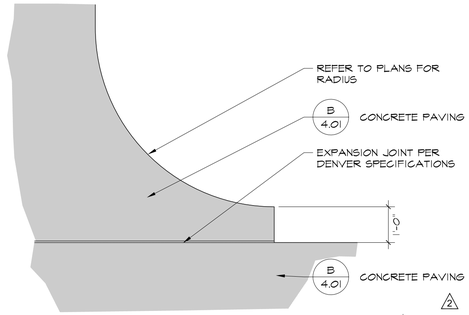

Stone Bench Section | M

3/4" = 1'-0" | L4.01



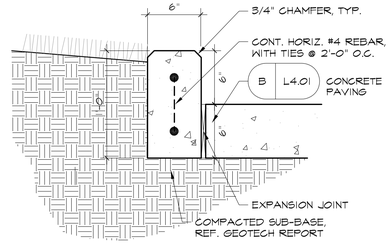

Stone Bench Elevation | I

3/4" = 1'-0" | L4.01



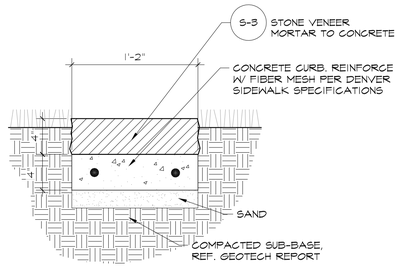

Sidewalk Intersection | K

Scale:1 1/2" = 1'-0" | L4.01



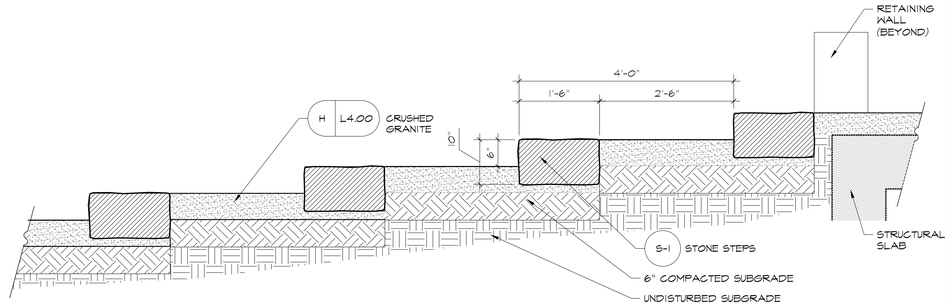

Concrete Curb | L

Scale:1 1/2" = 1'-0" | L4.01



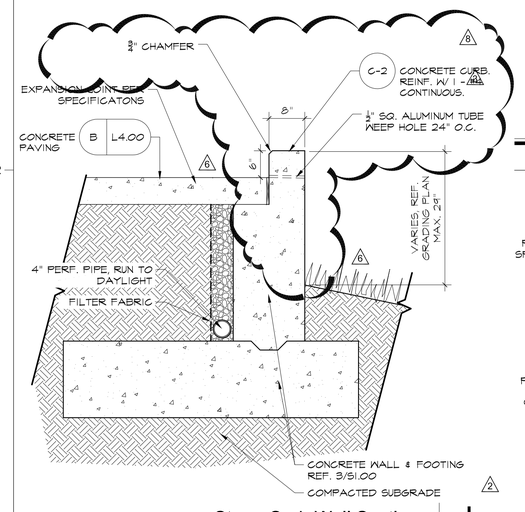

Stone Edging | H

Scale:1 1/2" = 1'-0" | L4.01




Stone Trail Steps | C

Scale: 3/4" = 1'-0" | L4.01

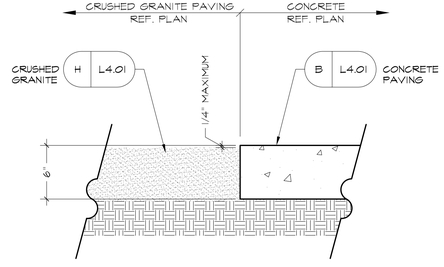



Stone Curb Wall Section | J

3/4" = 1'-0" | L4.01

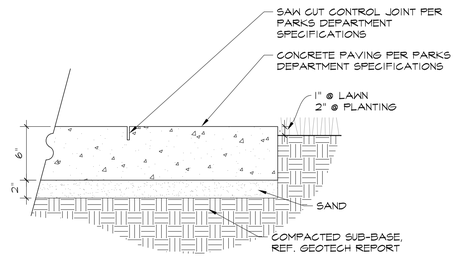
Common Park Stone Wall Example | G

NTS | L4.01



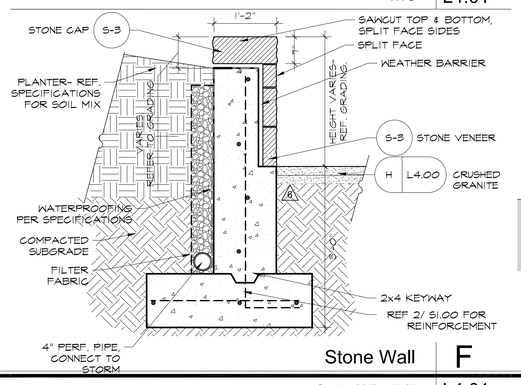

Crushed Granite Paving at Concrete | E

Scale: 1 1/2"=1'-0" | L4.01



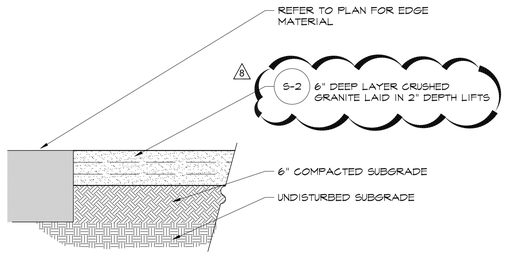

Typ. Concrete Sidewalk Paving | B

Scale:1 1/2" = 1'-0" | L4.01



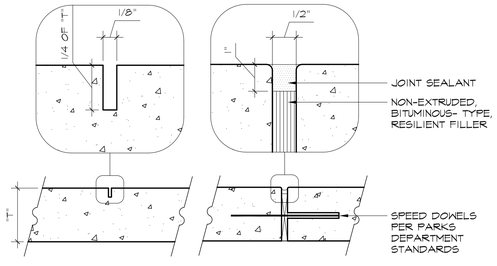

Stone Wall | F

Scale: 3/4" = 1'-0" | L4.01




Crushed Granite Detail | D

Scale: 1" = 1'-0" | L4.01




Expansion Joint | A

N.T.S. | L4.01

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f214.954.7162

Project Name

# CONFLUENCE PARK EAST

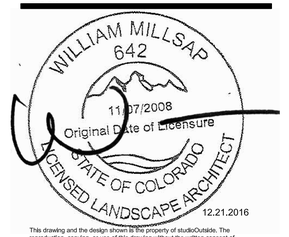
Issue Title

PERMIT

Issue / Addenda / Revisions

| | Date | Description |
|---|---|---|
| 1 | 7.26.16 | Permit Comments |
| 2 | 8.08.16 | Permit Comments |
| 3 | 9.01.16 | Permit Comments |
| 4 | 9.13.16 | Permit Comments |
| 5 | 9.20.16 | Permit Comments |
| 6 | 10.14.16 | Permit Comments |
| 7 | 11.28.16 | Permit Comments |
| 8 | 12.21.16 | Permit Comments |

Seal

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Drawing Title

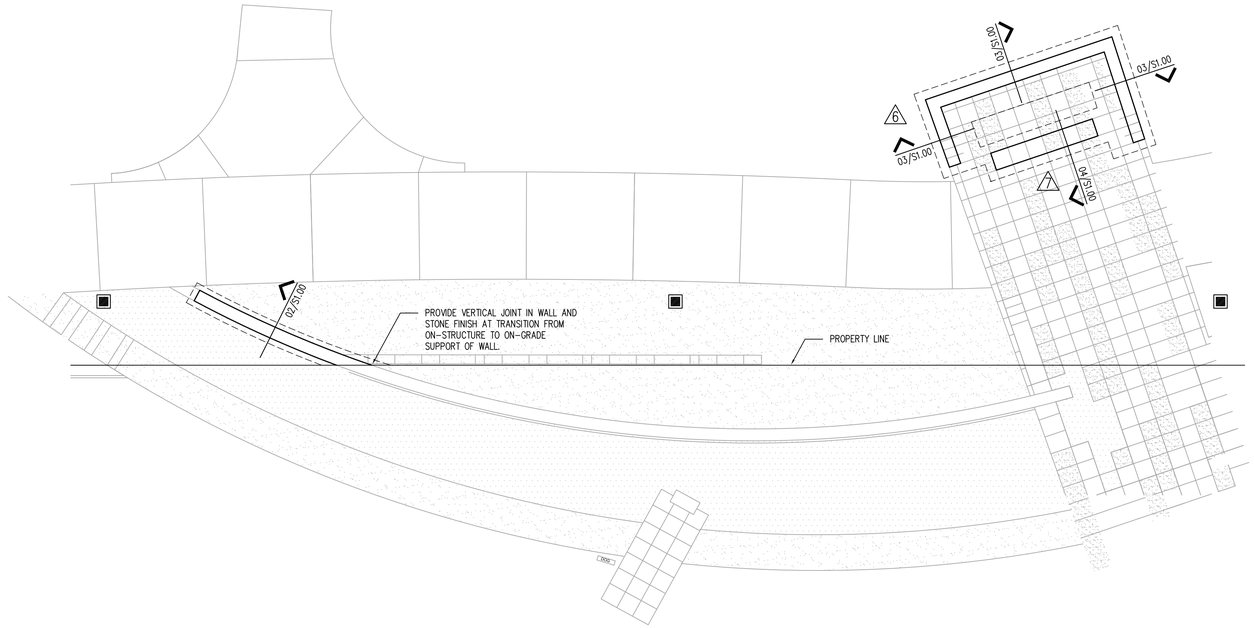
HARDSCAPE DETAILS

| | |
|---|---|
| Issue Date: | 12.21.2016 |
| Project No: | 14047 |
| Reviewed By: | MF |
| Drawn By: | BH |

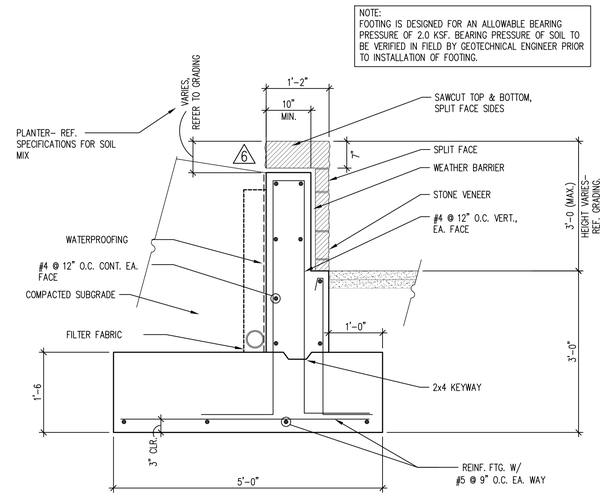
Sheet No.

L4.01

ASI 26-R5
12/22/2016




01 PARTIAL FOUNDATION PLAN
SCALE: 1/8" = 1'-0 (TYP. U.N.O.)




02 SECTION
SCALE: 1/2" = 1'-0

## GENERAL NOTES

1. THE STRUCTURAL DESIGN IS IN ACCORDANCE WITH THE PROVISIONS OF THE INTERNATIONAL BUILDING CODE, 2012 EDITION, WITH CITY OF DENVER AMENDMENTS.
2. THE USE OF EPOXY & ACRYLIC ADHESIVES IS NOT PERMITTED FOR USE AT MISPLACED AND/OR OMITTED EMBEDS, DOWELS, OR OTHER ITEMS INTENDED TO BE ANCHORED IN CONCRETE.
3. ELEVATION 100'-0 = DATUM ELEVATION 5188.00'. VERIFY DATUM ELEVATION WITH CIVIL AND ARCHITECTURAL DRAWINGS PRIOR TO CONSTRUCTION. REFER TO CIVIL DRAWINGS FOR LOCATIONS OF BUILDING ON SITE.

## CONCRETE NOTES

1. ALL CONCRETE SHALL BE LABORATORY DESIGNED AND CONTROLLED AND SHALL MEET THE REQUIREMENTS OF "BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE" (ACI 318-11). CONCRETE SHALL ALSO CONFORM TO THE FOLLOWING REQUIREMENTS:

| COMPRESSIVE STRENGTH @ 28 DAYS U.N.O. | TYPE AGGREGATE | AIR ENTRAINMENT | USAGE | WATER/CEMENT RATIO (MAX.) | MODULUS OF ELASTICITY (MIN.) |
|---|---|---|---|---|---|
| 4000 PSI | CRUSHED STONE | YES (a) | RETAINING WALLS, STRIP FOOTINGS | 0.44 | $3.8 \times 10^6$ PSI |

(a) PROVIDE 5% (±1%) AIR ENTRAINMENT ADMIXTURE WHERE NOTED ABOVE.

2. ALL CONCRETE WORK TO BE IN ACCORDANCE WITH ACI 318 AND ACI 301.
3. CONCRETE PROTECTION FOR REINFORCEMENT SHALL BE AS NOTED BELOW. REFERENCE ACI 318 SECTION 7.7 FOR CONDITIONS NOT NOTED.

| | |
|---|---|
| ALL CONCRETE PLACED AGAINST SOIL | 3" |
| SLABS-ON-GRADE | 1" TOP |
| RETAINING WALLS | 2" BACKFILLED SIDES<br>1" NON-BACKFILLED SIDES |
| CONCRETE EXPOSED TO SOIL OR WEATHER | 2" (#6 OR LARGER BARS)<br>1 1/2" (#5 BAR OR SMALLER) |

4. IN THE EVENT THAT CONCRETE CASTING IS INTERRUPTED HORIZONTAL OR NEARLY HORIZONTAL CONSTRUCTION JOINTS SHALL BE PREPARED BY ROUGHENING THE SURFACE IN AN APPROVED MANNER SO THAT THE AGGREGATE IS EXPOSED UNIFORMLY, LEAVING NO LAITANCE, LOOSE PARTICLES OR DAMAGED CONCRETE. ALL HORIZONTAL JOINTS AND REMEDIAL ACTION SHALL BE SUBMITTED TO THE ENGINEER FOR REVIEW AND APPROVED.

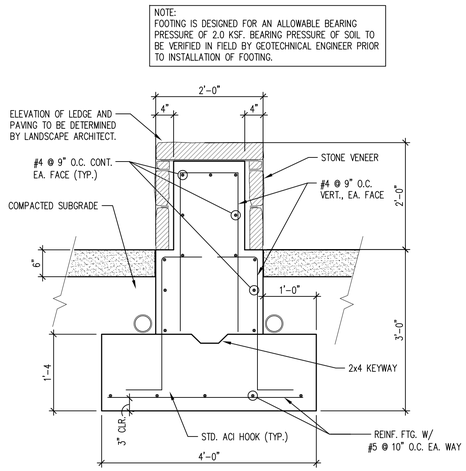
## REINFORCING STEEL NOTES

1. ALL REINFORCING SHALL BE NEW BILLET STEEL, ASTM A615 – GRADE 60 UNLESS NOTED OTHERWISE. REINFORCING SHALL BE DETAILED AND FABRICATED IN ACCORDANCE WITH THE ACI SP-66 AND ACI 318.
2. HORIZONTAL WALL REINFORCEMENT SHALL BE CONTINUOUS AND SHALL HAVE 90 DEGREE BENDS AND EXTENSIONS AT CORNERS AND INTERSECTIONS AS SHOWN ON THE DRAWINGS.
3. ALL LAPS IN WELDED WIRE FABRIC SHALL BE ONE MESH PLUS TWO INCHES AT SLICES.

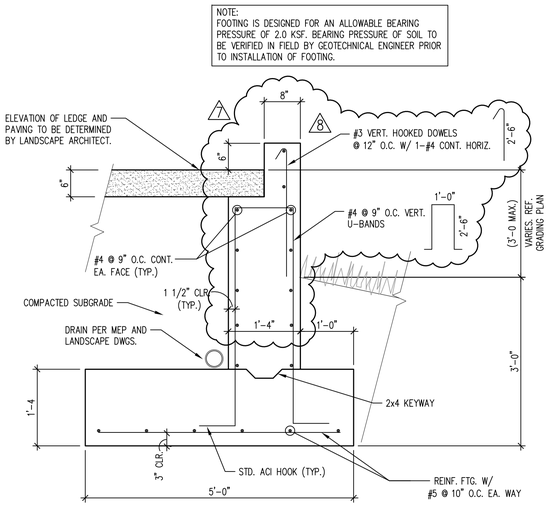
## BACKFILL NOTES

1. RETAINING WALLS ARE DESIGNED FOR AT-REST EQUIVALENT FLUID PRESSURES OF 55 PCF TO A DEPTH OF 15 FEET BELOW GRADE. ALL WALLS SHALL BE DRAINED AND BACKFILLED WITH FREE DRAINING, GRANULAR GRANULAR MATERIAL PER GEOTECHNICAL REQUIREMENTS. SELECT FILL SHALL BE PACED IN LOOSE LIFTS NOT EXCEEDING 12 INCHES IN THICKNESS AND COMPACTED TO AT LEAST 95 PERCENT OF MAXIMUM DENSITY AS DETERMINED BY ASTM D 1557, AND THE MOISTURE CONTENT SHALL BE MAINTAINED WITHIN 2% OF THE MATERIAL'S OPTIMUM MOISTURE CONTENT. REFERENCE GEOTECHNICAL REPORT FOR ADDITIONAL INFORMATION.
2. THE WALL SHALL NOT BE BACKFILLED UNTIL:
   1.) THE WALL AND FOOTING CONCRETE STRENGTH HAS REACHED THE SPECIFIED 28 DAY COMPRESSIVE STRENGTH.
3. BASEMENT WALL FOOTINGS, ELEVATOR PIT WALL FOOTINGS AND GARAGE RETAINING WALL FOOTINGS ARE DESIGNED FOR AN ALLOWABLE BEARING PRESSURE OF 2.0 KSF.

6




7 04 SECTION
SCALE: 1/2" = 1'-0




6 03 SECTION
SCALE: 1/2" = 1'-0

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Project Name

CONFLUENCE PARK EAST

Issue Title

ISSUE FOR CONSTRUCTION

Issue / Addenda / Revisions

| | | |
|---|---|---|
| 6 | 10/14/2016 | CITY COMMENT REVISIONS |
| 7 | 11/28/2016 | PERMIT COMMENTS |
| 8 | 12/21/2016 | PERMIT COMMENTS |

Seal

COLORADO REGISTERED PROFESSIONAL ENGINEER CODY B. CAMPBELL 41431

01/08/2016

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Drawing Title

| | |
|---|---|
| Issue Date: | 1.08.2016 |
| Project No: | 14047 |
| Reviewed By: | |
| Drawn By: | BDD |

Sheet No.

S1.00

ASI 26-R5
12/22/2016

## PLANT LEGEND

| PLANT SYMBOL | COMMON NAME<br>BOTANICAL NAME |
|---|---|
| | **TREES** |
| | IMPERIAL HONEY LOCUST<br>*Gleditsia triacanthos var. inermis 'Impcole'* |
| | KENTUCKY COFFEE TREE<br>*Gymnocladus dioicus* |
| ⚠1 | CHINKAPIN OAK<br>*Quercus muehlenergia* |
| | **ORNAMENTAL TREES** |
| | BIGTOOTH MAPLE<br>*Acer grandidentatum* |
| | **GROUNDCOVERS, SHRUBS, & PERRENIALS** |
| | BLONDE AMBITION BLUE GRAMA<br>*Bouteloua gracilis 'Blonde Ambition'* |
| | LITTLELEAF MOUNTAIN MAHOGANY<br>*Cercocarpus intricatus* |
| | FERNBUSH<br>*Chamaebatiaria millefolium* |
| | PRAIRIE SKY SWITCHGRASS<br>*Panicum virgatum 'Prairie Sky'* |
| ⚠2 | GRAND MESA BEARDTONGUE<br>*Penstemon mensarum* |
| | PRAIRIE CONEFLOWER<br>*Ratibida columnifera* |
| | ROSE SAGE<br>*Salvia pachyphylla* |
| | THE BLUES LITTLE BLUESTEM & SPOTTED GAYFEATHER MIX<br>*Schizachyrum scoparium 'The Blues' & Liatris punctata* |
| | SIOUX BLUE INDIANGRASS<br>*Sorghastrum nutans 'Sioux Blue'* |
| ⚠1 | SHORT GRASS SEED MIX<br>per Denver Parks Department Specifications |

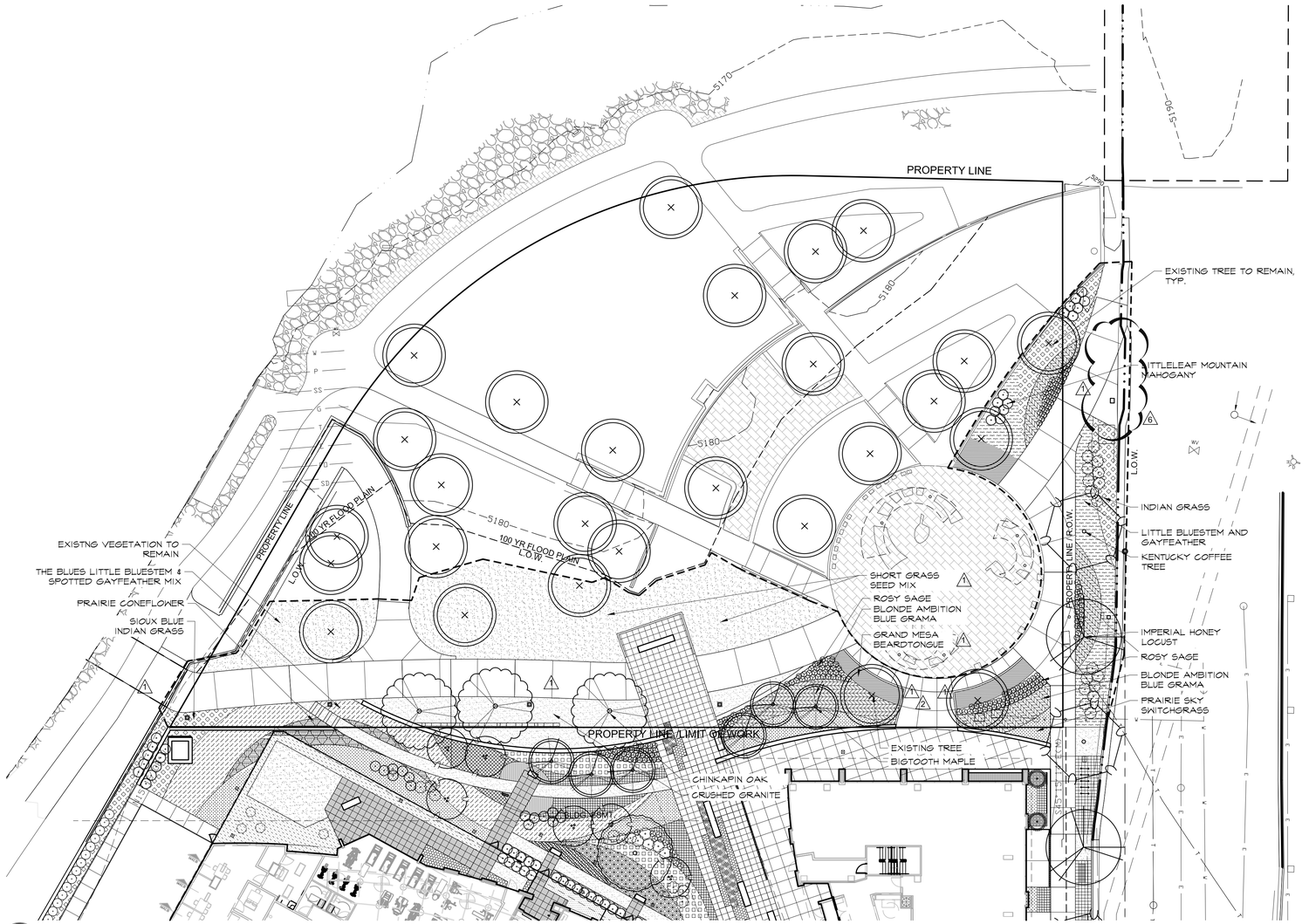
## ⚠1 ⚠2 TREE MITIGATION

Proposed Canopy removed (square footage):

| | |
|---|---|
| (9) Austrian Pines (83 sq.ft. each) | 750 |
| (1) Linden | 400 |
| (1) Cottonwood | 900 |
| **Total: Contractor Proposed Canopy Removed** | **2,050** |

Proposed Canopy replacement (square footage):

| | |
|---|---|
| (2) Chinkapin Oak (490 sf each) | 980 |
| (2) Bigtooth Maple (450 sf each) | 900 |
| (1) Honey locust | 600 |
| (1) Kentucky Coffeetree | 600 |
| **Total: Contractor Proposed Canopy Replacement** | **3,080** |




Planting Plan Ground Floor | A

Scale: 1" = 20'-0" | L5.01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Project Name

# CONFLUENCE PARK EAST

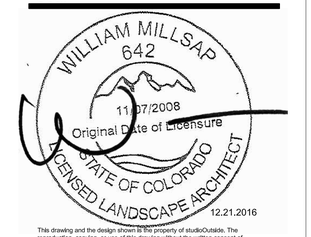
Issue Title

PERMIT

Issue / Addenda / Revisions

| | Date | Description |
|---|---|---|
| 1 | 7.26.16 | Permit Comments |
| 2 | 8.08.16 | Permit Comments |
| 3 | 9.01.16 | Permit Comments |
| 4 | 9.13.16 | Permit Comments |
| 5 | 9.20.16 | Permit Comments |
| 6 | 10.14.16 | Permit Comments |
| 7 | 11.28.16 | Permit Comments |
| 8 | 12.21.16 | Permit Comments |

Seal





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Drawing Title

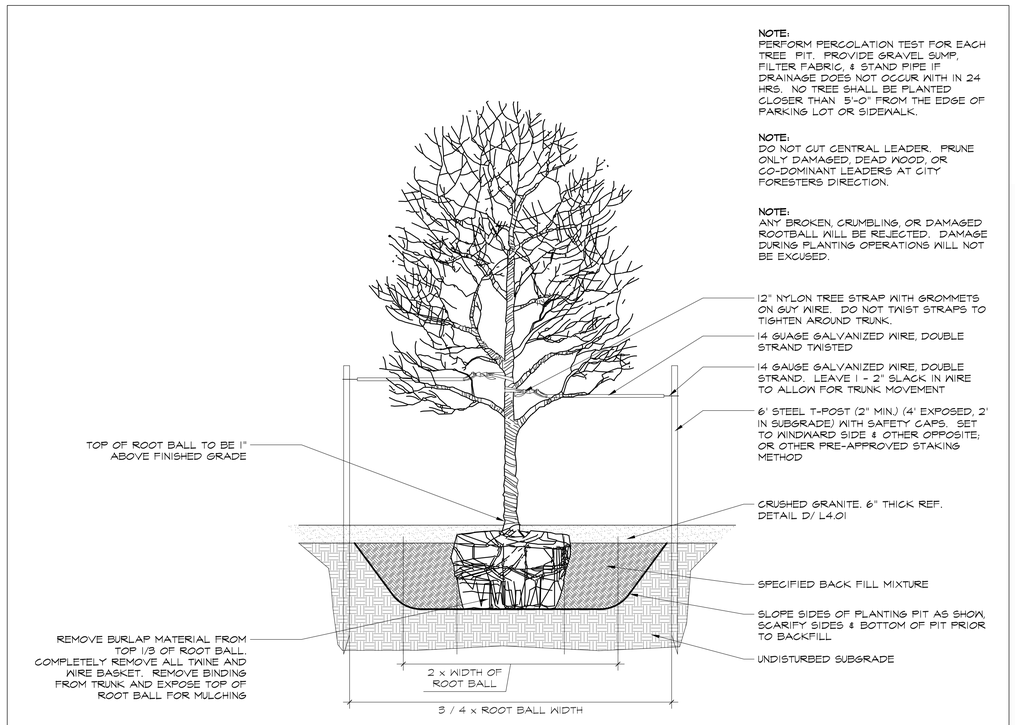
LANDSCAPE PLAN

| | |
|---|---|
| Issue Date: | 12.21.2016 |
| Project No: | 14047 |
| Reviewed By: | MF |
| Drawn By: | BH |

Sheet No.

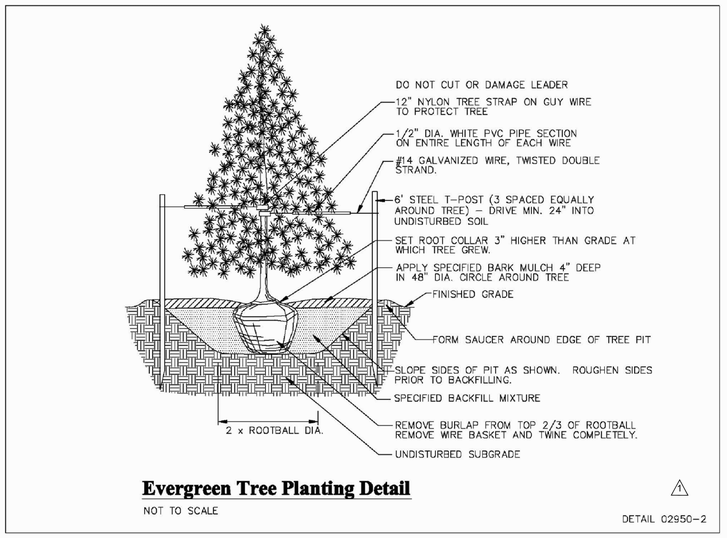
L5.01

ASI 26-R5
12/22/2016




Canopy Tree Planting in DG

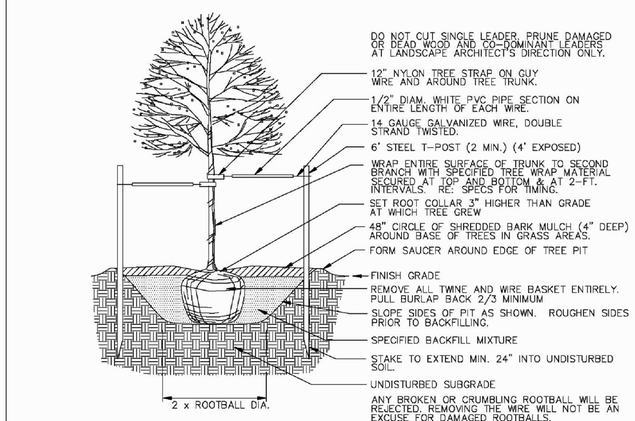
Scale: 1/2" = 1' - 0"




**Evergreen Tree Planting Detail**

NOT TO SCALE

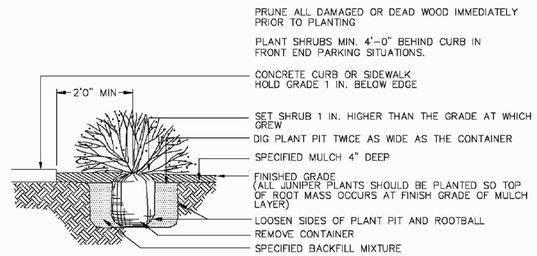
DETAIL 02950-2




**Deciduous Tree Planting Detail**

NOT TO SCALE

DETAIL 02950-1




**Shrub Planting Detail**

NOT TO SCALE

DETAIL 02950-3

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Project Name

# CONFLUENCE PARK EAST

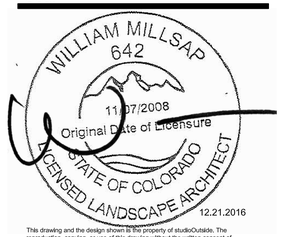
Issue Title

PERMIT

Issue / Addenda / Revisions

| | Date | Description |
|---|---|---|
| 1 | 7.26.16 | Permit Comments |
| 2 | 8.08.16 | Permit Comments |
| 3 | 9.01.16 | Permit Comments |
| 4 | 9.13.16 | Permit Comments |
| 5 | 9.20.16 | Permit Comments |
| 6 | 10.14.16 | Permit Comments |
| 7 | 11.28.16 | Permit Comments |
| 8 | 12.21.16 | Permit Comments |

Seal

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Drawing Title

PLANTING DETAILS

| | |
|---|---|
| Issue Date: | 12.21.2016 |
| Project No: | 14047 |
| Reviewed By: | MF |
| Drawn By: | BH |

Sheet No.

L5.02

ASI 26-R5
12/22/2016

# PLANTING NOTES:

1. CONTRACTOR SHALL STAKE OUT ALL INFORMAL TREE LOCATIONS IN FIELD FOR REVIEW BY THE LANDSCAPE ARCHITECT PRIOR TO PLANTING L.A. RESERVES THE RIGHT TO ADJUST PLANTS TO EXACT LOCATION IN FIELD.
2. PLANTING BEDS SHALL BE STAKED FOR REVIEW BY LANDSCAPE ARCHITECT PRIOR TO EXCAVATION.
3. LANDSCAPE CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING THE LOCATION OF ALL UNDERGROUND UTILITIES, PIPES, STRUCTURES, AND LINE RUNS IN THE FIELD PRIOR TO THE INSTALLATION OF ANY PLANT MATERIAL.
4. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO ADVISE THE LANDSCAPE ARCHITECT OF ANY CONDITION FOUND ON THE SITE WHICH PROHIBITS INSTALLATION AS SHOWN ON THESE DRAWINGS.
5. TREES OVERHANGING WALKS AND PARKING SHALL HAVE A MINIMUM CLEAR TRUNK HEIGHT OF SEVEN (7') FEET. TREES OVERHANGING PUBLIC STREET PAVEMENT DRIVE AISLES AND FIRE LANES SHALL HAVE A MINIMUM CLEAR TRUNK HEIGHT OF FOURTEEN (14') FEET.
6. ALL PLANT MATERIAL SHALL BE MAINTAINED IN A HEALTHY AND GROWING CONDITION AND MUST BE REPLACED WITH PLANT MATERIAL OF SAME VARIETY AND SIZE IF DAMAGED, DESTROYED, OR REMOVED.
7. LANDSCAPE CONTRACTOR SHALL BE RESPONSIBLE FOR FINE GRADING AND REMOVAL OF DEBRIS PRIOR TO PLANTING IN ALL AREAS.
8. FINAL FINISH GRADING SHALL BE REVIEWED BY THE LANDSCAPE CONTRACTOR THE GENERAL CONTRACTOR SHALL BE RESPONSIBLE FOR ANY ADDITIONAL TOPSOIL REQUIRED TO CREATE A SMOOTH CONDITION PRIOR TO PLANTING.
9. ALL PLANT MATERIAL SHALL CONFORM TO THE SPECIFICATIONS AND SIZES GIVEN IN THE PLANT LIST AND SHALL BE NURSERY GROWN IN ACCORDANCE WITH THE U.S.A. STANDARD FOR NURSERY STOCK. LATEST EDITION AMERICAN ASSOCIATION OF NURSERYMEN STANDARDS. ANY PLANT SUBSTITUTION SHALL BE APPROVED BY LANDSCAPE ARCHITECT PRIOR TO PURCHASE.
10. LANDSCAPE CONTRACTOR IS RESPONSIBLE FOR ANY COORDINATION WITH OTHER CONTRACTORS ON SITE AS REQUIRED TO ACCOMPLISH ALL PLANTING OPERATIONS.
16. WRITTEN DIMENSIONS & GRADES PREVAIL OVER SCALED DIMENSIONS. NOTIFY LANDSCAPE ARCHITECT OF ANY DISCREPANCIES PRIOR TO INSTALLATION.
17. LANDSCAPE CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING THE LOCATION OF ALL UNDERGROUND UTILITIES, PIPES, STRUCTURES, AND LINE RUNS IN THE FIELD PRIOR TO THE INSTALLATION OF ANY PLANT MATERIAL.
18. STUDIO OUTSIDE ASSUMES NO RESPONSIBILITY FOR ANY EXCAVATION OR GRADING NOT SHOWN ON SURVEYS OR CIVIL ENGINEER'S PLANS SUPPLIED TO STUDIO OUTSIDE. ALL PROPOSED AND FINISHED GRADES ARE BASED ON INFORMATION PROVIDED BY THE OWNER'S SURVEY AND/OR CIVIL ENGINEER. ANY DISCREPANCIES IN ACTUAL FIELD MEASUREMENTS ARE TO BE REPORTED TO THE ARCHITECT IMMEDIATELY.
19. LANDSCAPE CONTRACTOR IS RESPONSIBLE FOR ALL FINAL QUANTITIES PER DRAWINGS AND SPECIFICATIONS. ANY QUANTITIES PROVIDED BY STUDIO OUTSIDE ARE PROVIDED FOR CONVENIENCE ONLY AND SHALL NOT BE CONSIDERED ABSOLUTE. NOTIFY ARCHITECT IF ANY DISCREPANCIES OCCUR. CONTRACTORS ARE TO BID THEIR OWN VERIFIED QUANTITIES.

PLANT LEGEND

| PLANT SYMBOL | COMMON NAME<br>BOTANICAL NAME | SIZE MIN. | HEIGHT MIN. | SPREAD MIN. | COMMENTS |
|---|---|---|---|---|---|
| | **TREES** | | | | |
| | IMPERIAL HONEY LOCUST<br>*Gleditsia triacanthos var. inermis 'Impcole'* | 3" CAL. | 14'-16' | 5'-6' | NURSERY GROWN, MATCHED, WELL BRANCHED, STRONG CENTRAL LEADER, BALLED AND BURLAPPED |
| | KENTUCKY COFFEE TREE<br>*Gymnocladus dioicus* | 3" CAL. | 14'-16' | 4'-6' | NURSERY GROWN, MATCHED, WELL BRANCHED, STRONG CENTRAL LEADER, BALLED AND BURLAPPED |
| 1 | CHINKAPIN OAK<br>*Quercus muehlenergia* | 3" CAL. | 14'-16' | 4'-6' | NURSERY GROWN, MATCHED, WELL BRANCHED, STRONG CENTRAL LEADER, BALLED AND BURLAPPED |
| | **ORNAMENTAL TREES** | | | | |
| | BIGTOOTH MAPLE<br>*Acer grandidentatum* | 45 GAL. | 10' | 5'-6' | B&B, MATCHED, WELL BRANCHED, MULTI-TRUNK |
| | **GROUNDCOVERS, SHRUBS, & PERRENIALS** | | | | |
| | BLONDE AMBITION BLUE GRAMA<br>*Bouteloua gracilis 'Blonde Ambition'* | 1 GAL. | 8"-10" | 8"-10" | NURSERY GROWN, MATCHED AND WELL ROOTED, CONTAINER GROWN, PLANT 15" O.C. TRIANGULAR SPACING |
| | LITTLELEAF MOUNTAIN MAHOGANY<br>*Cercocarpus intricatus* | 5 GAL. | 24" | 24" | NURSERY GROWN, MATCHED AND WELL ROOTED, CONTAINER GROWN, PLANT 30" O.C. SPACING |
| | FERNBUSH<br>*Chamaebatiaria millefolium* | 5 GAL. | 36" | 36" | NURSERY GROWN, MATCHED AND WELL ROOTED, CONTAINER GROWN, PLANT 4' O.C. SPACING |
| | PRAIRIE SKY SNITCHGRASS<br>*Panicum virgatum 'Prairie Sky'* | 1 GAL. | 30" | 18" | NURSERY GROWN, MATCHED AND WELL ROOTED, CONTAINER GROWN, PLANT 30" O.C. TRIANGULAR SPACING |
| 2 | GRAND MESA BEARDTONGUE<br>*Penstemon mensarum* | 1 GAL. | 6" | 6" | NURSERY GROWN, MATCHED AND WELL ROOTED, CONTAINER GROWN, PLANT 8" O.C. |
| | PRAIRIE CONEFLOWER<br>*Ratibida columnifera* | 1 GAL. | 18" | 10" | NURSERY GROWN, MATCHED AND WELL ROOTED, CONTAINER GROWN, PLANT 18" O.C. SPACING. |
| | ROSE SAGE<br>*Salvia pachyphylla* | 1 GAL. | 18" | 18" | NURSERY GROWN, MATCHED AND WELL ROOTED, CONTAINER GROWN, PLANT 18" O.C. |
| | THE BLUES LITTLE BLUESTEM & SPOTTED GAYFEATHER MIX<br>*Schizachyrum scoparium 'The Blues' & Liatris punctata* | 1 GAL. | 14"-16" | 12" | 50/50 MIX, ALTERNATE SPECIES, NURSERY GROWN, MATCHED AND WELL ROOTED, CONTAINER GROWN, PLANT 12" O.C. TRIANGULAR. |
| | SIOUX BLUE INDIANGRASS<br>*Sorghastrum nutans 'Sioux Blue'* | 1 GAL. | 30" | 24" | NURSERY GROWN, MATCHED AND WELL ROOTED, CONTAINER GROWN, PLANT 3' O.C. SPACING |
| 1 | SHORT GRASS SEED MIX<br>per Denver Parks Department Specifications | SEED | - | - | REFER TO DENVER PARKS DEPARTMENT SPECIFICATIONS |


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Project Name

CONFLUENCE PARK EAST

Issue Title

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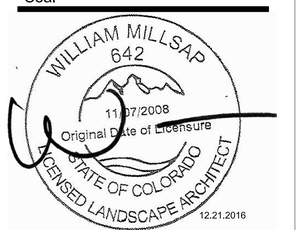
Issue / Addenda / Revisions

| | Date | Description |
|---|---|---|
| 1 | 7.26.16 | Permit Comments |
| 2 | 8.08.16 | Permit Comments |
| 3 | 9.01.16 | Permit Comments |
| 4 | 9.13.16 | Permit Comments |
| 5 | 9.20.16 | Permit Comments |
| 6 | 10.14.16 | Permit Comments |
| 7 | 11.28.16 | Permit Comments |
| 8 | 12.21.16 | Permit Comments |

Seal





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Drawing Title

PLANT LEGEND

Issue Date: 12.21.2016
Project No: 14047
Reviewed By: MF
Drawn By: BH

Sheet No.

L5.03

ASI 26-R5
12/22/2016

## IRRIGATION LEGEND

- SLEEVES: CLASS 200 PVC
- LATERAL PIPE TO SPRINKLERS: 100 PSI HIGH DENSITY POLYETHYLENE 1–INCH SIZE UNLESS OTHERWISE INDICATED
- UNCONNECTED PIPE CROSSING
- REMOTE CONTROL VALVE ASSEMBLY FOR SPRINKLER LATERALS: RAIN BIRD PEB–PRS (SIZED PER PLAN) AND 2–INCH CHAMPION 300–RS ANGLE VALVE

A1 / 14 / 1" / -

- INDICATES CONTROLLER AND STATION NUMBER
- INDICATES LATERAL DISCHARGE (GPM)
- INDICATES VALVE SIZE (INCHES)
- INDICATES SPRINKLER RISER POP–UP HEIGHT (4–INCH UNLESS OTHERWISE NOTED)

- EXISTING IRRIGATION SPRINKLERS
- EXISTING REMOTE CONTROL VALVE
- EXISTING MAINLINE
- EXISTING CONTROLLER: TORO SENTINEL: 24 STATIONS, 16 STATIONS EXISTING, 5 STATIONS ADDED
- EXISTING BACKFLOW PREVENTER

- POP–UP SPRAY SPRINKLER: RAIN BIRD 1800–SAM–PRS W/8 SERIES NOZZLE PRESSURE: 30 PSI RADIUS: 8 FEET FLOW (GPM): Q–0.26 H–0.52 F–1.05
- POP–UP SPRAY SPRINKLER: RAIN BIRD 1800–SAM–PRS W/10 SERIES NOZZLE PRESSURE: 30 PSI RADIUS: 10 FEET FLOW (GPM): Q–0.39 H–0.79 F–1.58
- POP–UP SPRAY SPRINKLER: RAIN BIRD 1800–SAM–PRS W/12 SERIES NOZZLE PRESSURE: 30 PSI RADIUS: 12 FEET FLOW (GPM): Q–0.65 H–1.30 F–2.60
- POP–UP SPRAY SPRINKLER: RAIN BIRD 1800–SAM–PRS W/15 SERIES NOZZLE PRESSURE: 30 PSI RADIUS: 15 FEET FLOW (GPM): Q–0.92 H–1.85 F–3.70
- POP–UP SPRAY SPRINKLER: RAIN BIRD 1800–SAM–PRS W/15SS SERIES NOZZLE PRESSURE: 30 PSI PATTERN: 4 X 15 FEET FLOW (GPM): EST–0.61 SST–1.21
- BUBBLER ASSEMBLY RAINBIRD 1402 AND RAINBIRD 1408 SEE DETAIL #9 PRESSURE 30 PSI FLOW: 0.50 GPM AND 2.0 GPM EACH

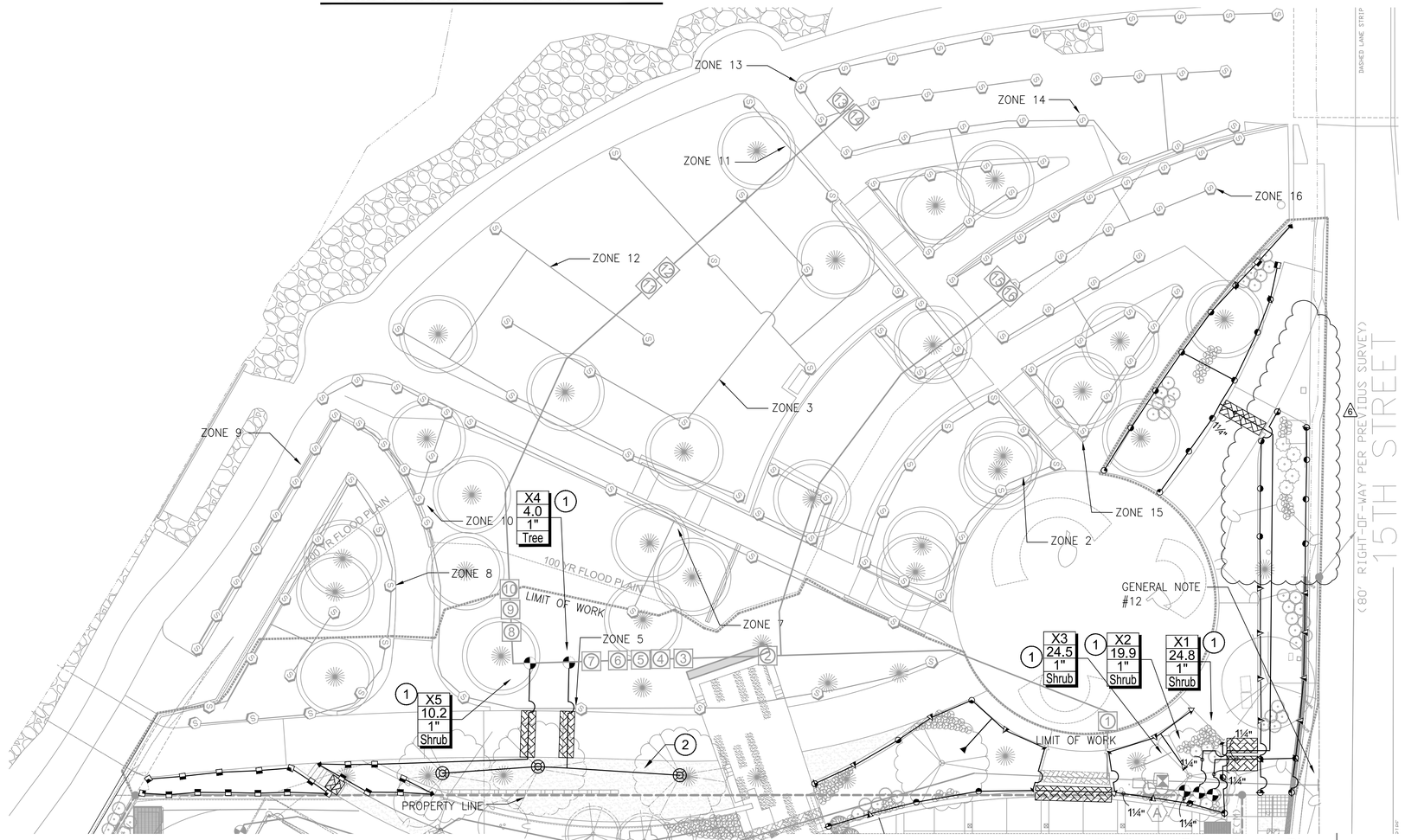
NOTE:
INSTALL RAIN BIRD 1806 SAM–PRS SPRAY BODIES FOR MOWED TURF, NOZZLE PER PLAN.
INSTALL RAIN BIRD 1812 SAM–PRS SPRAY BODIES FOR PLANTING BEDS AND NATIVE MIXES, NOZZLE PER PLAN.
PREVIOUS AS–BUILT DRAWINGS OF THE IRRIGATION SYSTEM ARE AVAILABLE FROM DENVER PARKS. CONTRACTOR TO REQUEST AS–BUILTS AND REVIEW BEFORE INSTALLATION OF NEW EQUIPMENT.

## CONSTRUCTION NOTES

1. CONTRACTOR SHALL FIELD LOCATED THE EXISTING MAINLINE AT THIS APPROXIMATE LOCATION. CONNECT NEW VALVE TO EXISTING MAINLINE AND ROUTE NEW CONTROL WIRE TO OPERATE VALVE BACK TO EXISTING CONTROLLER THROUGH THE AVAILABLE CONDUIT SWEEP. INSTALL IRRIGATION EQUIPMENT AS SHOWN.
2. REFER TO DETAIL #9 FOR TREE BUBBLER ASSEMBLY AND INSTALLATION PER DENVER PARKS AND RECREATION STANDARDS. INNER AND OUTER BUBBLERS SHOULD BE SEPARATED WITH BALL VALVES.

## INSTALLATION GENERAL NOTES

1. READ THOROUGHLY AND BECOME FAMILIAR WITH THE SPECIFICATIONS AND INSTALLATION DETAILS FOR THIS AND RELATED WORK PRIOR TO CONSTRUCTION.
2. COORDINATE UTILITY LOCATES ("CALL BEFORE YOU DIG") OF UNDERGROUND UTILITIES PRIOR TO CONSTRUCTION.
3. DO NOT PROCEED WITH THE INSTALLATION OF THE IRRIGATION SYSTEM WHEN IT IS OBVIOUS IN THE FIELD THAT OBSTRUCTIONS OR GRADE DIFFERENCES EXIST THAT MIGHT NOT HAVE BEEN CONSIDERED IN THE ENGINEERING. IF DISCREPANCIES IN CONSTRUCTION DETAILS, LEGEND, NOTES, OR SPECIFICATIONS ARE DISCOVERED, BRING ALL SUCH OBSTRUCTIONS OR DISCREPANCIES TO THE ATTENTION OF THE OWNER'S REPRESENTATIVE.
4. THE DRAWINGS ARE DIAGRAMMATIC. THEREFORE, THE FOLLOWING SHOULD BE NOTED:
   A. ALTHOUGH IRRIGATION COMPONENTS MAY BE SHOWN OUTSIDE PLANTING AREAS FOR CLARITY, INSTALL IRRIGATION PIPE AND WIRING IN LANDSCAPED AREAS WHENEVER POSSIBLE.
   B. TREE AND SHRUB LOCATIONS AS SHOWN ON LANDSCAPE PLANS TAKE PRECEDENCE OVER IRRIGATION EQUIPMENT LOCATIONS. AVOID CONFLICTS BETWEEN THE IRRIGATION SYSTEM, PLANTING MATERIALS, AND ARCHITECTURAL FEATURES.
   C. USE ONLY STANDARD TEES AND ELBOW FITTINGS. USE OF CROSS TYPE FITTINGS IS NOT ALLOWED.
6. PROVIDE THE FOLLOWING COMPONENTS TO THE OWNER PRIOR TO THE COMPLETION OF THE PROJECT:
   A. TWO (2) OPERATING KEYS FOR EACH TYPE OF MANUALLY OPERATED VALVES.
   B. TWO (2) OF EACH SERVICING WRENCH OR TOOL NEEDED FOR COMPLETE ACCESS, ADJUSTMENT, AND REPAIR OF ALL ROTARY SPRINKLERS.
7. SELECT NOZZLES FOR SPRAY AND ROTARY SPRINKLERS WITH ARCS WHICH PROVIDE COMPLETE AND ADEQUATE COVERAGE WITH MINIMUM OVERSPRAY FOR THE SITE CONDITIONS. CAREFULLY ADJUST THE RADIUS OF THROW AND ARC OF COVERAGE OF EACH ROTARY SPRINKLER TO PROVIDE THE BEST PERFORMANCE.
8. THE IRRIGATION CONTRACTOR IS RESPONSIBLE FOR THE INSTALLATION OF IRRIGATION SLEEVING. SLEEVES ARE REQUIRED FOR BOTH PIPING AND ELECTRICAL WIRING AT EACH HARDSCAPE CROSSING. COORDINATE INSTALLATION OF SLEEVING WITH OTHER TRADES. ANY PIPE OR WIRE WHICH PASSES BENEATH EXISTING HARDSCAPE WHERE SLEEVING WAS NOT INSTALLED WILL REQUIRE HORIZONTAL BORING BY THE IRRIGATION CONTRACTOR.
9. INSTALL ALL ELECTRICAL POWER TO THE IRRIGATION CONTROL SYSTEM IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE AND ALL APPLICABLE LOCAL ELECTRIC UTILITY CODES.
10. THE FOLLOWING SHOULD BE NOTED REGARDING PIPE SIZING: IF A SECTION OF UNSIZED PIPE IS LOCATED BETWEEN THE IDENTICALLY SIZED SECTIONS, THE UNSIZED PIPE IS THE SAME NOMINAL SIZE AS THE TWO SIZED SECTIONS. THE UNSIZED PIPE SHOULD NOT BE CONFUSED WITH THE DEFAULT PIPE SIZE NOTED IN THE LEGEND.
11. INSTALL TWO (2) #14 AWG CONTROL WIRES FROM CONTROLLER LOCATION TO EACH DEAD–END OF MAINLINE FOR USE AS SPARES INCASE OF CONTROL WIRE FAILURE. COIL 3 FEET OF WIRE IN VALVE BOX.
12. PARK SERVED FROM DENVER WATER 1 1/2–INCH TAP, TAP ID # 355975. ADDRESS 2190 15TH STREET.
13. THE EXISTING IRRIGATION SYSTEM OUTSIDE OF THE PROJECT SCOPE MUST REMAIN FUNCTIONAL DURING CONSTRUCTION AND EXISTING TREES THAT ARE TO REMAIN WITHIN THE PROJECT SCOPE MUST BE WATERED UNTIL NEW SYSTEM IS INSTALLED AND FUNCTIONAL.
14. CONTRACTOR SHALL COORDINATE WITH THE DENVER PARKS DEPARTMENT TO INTEGRATE THE NEW IRRIGATION SYSTEM WITH THE EXISTING SYSTEM.




Confluence Park Irrigation Plan

1-INCH = 16-FEET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Project Name

# CONFLUENCE PARK EAST

Issue Title

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Drawing Title

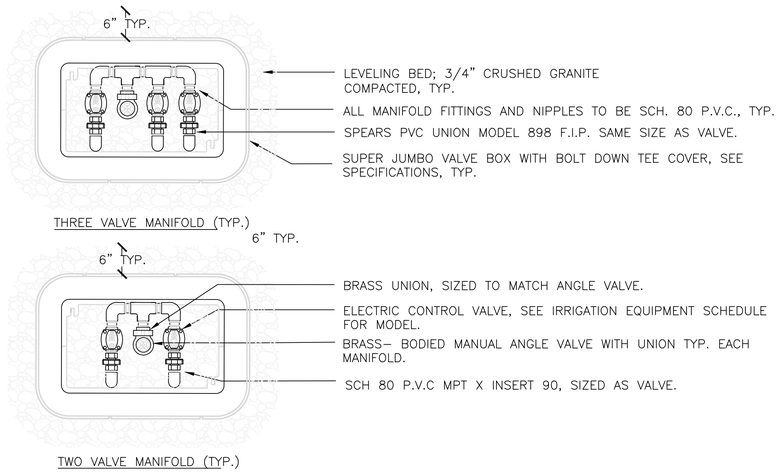
IRRIGATION PLAN

| | |
|---|---|
| Issue Date: | 12.14.2016 |
| Project No: | 14047 |
| Reviewed By: | EW |
| Drawn By: | JW |

Sheet No.

IR-1

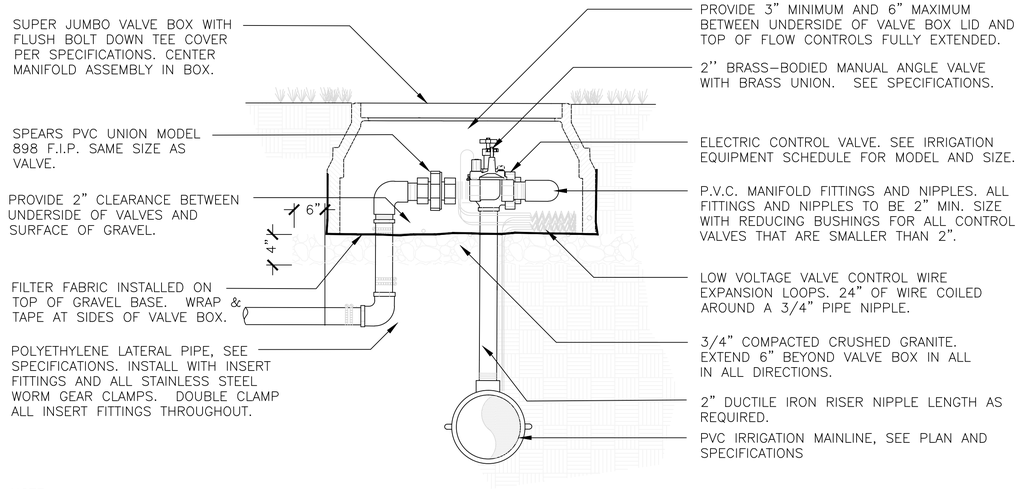
ASI 26-R5
12/22/2016




NOTE:

1. CENTER MANIFOLD ASSEMBLY IN BOX. ENSURE THAT LATERAL PIPE HAS 6" OF COVER MINIMUM WHERE IT PASSES UNDER VALVE BOX FRAME.
2. DO NOT MODIFY OR CUT SIDE WALLS OF VALVE BOX.
3. ASSEMBLE VALVE MANIFOLD ASSEMBLY FOR REVIEW AND APPROVAL PRIOR TO FABRICATION AND INSTALLATION.
4. LOCATE VALVE BOXES AND MAINLINE A MINIMUM DISTANCE OF 24" FROM CURBS AND WALKS AND A MINIMUM OF 36" FROM CENTER LINE OF DRAINAGE SWALES.

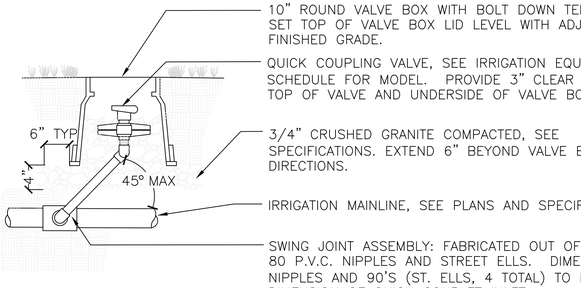
## REMOTE CONTROL VALVE — 1




NOTE:

1. SET TOP OF VALVE BOX LID LEVEL WITH ADJACENT FINISHED GRADE.
2. BRAND (STATION NO.) INTO VALVE BOX LID WITH 1" HIGH LETTERS MIN. AND LOCK TIE PLASTIC VALVE NO. TAGS TO FLOW CONTROL STEM ON EACH CONTROL VALVE.

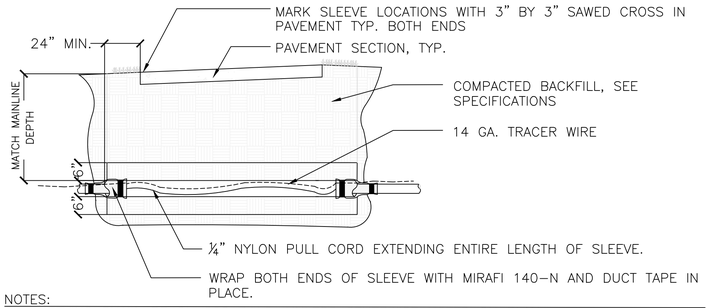
## REMOTE VALVE — 2




NOTE:

1. INSURE THAT HANDLE ON QUICK COUPLER KEY WILL CLEAR VALVE BOX IN ALL DIRECTIONS.
2. BRAND (QC) INTO VALVE BOX LID WITH 1" HIGH LETTERS MIN.
3. NIPPLE ANGLE TO BE 10 DEGREES MIN. AND 45 DEGREES MAX. INSTALL SWING JOINT SUCH THAT DOWNWARD PRESSURE ON VALVE WILL TIGHTEN FITTING INTO MAINLINE TEE.
4. FOR QUICK COUPLERS LOCATED WITHIN 100 FEET OF BACKFLOW PREVENTION DEVICES AND INTENDED FOR WINTERIZATION USE, ALL FITTINGS AND NIPPLES OF THE SWING JOINT ASSEMBLY MUST BE CONSTRUCTED ENTIRELY OF BRASS.

## QUICK COUPLER VALVE — 3




NOTES:

1. SLEEVING SHALL BE CL-200 P.V.C. UNLESS OTHERWISE NOTED ON PLAN.
2. ALL MAINLINE AND LATERAL SLEEVES SHALL BE A MINIMUM OF 2 PIPE SIZES LARGER THAN THE PIPE BEING SLEEVED.
3. DENVER WATER REQUIRES TRACER WIRE IN ALL SLEEVES THAT CROSS STREETS. IF SLEEVE IS FOR MAINLINE AND A TRACER WIRE IS ALREADY INCLUDED, NO ADDITIONAL TRACER WIRE IS NEEDED.
4. SLEEVES SHALL BE INSTALLED AT SAME DEPTH AS MAINLINE OR LATERALS.
5. SLEEVES TO BE INSTALLED 24" DEPTH MINIMUM UNDER ROADWAYS AND 30" DEPTH MINIMUM UNDER TREE CRITICAL ROOT ZONES.

## SLEEVING - BORE — 4

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Project Name

# CONFLUENCE PARK EAST

Issue Title

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Issue / Addenda / Revisions

| | Date | Description |
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| 1 | 7.26.16 | Permit Comments |
| 2 | 8.08.16 | Permit Comments |
| 3 | 9.28.16 | Permit Comments |
| 6 | 10.14.16 | Permit Comments |

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IRRIGATION DETAILS

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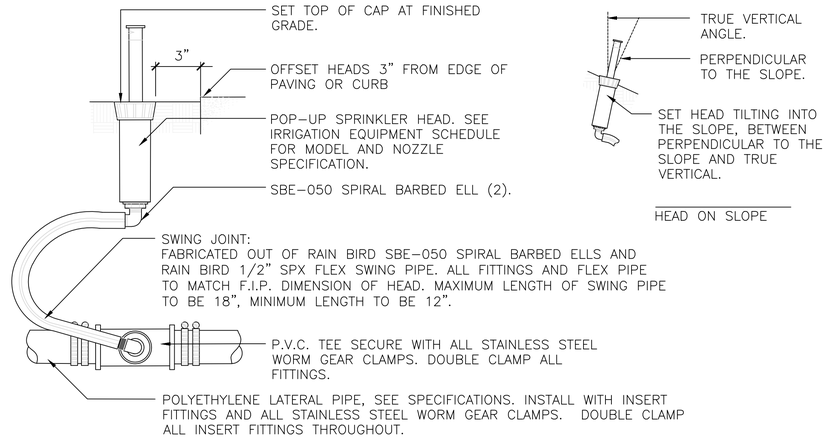
| Issue Date: | 12.14.2016 |
| Project No: | 14047 |
| Reviewed By: | EW |
| Drawn By: | JW |

Sheet No.

IR-2

ASI 26-R5
12/22/2016

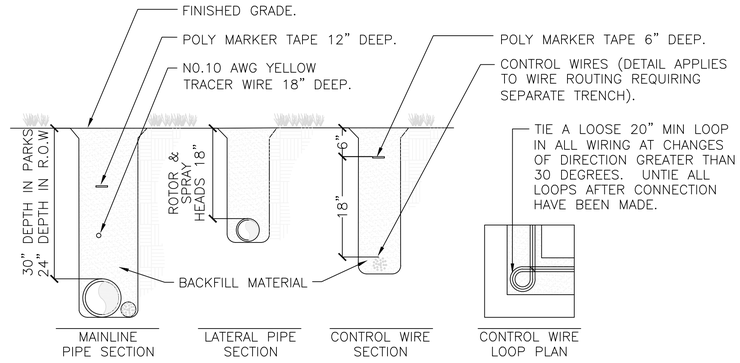






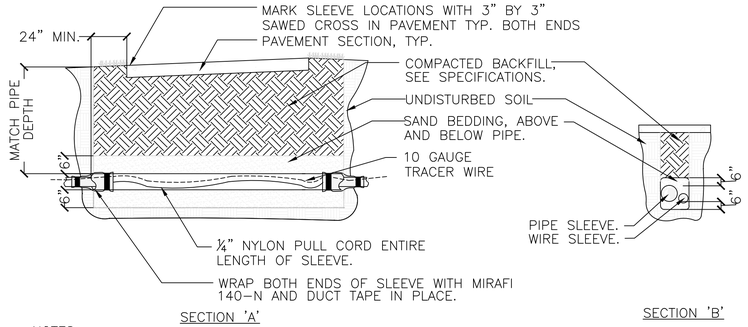
NOTE:
1. PLUMB HEAD PERPENDICULAR TO FINISHED GRADE OR AS SPECIFIED FOR HEADS ON A SLOPE.
2. SET TOP OF HEAD LEVEL WITH FINISHED GRADE IN TURF GRASS AREAS. SET TOP OF HEAD 1/2" ABOVE FINISHED GRADE IN SEEDED AREAS.
3. LATERAL PIPE TO BE PLACED 9" MIN FROM EDGE OF CURB/WALKS AND 36" MIN FROM THE CENTERLINE OF SWALES.

## POP-UP SPRAY HEAD — 5



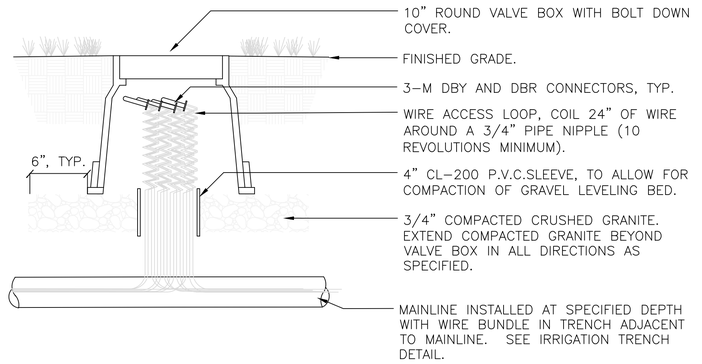

NOTE:
1. TRENCH DEPTHS ARE SHOWN AS MINIMUMS, MAXIMUM DEPTH VARIATION ALLOWABLE IS 2". SEE SPECIFICATIONS FOR MINIMUM TRENCH WIDTHS.
2. MULTIPLE IRRIGATION PIPES SHALL NOT BE INSTALLED IN THE SAME TRENCH.
3. IRRIGATION WIRE SHALL BE PLACED BESIDE IRRIGATION PIPE, NEVER STACKED.
4. BUNDLE AND TAPE ALL WIRES AT 10'-0" MINIMUM SECTIONS.
5. BACKFILL MATERIAL SHALL BE FREE OF RUBBISH, FROZEN MATERIALS AND STONES LARGER THAN 1". SEE SPECIFICATIONS FOR TYPICAL BACKFILL MATERIAL, PROCEDURES AND REGULATIONS.

## IRRIGATION TRENCH — 6




NOTES:
1. SLEEVING SHALL BE CL-200 P.V.C. UNLESS OTHERWISE NOTED ON PLAN.
2. ALL MAINLINE SLEEVES HAVE A SEPARATE COMPANION SLEEVE FOR WIRE, PLACED SIDE BY SIDE.
3. MULTIPLE SLEEVES INSTALLED ADJACENT TO ONE ANOTHER ARE TO BE PLACED SIDE BY SIDE, NEVER STACKED.
4. ALL MAINLINE AND LATERAL SLEEVES SHALL BE A MINIMUM OF 2 PIPE SIZES LARGER THAN THE PIPE BEING SLEEVED.
5. BACKFILL ANY RELATED SLEEVING EXCAVATIONS AND MECHANICALLY AND COMPACT IN 6" MAX. LIFTS TO 95% BY VIBRATORY COMPACTION METHOD UNDER ALL PAVEMENT SECTIONS.
7. SLEEVES SHALL BE INSTALLED AT SAME DEPTH AS MAINLINE OR LATERALS. SLEEVES TO BE INSTALLED AT 24" DEPTH MINIMUM UNDER ROADWAYS.
8. WATER SETTLING OF TRENCHES UNDER PAVEMENT IS NOT PERMITTED.

## IRRIGATION SLEEVING - TRENCHED — 7




NOTE:
1. SET TOP OF BOX LEVEL WITH WITH FINISHED GRADE IN TURF AREAS AND LEVEL WITH TOP OF MULCH IN PLANTING BEDS.
2. USE STANDARD RECTANGULAR VALVE BOX WITH BOLT DOWN LID FOR SPLICES OF MORE THAN TWENTY (20) WIRES.

## WIRE SPLICE — 8

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Project Name

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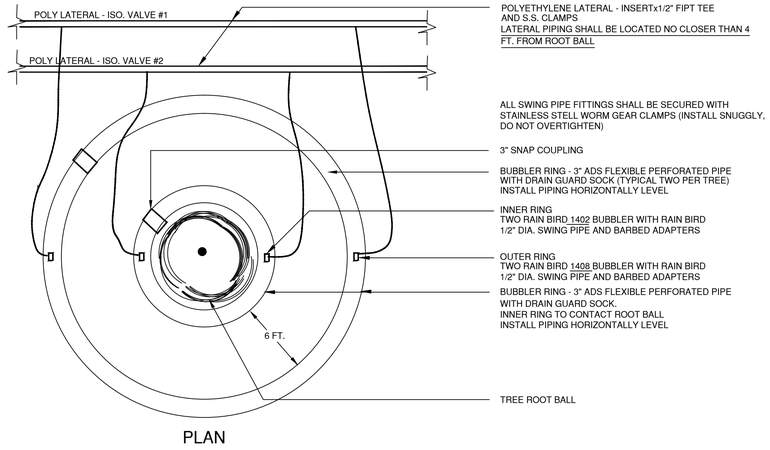
| Drawn By: | JW |

Sheet No.

IR-3

ASI 26-R5
12/22/2016




PLAN

POLYETHYLENE LATERAL - INSERTx1/2" FIPT TEE AND S.S. CLAMPS
LATERAL PIPING SHALL BE LOCATED NO CLOSER THAN 4 FT. FROM ROOT BALL

ALL SWING PIPE FITTINGS SHALL BE SECURED WITH STAINLESS STELL WORM GEAR CLAMPS (INSTALL SNUGGLY, DO NOT OVERTIGHTEN)

3" SNAP COUPLING

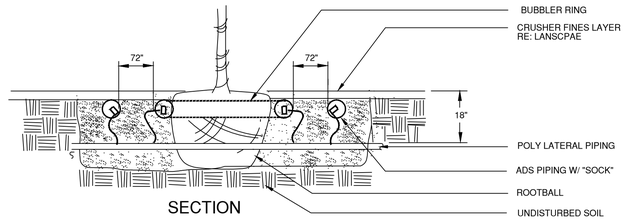
BUBBLER RING - 3" ADS FLEXIBLE PERFORATED PIPE WITH DRAIN GUARD SOCK (TYPICAL TWO PER TREE)
INSTALL PIPING HORIZONTALLY LEVEL

INNER RING
TWO RAIN BIRD 1402 BUBBLER WITH RAIN BIRD 1/2" DIA. SWING PIPE AND BARBED ADAPTERS

OUTER RING
TWO RAIN BIRD 1408 BUBBLER WITH RAIN BIRD 1/2" DIA. SWING PIPE AND BARBED ADAPTERS

BUBBLER RING - 3" ADS FLEXIBLE PERFORATED PIPE WITH DRAIN GUARD SOCK.
INNER RING TO CONTACT ROOT BALL
INSTALL PIPING HORIZONTALLY LEVEL

TREE ROOT BALL




SECTION

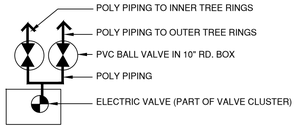
BUBBLER RING
CRUSHER FINES LAYER RE: LANSCPAE
POLY LATERAL PIPING
ADS PIPING W/ "SOCK"
ROOTBALL
UNDISTURBED SOIL

NOTE:

ALL PERFORATED PIPE SHALL BE INSTALLED LEVEL

SECURE ALL ADS COUPLINGS AND BUBBLERS WITH FABRIC-REINFORCED ADHESIVE TAPE

OPERATION RECOMMENDATIONS: IRRIGATE NEW TREE WITH INNER RING DURING FIRST TWO GROWING SEASONS. ACTIVATE OUTER RINGS (IN ADDITION TO INNER RINGS) FOR GROWING SEASON NO. 3 AND BEYOND




INSTALL ONE CHRISTY'S VALVE MARKER TAG ON EA. BALL VALVE. MARK INNER RING VALVWE AS "INNER" AND OUTER RING AS "OUTER". USE INDELIBLE INK

BUBBLER VALVE CONFIGURATION

# TREE BUBBLER ASSEMBLY DETAIL

9

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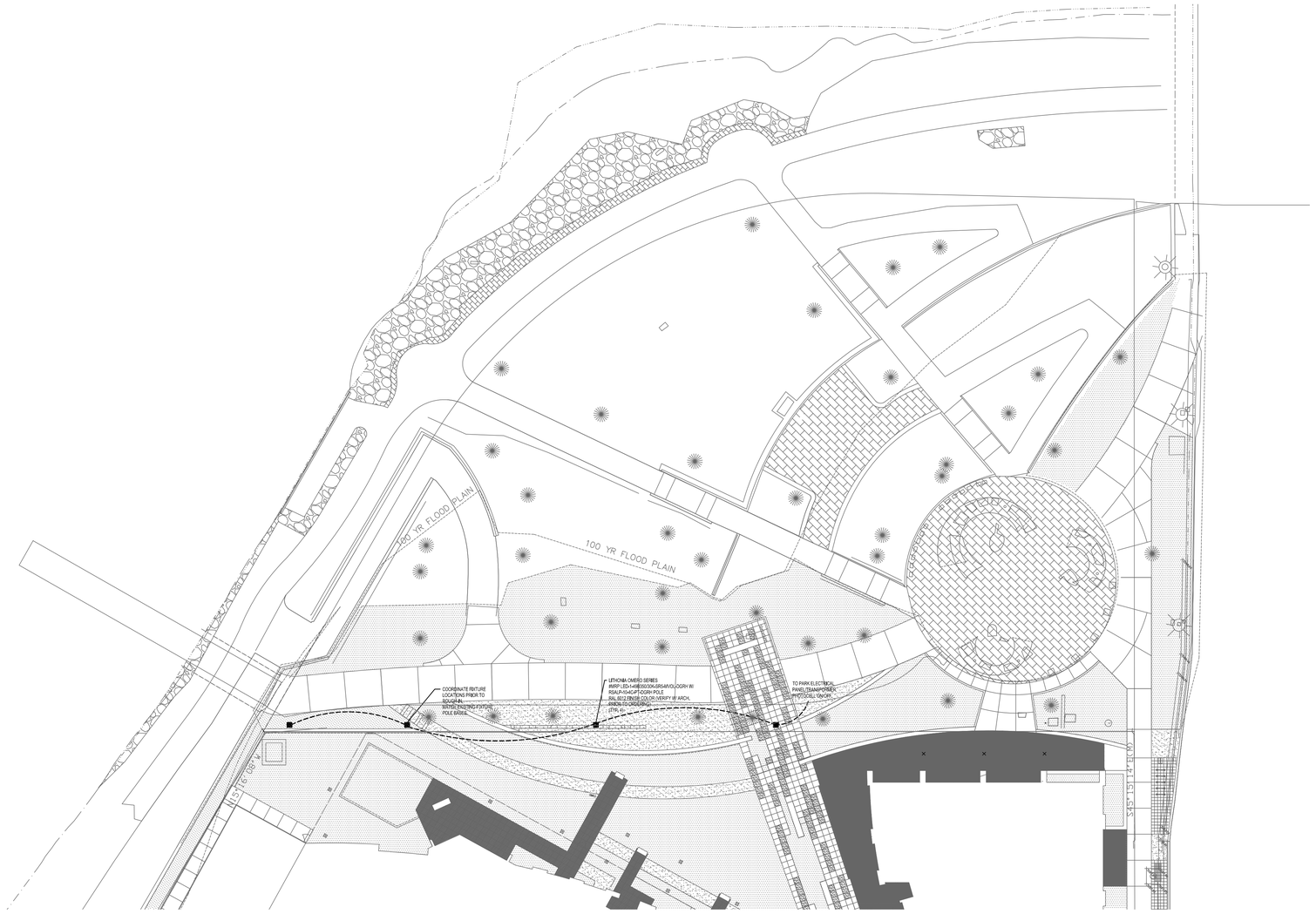


01 PARK SITE PLAN – LIGHTING

SCALE: 1" = 20'-0"

BLUM CONSULTING ENGINEERS, INC.
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JOB NO.
11-084

Project Name

# CONFLUENCE PARK EAST

Issue Title

PERMIT

Issue / Addenda / Revisions

| | Date | Description |
|---|---|---|
| 1 | 7.26.16 | Permit Comments |
| 2 | 9.13.16 | Permit Comments |
| | 9.20.16 | Permit Comments |
| 3 | 11.28.16 | Permit Comments |
| 4 | 12.21.16 | Permit Comments |

Seal

COLORADO LICENSED PROFESSIONAL ENGINEER 45097 12.21.2016

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Drawing Title

LIGHTING SITE PLAN

| | |
|---|---|
| Issue Date: | 1.08.2016 |
| Project No: | 14047 |
| Reviewed By: | X |
| Drawn By: | X |

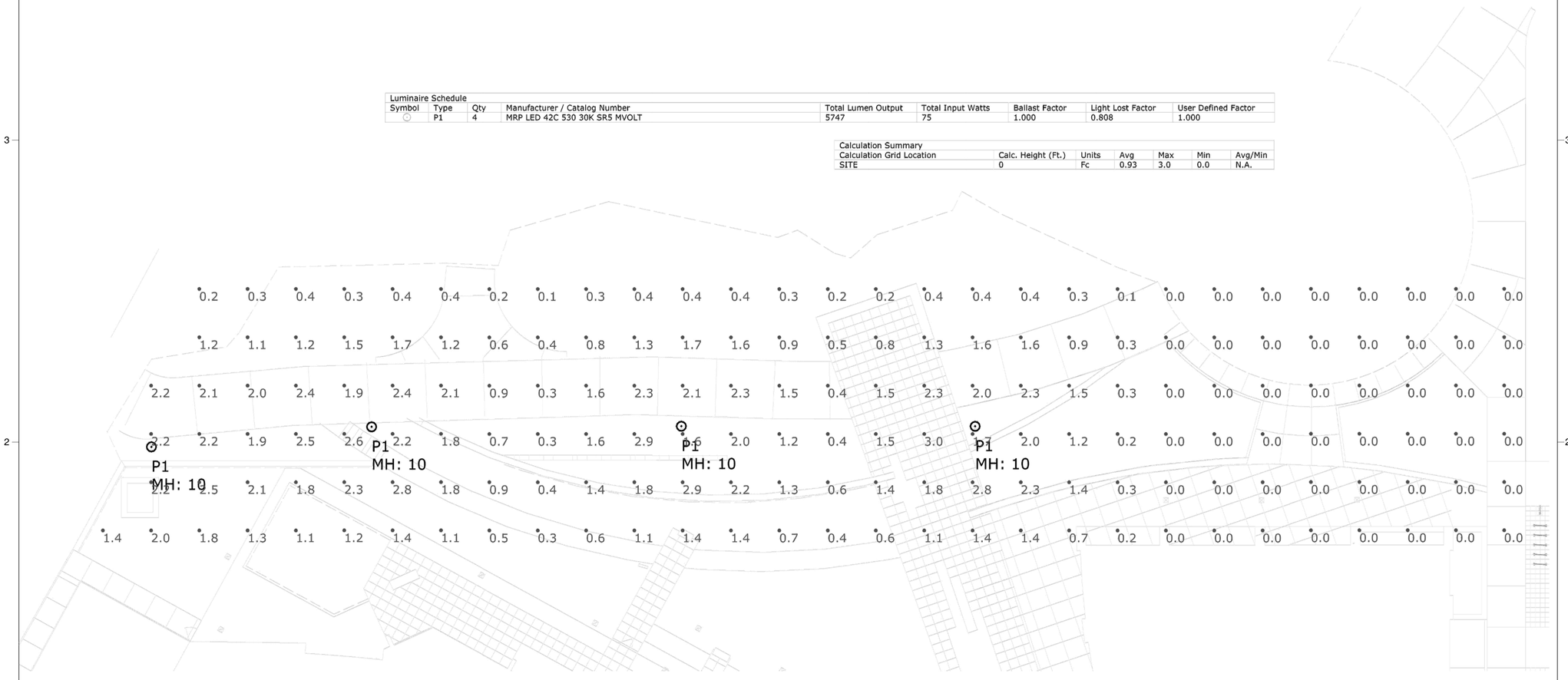
Sheet No.

E1.00

ASI 26-R5
12/22/2016

| Luminaire Schedule | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Symbol | Type | Qty | Manufacturer / Catalog Number | Total Lumen Output | Total Input Watts | Ballast Factor | Light Lost Factor | User Defined Factor |
| | P1 | 4 | MRP LED 42C 530 30K SR5 MVOLT | 5747 | 75 | 1.000 | 0.808 | 1.000 |

| Calculation Summary | | | | | | |
|---|---|---|---|---|---|---|
| Calculation Grid Location | Calc. Height (Ft.) | Units | Avg | Max | Min | Avg/Min |
| SITE | 0 | Fc | 0.93 | 3.0 | 0.0 | N.A. |




Photometric Plan | A

NTS | E1.01


studioOutside
824 Exposition Avenue, Ste. 5
Dallas, Texas 75226
o214.954.7160
f214.954.7162


Project Name

# CONFLUENCE PARK EAST

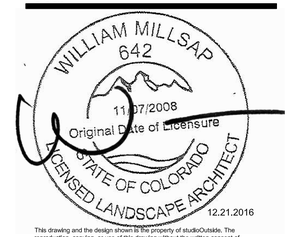
Issue Title

PERMIT

Issue / Addenda / Revisions

| | Date | Description |
|---|---|---|
| 1 | 7.26.16 | Permit Comments |
| 2 | 8.08.16 | Permit Comments |
| 3 | 9.01.16 | Permit Comments |
| 4 | 9.13.16 | Permit Comments |
| 5 | 9.20.16 | Permit Comments |
| 6 | 10.14.16 | Permit Comments |
| 7 | 11.28.16 | Permit Comments |
| 8 | 12.21.16 | Permit Comments |

Seal





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Drawing Title

PHOTOMETRIC PLAN

| | |
|---|---|
| Issue Date: | 12.21.2016 |
| Project No: | 14047 |
| Reviewed By: | MF |
| Drawn By: | BH |

Sheet No.

1 E1.01

ASI 26-R5
12/22/2016

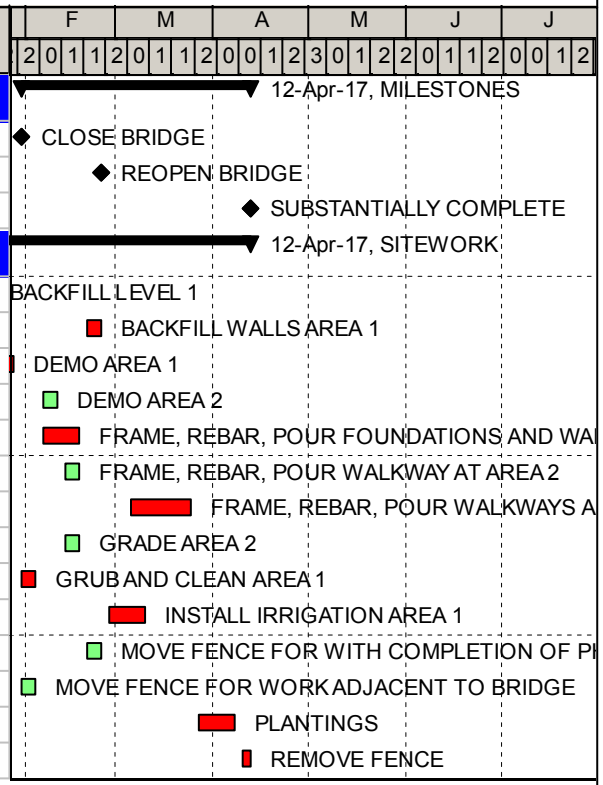
# AMENDED EXHIBIT D

Construction Specifications and Timeframes

(Attached)

CONFLUENCE APARTMENTS - PARK | Classic Schedule Layout | 12-Jan-17 12:08

| # | Activity ID | Activity Name | Start | Finish |
|---|---|---|---|---|
| 1 | **MILESTONES** | | 30-Jan-17 | 12-Apr-17 |
| 2 | MILE200 | CLOSE BRIDGE | 30-Jan-17 | |
| 3 | MILE210 | REOPEN BRIDGE | | 24-Feb-17 |
| 4 | MILE220 | SUBSTANTIALLY COMPLETE | | 12-Apr-17 |
| 5 | **SITEWORK** | | 16-Jan-17 | 12-Apr-17 |
| 6 | PARK1000 | BACKFILL LEVEL 1 | 16-Jan-17 | 20-Jan-17 |
| 7 | PARK1040 | BACKFILL WALLS AREA 1 | 20-Feb-17 | 24-Feb-17 |
| 8 | PARK1010 | DEMO AREA 1 | 16-Jan-17 | 27-Jan-17 |
| 9 | PARK2010 | DEMO AREA 2 | 06-Feb-17 | 10-Feb-17 |
| 10 | PARK1030 | FRAME, REBAR, POUR FOUNDATIONS AND WALLS AREA 1 | 06-Feb-17 | 17-Feb-17 |
| 11 | PARK2030 | FRAME, REBAR, POUR WALKWAY AT AREA 2 | 13-Feb-17 | 17-Feb-17 |
| 12 | PARK1060 | FRAME, REBAR, POUR WALKWAYS AREA 1 | 06-Mar-17 | 24-Mar-17 |
| 13 | PARK2020 | GRADE AREA 2 | 13-Feb-17 | 17-Feb-17 |
| 14 | PARK1020 | GRUB AND CLEAN AREA 1 | 30-Jan-17 | 03-Feb-17 |
| 15 | PARK1050 | INSTALL IRRIGATION AREA 1 | 27-Feb-17 | 10-Mar-17 |
| 16 | PARK2040 | MOVE FENCE FOR WITH COMPLETION OF PHASE 2 | 20-Feb-17 | 24-Feb-17 |
| 17 | PARK2000 | MOVE FENCE FOR WORK ADJACENT TO BRIDGE | 30-Jan-17 | 03-Feb-17 |
| 18 | PARK1070 | PLANTINGS | 27-Mar-17 | 07-Apr-17 |
| 19 | PARK1080 | REMOVE FENCE | 10-Apr-17 | 12-Apr-17 |




Actual Work | Critical Remaining ... | Remaining Work | Milestone



TASK filter: All Activities

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# EXHIBIT F

Technical Specifications

(Attached)

# Confluence Park East Improvements

Technical Specifications

31 August 2016

Prepared by:

GDA Architects/Studio Outside

**TECHNICAL SPECIFICATIONS** **TABLE OF CONTENTS**

**SECTION 01 11 00 SUMMARY OF WORK**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. The Work specified in this contract consists of furnishing all management, supervision, labor, materials, tools, equipment, services, testing, and incidentals for the construction of the Work indicated in the Contract Documents including lump sum items and unit price items.

~~B. Reference General Conditions as listed:~~
~~1. Article 301 "Consideration (Contractor's Promise of Performance)".~~
~~2. Article 306 "Working Hours and Schedule".~~
~~3. Title 8 "Protection of Persons and Property".~~
~~4. Article 804 "Protection of Municipal, Public Service, or Public Utility Systems".~~

1.3 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 or the cost thereof under this contract.

B. The Contractor further acknowledges, by submission of a bid and on each change in work proposal, 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 his inspection of the site and from reviewing available records of exploratory work furnished by the City. 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 the City. The City assumes no responsibility for any representations made by any of its officers or agents during or prior to the execution of this contract unless such representation is expressly stated in the contract.

1.4 DESCRIPTION OF WORK

A. The following work items are included in these specifications: **Confluence Park East Improvements** as listed in the Table of Contents of these specifications and as shown per the Contract Drawings. The materials and installation methods specified herein are to be

considered standard for all work ordered by and performed for the Department of Parks and Recreation in the construction of new facilities in the parks.

PART 2 - PRODUCTS (Not used)

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, City 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 will be performed at times other than during the eight-hour working day of Monday through Friday, daylight hours. Submit this schedule five working days prior to the beginning of Work to the Project Manager for review and acceptance. Approval to work at night may be obtained after Contractor presents a written program outlining special precautions to be taken to control the extraordinary hazards presented by night work. That program shall include, but not limited to, supplementary lighting of work areas, availability of medical facilities, security precautions, and noise limitations.
   1. Noise Ordinance variances through Denver Department of Environmental Health require several weeks advance public notice and approval is not guaranteed.

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, 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. Confirm coordination measures for each individual case with the City in writing.

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. The City 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 the City 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.

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 City, government bodies, public and private utilities, and other contractors.

~~PART 4 - MEASUREMENT AND PAYMENT~~

~~4.1 MEASUREMENT~~

~~A. No separate measurement shall be made for work under this Section.~~

~~4.2 PAYMENT~~

~~A. No separate payment will be made for work under this section including any and all necessary relocations requested by the City. The cost of the work described in this section shall be included in the Contract price.~~

**END OF SECTION 01 11 00**

**SECTION 01 31 13 COORDINATION**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for project and construction 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. Reference General Conditions as listed:~~
~~1. Title 3 "Contractor Performance and Services".~~
~~2. Article 301 "Consideration (Contractor's Promise of Performance)".~~
~~3. Article 308 "Communications".~~

~~C.~~B. Related Sections:
~~1. Division 01 Section "Construction Surveying".~~
~~2. Division 01 Section "Administration, Procedures, Codes".~~
~~3.~~1. Division 01 Section "Project Meetings".

1.3 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:
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 City's property.

D. Site Utilization: In addition to the site utilization limitations and requirements shown on the Contract Drawings and 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 Division 01 Section "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 Contract 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 Project Manager. The Contractor shall provide surveying for the layout of all improvements including both horizontal and vertical control, in accordance with the requirements of Division 01 Section "Construction 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.

1.4 COMPLETE SYSTEMS

A. 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.

1.5 COMPATIBILITY

A. 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 Used)

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. Re-check 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 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 Project Manager 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 Project Manager for final decision.

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 substantial 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.

~~PART 4 - MEASUREMENT AND PAYMENT~~

~~4.1 MEASUREMENT~~

~~A. No separate measurement shall be made for work under this Section.~~

~~4.2 PAYMENT~~

~~A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Contract price.~~

**END OF SECTION 01 31 13**

**SECTION 01 31 19 PROJECT MEETINGS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for the Contractor, including his field superintendent and quality control representative, to attend meetings scheduled by the City for the collection and dissemination of information related to the subject contract.
   1. The Contractor will prepare the minutes of each meeting and distribute them to each of the participants.

1.3 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 the City after the Contract has been signed by all parties. The purpose of this meeting is to introduce the City's Representatives to their counterparts in the Contractor's organization and to establish lines of communication between the representatives and outline some of the contract requirements. The Contractor's superintendent[**,** and quality control representative(s) shall attend this meeting.
   1. The Project Manager will distribute a notice of this meeting, along with an agenda of the subjects to be addressed.
   2. The Project Manager will explain and discuss the responsibilities and authorities of the City, the Designer, and the Project Manager's organization.
   3. The Project Manager will provide highlights of the following information at this meeting:
      a. Minority Business Enterprise (MBE) and Women Business Enterprise (WBE) requirements.
      b. Insurance, laws, codes, traffic regulations, and permit requirements of public agencies and their regulations.
      c. Procedures for processing change orders.
      d. Procedures for submitting shop and working drawings, product data and samples.
      e. Monthly pay estimate cutoff dates.
      f. Payment procedures.
      g. Request for information procedures.
      h. Communication procedures.
      i. Contractor-required Daily Reports.

j. Scheduling and coordination requirements.
k. Quality Control/Quality Assurance procedures.
l. Environmental requirements and permits.
m. Milestones for Substantial Completion and Final Acceptance.
n. Record documents.
o. Project closeout requirements.

B. The Contractor will introduce the Contractor's representatives and briefly describe each person's responsibilities. The Contractor shall 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 and security procedures, including the name and contact information for the Contractor's insurance company.
4. 60 day preliminary schedule.
5. Sequence of Work.
6. Construction methods, 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 requirements for utility work.
10. Deliveries and priorities of major equipment.
11. Submittal schedule.

C. Explanations provided by the City 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 or 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 Project Manager. Meetings will be chaired by the Contractor.

C. The Contractor's personnel, as listed in Paragraph 3.1.A, above, shall attend unless otherwise agreed by the Project Manager.

D. The Contractor's 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 Representative shall present and discuss the Independent Testing Agency weekly test report and/or testing schedule.
b. The Contractor's Quality Control representative shall report on inspections by other agencies and any follow-up activity required.
c. The Project Manager shall present and discuss issues regarding quality control.

3. Quality Assurance: The Project Manager shall present and discuss issues regarding quality assurance.
4. Design Activities: Open discussion.
5. Shop Drawings / Submittals / Material Procurement:
   a. The Contractor shall provide and review the 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 re-submit with changes.
   d. 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).
      1) This information shall be provided by the Contractor in a format satisfactory to the City Project Manager and shall include, at a minimum:
         a) Submittal/shop drawing preparation duration.
         b) Review duration.
         c) Fabrication duration.
         d) Delivery duration.

      2) All long-lead items shall be identified with a separate activity on the approved CPM project 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 Project Manager 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 based on the approved CPM, and shall include dates of testing activities, items in progress, percentage of completion of items, responsible subcontractor for the items.

~~PART 4 - MEASUREMENT AND PAYMENT~~

~~4.1 MEASUREMENT~~

~~A. No separate measurement shall be made for work under this Section.~~

~~4.2 PAYMENT~~

~~A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Contract price.~~

**END OF SECTION 01 31 19**

**SECTION 01 32 13 SCHEDULE**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the requirements for the preparation of a preliminary schedule, construction schedule, related narratives, and monthly progress reports, all encompassing complete performance of contract requirements.

B. The Contractor shall schedule and coordinate the work of all of its subcontractors and suppliers including their use of the worksite. The Contractor shall keep the subcontractors and suppliers informed of the project construction schedule to enable the subcontractors and suppliers to plan and perform their work properly.

C. The Contractor shall, in accordance with the requirements of the technical specifications, submit a construction schedule that shall provide for the expeditious and practicable execution of the Work.

D. The construction schedule for the performance of the Work shall be a Critical Path Method (CPM) system in bar chart format, unless an alternate system is specifically identified in the technical specifications, with reasonable detail including a time scaled network and computer printout as more fully detailed in the technical specifications.

E. Float or slack is defined as the amount of time between the early start date and the late start date or the early finish date and the late finish date of any activities in the schedule. Float or slack is not time for the exclusive use or benefit of either the Contractor or the City.

F. The Contractor shall submit a monthly progress report and schedule update in accordance with the scheduling provisions of the technical specifications.

G. The Contractor shall complete the Work within the contract time and in accordance with the most recent schedule submittal that has been approved in writing by the Project Manager.

~~H. Reference the General Conditions as listed:~~
~~1. Article 306 "Working Hours and Schedule".~~
~~2. Article 603 "Delay Damages".~~
~~3. Article 909 "Additional Withholding of Progress Payments".~~
~~4. Article 1103 "Contractor Change Request".~~
~~5. Article 1202 "Submittal of Claims".~~

1.3 PLANNING

A. The schedule shall show total contract time, including project milestones, as indicated in the Special Conditions or elsewhere in the contract documents.

B. The Contractor shall prepare a work plan to complete the work within the contract time and complete those portions of work relating to each milestone date and other contract requirements.
   1. The Contractor shall generate a computerized Critical Path Method (CPM) schedule in the Precedence Diagram Method (PDM) format for the Work.
   2. The computerized format shall be compatible with the City's Primavera system, version 3.1 or Microsoft Office Project Professional 2003 or later.
   3. The Schedule shall be submitted electronically to the Project Manager in a dynamic format which will allow review and manipulation of any part of the schedule, and in reproducible hard copy.
   4. The schedule activities shall be resource loaded showing labor man hours by crafts, major construction equipment by type and value of the work.
   5. The value of the work shall summarize each pay item shown in the Schedule of Values and balance to their amount.

C. In addition to the construction activities, the schedule shall include activities for furnishing materials and equipment and vendor shop drawing preparation.
   1. The construction schedule, a supporting narrative, and the overall progress curve shall be submitted for approval within thirty (30) days after Notice to Proceed.
   2. Within thirty (30) days the City will respond with approval or direction to revise and resubmit within ten days.
   3. Failure of the Contractor to have a construction schedule approved by the City will be considered cause for withholding progress payment(s).

D. To the extent that the construction schedule or any revisions thereof contains anything not jointly agreed upon in writing, or fails to show anything jointly agreed upon in writing, it shall not be considered to have the approval of the City.
   1. Failure to include any work item required for performance of this contract shall not excuse the Contractor from completing all work within applicable completion dates, regardless of the City's approval of the schedule.

E. Failure of the Contractor to comply with this Section will be considered cause for withholding progress payment(s) or termination for default.

1.4 SUBMITTALS

A. Refer to Division 01 Section "Submittals" for submittal procedures. Submit the following as indicated:
   1. Preliminary schedule (with narrative).
   2. Construction schedule data and work plan (with narrative).
   3. Monthly progress report.
   4. Construction schedule change request (as needed).
   5. Record construction schedule.

PART 2 - PRODUCTS

2.1 PLOT AND REPORT FORMAT

A. All plots shall be either 24- x 36-inches or 36- x 44-inches. They shall contain a title block with a minimum eighteen (18) point font showing:
   1. Contractor's name.

2. Contract number and title.
3. Plot date.
4. Data date.
5. Symbol definitions.
6. List of all approved changes to the original approved schedule.

B. Plots shall contain a time line at the top.

C. Reports shall be submitted on 8-1/2- x 11-inch paper with a one-inch margin in a 3-ring binder, or as directed by the Project Manager.

## PART 3 - EXECUTION

### 3.1 PRELIMINARY SCHEDULE

A. The Contractor shall prepare a preliminary schedule covering the first 90 calendar days of the contract. All reports shall be on 8-1/2- x 11-inch paper. This preliminary schedule shall be submitted at the Preconstruction Meeting and shall be accompanied by a narrative description of the work plan. Within fourteen (14) days, the City will respond with acceptance or direction to revise and resubmit within ten days.

B. The preliminary schedule shall show all significant work tasks that occur in the first ninety (90) days, including planning, mobilization, shop submittals and approvals, procurement, fabrication and construction. It shall identify work items or milestones that affect or are affected by the City, other Contractor's work, utilities and other third parties, and it shall list major data submittals required by the contract.

C. The preliminary schedule shall be accompanied by a narrative describing the Contractor's approach to mobilization, procurement and construction during the first 90 days. The narrative shall elaborate on the basis of duration, production rates, major equipment to be used, and shall identify all major assumptions used to develop the schedule.

### 3.2 CONSTRUCTION SCHEDULE

A. The construction schedule shall be a computerized CPM schedule that includes:
1. Work items identified in a Work Breakdown Structure (WBS) format that corresponds with the technical specifications.
2. The order, sequence and interdependence of all significant work items including construction, procurement, fabrication, testing, startup and inspection and delivery of critical or special materials and equipment, submittals and approvals of critical samples, shop drawings, procedures, or other documents that could have a schedule impact.
3. Work items by the City, other Contractors, utilities and other third parties that may affect or be affected by Contractor's activities.
4. Proper referencing of all work items to identify applicable subcontractors or other performing parties.
5. Work item duration not to exceed twenty (20) working days. No more than twenty five percent (25%) of the work item may be on the critical path.
6. Work items shall be resource loaded to show the direct craft man-hours estimated to perform the work including work by subcontractors.

7. A narrative that explains the basis for the Contractor's determination of construction logic. It shall include estimated quantities and production rates, hours per shift, work days per week, and types, number and capacities of major construction equipment to be used and whether the Contractor plans to work weekends or holidays.

B. The construction schedule shall be prepared to include the data for the total contract duration, and the critical path shall be identified, including critical paths for interim completion dates. Scheduled start or completion dates imposed on the schedule by the Contractor shall be consistent with contract milestone dates. Milestone events shall be the schedule dates specified in the Special Conditions and shall be prominently identified and connected to the appropriate work item, denoting its start or completion. Work items related to any interim milestones shall be coded for that milestone.

C. The Contractor shall submit the following documents to the City upon completion of preparation of the construction schedule:
1. A time phased plot of the CPM schedule in PDM format showing all logic ties and an electronic copy in dynamic format.
2. Various computer generated construction schedule reports that contain the following data for each work item: Identification, description, responsibility, duration, early start and early finish, late start and late finish, total float, and resources. The work items shall be sorted by float, early start, subcontractor or other sorts mutually agreed to. The reports shall also show the logic ties of successor and predecessor work items.
3. A physical progress curve showing either manpower or other appropriate key contract items derived from the construction schedule and against which physical progress performance will be measured for schedule and payment purposes.
4. The narrative described in paragraph 3.2.A.7, above.

3.3 PROGRESS REPORTING

A. The Contractor shall submit a monthly progress report at the end of each month following the Notice to Proceed. At the end of each month, the Contractor and Project Manager shall agree on the progress of the work and the Contractor shall update the construction schedule accordingly. The updated construction schedule is a prerequisite to the submittal of the Contractor's application for progress payment. The schedule shall be made in accordance with Article 3.2, above. This review does not constitute an approval of the construction schedule and shall not be used for the purposes of modifying the initially approved construction schedule.

B. The Contractor shall submit the monthly progress report consisting of a written narrative and various construction schedule reports. This report will be reviewed in a meeting between the Contractor and Project Manager.
1. The narrative report shall describe overall progress of the work, provide a critical path analysis, discuss significant problems with proposed corrective action, and show the status of major changes and any other changes in sequence of the Work.
2. The construction schedule reports shall include tabular reports showing the status of resources for completed and in progress work items and for work items scheduled to start in the next thirty (30) days. The report shall include all the information outlined in paragraph 3.2.C.2, above.
3. A bar chart format schedule shall be provided showing the Contractor's completion status (progress) on each work item along with plots described in paragraph 3.2.C.1, above.
4. The physical progress curve shall be updated to show actual progress.

C. The latest completion time for any work item does not fall within the time allowed by the construction schedule, the sequence of work and/or duration shall be revised by the Contractor through concurrent operations, additional manpower, additional shifts or overtime, additional equipment or alternative construction methods until the schedule produced indicates that all significant contract completion dates, occupancy dates and milestones will be met. No additional costs will be allowed if such expediting measures are necessary to meet the agreed completion date or dates except as provided elsewhere in the contract documents.

## 3.4 SCHEDULE CHANGES

A. The Contractor's request for construction schedule changes shall be made on the latest approved construction schedule and shall be accompanied by a narrative description and justification for the change, and shall be submitted in accordance with the General Conditions Article 1105 "Time Extensions" on changes in time. Minor revisions submitted at monthly progress review meetings are not considered as changes in this context.

B. The construction schedule may be changed when one or more of the following occur:
1. When a change order significantly affects the contract completion date or sequence of work items.
2. When the Contractor elects to change the sequence or duration of work items affecting the critical path.
3. When the City directs a change that affects a milestone date(s) specified in the Special Conditions or alters the length of a critical path.

C. If, after submitting a request for change to the construction schedule, the Project Manager does not agree with the request, the Project Manager will schedule a meeting with the Contractor to discuss the differences. If a settlement cannot be reached on the change in the construction schedule or if the Contractor has failed to submit revisions to the network, the Project Manager has the option of providing suggested logic and/or duration times in all subsequent updating reports. The suggested logic and/or duration times will remain in effect until the change in the construction schedule is settled or until the logic and duration are superseded.
1. If the Contractor has any objections to the data furnished by the Project Manager, he shall advise the Project Manager within ten days in writing, fully supporting the objections with a counter plan. The revisions suggested by the Project Manager shall be used for updating reports until the Project Manager approves the counter plan.
2. If the Contractor does not submit a counter plan and data within ten days after the date of the Project Manager's suggested logic, the Contractor is deemed to concur with the Project Manager's suggested logic/duration time changes. The Project Manager's plan will be the basis of negotiations for any adjustment of the time and cost for performance of the Work.

## 3.5 CONTRACT EXTENSIONS

A. If the Contractor is granted an extension of time for completion of any milestone or contract completion date under the provisions of the contract, the determination of the total number of extended days will be based upon the current analysis of the schedule and upon all data relevant to the extension. Such data shall be incorporated in the next monthly update of the schedule.

B. The Contractor acknowledges and agrees that delays in work items which, according to schedule analysis do not affect any milestone dates or contract completion date shown on the CPM network at the time of the delay will not be the basis for a contract extension.

C. Weather Delays: Impacts to the project schedule related to abnormal weather conditions will be based on General Conditions Section 1105.3.

3.6 RECORD CONSTRUCTION SCHEDULE

A. After all contract work items are complete, the Contractor shall submit an Record Construction Schedule showing actual start and finish dates for all work items and milestones.

~~PART 4 - MEASUREMENT AND PAYMENT~~

~~4.1 MEASUREMENT~~

~~A. No separate measurement shall be made for work under this Section.~~

~~4.2 PAYMENT~~

~~A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Contract price.~~

**END OF SECTION 01 32 13**

**SECTION 01 32 19 SUBMITTALS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section summarizes the requirements for the submittal of documents to the City that are defined in these Specifications. It also describes the procedures for "supplemental" submittals.

~~B. Reference the General Conditions as listed:~~
~~1. Article 309 "Contractor Submittals and other Written Communications to the City".~~
~~2. Article 405 "Shop Drawings, Product Data, and Samples".~~

PART 2 - PRODUCTS

2.1 SUBMITTAL SCHEDULE

A. The Contractor shall provide a submittal schedule within fourteen (14) days after Notice to Proceed. The Submittal Schedule shall be directly related to the CPM schedule, 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.

B. The submittal schedule shall be updated every two weeks by the Contractor and submitted with the progress payment request.

C. One electronic submittal submitted on a single CD-ROM or DVD-ROM.

2.2 ELECTRONIC SUBMITTALS

A. All submittals shall be delivered to the Project Manger 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 Project Manager 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 include any related x-ref files, plot files and pen settings.

c. Other files pre-approved by the Project Manager.

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 Project Manager: 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: 005-012973-002", five submittals have been logged overall with two submittals made to Division 01 Section "Schedule of Values".
   f. Example B: 009-012973-002-R3, nine submittals made overall and three revisions to submittal 012973-002.

## 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 an engineer 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 the Project Manager may indicate the action taken.

C. Make submissions sufficiently in advance so that the Project Manager 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 the City.

E. The Contractor shall at the time of submission describe variations from the contract documents in writing, separate from the submittal document. If the Project Manager approves any such variations, an appropriate contract change order shall be issued 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.

F. Changes in accepted submittal documents will not be permitted unless those changes have been accepted, in writing, by the City.

G. The form and quality of submittal documents shall comply with Article 2.2, above.

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 Project Manager for conformance to requirements of the contract drawings and specifications. Review of a separate item will not constitute review of an assembly in which the item functions. The Project Manager will withhold approval of submittals that depend on other submittals not yet submitted. Review and acceptance will not relieve the Contractor from his responsibility for accuracy of submittals, for conformity of submittal document to requirements of contract drawings and specifications, for compatibility of described product with contiguous products and the rest of the system, or for protection and completion of the contract in accordance with the contract drawings and specifications.

B. The Project Manager 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 - NO EXCEPTIONS TAKEN: no corrections or resubmissions required; fabrication may proceed.
2. B - MAKE CORRECTIONS NOTED: If Contractor complies with noted corrections, fabrication may proceed and resubmission is not required. If for any reason the Contractor cannot comply with the noted corrections, fabrication shall not proceed and Contractor shall resubmit for additional review and comment.
3. C - REVISE AND RESUBMIT means that the submittal is unacceptable and must be revised and resubmitted. Fabrication shall not proceed.
4. E - NOT ACCEPTED Submittal is not in compliance with the Contract Documents, and is not acceptable. Resubmit Contract compliant material.

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 the City's review, correction and acceptance of submittals.

C. Contractor's liability to the City, in case of variations in the submittal document from the requirements of the contract documents, is not relieved by the City's review and acceptance of submittals containing variations unless the City expressly approves the deviation in writing, in which the City 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 the City with the Record Documents at the end of the job.

E. Schedule impact due to resubmittal requirements is the responsibility of the Contractor.

~~PART 4 - MEASUREMENT AND PAYMENT~~

~~4.1 MEASUREMENT~~

~~A. No separate measurement shall be made for work under this Section.~~

~~4.2 PAYMENT~~

~~A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Contract price.~~

**END OF SECTION 01 32 19**

# SECTION 01 33 23 SHOP AND WORKING DRAWINGS, PRODUCT DATA, AND SAMPLES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. This Section includes requirements for preparing and submitting shop and working drawings, product data, samples, and record documents required by other specifications sections.
   1. The Contractor shall submit all shop and working drawings, product data and samples, as defined in the General Conditions, to the Project Manager in accordance with the requirements in the specifications. The Project Manager will return one copy of the shop and working drawings, and product data to the Contractor with a written transmittal within the time periods noted in the specifications.

~~B. Reference the General Conditions as listed:~~
~~1. Article 111 "Final Completion".~~
~~2. Article 117 "Shop Drawings".~~
~~3. Article 405 "Shop Drawings, Product Data, and Samples".~~

### 1.3 SUBMITTALS

A. Refer to Division 01 Section "Submittals" for submittal procedures.

B. All submittals shall be delivered to the Project Manager 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 Project Manager 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 include any related x-ref files, plot files and pen settings.

         3) Other files pre-approved by the Project Manager.

   2. Adobe Acrobat Requirements:
      a. Drawings shall have security set to "No Security". Commenting, printing, adding photos, filling in 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.

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 Project Manager: 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: 005-012973-002", five submittals have been logged overall with two submittals made to Division 01 Section "Schedule of Values".
   f. Example B: 009-012973-002-R3, nine submittals made overall and three revisions to submittal 012973-002.

C. Quantities:
1. Post electronic submittals as PDF electronic files directly to the Project Manager, Contractors FTP site, a site specifically established for the Project, or in a digital delivery method agreed to by the Project Manager.
   a. The Contractor should send an email for each submittal posted to all parties notifying them the submittal is available for review.
   b. The Project Manager 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 Project Manager.
3. Samples: Submit four (4) 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 the Project Manager will be in electronic form and incorporated into the electronic submittal file.
2. Comments from Project Manager will be formatted as described in Division 1 Section "Submittals".
3. Resubmittals of electronic documents shall modify the original electronic file with new information and include the Project Manager's comments with appropriate responses and additional information.

1.4 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 the City.

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 drawings and specifications.
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 Division 01 Section "Submittals", 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.
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 drawing 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 the City not later than thirty (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.

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 Project Manager is 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 Division 01 Section “Contract Closeout”.

3.2 REVIEW BY THE CITY

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 Project Manager. 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.

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 the City.

~~PART 4 - MEASUREMENT AND PAYMENT~~

~~4.1 MEASUREMENT~~

~~A. No separate measurement shall be made for work under this Section.~~

~~4.2 PAYMENT~~

~~A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Contract price.~~

**END OF SECTION 01 33 23**

**SECTION 01 35 23 CONSTRUCTION SAFETY**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for construction safety precautions and programs by the Contractor and the basis for reviews by the Project Manager.

~~B. Reference the General Conditions as listed:~~
~~1. Article 801 "Safety of Persons".~~
~~2. Article 802 "Protective Devices and Safety Precautions".~~
~~3. Article 803 "Protection of Property and Work in Progress".~~

1.3 RESPONSIBILITY

A. The General Conditions make it clear that all safety precautions during the construction process are the responsibility of the Contractor. The Contractor is responsible for the health and safety of his 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 the Project Manager or his authorized representatives shall relieve the Contractor of any of its obligations and duties hereunder.

1.4 SUBMITTAL

A. Refer to Division 01 Sections "Submittals" and "Shop and Working Drawings, Product Data, and Samples" for the process. A safety plan shall be submitted by the General Contractor prior to commencing any work.

1.5 PROJECT MANAGER'S REVIEW

A. The Contractor shall provide two (2) copies of its safety program to the Project Manager 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 8.0 or newer and one body hard copy of the following information for acceptance by the Project Manager 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 (24) hours per day emergency phone numbers of Contractor site management to be used in case of injury or accident. Provide at least four contacts.
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.
    1) The Contractor shall also show how material will be stored beside the excavation.
    2) 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 within the project area by the Contractor.
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 firefighting equipment the Contractor will have available and how this equipment's condition will 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 a contractor or subcontractor employee, the Contractor shall provide the Project Manager 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 Division 01 Section "Summary of Work".

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 section.

~~PART 4 - AND PAYMENT~~

~~4.1 MEASUREMENT~~

~~A. No separate measurement shall be made for work under this Section.~~

~~4.2 PAYMENT~~

~~A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Contract price.~~

**END OF SECTION 01 35 23**

**SECTION 01 43 00 QUALITY ASSURANCE**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Quality Assurance is defined as measures, tests, and/or audits that may be performed by the City or City Representatives to ensure the Contractors work is installed per the construction documents and the contractors Quality Control plan.

B. This Section identifies inspection activities to be performed by inspectors and testing agencies employed by the City and working under the direction of the Project Manager.
   1. Inspection and tests, conducted by persons or agencies other than the Contractor, shall not in any way relieve the Contractor of his responsibility and obligation to meet all specifications and the referenced standards.
   2. The inspection and approval of work by other agencies above does not constitute inspection or acceptance of work required by the City. Technical specifications may contain requirements more stringent than Building Inspection Division or other code agency requirements.

~~C. Reference General Conditions as listed:~~
   ~~1. Article 1701 "Construction Inspection by the City".~~
   ~~2. Article 1702 "Authority of Inspectors".~~
   ~~3. Article 1703 "Observable Defects".~~
   ~~4. Article 1704 "Defects – Uncovering Work".~~
   ~~5. Article 1705 "Latent Defects".~~
   ~~6. Article 1706 "Removal of Defective Materials and Work".~~

~~D.~~C. Related Sections:
   1. Division 01 Section "Contractor Quality Control".
   2. Division 01 Section "Submittals".
   3. Division 01 Section "Shop and Working Drawings, Product Data, and Samples".

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 CITY'S QUALITY ASSURANCE MEASURES

A. According to the judgment of the Project Manager, any portion of the work in this contract may be tested at any time for any reason.

B. Contractor shall not rely upon these tests to assure compliance with the Contract Documents.

3.2 TESTING – GENERAL

A. Tests: Made by testing laboratory approved by the Project Manager. Except as otherwise provided, sampling and testing of materials and laboratory methods and testing equipment shall be in accordance with latest standards and tentative methods of ASTM.
   1. Specific information concerning testing methods, sample sizes, etc., is included under applicable sections of Specifications.
   2. Any modification of, or elaboration on, these test procedures included for specific materials under their respective sections in Specifications shall take precedence over these procedures.

3.3 COST OF TESTING

A. Unless indicated otherwise, additional testing required by the City's Agents shall be performed by the City's authorized agents, at the City's expense.

B. Costs for testing shall be borne by the Contractor only if such tests indicate that work does not meet Contract Document requirements.

C. Costs for re-testing of non-complying work shall be borne by the Contractor.

3.4 TEST REPORTS

A. Test reports, whether performed for the City or the Contractor, shall be submitted to the Project Manager and Contractor as soon as results are available. Reports shall be clear, concise, comprehensive written forms containing required test results.

B. Reports of tests made by testing laboratories shall be distributed by testing laboratory as follows:
   1. Two (2) Copies – Project Manager.
   2. One (1) Copy – Contractor.
   3. One (1) Copy – Applicable Supplier or Subcontractor.

3.5 MANUFACTURING AND FABRICATION INSPECTIONS

A. The Project Manager may elect to perform additional inspections and/or tests at the place of the manufacturer, the shipping point, or at the destination to verify conformance to applicable specifications. Inspections and tests performed by the City shall not relieve the Contractor from the responsibility to meet the specifications, nor shall such inspections/tests be considered to be a guarantee for acceptance of materials that will be delivered at a later time.

B. The Project Manager or his authorized representative may inspect at its source any material or assembly to be used in the Work. Manufacturing plants may be inspected from time to time for the purpose of determining compliance with specified manufacturing methods or materials to be used in the Work and to obtain samples for testing and further inspection.

C. Should the Project Manager conduct plant inspections the following conditions shall exist:
   1. The Project Manager shall have the cooperation and assistance of the Contractor and the producer with whom the Contractor has contracted for materials.

2. The Project Manager shall have full access during scheduled production or warehousing working hours to parts of the plant that are concerned with the manufacture, production, storage or shipping of materials being furnished.
3. The Contractor shall arrange for adequate office or working space that can reasonably be needed for conducting a plant inspection. Office or working space shall be conveniently located with respect to the plant and/or warehouse as required by the Project Manager.

D. It is understood and agreed that the City shall have the right to re-test, at the City's expense, any materials that have been tested and accepted at the source of supply after it has been delivered to the site.

~~PART 4 - MEASUREMENT AND PAYMENT~~

~~4.1 MEASUREMENT~~

~~A. No separate measurement shall be made for work under this Section.~~

~~4.2 PAYMENT~~

~~A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Contract price.~~

**END OF SECTION 01 43 00**

**SECTION 01 45 16 CONTRACTOR QUALITY CONTROL**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section identifies the Quality Control activities to be performed during all phases of the contract by the Contractor. Quality Control is defined as the process by which the Contractor ensures the project is constructed per the construction documents.

B. The Contractor shall have in place his Quality Control Program as necessary to ensure that all materials and work are completed in compliance with contract documents. The Contractor is solely responsible for Quality Control. The City reserves the right to conduct additional tests or audits to verify compliance per Division 1 section “Quality Assurance”.

C. Test schedules and/or testing requirements for materials used on this project are included in the technical specifications. Laboratory and field testing identified in the technical specifications shall be conducted by an Independent Testing Agency (ITA) retained by the Contractor.

1.3 LEVEL OF CONTROL

A. The intent of this section is to enable the Contractor to establish a necessary level of control that will:
   1. Adequately provide for the production of acceptable quality materials.
   2. Provide sufficient information to ensure both the Contractor and the Project Manager that the specification requirements are being met.
   3. Allow the Contractor as much latitude as possible to develop his or her own standards of control.

1.4 SUBMITTALS

A. Refer to Division 01 Sections “Submittals” and “Shop and Working Drawings, Product Data, and Samples”, for submittal requirements.

B. Quality Control Plan: Within ten (10) days after Notice to Proceed, the Contractor shall submit a Quality Control Plan for review and acceptance. Acceptance by the Project Manager does not relieve the Contractor of compliance with the contract requirements. The Contractor Quality Control Plan shall address the following as a minimum:
   1. Provide a general description of Quality Control monitoring to be performed until final acceptance by the City. Include monitoring activities of Work and the worksite during times no construction activity is scheduled to take place.
   2. The Contractor shall designate an employee as the Quality Control Representative qualified to perform quality control monitoring of the Work. The designated individual shall have the authority to direct work changes required to bring the Work into

conformance with contract requirements including stopping non-conforming work in progress.

3. The Quality Control Plan shall address each technical specification division's requirements for quality control. The Contractor shall identify each item requiring submittal and approval/acceptance prior to installation of work. Also, the Contractor shall identify each item of work requiring testing by the independent testing agency.
4. The Quality Control Plan shall address and establish controls and documentation format to ensure that items or materials that have been accepted through receiving inspection are used or installed. Identification and traceability shall be provided throughout all inspections, test activities and records. For stored items, provisions shall be made for the control of item/material identification, consistent with the expected duration and type of storage.
5. Provide methodology of monitoring, testing and exercising of all equipment, valves and/or assemblies to ensure the Work installed is in proper working order.

C. List of Suppliers and Subcontractors: Submit a list of suppliers and subcontractors, including items to be supplied by each supplier and/or subcontractor. Identify work to be performed by each subcontractor. The list shall be updated and resubmitted as required.

D. Emergency Contact List: Submit a list of emergency contact information including name, company, title, work phone number, home phone number, and other means of contact for at least four individuals.

1. Review the Emergency Contact list on a daily basis. In the event there is any change in any of the information, the Contractor shall forward the updated list to the Project Manager.
2. The Emergency Contact list shall include the project number, project title, and date of issue.

E. Quality Control Report:

1. The Quality Control Report shall be submitted weekly or per the discretion of the Project Manager in the format detailed in Division 01 Section "Standard Forms". The report shall address as a minimum the following: identify notifications and discussions with/by other agency inspectors, identify work placed that day and any deviations and/or corrections required to bring the Work into conformance with the contract. Reporting must be digital format and signed by the Contractors Quality Control Representative. Legible, hand written reports on the approved form shall be accepted. Scanned copies of daily reports are acceptable.
2. Submit one electronic copy of the Quality Control Report to the Project Manager the week following the work or per the discretion of the Project Manager. The report shall be signed by the Contractor's Quality Control Representative and the Contractor's Superintendent.

F. Corrective Action Report (CAR): Conditions adverse to quality will be reviewed by the Contractor and the City Representative to determine the cause and to recommend a corrective action that will preclude recurrence.

1. The condition, its cause, and the corrective action planned shall be reported to the Project Manager prior to implementation.
2. Follow-up action shall be taken to verify implementation of the corrective action.
3. The Contractor will document the corrective action and a copy of the Corrective Action Report (CAR) will be transmitted to the Project Manager.

1.5 DOCUMENTATION

A. The Contractor shall not change or alter approved submittals, procedures, specifications, drawings, or other pertinent documentation without the Project Manager's written authorization.

B. All records and documents that are quality related shall be prepared, identified, and maintained by the Contractor and shall be made available to the City upon request. Records shall be protected from damage, deterioration or loss. A copy of the records and documents shall be maintained at the Work site at all times unless the Project Manager has approved other locations in writing. .

C. The Contractor shall maintain records at the actual worksite and at Contractor's office to show the inspection status of materials and items installed in order to ensure that the required inspections and tests have been performed in a timely and correct manner.

1.6 INSPECTIONS AND TESTS

A. Inspections, tests, and system shut down requests, conducted by persons or agencies other than the Contractor, shall not in any way relieve the Contractor of his responsibility and obligation to meet all specifications and the referenced standards. The Contractor's designated Quality Control Representative shall inspect the work and shall ensure the work complies with the contract requirements prior to any requests for inspection or testing.

B. When the specifications, laws, ordinances, rules, regulations or orders of any public agency having jurisdiction require the Project Manager's surveillance of inspections or tests, the Contractor shall notify the Project Manager of the place, date and time forty eight (48)-hours prior to the inspection and/or test. The Contractor shall be responsible for notifying and requesting inspection by other agencies including but not limited to the Denver Building Inspection Division, Denver Fire Department, Denver Wastewater Management Division and Denver Water. Prior to request for other agency inspections, the Contractor shall meet and plan inspection times with the Project Manager and or his designated representative.

C. Special inspections or tests may be required by the technical specifications, City, State and/or Federal Agencies in addition to those tests already performed. The Contractor shall notify the Project Manager at least forty eight (48)- hours in advance of the additional inspections or tests.

1.7 INSPECTION PLAN

A. The Contractor shall utilize the following six-point inspection plan to ensure the conformance of the Work performed by the Contractor meets the requirements of the contract drawings and specifications, the referenced codes and standards and the approved submittals:

1. Pre-work Coordination: Prior to the start of construction work, work under each separate specification section, where a change in a construction operation is contemplated by the Contractor, and a new subcontractor starting work, a coordination meeting will be held with the Contractor's superintendent, Quality Control, and Safety representative(s), and the ITA representative. Supervisory, Safety, and Quality Control representatives of all applicable subcontractors shall also attend. The Contractor's Quality Control Representative shall chair the meeting, and prepare and distribute minutes of Quality Control meetings. Meeting minutes shall be electronically distributed within twenty four (24) - hours of the meeting.

2. The purpose of the meeting is to ensure that the Contractor's personnel have no misunderstandings regarding their safety and quality procedures as well as the technical requirements of the contract. The following items shall be presented and reviewed by the Contractor:
   a. Contract requirements and specifications.
   b. Shop drawings, certifications, submittals and Record Drawings.
   c. Testing and inspection program and procedures.
   d. Contractor's Quality Control program.
   e. Familiarity and proficiency of the Contractor's and subcontractor's workforce to perform the operation to required workmanship standards including certifications of installers.
   f. Safety, security, and environmental precautions to be observed.
   g. Any other preparatory steps dependent upon the particular operation.
   h. The Contractor's means and methods for performing the Work.

3. Initial Inspection: Upon completion of a representative sample of a given feature of the Work and no later than two weeks after the start of a new or changed operation, the Project Manager and/or his designated representative will meet with the Contractor's Quality Control representative and applicable subcontractor's supervisor and their Quality Control representatives to check the following items, as a minimum:
   a. Workmanship to established quality standards.
   b. Conformance to contract drawings, specifications and the accepted shop drawings.
   c. Adequacy of materials and articles utilized.
   d. Results of inspection and testing methods.
   e. Adequacy of Record Drawings maintained daily.

4. Once accepted, the representative sample will become the physical baseline by which ongoing work is compared for quality and acceptability. To the maximum practical extent, approved representative samples of work elements shall remain visible until all work in the appropriate category is complete. Acceptance of a sample does not waive or alter any contract requirements or show acceptance of any deviation from the contract not approved in writing by the Project Manager.
5. Follow-up Inspection: The Contractor's Quality Control representative will monitor the work to review the continuing conformance of the work to the workmanship standards established during the preparatory and initial inspections.
6. Completion Inspection: This is not an acceptance inspection. Forty eight (48) - hours prior to the completion of an item or segment of work and prior to covering up any work, the Contractor will notify the Project Manager who will verify that the segment of work is substantially complete, all inspections and tests have been completed and the results are acceptable.
   a. The purpose of this inspection is to allow further corrective work upon, or integral to, the completed segment of work.
   b. If any items are determined to be deficient, need correction or are non-conforming, a Deficiency List will be prepared and issued to the respective Contractor for correction, repair or replacement of any deficient or non-conforming items.
   c. The Project Manager and Contractor's Quality Control representative will verify the correction of the deficient and/or non-conforming items prior to the start of the next operation.

7. Substantial Completion Inspection: Prior to requesting a Substantial Completion Inspection by the City, all work and operational systems to be inspected shall be satisfactorily completed and tested by the Contractor.
   a. The Contractor's written request for this inspection shall be made seventy two (72) - hours in advance.
   b. With the request shall come a list of any known deficiencies and when they will be corrected.
   c. If the list is too large or contains too many significant items, in the opinion of the Project Manager, no inspection will be held because of the incompleteness of the work.

8. The Contractor will schedule the Substantial Completion Inspection and will prepare a list of deficient items (punch list) discovered during the inspection.
   a. If during the inspection the list becomes too large or too many significant items are on the list, the inspection will be canceled.
   b. After the inspection is completed, the Deficiency List will be transmitted to the Project Manager identifying all deficient items.

9. Final Acceptance Inspection: After the Contractor has completed all items on the Deficiency List (generated from the Substantial Completion Inspection) he shall request a Final Acceptance Inspection. The request shall be made in writing at least seventy two (72) hours in advance of the inspection.
   a. All areas must be cleaned and ready for turnover prior to this inspection. The Project Manager, the design consultant, a representative of the funding agency (if applicable) and other interested parties will inspect the subject Work to ensure that all deficiencies have been satisfactorily attended to and that no new deficiencies have appeared and that all systems are completely functional.
   b. Any outstanding or additional deficient items will be noted and handled per the requirements of the Substantial Completion Inspection noted above until the Work is acceptable to the Project Manager.

1.8 SAMPLES

A. The Contractor shall maintain at the worksite a copy of all samples submitted and accepted by the City. Samples shall be made available to the designer or the Project Manager's designated representatives for review and comparison in the field. The Project Manager prior to use on the project must accept all items and materials.

B. The installed work will be compared to the samples and if any of the work is not of the same quality, material, finish, color, texture or appearance as the sample, that portion that is not the same will be considered defective and in nonconformance.

C. Contractor selection of samples will only be considered if taken at random. The Contractor shall permit representatives of the City to witness the selection of samples. Inspection or tests of items or materials that fail shall be sufficient cause to terminate further inspections/tests of the same brand, make or source of that product.

D. The Contractor is obligated to correct any item deemed deficient.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 REQUIREMENTS

A. The Contractor is responsible for Quality Control of the Construction. All acquisition of materials, sequence of construction (except as otherwise indicated), and means and methods of construction shall be the responsibility of the Contractor. Establish system to perform sufficient inspection and tests of all items of work, including that of subcontractors, to ensure conformance to Contract Documents for materials, workmanship, construction, finish, functional performance and identification.
   1. Control System: Establish for all construction except where Contract Documents provide for specific compliance tests by testing laboratories and engineers employed by the City.
   2. Control System: Specifically include all testing required by various sections of Specifications.
   3. Quality Control System: Means by which Contractor assures himself that construction complies with requirements of Contract Documents.
      a. Controls: Adequate to cover all construction operations and keyed to proposed construction schedule.

B. All materials required for the contract shall be new except where specified otherwise. The Project Manager may elect to perform additional inspections and/or tests at the place of the manufacture, the shipping point or at the destination to verify conformance to applicable specifications. Inspections and tests performed by the City shall not relieve the Contractor from the responsibility to meet the specifications, nor shall such inspections/tests be considered a guarantee for acceptance of materials that will be delivered at a later time.

C. The Contractor is obligated to correct or remove non-conforming materials, whether in place or not. If necessary, the Project Manager will send written notification to the Contractor to correct or remove the defective materials from the project. If the Contractor fails to respond, the Project Manager may order correction, removal and/or replacement of defective materials by others, in which case the Contractor shall bear all costs incurred by such actions.

D. Materials accepted on the basis of a Certificate of Compliance may be sampled and inspected/tested by the Project Manager or it's Designer at any time. The fact that the materials were accepted on the basis of such certification shall not relieve the Contractor of his responsibility to use materials that conform to the specifications.

E. The Contractor shall impose upon his suppliers the same quality control requirements, including inspection and test procedures, as imposed upon him by the specifications and referenced standards. The Contractor shall apply appropriate controls, designed to ensure that all materials supplied meet the requirements and specifications.

3.2 CONTRACTOR'S QUALITY CONTROL SYSTEM

A. The Contractor is responsible for Quality Control of the Construction. All acquisition of materials, sequence of construction (except as otherwise indicated), and means and methods of construction shall be the responsibility of the Contractor. Establish system to perform sufficient inspection and tests of all items of work, including that of subcontractors, to ensure

conformance to Contract Documents for materials, workmanship, construction, finish, functional performance and identification.

1. Control System: Establish for all construction except where Contract Documents provide for specific compliance tests by testing laboratories and engineers employed by the City.
2. Control System: Specifically include all testing required by various sections of Specifications.
3. Quality Control System: Means by which Contractor assures himself that construction complies with requirements of Contract Documents.
    a. Controls: Adequate to cover all construction operations and keyed to proposed construction schedule.

B. The Contractor shall be responsible for assuring compliance with the quality standards as indicated in the Contract Documents. In addition, the Contractor shall be responsible for:

1. Review of submittals prior to their being forwarded to the Project Manager for review. The Contractor shall mark submittals with comments and shall indicate the date and party conducting the Contractor's review of each submittal.
2. Final inspection of the project prior to calling for the Project Manager to conduct a final inspection. The Contractor shall provide his inspection comments to the Project Manager prior to the scheduled final inspection.
3. Verification of completion of punch-list items prior to calling for verification inspection by the Project Manager.

C. Records: Maintain correct records on appropriate forms for all inspections and tests performed, instructions received from the Project Manager and actions taken as result of those instructions.

1. Records: Include evidence that required inspections or tests have been performed (including type and number of inspections or tests, nature of defects, causes for rejection, etc.) proposed or directed remedial action, and corrective action taken.
2. Document inspections and tests as required by each section of Specifications.

## 3.3 MATERIAL AND WORKMANSHIP

A. Unless otherwise specified, or indicated on the Drawings, material shall be new, of best quality, and without flaws, and delivered upon completion in an undamaged condition.

B. Workmanship shall be the best of its respective kind. Labor shall be performed in a thorough workmanlike manner by qualified, efficient, and skilled mechanics, acceptable to the Project Manager, and other trades involved on the job requiring acceptable substrate for the performance of their work.

## 3.4 TESTING – GENERAL

A. Testing Laboratory and/or Engineering services are required for quality control in portions of the work identified in other sections of these specifications.

B. Tests required by these Specifications shall be performed in strict accordance with referenced testing methods, procedures, and conditions. Pertinent data shall be included in clear, comprehensive written forms according to the requirements of these Contract Documents.

C. Contractor: Provide equipment and facilities as required for testing at no additional cost, subject to Project Manager's review, for conducting field tests and for collecting and forwarding samples.
   1. Do not use materials or equipment represented by samples until tests, if required, have been made and materials or equipment found to be acceptable.
   2. Do not incorporate any product into work which becomes unfit for use after acceptance thereof.

D. Testing: Materials or equipment proposed to be used may be tested at any time during their preparation or use. Furnish required samples without charge and give sufficient notice of placing of orders to permit testing. Products may be sampled either prior to shipment or after being received at site of work.

E. Tests: Made by testing laboratory approved by the Project Manager. Except as otherwise provided, sampling and testing of materials and laboratory methods and testing equipment shall be in accordance with latest standards and tentative methods of ASTM.
   1. Specific information concerning testing methods, sample sizes, etc., is included under applicable sections of Specifications.
   2. Any modification of, or elaboration on, these test procedures included for specific materials under their respective sections in Specifications shall take precedence over these procedures.

3.5 OTHER TESTING

A. Following Testing: Performed at expense of Contractor:
   1. Any additional tests required because of any tests that fail subject to following conditions:
      a. Quantity and Nature of Tests: Determined by the Project Manager.
      b. Tests: Taken in presence of the City and/or the Project Manager.
      c. Proof of Noncompliance: Contractor liable for corrective action which the Project Manager feels is required including complete removal and replacement of defective material.

   2. Material Substitution: Any tests of material or equipment offered as substitute for specified item on which test may be required in order to prove its compliance with the Contract Documents.

B. Contractor: May have tests performed on material and equipment for his own information and job control so long as the City does not assume responsibility for costs or for giving them consideration when appraising quality of materials.

3.6 EQUIPMENT TESTING

A. Equipment testing shall be as determined appropriate by the Project Manager to assure proper performance according to the manufacturer's specifications for each equipment item.

B. After all utility connections to equipment have been completed, the Contractor shall conduct final tests of equipment in presence of the City and Project Manager.

C. Unless waived in writing by the Project Manager, the requirements of this section shall apply to all installed equipment items having utility connections.

3.7 NOTIFICATION

A. The Contractor shall be responsible for notifying the Project Manager at least 3 working days prior to commencing work which is identified as requiring testing.

B. The Contractor shall be responsible for scheduling and coordinating all required testing with the Project Manager and, when required by the City's Agents, the City's Independent Testing Agency.

3.8 TEST REPORTS

A. Test reports, whether performed for the City or the Contractor, shall be submitted to the Project Manager and Contractor as soon as results are available. Reports shall be clear, concise, comprehensive written forms containing required test results.

B. Reports of tests made by testing laboratories shall be distributed by testing laboratory as follows:
1. Two (2) Copies – Project Manager.
2. One (1) Copy – Contractor.
3. One (1) Copy – Applicable Supplier or Subcontractor.

~~PART 4 - MEASUREMENT AND PAYMENT~~

~~4.1 MEASUREMENT~~

~~A. No separate measurement shall be made for work under this Section.~~

~~4.2 PAYMENT~~

~~A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Contract price. If the City is required to re-inspect work or conduct a special test because a previous inspection, requested by the Contractor, showed that the work was defective or not in conformance, the Manager or authorized representative may deduct from the contract value the cost of re-inspection at the rate of seventy-five dollars ($75.00) per man-hour.~~

**END OF SECTION 01 45 16**

**SECTION 01 56 39 TREE RETENTION AND PROTECTION**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section consists of retention and protection of trees during the construction of the project.

1.3 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.

1.4 GENERAL REQUIREMENTS

A. Appropriate tree pruning and/or removal permits must be secured prior to beginning work.

B. City Forestry Staff or Appointee will conduct daily observation of Contractor's field crews the 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. City Forester may require a consulting arborist be hired to oversee the project. Contractor to notify Project Manager and City Forester at least two (2) weeks prior to when such observations will be needed.

C. If it appears that the completion of the construction may cause damage to the branches of any tree, the Contractor shall contact the Project Manager and the City Forester's Office. The Project Manager and City Forester will make a determination as to whether such damage is imminent.

D. 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 to the Project Manager. These routes shall be marked at the site, prior to commencement of construction, with tree protection fencing and signage as specified in Articles 3.6 and 3.7 of this section. A Tree Protection Plan shall be submitted to the Project Manager for approval by the City Forester.

E. 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 twelve inches (12") of wood mulch with overlapping three

quarter inch (3/4") thick plywood on top to help distribute the weight of equipment and to minimize soil compaction and rutting. Plywood and/or mulch are not acceptable bridging materials for driving over exposed tree roots. Exposed tree roots shall not be driven over. The City Forester or Project Consulting Arborist shall be notified and shall approve of the access and driving surface prior to its use.

F. 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 twelve inches (12") of wood mulch with overlapping three quarter inch (3/4") thick plywood on top to help distribute the weight of equipment and to minimize soil compaction and rutting. Plywood and/or mulch are not acceptable bridging materials for driving over exposed tree roots.

G. 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 City Forester or Project Consulting Arborist.

1.5 DEFINITIONS

A. Critical Root Zone: Shall be defined as the tree protection area encompassing one and one half (1.5) minimum to two (2) times the distance between the trunk and drip line.

B.

| 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.

C. Drip Line: The outermost edge of the tree's canopy or branch spread. The area within a tree's drip line is all the ground under the total branch spread.

D. High Value Shrub: Any specimen shrub with an appraised value of one-hundred dollars ($100.00) or more.

E. 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.

F. Tree Protection Area: The tree protection area should consist of the ground encompassing from one and one half (1.5) minimum to two (2) times the distance between the trunk and drip line, or one linear foot away from the trunk base for every inch diameter of the trunk, whichever is greater (see definition of drip line, 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 drip line is also referred to as the "Critical Root Zone" (see definition of critical root zone, 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.

1.6 SUBMITTALS

A. Tree Protection Plan: Submit tree protection plan for approval by the City Forester.

B. 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 City Forester prior to commencement of construction near tree protection areas.

C. Proposed methods, materials, and schedule for root pruning, branch pruning, and other tree maintenance shall be submitted for approval.
1. The City Forester or Forestry Appointee shall mark the location of root pruning lines in the field prior to the operation.
2. If possible, root pruning should occur between autumnal leaf fall and spring foliation.
3. Root pruning during the growing season shall require approval of the City Forester or Forestry Appointee.

D. Maintenance Schedule: Submit maintenance schedule to City Forester for approval.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. This section provides standards and guidelines for the retention and protection of trees and high-value shrubs for any proposed construction project.

3.2 DEMOLITION OF EXISTING CONCRETE

A. 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.

B. Breaking of the existing concrete and asphalt for removal should be done in a manner that will minimize ground disturbance and vibration.

C. 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.

D. 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.

E. During the removal of concrete, all root systems and soil areas exposed shall not be disturbed.

F. 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.

G. Should access be necessary within designated tree protection areas, the existing grade shall be covered with double, overlapping sheets of 3/4-inch thick plywood and twelve inches (12") of wood mulch to help distribute the weight of equipment and to minimize soil compaction and rutting.
1. Plywood and/or mulch are not acceptable bridging materials for driving over exposed tree roots. Exposed tree roots shall not be driven over.
2. The City Forester 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

A. The following procedures shall be used when constructing sidewalks, curbs, concrete, asphalt paving, and drainage inlets.
1. Keep all materials and equipment within the street bounded by existing curbs.
2. Protect exposed roots from contamination by stabilization materials and concrete.
3. Locate concrete washout areas away from roots and tree protection areas.
4. When excavating for the construction of inlets, excavated soil shall be deposited in trucks and hauled off or deposited temporarily on three quarter inch (3/4") thick plywood outside the critical root zone. Excavated and fill soil shall not be deposited, even temporarily, on unprotected natural grade.
5. After proper pruning, as needed, cover exposed roots within thirty (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.
6. 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).
7. Place a sheet of 6-mil or thicker plastic over the grade within affected portions of tree protection areas prior to placing concrete sidewalks, curbs, inlets, ramps, and driveway approaches. The plastic will assist in providing a non-leaching barrier between the concrete, soil and roots.
8. 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.
9. Grading within the critical root zone shall consist of the ground encompassing from one and one half (1.5) minimum to two (2) times the distance between the trunk and drip line, 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 one inch (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 one inch (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.

10. 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.
11. 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 scoring (as shown on the documents) 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 eighty percent (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.
12. Where appropriate, and under the direction of the City Forester or Appointee, root restricting barriers can be installed with a minimal amount of disturbance away from sidewalks, curbs and streets. Materials include:
    a. Eight (8) Mesh Copper (0.028-inch or greater) wire screen.
    b. "Typar BioBarrier" as manufactured by Fiberweb, Inc. www.biobarrier.com. Contact Dave Zill, (651)330-2920.
    c. Or acceptable substitution.

13. 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 Article 3.5 - Root Pruning.
    a. Excavate soil by hand at the construction cut limit to a depth of thirty (30) inches or to the depth of the required root cut, whichever is less.
    b. Prune roots as specified.
    c. Protect exposed roots as specified.

14. 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 City Forester 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 Project Manager, and, if appropriate in accordance with guidelines established in the "Guide for Plant Appraisal". All costs of such mitigating shall be charged to and paid by the Contractor. See Article 3.9 – Injuries to Existing Plants – Damage Penalties of this section for definition of high value trees and shrubs.

1. All irrigation lines shall be indicated on construction plans and pre-approved by the City Forester or Project Manager. No irrigation lines shall be located within ten feet (10') of any existing tree trunk, without prior approval of City Forester or Project Manager.

B. Existing Trees: The City Forester 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 ten percent (10%) of the critical root zone area is to be disturbed the Contractor shall notify the City Forester or Project Consulting Arborist to review the conditions. Final approval must be provided by City Forester 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:

| **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:

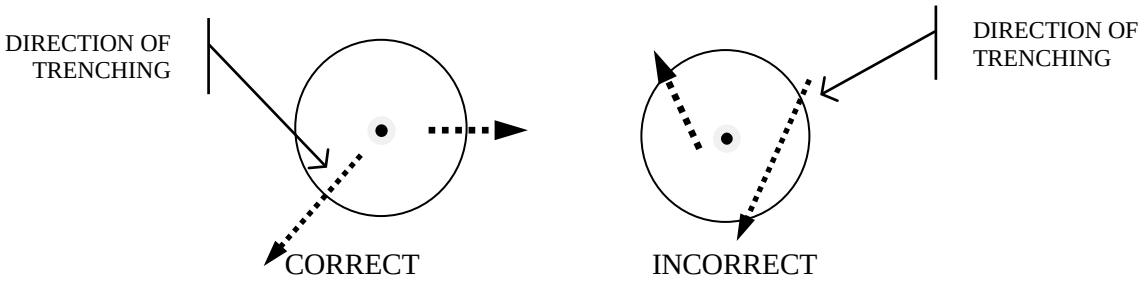
1. If excavation, trenching or utility installation only occurs on one side of the tree or within a six inch (6") linear distance from the trunk base for every one inch (1") of trunk diameter, horizontal directional boring (auger tunneling), shall be used for irrigation or utility line installations.
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') linear distance from the trunk base for every one inch (1") of trunk diameter, then horizontal directional boring (auger tunneling) shall be used.

E. All trenching or other work within the drip line of any tree shall be done by hand or other methods approved by the City Forester or Project Manager, 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 Article 3.5 - Root Pruning. 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 City Forester, Project Consulting Arborist, or Project Manager 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.




3.5 ROOT PRUNING

A. Tree roots shall not be pruned or cut unless their removal is unavoidable or absolutely necessary. The City Forester or Project Manager shall be notified prior to any operation known or suspected to involve cutting of more than:
1. The City Forester or Project Consulting Arborist shall be notified immediately in the event that roots in excess of one-half the diameter of the tree, as measured per Paragraph 1.4.D, are cut, torn, ripped, or otherwise injured.

B. Upon approval by the City Forester, 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 fourteen inches (14”). 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 the diameter of the tree, as measured per Paragraph 1.5.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 one third (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 City Forester 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.
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 one third (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 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 inches (12") 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 the diameter of the tree caliper as measured per Paragraph 1.5.D shall be examined by the City Forester 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 one third (1/3) the size of the root being removed.
2. All roots larger than one-half the diameter of the tree caliper as measured per Paragraph 1.5.D diameter are to be preserved unless their removal is absolutely necessary and approved by the City Forester. 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 City Forester 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.

3.6 TREE PROTECTION FENCING

A. Tree protection fencing should be installed 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 Project Manager and City Forester or Project Consulting Arborist.

B. Tree protection fences should be constructed of one of the following:
1. Galvanized Chain-link – Six feet (6') in height. Posts should be installed no less than ten feet (10') on center, at a depth of thirty six inches (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 forty eight inches (48") in height.

C. Fencing should be installed to completely surround the limits of tree protection areas, and should extend at least ten feet (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 City Forester or the Project Manager.

3.7 TREE PROTECTION SIGNAGE

A. A standard Forestry Tree Protection sign shall be mounted on tree protection fencing at fifty foot (50') intervals warning construction personnel and the public to keep out of the tree protection areas.
1. Signs may be picked up at the City Forestry office in the Webb Building at 201 W. Colfax Avenue.

3.8 PROJECT SITE MONITORING

A. As determined by the City Forester 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.
1. 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.
2. Specific monitoring schedules should be developed at preconstruction meetings and modified as deemed necessary by the appropriate parties.
3. Schedules shall be relayed to the City Forester and the Project Manager along with reports of site visits.

3.9 INJURIES TO EXISTING PLANTS - DAMAGE PENALTIES

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 Contractor's office.
1. 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 penalty.

B. Documentation for appraisals will consist of:

1. Measurement of plant size.
2. Identification by common and botanical names.
3. Current condition (overall health, injuries, overt hazard status, etc.).
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 one-hundred dollars ($100.00); only those trees and shrubs estimated to have a monetary value greater than one-hundred dollars ($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 will result in a penalty of up to three times the appraised value of the tree as determined by the City Forester or Forestry Appointee as described in Chapter 57 of the Denver Revised Municipal Code.

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 City Forester or Forestry Appointee. Loss or partial injury to any of these trees due to Contractor neglect or improper construction activities will result in a penalty of up to three times the appraised value of the trees as determined by the City Forester or Project Consulting Arborist as described in Chapter 57 of Denver Revised Municipal Code. Injury to a portion of these trees will be assessed by the City Forester or Project Consulting Arborist and a corresponding portion of the damages will be assessed to the Contractor.

F. A fine of one-thousand dollars ($1,000.00) will be levied against the Contractor 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 appraised value of the tree or tree part.

G. Trees or roots visibly and unnecessarily injured, in the opinion of the Project Manager, City Forester and/or Project Consulting Arborist will cause the City to withhold from the Contractor an assessed amount conforming to the requirements stipulated above, for a period of one full year. After that period the impact of the injury to any tree will be assessed by the City Forester or the Forestry Appointee.

3.10 TREE AND OTHER PLANT MAINTENANCE DURING AND AFTER COMPLETION OF CONSTRUCTION

A. Tree Maintenance: Proper maintenance shall include, but be limited 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 City Forester or Forestry Appointee, based on factors associated with the site and affected plants.

C. Submit maintenance schedule to the City Forester for approval prior to work beginning.

~~PART 4 - MEASUREMENT AND PAYMENT~~

~~4.1 MEASUREMENT **[Consultant to select A or B]**~~

~~A. Measurement will be based on the percentage complete for the lump sum contract amount for Tree Retention and Protection.~~

~~B. Measurement will be made by the contract unit specified for Tree Retention and Protection. Measurement shall include the actual number of units of specified material(s) placed and accepted at the locations shown on the Contract Drawings, or as directed by the Project Manager, and in accordance with the Specifications.~~

~~4.2 PAYMENT~~

~~A. Payment will be made at the **[contract unit]** **[lump sum contract]** price, and shall include required materials, transportation, equipment, and labor, <**Insert additional items**> required to establish tree protection, and remove the tree protection at the end of the project as required in accordance with the Contract Drawings and Specifications. Payment will also include the maintenance of the tree protection throughout the duration of the project as well as the labor, materials and equipment required to restore the site to its original condition at the completion of the project.~~

**END OF SECTION 01 56 39**

**SECTION 01 57 13 EROSION AND SEDIMENTATION CONTROL**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section consists of requirements for the installation and maintenance of erosion and sedimentation prevention and protection measures during the construction of the project from just prior to the start of earth disturbance until final site stabilization. The cost of maintaining, repairing, and/or replacement of damaged BMP's will be at the Contractors expense.

B. Refer to "City and County of Denver Construction Activities Stormwater Manual" by City and County of Denver Wastewater Management Division, Department of Public Works, revised June 2010, or latest edition, at:

http://www.denvergov.org/Portals/711/documents/StormConsCriteriaFinWCover121610.pdf

C. Refer to applicable sections within the **Wastewater Capital Projects Management Standard Construction Specifications**, Wastewater Management Division, Department of Public Works, specifications updated September 2014, or latest edition.

PART 2 - PRODUCTS

2.1 Refer to "City and County of Denver Construction Activities Stormwater Manual".

PART 3 - EXECUTION

3.1 Refer to "City and County of Denver Construction Activities Stormwater Manual".

**END OF SECTION 01 57 13**

**SECTION 01 60 00 MATERIAL AND EQUIPMENT**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements governing the Contractor's selection of products for use in the project.

1.3 DEFINITIONS

A. Definitions used in this Article are not intended to change the meaning of other terms used in the Contract Documents, such as "specialties", "systems", "structure", "finishes", "accessories", and similar terms. Such terms are self-explanatory and have well-recognized meanings in the construction industry.
   1. Products: Are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term "Product" includes the terms "material", "equipment", "system" and terms of similar intent.
   2. Named Products: Are items identified by manufacturer's product name, including make or model designation, indicated in the manufacturer's published product literature that is current as of the date of the Contract Documents.
   3. Materials: Are products that are substantially shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the Work.
   4. Equipment: Is a product with operational parts, whether motorized or manually operated, that requires service connections such as wiring or piping.

1.4 SUBMITTALS

A. Product List: A list of products is included in each appropriate specification division. Prepare a schedule in tabular form showing each product listed. Include the manufacturer's name and proprietary product names for each item listed.
   1. Coordinate product list with the Contractor's Construction Schedule and the Schedule of Submittals.
   2. Form: Prepare product list with information on each item tabulated under the following column headings:
      a. Related Specification Section number.
      b. Generic name used in Contract Documents.
      c. Proprietary name, model number, and similar designations.
      d. Manufacturer's name and address.
      e. Supplier's name and address.
      f. Installer's name and address.
      g. Projected delivery date or time span of delivery period.

3. Initial Submittal: Within thirty (30) days after date of commencement of the Work, submit three (3) copies of an initial product list. Provide a written explanation for omissions of data and for known variations from Contract requirements.
4. Completed List: Within sixty (60) days after date of commencement of the Work, submit three (3) copies of the completed product list. Provide a written explanation for omissions of data and for known variation from Contract requirements.
5. Action: The Project Manager will respond in writing to Contractor within two (2) weeks or receipt of the completed product list. No response within this period constitutes no objection to listed manufacturers or products, but does not constitute a waiver of the requirement that products comply with Contract Documents. The Project Manager's response will include a list of unacceptable product selections, containing a brief explanation of reasons for this action.

## 1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products according to the manufacturer's recommendations, using means and methods that will prevent damage, deterioration and loss, including theft.
1. Schedule delivery to minimize long-term storage at the site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to assure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to the site in an undamaged condition in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting and installing.
4. Inspect products upon delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
5. Store products at the site in a manner that will facilitate inspection and measurement of quantity or counting of units.
6. Store products subject to damage by the elements above ground, under cover in a weathertight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.

## 1.6 GENERAL PRODUCT REQUIREMENTS

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, new at the time of installation.
1. Provide products complete with accessories, trim, finish, safety guards, and other devices and details needed for a complete installation and the intended use and effect.
2. Standard Products: Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.

B. It is the responsibility of the Contractor and his installers, as experts, to notify the Project Manager of any specified product that to his knowledge will not meet the requirements or is unsuited to the application indicated or specified.

C. The use of manufacturer's and trade names is intended only to establish standards of quality and performance and not to limit competition.

D. Substitution of Materials and Equipment: All bids are to be based on those materials and equipment specified in the Contract Documents. Substitutions after the bid will be made in

accordance with the provisions of General Contract Conditions Article 406 “Substitution of Materials and Equipment”, and Division 01 Section “Substitutions”.

## PART 2 - PRODUCTS

### 2.1 PRODUCT SELECTION PROCEDURES

A. The Contract Documents and governing regulations govern product selection. Procedure governing product selection include the following:

1. Proprietary Specification Requirements: Where Specifications name only a single product or manufacturer, provide the product indicated. No substitutions will be permitted.
2. Semi-proprietary Specification Requirements:
   a. Where Specifications name two or more products or manufacturers, provide one (1) of the products indicated. No substitutions will be permitted.
   b. Where Specifications specify products or manufacturers by name, accompanied by the term “or equal” or “or approved equal,” comply with the Contract Document provisions concerning “substitutions” to obtain approval for use of an unnamed product.
3. Non-proprietary Specifications: When Specifications list products or manufacturers that are available and may be incorporated in the work, but do not restrict the Contractor to use of these products only, the Contractor may propose any available product that complies with Contract requirements. Comply with Contract Document provisions concerning “substitutions” to obtain approval for use of an unnamed product.
4. Descriptive Specification Requirements: Where Specifications describe a product or assembly, listing exact characteristics required, with or without use of a brand or trade name, provide a product or assembly that provides the characteristics and otherwise complies with Contract requirements.
5. Performance Specification Requirements: Where Specifications require compliance with performance requirements, provide products that comply with these requirements and are recommended by the manufacturer for the application indicated. Manufacturer’s recommendations may be contained in published product literature or by the manufacturer’s certification of performance.
6. Compliance with Standards, Codes and Regulations: Where Specifications only require compliance with an imposed code, standard, or regulation, select a product that complies with the standards, codes, or regulations specified.
7. Visual Matching:
   a. Where Specifications require matching an established Sample, the Project Manager’s decision will be final on whether a proposed product matches satisfactorily.
   b. Where no product available within the specified category matches satisfactorily and complies with other specified requirements, comply with provisions of the Contract Documents concerning “substitutions” for selection of a matching product in another product category.
8. Visual Selection: Where specified product requirements include the phase “...as selected from manufacturer’s standard colors, patterns, textures...” or a similar phrase, select a product and manufacturer that complies with other specified requirements. The Project Manager will select the color, pattern, and texture from the product line selected.

PART 3 - EXECUTION

3.1 INSTALLATION OF PRODUCTS

A. Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated. Anchor each product securely in place, accurately located and aligned with other work. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

3.2 QUALITY ASSURANCE

A. Source Limitations:
   1. To the fullest extent possible, provide products of the same kind from a single source.
   2. Substitutions to the specified products will only be allowed in accordance with General Contract Conditions Article 406 "Substitution of Materials and Equipment", and Division 01 Section "Substitutions".

B. Nameplates: Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on surfaces of products that will be exposed to view in occupied spaces or on the exterior.
   1. Labels: Locate required product labels and stamps on concealed surfaces or, where required for observation after installation, on accessible surfaces that are not conspicuous.
   2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on an easily accessible surface that is inconspicuous in occupied spaces. The nameplate shall contain the following information and other essential operating data:
      a. Name of product and manufacturer.
      b. Model and serial number.
      c. Capacity.
      d. Speed.
      e. Ratings.

~~PART 4 - MEASUREMENT AND PAYMENT~~

~~4.1 MEASUREMENT~~

~~A. No separate measurement shall be made for work under this Section.~~

~~4.2 PAYMENT~~

~~A. The cost of the Work described in this Section shall be included in the Contract price.~~

**END OF SECTION 01 60 00**

**SECTION 01 66 00 STORAGE AND PROTECTION**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. The Work specified in this Section consists of providing storage and protection of the materials, products and supplies which are to be incorporated into the construction and indicating such storage areas on the Contract Drawings with the location and dates when such areas will be available for each purpose.

~~B. Reference General Contract Conditions Article 803 "Protection of Property and Work in Progress".~~

1.3 SUBMITTALS

A. Refer to Division 01 Sections "Submittals" and "Shop and Working Drawings, Product Data, and Samples" for submittal procedures. Submit concurrently with submittals required in Division 01 Section "Layout of Work and Surveys".

B. Storage Site Plan: Submit working drawings showing locations of storage areas not indicated on the Contract Drawings.

C. Storage and Protection Methods: Submit descriptions of proposed methods and locations for storing and protecting products.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials required for the storage and protection of the items specified shall be durable, weatherproof and either factory finished or painted to present an appearance acceptable to the Project Manager. Storage facilities shall be uniform in appearance with similar materials used to the maximum extent possible.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS OF EXECUTION

A. Palletize materials, products and supplies which are to be incorporated into the construction and stored off the ground. Store these items in a manner which will prevent damage and which will facilitate inspection. Leave seals, tags and labels intact and legible. Maintain access to products to allow inspection. Protect products that would be affected by adverse environmental conditions.

B. Periodically inspect stored products to ensure that products are being stored as stipulated and that they are free from damage and deterioration.

C. Do not remove items from storage until they are to be incorporated into the Work.

D. The Contractor shall ensure that all protective wrappings and coverings are secure and ballasted to prevent any items from deterioration and/or subsequent dislodgment. All items on the worksite that are subject to becoming windborne shall be ballasted or anchored.

3.2 HANDLING AND TRANSPORTATION

A. Handling:
1. Avoid bending, scraping or overstressing products. Protect projecting parts by blocking with wood, by providing bracing or by other approved methods.
2. Protect products from soiling and moisture by wrapping or by other approved means.
3. Package small parts in containers such as boxes, crates, or barrels to avoid dispersal and loss. Firmly secure an itemized list and description of contents to each container.
4. Refer to Division 32 Sections related to landscape materials for proper handling and storage of plant material.

B. Transportation: Conduct the loading, transporting, unloading, and storage of products so that they are kept clean and free from damage.
1. Refer to Division 32 Sections related to landscape materials for proper transportation of plant material.

3.3 STORAGE

A. Store items in a manner that shall prevent damage to the City's property. Do not store hydraulic fluids, gasoline, liquid petroleum, gases, explosives, diesel fuel, and other flammables in excavations, except one day's supply of diesel fuel may be stored in open excavations.

B. Provide sheltered weather-tight or heated weather-tight storage as required for products subject to weather damage.

C. Provide blocking, platforms or skids for products subject to damage by contact with the ground.

D. All material shall be stored according to the manufacturer's recommendations. Any material that has to be stored within specified temperature or humidity ranges shall have a twenty four (24) hour continuously written recording made of the applicable condition. Should the recording show that the material was not stored within the recommended ranges the material shall be considered defective and in nonconformance. If a certification from the manufacturer's engineering design representative is provided stating that the actual variations are acceptable and will in no way harm the material or affect warranties, then the deficiency will be considered corrected.

E. Store hazardous material separately, with all material marked with a label showing the hazard and how to treat exposure to the material.

3.4 LABELS

A. Storage cabinets and sheds that will contain flammable substances and explosive substances shall be labeled FLAMMABLE--KEEP FIRE AWAY and NO SMOKING with conspicuous lettering and conforming to OSHA requirements.

~~PART 4 - MEASUREMENT AND PAYMENT~~

~~4.1 MEASUREMENT~~

~~A. No separate measurement shall be made for work under this Section.~~

~~4.2 PAYMENT~~

~~A. The cost of the Work described in this Section shall be included in the Contract price. See Division 01 Section "Schedule of Values" for additional requirements for the possible payment of stored material.~~

**END OF SECTION 01 66 00**

**SECTION 01 71 23 LAYOUT OF WORK AND SURVEYS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the procedures and accuracy requirements for survey services for layout of work and field measurement of work quantities to be determined by surveys.
   1. The Work is to be verified and coordinated with Contract Drawings. Variations between Contract Drawings and actual field conditions are to be immediately brought to the attention of the Project Manager.
   ~~2. Reference Construction General Contract Conditions Article 318 "Construction Surveys" and Article 319 "Preservation of Permanent Land Survey Control Markers".~~

1.3 SUBMITTALS

A. Refer to Division 01 Sections "Submittals" and "Shop and Working Drawings, Product Data, and Samples" for the submittal process.

B. Field Notes: Submit Copies of original pages of field notes.

C. Closeout Submittals:
   1. Original field notebooks when filled and at end of contract.
   2. Measurements for Record Documents.

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. The City 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 his obligations according to the terms of this 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 licensed surveyor.

3.2 DIGITAL FILES

A. If approved by the Project Manager, Contractor may elect to utilize design consultant's digital CADD files as guidance for layout and location of site elements.

B. Layout and location of site elements, grades and features from digital CADD files does not relieve the Contractor of requirements, locations and grades shown on the Contract Drawings.

C. Contractor is responsible to verify locations of elements staked with digital data to assure conformance with the Contract Drawings at a level of accuracy as stated in Section 3.3 below.

3.3 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 drawings or specifications, and shall not otherwise relieve the Contractor of responsibility for measurements in compliance therewith.

3.4 RECORD MEASUREMENTS

A. Provide record measurement for items that will be hidden or visible including all civil, mechanical and electrical, control work, and all utilities that are placed in concrete, earth, or behind walls shall be made.

B. Items located within or five feet beyond a building shall be referenced to building column lines and finish floor elevations.

C. 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.

~~PART 4 - MEASUREMENT AND PAYMENT~~

~~4.1 MEASUREMENT~~

~~A. No separate measurement shall be made for work under this Section~~

~~4.2 PAYMENT~~

~~A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Contract price.~~

**END OF SECTION 01 71 23**

**SECTION 01 74 23 CLEANING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the requirements for maintaining a clean, orderly, hazard free worksite during construction, and final cleaning for the City's Final Acceptance. Failure to maintain the worksite will be grounds for withholding monthly payments until corrected to the satisfaction of the Project Manager.

~~B. Reference General Contract Conditions as listed:~~
~~1. Article 325 "Cleanup During Construction".~~
~~2. Article 803 "Protection of Property and Work in Progress".~~
~~3. Article 2001 "Cleanup Upon Completion".~~

1.3 JOB CONDITIONS

A. Safety Requirements: 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.
1. 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: Maintain the worksite to permit access by other 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.

B. Maintain current Safety Data Sheets (SDS) on site for all chemicals. Refer to following link for associated OSHA requirements. https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10103

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 construction 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 City’s property.

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 was 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.

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, 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 the City's records.

F. Repair damaged materials to the specified finish or remove and replace.

G. Clean all catch basins, manholes, drains, strainers, and filters after all trades have completed their work and just before Final Acceptance

H. Sweep roadway, driveways, floors, steps, and walks.

I. Interior areas of buildings shall be vacuumed clean and mopped.

J. Final cleanup applies to all areas within and adjacent to the site.

~~PART 4 - MEASUREMENT AND PAYMENT~~

~~4.1 MEASUREMENT~~

~~A. No separate measurement shall be made for work under this Section.~~

~~4.2 PAYMENT~~

~~A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Contract price.~~

**END OF SECTION 01 74 23**

**SECTION 01 77 00 CONTRACT CLOSEOUT**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes procedures required for Substantial Completion under Title 19 and Final Completion and Acceptance of the Work under Title 20 of the General Contact Conditions and Division 01 Section "Contract Record Documents".

~~B. Reference General Contract Conditions as listed:~~
~~1. Article 906 "Applications for Payment".~~
~~2. Article 909 "Additional Withholding of Progress Payments".~~
~~3. Article 2003 "Final Settlement".~~

1.3 PREPARATION FOR FINAL INSPECTION

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

1.4 FINAL INSPECTION

A. When the Contractor considers that the Work 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 required Record 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 General Conditions.

C. If the Project Manager finds incomplete or defective work:
1. The Project Manager may, at his 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 the Project Manager that Work is complete.

3. The Project Manager will then re-inspect the Work.

~~1.5 REINSPECTION FEES~~

~~A. Should the Project Manager perform re-inspection due to failure of the Work to comply with the claims of status of completion made by the Contractor:~~
~~1. The Contractor shall compensate the City for such additional services at the rate of seventy-five dollars ($75.00) per man-hour.~~
~~2. The City shall deduct the amount of such compensation from the final payment to the Contractor.~~

~~1.6 FINAL ADJUSTMENT OF ACCOUNTS~~

~~A. Submit a Final Statement of Accounting to the Project Manager.~~

~~B. The Final Statement of Accounting shall reflect all adjustments to the contract amount and shall include the following:~~
~~1. The original contract amount.~~
~~2. Additions and deductions resulting from:~~
~~a. Previous change orders.~~
~~b. Allowances.~~
~~c. Final quantities for unit price items. Along with this statement shall be detailed backup for the quantities.~~
~~d. Deductions or corrected work.~~
~~e. Penalties.~~
~~f. Deductions for liquidated damages.~~
~~g. Deductions for re-inspection payments.~~
~~h. City resurveys required due to the Contractor.~~
~~i. Other adjustments.~~

~~3. Total contract amount, as adjusted.~~
~~4. Previous payments.~~
~~5. Sum remaining due.~~

~~C. If required, the Project Manager will prepare a final change order, reflecting approved adjustments to the Contract sum which were not previously made by change orders.~~

~~1.7 FINAL APPLICATION FOR PAYMENT~~

~~A. The Contractor shall submit the final application for payment in accordance with the procedures and requirements stated in the General Conditions Title 20 "Final Completion and Acceptance of the Work".~~

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

~~PART 4 - MEASUREMENT AND PAYMENT~~

~~4.1 MEASUREMENT~~

~~A. No separate measurement shall be made for work under this Section.~~

~~4.2 PAYMENT~~

~~A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Contract price.~~

**END OF SECTION 01 77 00**

**SECTION 01 78 23 OPERATION AND MAINTENANCE DATA**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section consists of requirements for preparing and submitting operation and maintenance data for mechanical, electrical, and other specified equipment.

1.3 SUBMITTALS

A. Refer to Division 01 Sections “Submittals” and “Shop and Working Drawings, Product Data, and Samples” 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 acceptance tests and 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.

1.4 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 are the requirements of hard copies:
   1. Paper Size: 8-1/2-inches x 11-inches.
   2. Paper: White bond, at least twenty (20) pound weight.
   3. Text: Typewritten.
   4. 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.
   5. Drawings: 8-1/2-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.
   6. Prints of Drawings: Black ink on white paper, sharp in detail, and suitable for making reproductions.

7. Flysheets: Separate each portion of the manual with colored, neatly prepared flysheets briefly describing the contents of the ensuing portion.
8. Covers: Provide forty (40) to fifty (50)-mil, clear plastic, front and plain back covers for each manual. The front covers shall contain the information required in Article 3.2 below.
9. 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. Title: "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. Names, addresses, 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.

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 (1) copy of each piping diagram.

T. Location where all measurements are to be made.

U. One (1) copy of each duct diagram.

V. One (1) copy of control diagram.

W. One (1) copy of each accepted shop drawing.

X. One (1) 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 (2) 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.

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.

~~PART 4 - MEASUREMENT AND PAYMENT~~

~~4.1 MEASUREMENT~~

~~A. No separate measurement shall be made for work under this Section.~~

~~4.2 PAYMENT~~

~~A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Contract price.~~

**END OF SECTION 01 78 23**

**SECTION 01 78 35 WARRANTIES AND BONDS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the requirements for preparing and submitting warranties and bonds required by these specifications.

~~A. Reference the General Contract Conditions as listed:~~
~~1. Article 111 "Final Completion".~~
~~2. Article 1501 "Surety Bonds".~~
~~3. Article 1502 "Performance Bond".~~
~~4. Article 1503 "Payment Bond".~~
~~5. Article 1801 "Contractor's Warranties, Guarantees, and Correction of Work".~~
~~6. Article 1802 "Performance During Warranty Period".~~

1.3 SUBMITTALS

A. Refer to Division 01 Section "Submittals" for submittal procedures.

B. Submit executed warranties and bonds.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 WARRANTIES AND BONDS

A. Execute the warranties and bonds required by the Contract Documents. Prepare and submit a list of all warranties and bonds on the form provided by the City. Reference Division 01 Section "Standard Forms".

B. Provide warranties or bonds 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 General Contract Conditions. Refer to the individual specifications sections for all specific items requiring longer warranty periods.

C. Provide all warranties and bonds that the manufacturer or supplier furnishes at no additional cost in regular commercial trade. All warranties shall be in accordance with the General Contract Conditions. Refer to the individual specifications sections for all specific items requiring longer warranty periods.

~~PART 4 - MEASUREMENT AND PAYMENT~~

~~4.1 MEASUREMENT~~

~~A. No separate measurement shall be made for work under this Section.~~

~~4.2 PAYMENT~~

~~A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Contract price.~~

**END OF SECTION 01 78 35**

**SECTION 01 78 39 CONTRACT RECORD DOCUMENTS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the requirements for maintaining, marking, recording, and submitting contract record documents, including shop drawings, warranties, contract documents, and Contractor records.

B. Reference ~~General Contract Conditions Article 324 "Documents and Samples at the Site" and~~ Division 32 Sections "Irrigation Systems" and "Automatic Irrigation Controllers".

1.3 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. Shop drawings, diagrams, illustrations, schedules, charts, brochures and other similar data, updated to record status.
2. Warranties, guarantees, and bonds.
3. Contract documents.
4. Contractor records.

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 drawings, 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 field-modified 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. Reference Standards in accordance with Division 01 Section “Definitions and Conventions”.
d. 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-installed elevations and location (station and offset).
    4) Details not on original contract drawings but obtained through requests for information or by other communications with the City.

2. Contractor Records:
    a. Daily QC Reports.
    b. Certificates of compliance for materials used in construction.
    c. Nonconformance Reports (NCRs).
    d. Remedial Action Requests (RARs).
    e. Completed inspection list.
    f. Inspection and test reports.
    g. Test procedures.
    h. Qualification of personnel.
    i. Approved submittals.
    j. Material and equipment storage records.
    k. Safety Plan.
    l. Erosion, sediment, hazardous and quality plans.
    m. Hazardous material records.
    n. First report of injuries.

## 3.2 RECORDING

A. Keep record documents current daily.

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

C. Legibly mark up each Section of the technical specifications and contract 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 the City prior to final acceptance.

B. Do not use record documents for construction purposes.

C. Make documents available for inspection by the Project Manager and any others having jurisdiction.

3.4 REVIEW

A. Project Manager or their designated representative will inspect the Record Drawings at each weekly progress meeting to ensure that they are being maintained and contain the most current data.

B. Prior to any application for payment, the Project Manager or his designated representative will inspect the record documents to ensure that they are being maintained and contain the most current correct data with particular attention to Record Drawings.

C. If, during the inspection, the Project Manager determines that the documents are not being maintained and kept current as to as-installed conditions, an amount may be withheld from the payment request and deducted from the contract value to cover the City's cost of collecting and recording the Record Contract data. This cost will be determined on the basis of seventy-five dollars ($75.00) per man-hour of effort.

3.5 QUALITY CONTROL

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

3.6 IRRIGATION RECORD DRAWINGS

A. Refer to Division 32 Section "Irrigation Systems", Article 1.5.G

~~PART 4 MEASUREMENT AND PAYMENT~~

~~4.1 MEASUREMENT~~

~~A. No separate measurement shall be made for work under this Section.~~

~~4.2 PAYMENT~~

~~A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Contract price.~~

**END OF SECTION 01 78 39**

**SECTION 02 41 00 DEMOLITION**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the requirements for demolition and removal of:
1. Asphalt walks, concrete slabs and curbs.
2. Signs.
3. Abandoned utilities.
4. Miscellaneous site furnishings.

B. Related Sections:
1. Division 01 Section “Temporary Facilities and Controls”.
2. Division 01 Section “Erosion and Sedimentation Control”.
3. Division 01 Section “Tree Protection and Retention”.
4. Division 31 Section “Earth Moving”.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to the City in a condition ready for re-use.

C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

E. Recyclable Material: Material generated during demolition operations that can be reconditioned and reclaimed for the same or different use. Such materials include asphalt, concrete, metals (steel, iron, aluminum, copper, etc), rubber, glass and paper.

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 per Division 01 Section “Temporary Facilities and Controls”.

1.5 PRE-CONSTRUCTION MEETINGS

A. Preconstruction: Inspect and discuss condition of construction to be selectively demolished.

B. Review structural load limitations of existing structure.

C. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.

D. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.

E. Review areas where existing construction is to remain and requires protection.

F. Agenda Items

1.6 INFORMATIONAL SUBMITTALS

A. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property **for environmental protection, for dust control.** Indicate proposed locations and construction of barriers.

B. Schedule of Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure the City's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.

C. Inventory: Submit a list of items to be removed and salvaged and deliver to the City prior to start of demolition.

D. Preconstruction Photographs or Video: Submit before Work begins.

1.7 CLOSEOUT SUBMITTALS

A. Inventory:
1. Submit a list of items that have been removed and salvaged.
2. Include documentation of the type and volume/weight of materials hauled to the nearest recycling center.

B. Landfill Records: Provide records of receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

PART 2 - PRODUCTS

2.1 FILL MATERIALS

A. Soils as indicated on documents, free of debris, frozen materials, roots, and other organic matter. See Division 01 Section "Earth Moving".

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 Division 01 Section "Temporary Facilities and Controls" and Division 01 Section "Tree Protection and Retention", prior to proceeding with any demolition.

C. Protection and Repair of Underground lines:
1. Existing Public Utilities: Locate existing underground utilities within the limits of work per General Contract Conditions, Article 804 Protection of Municipal, Public Service or Public Utility Systems. Request utility locates seventy two (72) hours in advance of any excavations by calling the Utility Notification Center of Colorado at 811. The contractor is responsible for providing written and graphical documentation from the utility owner. Take whatever precautions are necessary including potholing to verify location and depth to protect these underground lines from damage. Should unmarked or incorrectly marked utilities or other piping be encountered during excavation, notify the Project Manager immediately for direction. If damage does occur, all damage shall be repaired by the utility owner and all costs of such repair shall be paid by the contractor. Only written all clears will be acceptable, verbal all clears will not be accepted.
2. Existing Private Utilities: Locate existing underground utilities within the limits of work per General Contract Conditions, Article 804 Protection of Municipal, Public Service or Public Utility Systems. The contractor is required to contact all private utility companies including Denver City departments to locate all private utilities. The contractor is responsible for providing written and graphical documentation from the private utility owner. The request for locates shall be a minimum of seventy two (72) prior to proceeding with any excavation. If, after such requests, private utilities are encountered and damaged by the contractor these shall be repaired at no cost to the city. If the contractor damages staked or located private utilities they shall be repaired by the utility owner and all costs of such repair shall be paid by the contractor. Only written all clears will be acceptable, verbal all clears will not be accepted.

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 to Denver Arapahoe Disposal Site (DADS). DADS Disposal tickets shall be provided to the Contractor by Project Manager.
2. Remove asphalt paved roads, parking lots, walks, curbs and miscellaneous asphalt as indicated on Contract 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 to DADS. DADS Disposal tickets shall be provided to the Contractor by Project Manager.
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 to DADS. DADS Disposal tickets shall be provided to the Contractor by Project Manager.

b. When Asbestos Concrete Pipe (ACP) is determined or suspected to be present the Contractor will need to hand dig the pipe sections to be removed. Any ACP sections will need to remain intact. The use of mechanical trenching equipment within eighteen inches (18") of any known or suspected ACP will not be permitted. Once the section that is to be removed has been excavated, an abatement contractor will remove the sections of the pipe that are to be replaced or removed and the pipe shall be flush cut. The Contractor is responsible for notifying the Project Manager of any ACP that needs to be removed forty-eight (48)-hours prior to excavation of the area. If ACP is excavated that has not be previously identified the Contractor is responsible to contact the Project Manager either verbally or by email immediately upon discovery. Any ACP that is discovered to be damaged must be immediately reported to the Project Manager. The Project Manager will then notify the Abatement Contractor of the work that needs to be performed. The Abatement Contractor has twenty four (24)-hours to respond and remove the ACP section(s).

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 Project Manager. All recyclable materials shall be hauled to nearest recycling center and any non-recyclable materials shall be hauled to DADS. DADS Disposal tickets shall be provided to the Contractor by Project Manager.

B. Abandoned Utilities: Remove aboveground utilities and terminate as approved by the utility company and the Project Manager. Remove necessary portions of underground utilities to a minimum of twenty-four (24)-inches below the elevation 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 Division 31 Section "Earth Moving".

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 Division 31 Section "Earth Moving".

## 3.4 DISPOSAL

A. Remove trash, debris and waste materials, haul and legally dispose of it off the property. All recyclable materials shall be hauled to nearest recycling center and any non-recyclable materials shall be hauled to DADS. DADS Disposal tickets shall be provided to the Contractor by Project Manager.

B. Salvaged Material: All salvaged material remains the property of the City. Store or deliver as directed by the Project Manager.

3.5 QUALITY CONTROL

A. Comply with safety requirements for demolition, ANSI A10.6-83.

~~PART 4 - MEASUREMENT AND PAYMENT~~

~~4.1 MEASUREMENT **[Consultant to select A or B]**~~

~~A. Measurement will be based on the percentage complete for the lump sum contract amount for Demolition.~~

~~B. Measurement will be made by the contract unit specified for Demolition. Measurement shall include the actual number of units of specified materials(s) removed or placed and accepted at the locations shown on the Contract Drawings, or as directed by the Project Manager, and in accordance with the Specifications.~~

~~4.2 PAYMENT~~

~~A. Payment will be made at the **[contract unit]** [**lump sum contract**] price, and shall include required materials, transportation, equipment, labor, excavation, stockpiling, disposing, hauling off, watering, dust control, erosion and sediment control, <**Insert additional items**> as required in accordance with the Contract Drawings and Specifications. The price shall include sawing or otherwise effectively cutting the existing paving, curb and gutter or concrete pipe smoothly and squarely in a manner satisfactory to the Project Manager. The price shall include the removal and offsite disposal of all materials including all materials and any base course deemed unsuitable by the Project Manager. No payment will be made for the removal and/or replacement of any paving, curb and gutter or pipe sections damaged by the Contractor beyond the authorized limits of removal.~~

**END OF SECTION 02 41 00**

**SECTION 03 30 00 CAST-IN-PLACE CONCRETE**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section of the Work includes 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 Sections:
1. Division 01 Section “Layout of Work and Surveys”
2. Division 01 Section “Submittals”.
3. Division 01 Section “Contractor Quality Control”.
4. Division 01 Section “Erosion and Sedimentation Control”.
5. Division 31 Section “Earth Moving”.
6. Division 32 Section “Aggregate Base Course”.
7. Division 31 Section “Concrete Walks, Curbs, and Miscellaneous Flatwork”.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 REFERENCES

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

B. American Concrete Institute (ACI):
1. ACI 117 - Standard Tolerances for Concrete Construction and Materials.
2. ACI 301 - Specifications of Structural Concrete for Buildings.
3. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
4. ACI 305 and 306 - Hot and Cold Weather Protection for Concrete.
5. ACI 315 - Details and Detailing of Concrete Reinforcement.
6. ACI 318 - Building Code Requirements for Reinforced Concrete.
7. ACI 347 - Recommended Practice for Concrete Formwork.

C. American National Standards Institute (ANSI):
1. ANSI/ASTM A82 - Cold Drawn Steel Wire for Concrete Reinforcement.
2. ANSI/ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement.

D. American Society for Testing and Materials (ASTM):
1. ASTM A615 - Deformed and Plain Billet-Steel for Concrete Reinforcement.
2. ASTM C33 - Concrete Aggregates.
3. ASTM C94 - Ready-Mixed Concrete.
4. ASTM C150 – Portland Cement.
5. ASTM C260 - Air Entraining Admixtures for Concrete.
6. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.
7. ASTM C494 - Water Reducing Admixtures for Concrete.
8. ASTM C618 - Fly Ash Mineral Admixture for Concrete.
9. ASTM C672 - Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals.
10. ASTM-C800 - Curing Compound, Concrete, for New and Existing Surfaces.
11. ASTM-C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete

E. Concrete Reinforcing Steel Institute (CRSI) - Manual of Standard Practice.

F. Colorado Department of Transportation (CDOT) - Standard Specifications for Road and Bridge Construction.

G. National Ready Mixed Concrete Association (NRMCA)

1.5 QUALITY CONTROL

A. Reference Standards: Comply with following standards except where more stringent requirements are shown or specified:
1. American Concrete Institute (ACI) Publications: Comply with the following unless modified by requirements in the Contract Drawings. 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. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
k. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
l. ASTM A615 - Deformed and Plain Billet-Steel for Concrete Reinforcement.
m. ASTM C33 - Concrete Aggregates.
n. ASTM C94 - Ready-Mixed Concrete.
o. ASTM C150 - Portland Cement.
p. ASTM C260 - Air Entraining Admixtures for Concrete.
q. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.
r. ASTM C494 - Water Reducing Admixtures for Concrete.
s. ASTM C618 - Fly Ash Mineral Admixture for Concrete.
t. ASTM C672 - Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals.

2. ASTM-C800 - Curing Compound, Concrete, for New and Existing Surfaces.
3. Concrete Reinforcing Steel Institute (CRSI) - Manual of Standard Practice.

B. Pre-Construction Conference: Conduct conference at location approved by Project Manager.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

   a. Contractor's superintendent.
   b. Independent testing agency responsible for concrete design mixtures.
   c. Ready-mix concrete manufacturer.
   d. Concrete subcontractor.
   ~~e. Special concrete finish subcontractor.~~

2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semi-rigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, concrete repair procedures, and concrete protection.

C. Refer to Part 3 QUALITY CONTROL for Contractor’s testing requirements.

1.6 SUBMITTALS

A. Product Data: For each type of product specified.

B. Mix Designs:
1. Submit substantiating data for each concrete mix design specified for use to the Project Manager 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 Project Manager).
   e. Wet and dry unit weight.
   f. Entrained air content.
   g. Design slump.
   h. Strength qualification data.

C. 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.

D. Qualification Data: Installer to document for Owner’s Representative experience on projects of similar scope and scale successfully completed within the past five (5) years.

E. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials and aggregates.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Fiber reinforcement.
6. Waterstops.
7. Curing compounds.
8. Floor and slab treatments.
9. Bonding agents.
10. Adhesives.
11. Vapor retarders.
12. Semirigid joint filler.
13. Joint-filler strips.
14. Repair materials.
15. Epoxy joint filler.

F. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

G. Field quality-control reports.

H. Minutes of Pre-Construction conference.

1.7 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 initial 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 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.

1.8 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 degree (40°) F or when the average outdoor temperature is expected to drop below forty degrees forty degree (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 Project Manager 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 Project Manager. 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 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.
1. Curved elements shown on plans are to be constructed with smooth-curved forms. Faceted forms composed of straight sections will not be accepted.

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. Tie Wire: ASTM A82, minimum sixteen (16) gauge annealed type.

C. Chairs, Bolsters, Bar Supports, and 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 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade sixty (60), plain-steel bars, cut true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class one (1) plastic-protected steel wire or CRSI Class two (2) stainless-steel bar supports.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.4 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
3. Fly ash: ASTM C618 Class C or F.
4. Aggregate: ASTM C33.
   a. Obtain from same source throughout project.
   b. All sand and aggregates to meet C-33 Table 3 for Class 4S “Severe Weathering Region”.
      1) Fine Aggregate: Clean, natural sand.
      2) Coarse Aggregate: Clean gravel or crushed stone.

5. Water: ASTM C 94/C 94M, clean and not detrimental to concrete.

2.5 ADMIXTURES

A. General: Unless specified, no admixtures may be used without specific approval of the Project Manager.

B. Prohibited Products: Calcium chloride or admixtures containing more than one half of one percent (0.05%) chloride ions or thiocyanates are not permitted.

C. Color Admixture: Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Davis Colors.
   b. Acceptable substitution.

2. Color: Match Architect's sample.

D. Air-Entraining Admixture: ASTM C260. Subject to compliance with requirements, provide one of the following:
1. “Air Mix” by Euclid Chemical Co.
2. “Darex ARA” by W. R. Grace.
3. “Micro-Air” by Master Builders.
4. Acceptable substitution.

E. Water Reducing Admixture: ASTM C494, Type A. Subject to compliance with requirements, provide one of the following:
1. “Eucon WR-75” by Euclid Chemical Co.
2. “Rheobuild 1000” by Master Builders.
3. “Plastocrete 106” by Sika Chemical Co.
4. Acceptable substitution.

F. 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” by Euclid Chemical Co.
2. “Pozzolith 400N” by Master Builders.
3. “Sikament” by Sika Chemical Co.
4. Acceptable substitution.

G. Warm Weather Admixtures: ASTM C494. Use of admixtures will not relax warm weather placement requirements.

H. Cold Weather Admixtures: ASTM C494. Use of admixtures will not relax cold weather placement requirements.

2.6 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” by Protex.

2. "Cast Off" by Sonneborn.
3. "Debond" by L&M Construction Chemicals.

B. Epoxy Adhesive: ASTM C881; two (2)-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" by Sika Chemical Corp.
2. "Patch and Bond Epoxy" by Burke.
3. "Epoxtite" by A.C. Horn.
4. "Sure-Poxy" by Kaufman Products, Inc.
5. "Euco Epoxy 463 or 615" by 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") thick. 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") thick.

D. Slip Joints:
1. Speed Dowel Model PSD09/#4TX, nine inch (9") long sleeve to accommodate eighteen inch (18") smooth steel round bar. Manufactured by Sika/Greenstreak, (800)325-9504.
2. Dowel, eighteen inch (18") long smooth round steel bar, five eighth inch (5/8") diameter. De-bur cut ends.

E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

F. Chamfer Strips: Wood, metal, PVC, or rubber strips, shaped as sized on the drawings.

G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

H. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials. Form-release agent is not to stain or discolor final concrete surface.

I. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete surface.

1. Furnish units that will leave no corrodible metal closer than 1 inch (1") to the plane of exposed concrete surface, or as shown on the drawings.
2. Furnish ties that, when removed, will leave holes no larger than 1 inch (1") in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

J. Spray Curing Compound: All spray curing compound shall meet ASTM C-1315, and be prepared by manufacturer's instructions. Use per where required in Section 3.9.

## 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:

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. Fly ash: ASTM C618 Class C or F. Fly ash shall not exceed fifteen (15%) of total cementitious material by weight unless approved by Project Manager.
4. Maximum water-cement ratio: 0.45.
5. Slump: Four inches (4") maximum.
6. Air Entrainment: Five percent (5%) to eight percent (8%).
7. Aggregate Size: three quarter inch (3/4"), maximum.
8. 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 from batch time, or three hundred (300) revolutions of the drum after the initial mixing water has been added, whichever is earliest.
9. During cold weather (below forty five degree (45°) F), use heated water and aggregates if necessary to maintain concrete temperature between sixty degree (60°) F. and ninety degree (90°) F.
10. Concrete for Footings, Walls, and Interior Slabs-on-Grade shall be Class B or Class D, as approved by the Project Manager.
11. Fly Ash: Per CDOT Standard Specifications for Road and Bridge Construction Section 701.02.

## 2.8 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

## 2.9 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, and furnish batch ticket information.

1. When air temperature is between eighty five (85°) and ninety degrees (90°) F, reduce mixing and delivery time from one and one-half (1-1/2) hours to seventy five (75) minutes; when air temperature is above ninety degrees (90°) F, reduce mixing and delivery time to sixty (60) minutes.

2. Project-Site Mixing: Not allowed without prior approval from Project Manager. If allowed, submit process description to Project Manager for approval prior to construction.

## PART 3 - EXECUTION

### 3.1 QUALITY CONTROL

A. Requirements of Regulatory Agencies: Comply with all applicable provisions of the state and local building and safety codes.

B. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer, unless otherwise approved by Project Manager.

C. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

D. Testing: All testing shall be completed by the Contractor at their expense unless otherwise specified by the contract.

E. Testing Agency Qualifications: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures. Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

F. Testing Frequency: Obtain at least one composite sample for each one hundred (100) cubic yards, or fraction thereof of each concrete mixture placed each day.
   a. When frequency of testing will provide fewer than five (5) compressive-strength tests for each concrete mixture, testing shall be conducted from at least five (5) randomly selected batches or from each batch if fewer than five (5) are used.
2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one (1) test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one (1) set of four (4) standard cylinder specimens for each composite sample.
5. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at twenty eight (28) days. and keep one for backup in the event a sample should break.
   a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at twenty eight (28) days.

G. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than two-hundred (200) psi.

H. Test results shall be reported in writing to Project Manager, concrete manufacturer, and Contractor within forty eight (48) hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at twenty eight (28) days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both seven (7) and twenty eight (28) day tests.

I. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Project Manager.

J. Concrete work will be considered defective if it does not pass tests and inspections.

K. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

L. Prepare test and inspection reports.

M. Record of Work: A record shall be kept by the 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 Project Manager for examination at any time.

N. Mockups: If requested by the Project Manager, prior to starting any concrete work, provide a sample panel using materials indicated for project work. For each type, color and finish of concrete specified, build panel at the site of full thickness and approximately ten feet (10') by 10 feet (10'), including reinforcement, expansion joints, control joint, scales, fillers, and one radial edge. Provide the workmanship proposed for the work. Correct and replace sample panel until Project Manager's acceptance of the work. Retain panel(s) during construction as a standard for completed paving work.

1. Build panel approximately one-hundred (100) sq. ft. in the location indicated or, if not indicated, as directed by Project Manager.
2. Approved mockups may become part of the completed Work if approved prior to the construction of the mock up and is undisturbed at time of Substantial Completion.
3. Notify the Project Manager a minimum of seven (7) days in advance of dates and times when mockups will be constructed.
4. Obtain the Project Manager's written approval of the mockups before starting construction.
5. If the Project Manager determines that the mockup does not meet the requirements, demolish and remove from the site and cast another until the mockup is approved.
6. Maintain the mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed by Project Manager.

O. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semi-rigid joint

fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, concrete repair procedures, and concrete protection.

3.2 FORMWORK ERECTION

A. Construct formwork to maintain tolerances in accordance with ACI 301.

B. Verify lines, levels, and measurement before proceeding with formwork.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, one eighth inch (1/8”) for smooth-formed finished surfaces.
2. Class B, one-quarter inch (1/4”) for rough-formed finished surfaces.

D. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

E. Elements shown as curved on plans are to be formed with flexible form material to form smooth curve transitions. Disjointed, poorly transitioned form alignments will not be accepted. Curved sections formed with straight facets will not be accepted.

F. Contractor shall notify the Project Manager 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. If formwork is not in place at time of the scheduled inspection, then the Contractor will be responsible for compensation of the Project Manager’s time and expenses per the General Contract Conditions.

G. Minimize form joints. Symmetrically align form joints and make watertight to prevent leakage of mortar.

H. Provide chamfer strips on all exposed corners or as indicated on construction documents.

I. 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 contact surfaces of untreated forms with clean water. Keep surfaces wet prior to placing concrete.

J. Coordinate work of other Sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, dowels, anchors, and other inserts and embedded materials.

K. 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.

L. 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.

## 3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than fifty degrees (50°) F for twenty four (24) hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

1. Leave formwork for structural elements that supports weight of concrete in place until concrete has achieved at least seventy percent (70%) of its twenty eight (28) day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Project Manager.

## 3.4 SHORES AND RESHORES

A. Comply with ACI 318 (ACI 318M) and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

## 3.5 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

## 3.6 REINFORCEMENT

A. Place, support, and secure reinforcement against displacement.

B. Locate reinforcing splices per ACI 318 unless indicated otherwise on the Contract Drawings.

3.7 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Project Manager.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
1. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
2. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

D. Joint Sealants: See Division 3 Section “Concrete Paving Joint Sealants”.

3.8 CONCRETE PLACEMENT

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. Project Manager’s Review: Contractor shall provide minimum of forty eight (48) hours notice to the Project Manager to allow review of forms and reinforcement before concrete is placed and to observe placing of concrete.

C. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

D. Do not add water to concrete during delivery, at Project site, or during placement. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least six inches (6”) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for concrete pavements in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.

3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces as indicated on drawings.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
6. Allow time for bleed water to appear, then scrape or push off all bleed water. Do not work water into surface.
7. Final level, light bull float, but do not trowel surface.
8. Broom or drag surface or other specified finish, per Subsection 3.8 this Section.
9. Do not use evaporative retarders as finishing aid.

F. Cold-Weather Placement: Comply with ACI 301, ACI 304, ACI 306R and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below forty degrees (40°) F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

G. Hot-Weather Placement: Comply with ACI 301, ACI 304, ACI 305R, and as follows:

1. Maintain concrete temperature below ninety degrees (90°) F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is prohibited.
2. Spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

H. Ensure reinforcement, inserts, embedded parts and formed joints are not disturbed during concrete placement.

## 3.9 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. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

## 3.10 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 and in accordance with ACI 308.1. Coordinate with and choose a curing method that is compatible with the requirements for subsequent material usage on the concrete surface.

1. 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 inches (3") and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
2. 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:
1. Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by application of appropriate curing method.

## 3.11 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.

## 3.12 TOLERANCES

A. Formed Surfaces and Building Lines: Conform to ACI 301 4.3.

B. Slab Finishing Tolerances: See Division 32 Section “Concrete Walks, Curbs, and Miscellaneous Flatwork”.

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”).

## 3.13 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Project Manager. Remove and replace concrete that cannot be repaired and patched to Project Manager's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a Number sixteen (#16) sieve, using only enough water for handling and placing. Achieve approval of Project Manager prior to any patching as to location of patches and patch material.

C. Patch Testing: On a portion of the work which will, in the finished condition, be concealed, test patch materials and methods and obtain Project Manager’s approval prior to patching concrete surfaces needing repair that will be visible in the final construction.

D. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than one half inch (1/2”) in any dimension to solid concrete. Limit cut depth to three quarter inch (3/4”). Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color and texture. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Project Manager.

E. Repairing Unformed Surfaces: Test unformed surfaces, such tops of walls, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped for trueness of slope and smoothness; use a sloped template.

1. After obtaining approval of Project Manager, repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of one-one hundredths inch (0.01") wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
   a. If, after repairs are complete, the Project Manager deems the repairs did not successfully correct the original deficiencies, the pavement or concrete element in question is to be removed and replaced per Subsection 3.13.E.1. above.

2. After concrete has cured at least fourteen (14) days, test for low and high spots in finished surface. Areas that do not conform to the tolerances set forth in Division 32 and in other reference standards identified in this specification are to be sawcut to the nearest joint as approved by the Project Manager, defective concrete removed, and new conforming paving reinstalled. Color and finish is to match adjacent concrete.
3. If approved by Project Manager, repair random cracks and single holes one inch (1") or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least seventy two (72) hours.

F. Perform structural repairs of concrete, subject to Project Manager's approval, using epoxy adhesive and patching mortar.

G. Repair materials and installation not specified above may be used, subject to Project Manager approval.

H. and all other items required to complete the work as required in accordance with the Contract Drawings and Specifications.

**END OF SECTION 03 30 00**

**SECTION 31 11 00 CLEARING AND GRUBBING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for stripping sod, and removing and disposing of vegetation and debris.

B. Related Sections:
1. Division 01 Section “Erosion and Sedimentation Control”.
2. Division 01 Section “Tree Retention and Protection”.
3. Division 31 Section “Earth Moving”
4. Division 32 Section “Tree Transplanting”.

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” refers to removing and disposing trees, brush, stumps, logs, grass, weeds, roots, decayed vegetable matter, poles, stubs, rubbish, refuse dumps, sawdust piles, and loose boulders of one cubic yard (1 $yd^3$) or less existing outside of the construction limits, debris resting on or protruding through the ground surface, or appearing on the construction limits before final acceptance of the work. Clearing also includes removing and disposing of obstructions, such as fences, bridges, buildings, and other incidental structures within the construction limits and shown on the Site Demolition Plans.

D. The term “grubbing” refers to removal from the area within the construction limits and proper disposal of all objectionable matter defined above under clearing, which is embedded in the underlying soil. Grubbing also includes removing and properly disposing of sidewalks, driveways, catch basins, drop inlets, manholes, curbing, retaining walls, utilities, foundations, paved floors, underground tanks, and portions of plants to be removed that are below grade, and other structures within the construction limits.

E. Subsoil: All soil beneath the topsoil layer of the soil profile and typified by the lack of organic matter and soil organisms.

F. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow, and ; reasonably free of subsoil, clay lumps, gravel, and other objects more than two-inches (2”) in diameter; and free of subsoil and weeds, roots, toxic materials, or other non-soil materials.

G. Plant-Protection Area: Area surrounding shrub beds or massings, or other vegetation or sensitive areas to be protected during construction, and indicated on Contract Drawings.

H. Tree-Protection Area: Area surrounding individual trees or groups of trees to be protected during construction, see Division 01 Section “Tree Retention and Protection”.

I. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

A. All materials except for stripped topsoil, those materials indicated to remain or to be stockpiled, shall remain the property of the City, all other materials shall be removed at the Contractor's expense.

1.5 SUBMITTALS

A. Existing Conditions: Documentation of existing conditions, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
1. Use sufficiently detailed photographs or videotape.
2. Include plans and notations to indicate specific damaged conditions of existing construction, site elements, and landscape.

B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions. Submit to Project Manager prior to start of construction.

1.6 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Project Manager.
2. Provide alternate routes around closed or obstructed traffic ways if required by Project Manager.

B. Improvements on Adjoining Property: Not allowed without prior approval from Project Manager. Work only within Work Limit Line as defined on drawings.

C. Salvable Items: Carefully remove items indicated to be salvaged and store on City property where indicated.

D. Protection and Repair of Underground lines:
1. Existing Public Utilities: Locate existing underground utilities within the limits of work per General Contract Conditions, Article 804 Protection of Municipal, Public Service or Public Utility Systems. Request utility locates seventy two (72) hours in advance of any excavations by calling the Utility Notification Center of Colorado at 811. The contractor is responsible for providing written and graphical documentation from the utility owner. Take whatever precautions are necessary including potholing to verify location and depth to protect these underground lines from damage. Should unmarked or incorrectly marked utilities or other piping be encountered during excavation, notify the Project Manager

immediately for direction. If damage does occur, all damage shall be repaired by the utility owner and all costs of such repair shall be paid by the contractor. Only written all clears will be acceptable, verbal all clears will not be accepted.

2. Exiting Private Utilities: Locate existing underground utilities within the limits of work per General Contract Conditions, Article 804 Protection of Municipal, Public Service or Public Utility Systems. The contractor is required to contact all private utility companies including Denver City departments to locate all private utilities. The contractor is responsible for providing written and graphical documentation from the private utility owner. The request for locates shall be a minimum of seventy two (72) prior to proceeding with any excavation. If, after such requests, private utilities are encountered and damaged by the contractor these shall be repaired at no cost to the city. If the contractor damages staked or located private utilities they shall be repaired by the utility owner and all costs of such repair shall be paid by the contractor. Only written all clears will be acceptable, verbal all clears will not be accepted.

E. Do not commence site clearing operations until temporary erosion- and sedimentation-control and tree and or plant protection measures are in place.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PROTECTION

A. Protect existing site improvements to remain from damage during construction.
   1. Restore existing improvements damaged by Contractor during the work of this Contract to their original condition, as acceptable by Project Manager.

3.2 TRANSPLANTING

A. See Division 32 Section “Tree Transplanting”.

3.3 CLEARING

A. Remove brush and vegetation from areas designated to be cleared. As directed by Project Manager, trim low hanging, unsound, or unsightly branches on existing trees and shrubs designated to remain. All cuts shall be in accordance with Denver Forestry standards.

3.4 GRUBBING

A. 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 eighty five percent (85%) in landscape areas and ninety five percent (95%) under hardscape or as directed by the City Forester and Project Manager.

3.5 TOPSOIL STRIPPING

A. See Division 31 Section “Earth Moving”.

3.6 SOD STRIPPING

A. Strip sod in all areas to be re-graded to a depth of one-inch (1”), so that a relatively clean dirt surface remains.

3.7 TREE REMOVAL

A. In all proposed landscaped areas, stumps and surface roots shall be ground to a minimum of twelve-inches (12”) below finish grade. In proposed hardscape areas, all roots shall be removed entirely.

3.8 DISEASED TREE REMOVAL AND DISPOSAL

A. 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.

3.9 DISPOSAL

A. Haul and dispose of all removed materials, trash, debris and waste materials legally outside of the City’s property. All recyclable materials shall be hauled to nearest recycling center and any non-recyclable materials shall be hauled to Denver Arapahoe Disposal Site (DADS). DADS Disposal tickets shall be provided to the Contractor by Project Manager.

**END OF SECTION 31 11 00**

**SECTION 31 20 00 EARTH MOVING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the requirements for 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 Sections:
1. Division 01 Section “Erosion and Sedimentation Control”.
2. Division 01 Section “Removals”.
3. Division 01 Section “Tree Retention and Protection”.
4. Division 01 Section “Clearing and Grubbing”.
5. Division 31 Section “Excavation and Backfilling of Trenches”.
6. Division 32 Section “Topsoil”.

1.3 DEFINITIONS

A. Excavation: The 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. Classified Excavation: The term “classified excavation”, as used herein, defines the soil conditions that are expected to be encountered and makes provisions for measurement and payment of any rock encountered at an agreed upon unit price.

D. Unauthorized Excavation: Inadvertent or purposely removing materials beyond indicated subgrade elevations or dimensions without specific direction of the Project Manager. Unauthorized excavation, as well as remedial work resulting from unauthorized excavation shall be at Contractor’s expense.

E. Unsuitable Materials: For the purposes of classified excavation, unsuitable material shall be defined as material below subgrade elevation that exhibits excessive pumping or that does not meet density requirements due to unsatisfactory material as determined by geotechnical engineer and/or Project Manager.

F. Subgrade: The undisturbed earth or the compacted soil layer immediately below proposed pavement topping materials.

G. Structure: Walls, foundations, slabs, pavement or other man-made stationary features occurring above or below ground surface.

H. Structural Fill: The term “structural fill”, as used herein, includes soil materials used for general site filling under pavements or structures.

1.4 SUBMITTALS

A. Samples for Verification: For the following products, in sizes indicated below:
1. Warning Tape: Twelve-inches (12”) long; of each color.

B. Qualification Data: For qualified testing agency.

C. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:
1. Location of soil source.
2. Classification according to ASTM D 2487.
3. Laboratory compaction curve according to ASTM D 698.

D. Provide one (1) cubic foot sample of imported backfill material for approval by Project Manager.

E. For imported backfill materials, general or structural, the Contractor shall provide, at a minimum, a soils report indicating gradation tests, liquid limit, plasticity index and standard proctor density test and free of environmental contaminants. Depending on the use of the imported backfill materials the Project Manager may request that a soils analysis be performed to determine percent organic content of the soils, salt levels, and environmental contaminants of concern. Division 32 Section “Topsoil” for additional information.

F. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.

1.5 QUALITY CONTROL

A. Coordinated and paid for by Contractor.

B. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

C. Comply with requirements within project Geotechnical Report.

D. 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.

E. Testing Agency: All testing required to determine compliance for the work of this section will be completed as specified in Division 01 Section “Contractor Quality Control”. Testing Agency to test the following, and as stated throughout this Section:
1. Determine prior to placement of fill that site has been prepared in compliance with requirements.

2. Determine that fill material and maximum lift thickness comply with requirements.
3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.

F. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

G. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Project Manager.

H. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every two thousand (2,000) sq. ft. or less of paved area or building slab, but in no case fewer than three (3) tests.
2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 50 feet (50') or less of wall length, but no fewer than two tests.
3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every one hundred fifty feet (150') or less of trench length, but no fewer than two tests.
4. Landscaped areas: At least one test every twenty thousand (20,000) sq. ft or less of disturbed landscaped area, but in no case fewer than two tests.

I. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; re-compact and retest until specified compaction is obtained.

J. Submit testing report documentation to Project Manager per Division 01 Section "Quality Assurance".

1.6 DELIVERY, STORAGE, & HANDLING

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
1. Stockpile soil materials away from edge of excavations. Do not store within drip line of existing trees or within Tree Protection Fencing. Refer to Division 01 Section "Tree Retention and Protection".

1.7 PROJECT CONDITIONS

A. Protection and Repair of Underground lines:
1. Existing Public Utilities: Locate existing underground utilities within the limits of work per General Contract Conditions, Article 804 Protection of Municipal, Public Service or Public Utility Systems. Request utility locates seventy two (72) hours in advance of any excavations by calling the Utility Notification Center of Colorado at 811. The Contractor is responsible for providing written and graphical documentation from the utility owner. Take whatever precautions are necessary including potholing to verify location and depth

to protect these underground lines from damage. Should unmarked or incorrectly marked utilities or other piping be encountered during excavation, notify the Project Manager immediately for direction. If damage does occur, all damage shall be repaired by the utility owner and all costs of such repair shall be paid by the Contractor. Only written all clears will be acceptable, verbal all clears will not be accepted.

2. Existing Private Utilities: Locate existing underground utilities within the limits of work per General Contract Conditions, Article 804 Protection of Municipal, Public Service or Public Utility Systems. The Contractor is required to contact all private utility companies including Denver City departments to locate all private utilities. The Contractor is responsible for providing written and graphical documentation from the private utility owner. 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 at no cost to the city. If the Contractor damages staked or located private utilities they shall be repaired by the utility owner and all costs of such repair shall be paid by the Contractor. Only written all clears will be acceptable, verbal all clears will not be accepted.

B. Use of Explosives: Use of explosives is not permitted.

C. Protection of Persons and Property: The Contractor is responsible for installing barricades and posting with warning lights all open excavations occurring as part of this work.

1. 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 the City.

F. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures, specified in Division 01 Sections "Temporary Facilities and Controls” and “Tree Retention and Protection”, and Division 31 Section "Clearing and Grubbing," are in place.

## 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-inches (3”). Project Manager to approve material prior to placement.

1. The Contractor is responsible for furnishing load tickets and providing a daily log of cubic yards of soil materials imported or exported.

B. Structural Fill: Shall be Class 1 or Class 2 material composed of non-organic mineral aggregates and soil from excavations of existing soils obtained from on-site or imported fill,

including granular or aggregate base course from removed pavements. Fill containing organic matter or any other deleterious substances, including overly wet soils, bedrock, or high swell content soils will not be accepted. 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 the City. 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") minimum of organic material in the excavation zone shall be stripped stockpiled prior to other earthwork operations. All stockpiled topsoil shall be reused on site.

2.2 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, six-inches (6") wide and four (4) mils thick, continuously inscribed with a description of the utility; colored as follows:
1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of six-inches (6") wide and four (4) mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to thirty-inches (30") deep; colored as follows:
1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where the Work of this Section will be performed for compliance with requirements and conditions affecting installation and performance.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within the work area.
2. Verify that final grades are completed in accordance with the drawings.

B. Proceed with installation only after unsatisfactory conditions have been corrected and approved by Project Manager.

3.2 GENERAL PROCEDURES

A. Comply with Division 01 Section “Erosion and Sedimentation Control” and all local, state and national erosion control requirements.

B. Erosion Control shall be maintained during all phases of site excavation and site development and maintained throughout the construction period in order to protect adjacent properties, streets, and storm sewers from erosion and sediment runoff during the construction process. Do not commence excavation and grading work until erosion control measures are in place and have been inspected and approved by the Wastewater Management Inspector. Contractor shall be responsible for maintaining erosion control measures throughout construction. Frequent monitoring, cleaning and other work required for proper operation shall be Contractor’s responsibility. Contractor shall modify/replace all erosion control measures to fit field conditions following direction for corrective actions from Project Manager and or Wastewater Management Inspector.

3.3 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 to the City.

3.4 GROUND SURFACE PREPARATION

A. Complete clearing and grubbing operations in accordance with Division 31 Section “Clearing and Grubbing”. 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 any new sections of asphalt or concrete pavement, the entire subgrade shall be scarified to a depth of six-inches (6”). In areas where existing pavement is to be removed and replaced the existing compacted subgrade may be reused if the subgrade meets specified compaction. In areas of existing subgrade that do not meet the specified compaction, materials shall be removed, replaced and compacted to meet the specified proctor density. Adjust moisture content and compact as hereinafter specified.

3.5 STRIPPING AND STOCKPILING TOPSOIL

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

B. Placing topsoil, refer to Division 32 Section “Topsoil”.

3.6 EXCAVATION

A. Stability of excavations: Comply with local codes, ordinances, and requirements of agencies having jurisdiction to include the latest revision to OSHA standards.

B. Excavation for Structures: Conform to elevations and dimensions shown within a tolerance of +/- one tenth foot (0.1'), and extending a sufficient distance to permit installation of services and other construction, and for inspection.

C. Excavation for Pavements: Cut surface under pavements to comply with cross-sections, elevations and grades as indicated within a tolerance of +/- one tenth foot (0.1').

D. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
   1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
   2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
      a. Twenty four-inches (24") outside of concrete forms other than at footings.
      b. Twelve-inches (12") outside of concrete forms at footings.
      c. Six-inches (6") outside of minimum required dimensions of concrete cast against grade.
      d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
      e. Six-inches (6") beneath bottom of concrete slabs-on-grade.
      f. Six-inches (6") beneath pipe in trenches, and the greater of twenty four-inches (24") wider than pipe or forty two-inches (42") wide.

E. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by Project Manager and approved by Project Manager. The Contract Sum will be adjusted for rock excavation according to unit prices included in the Contract Documents. Changes in the Contract Time may be authorized for rock excavation.
   1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.
      a. Intermittent drilling; ram hammering; or ripping of material not classified as rock excavation is earth excavation.
   2. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the following dimensions:
      a. Twenty four-inches (24") outside of concrete forms other than at footings.
      b. Twelve-inches (12") outside of concrete forms at footings.
      c. Six-inches (6") outside of minimum required dimensions of concrete cast against grade.
      d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
      e. Six-inches (6") beneath bottom of concrete slabs-on-grade.

f. Six-inches (6”) beneath pipe in trenches, and the greater of twenty four-inches (24”) wider than pipe or forty two-inches (42”) wide.

## 3.7 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions shown on Contract Drawings within a tolerance of plus or minus one tenth foot (0.1’). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
   1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
   2. Pile Foundations: Stop excavations six to twelve-inches (6” – 12”) above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.

## 3.8 EXCAVATION FOR WALKS AND PAVEMENTS

A. See project Geotechnical Report.

B. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 0.1 foot.

C. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.
   1. Prior to placing the pavement section, the entire subgrade should be scarified to a depth of six-inches (6”), adjusted to a moisture content near optimum and compacted as indicated in the Geotechnical Report.

## 3.9 SUBGRADE INSPECTION

A. Notify Project Manager when excavations have reached required subgrade.

B. If Project Manager determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade in twenty (20) locations identified by the Project Manager with a pneumatic-tired and loaded ten (10-wheel), tandem-axle dump truck weighing not less than fifteen (15) tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
   1. Completely proof-roll subgrade in one direction. Limit vehicle speed to three (3) mph.
   2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Project Manager, and replace with compacted backfill or fill as directed.

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Project Manager, without additional compensation.

3.10 SPECIAL CONDITIONS

A. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than thirty five degrees (35°) F.

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 Project Manager immediately upon finding subsurface or other conditions which are not shown or which cannot be reasonably assumed from existing surveys. Secure Project Manager'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: When excavation has reached required subgrade elevations, the Contractor shall contact the testing agency, which will make an observation of conditions. If unsuitable bearing materials are encountered at required subgrade elevations, carry excavations deeper and replace excavated material as directed by the testing agency.

3.11 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.
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.

3.12 PLACEMENT AND COMPACTION

A. Abide by requirements of project Geotechnical Report unless otherwise directed by Project Manager.

B. 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. Present remediation options to Project Manager for any soils that do not meet the specified standard proctor density to bring those soils into compliance with the specifications.

C. 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.

D. 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.

E. 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 sheepsfoot rollers, multiple-wheel pneumatic-tired rollers, or other equipment required to meet specifications. Granular fill shall be compacted using vibratory equipment or other equipment required to meet specifications. Compaction of 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 3.12.I herein 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.

F. 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, compact to a density as specified in Paragraph 3.12.I. 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.

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 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 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.

I. Density Tests: Field density tests shall be made by the Contractor per Division 01 Section "Contractor Quality Control" locations and depths selected by the Project Manager. Where sheepsfoot 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 Project Manager. On-site or imported clay materials shall be compacted to at least ninety five percent (95%) of maximum standard Proctor dry density (ASTM D 698) at moisture content within two percent (2%) of optimum. Granular material, whether imported or developed on-site, shall be moisture conditioned to within two percent (2%) of optimum and compacted to at least 95% of maximum modified Proctor dry density (ASTM D 1557).
2. Under landscape areas (top 12-inches): Eighty five percent (85%) of maximum standard Proctor dry density at moisture content within two percent (2%) of optimum (ASTM D 698).

3.13 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 one-hundredths foot (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.

3.14 PLACING STOCKPILED TOPSOIL

A. Refer to Division 32 Section "Topsoil".

3.15 FIELD QUALITY CONTROL

A. Special Inspections: Project Manager may engage a qualified special inspector to perform the inspections in addition to the Contractors requirements for testing for the purposes of verifying results of Contractor's Testing Agency.

3.16 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
   1. Scarify or remove and replace soil material to depth as directed by Project Manager; reshape and re-compact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
   1. Restore appearance, quality, and condition of finished surfacing to match adjacent work.

3.17 MAINTENANCE

A. 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.

B. 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.

3.18 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 off City's property at Contractor's expense. All recyclable materials shall be hauled to nearest recycling center and any non-recyclable materials shall be hauled to Denver Arapahoe Disposal Site (DADS). DADS Disposal tickets shall be provided to the Contractor by Project Manager.

B. Remove any excess fill material from the site, unless otherwise directed by the Project Manager.

C. Remove any materials determined to be hazardous or contaminated to DADS. DADS Disposal tickets or hazardous waste manifest tickets shall be provided to the Contractor by Project Manager.

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.

~~PART 4 - MEASUREMENT AND PAYMENT~~

~~4.1 MEASUREMENT **[Consultant to select A or B]**~~

~~A. Measurement will be based on the percentage complete for the lump sum contract amount for Earth Moving.~~

~~B. Measurement will be made by the contract unit specified for Earth Moving. Measurement shall include the actual number of units of specified material(s) placed and accepted at the locations shown on the Contract Drawings, or as directed by the Project Manager, and in accordance with the Specifications.~~

~~4.2 PAYMENT~~

~~A. Payment will be made at the **[contract unit]** [**lump sum contract**] price, and shall include required materials, transportation, equipment, labor, excavation, stockpiling, disposing, hauling off, importing fill, re-transporting to fill locations (from locations of excavation or from onsite stockpiles), watering, compaction, sub-grade preparation, measuring of subgrade to bring within tolerances, backfilling, dust control, erosion and sediment control, rough grading, fine grading, as required in accordance with the Contract Drawings and Specifications. Stripping and stockpiling of topsoil shall be paid for separately under Division 32 Section "Topsoil".~~

**END OF SECTION 31 20 00**

**SECTION 31 23 16 EXCAVATION AND BACKFILLING OF TRENCHES**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for the excavation and backfill for all piping, conduit, or 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.
1. www.denvergov.org/wastewatermanagement/WastewaterManagement/EngineeringandPermits/WastewaterDetailandTechnicalSpecifications/tabid/442699/Default.aspx

B. Related Work: Contractor shall comply with the requirements of the following Sections when installing underground utilities.
1. Division 01 Section “Layout of Work and Surveys”.
2. Division 01 Section “Tree Retention and Protection”.
3. Division 31 Section “Clearing and Grubbing”.
4. Division 31 Section “Earth Moving”.
5. Division 32 Section “Soil Preparation”.
6. Division 32 Section “Topsoil”.
~~7. Division 32 Section “Turfgrass Seeding”.~~
~~8.~~7. Division 32 Section “Native Seeding”.
~~9. Division 32 Section “Sodding”.~~
~~10.~~8. Division 32 Section “Landscape Irrigation”.
~~11.~~9. Division 32 Section “Automatic Irrigation Controllers”

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

~~PART 4 - MEASUREMENT AND PAYMENT~~

~~4.1 MEASUREMENT **[Consultant to select A or B]**~~

~~A. Measurement will be based on the percentage complete for the lump sum contract amount for Excavation and Backfilling of Trenches.~~

~~B. Measurement will be made by the contract unit specified for Excavation and Backfilling of Trenches. Measurement shall include the actual number of units of specified material(s) placed~~

and accepted at the locations shown on the Contract Drawings, or as directed by the Project Manager, and in accordance with the Specifications.

4.2 PAYMENT

A. Payment will be made at the **[contract unit]** [**lump sum contract**] price, and shall include required materials, transportation, equipment, labor, excavation, stockpiling, disposing, hauling off, importing fill, re-transporting to fill locations (from locations of excavation or from onsite stockpiles), watering, compaction, sub-grade preparation, measuring of sub-grade to bring within tolerances, backfilling, dust control, erosion and sediment control, rough grading and fine grading <**Insert additional items**> as required to construct in accordance with the Contract Drawings and Specifications. Stripping and stockpiling of topsoil shall be paid for separately under Division 32 Section "Topsoil".

**END OF SECTION 31 23 16**

**SECTION 31 32 50 WATERING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for furnishing, hauling, and applying water required for compaction of embankments, backfills, sub-grade, and for landscaping, dust control, and other construction operations.

B. Related Sections:
1. Division 01 Section “Erosion and Sedimentation Control”.
2. Division 31 Section “Earth Moving”.
3. Division 31 Section “Excavation and Backfilling of Trenches.
~~4. Division 32 Section “Aggregate Base Course”.~~
~~5. Division 32 Section “Turfgrass Seeding”.~~
~~6.~~4. Division 32 Section “Native Seeding”.
~~7.~~5. Division 32 Section “Sodding”.
~~8.~~6. Division 32 Section “Trees, Plants, and Groundcovers”.

PART 2 - PRODUCTS

2.1 WATER

A. If water supply is from a hydrant, the Contractor shall supply a Denver Water approved and calibrated water meter to measure water usage and be responsible to pay all costs related to water usage. The cost of water shall be charged at the current City and County of Denver rate through Denver Water.

B. Water applied for moisture density control, pre-wetting, and as dust palliative shall be free of debris, organic matter, and other objectionable substances.

C. Water for landscaping shall be free from oils, acids, salts or any substance that may be harmful to plant life. Non-potable water may be accepted on a case-by-case basis as approved by Project Manager.

D. When the water source proposed for use by the Contractor is not known, the Contractor shall provide an analysis of water samples from an approved testing laboratory. The analysis shall be provided to the Project Manager prior to use.

PART 3 - EXECUTION

3.1 WATER TRUCK

A. At least one water truck shall be on site or as directed by Project Manager.
   1. Truck shall have capacity of at least one-thousand (1,000) gallons, or be of adequate size related to the scope of work or as directed by the Project Manager.
   2. Water is to be metered for measurement, the Contractor shall provide and use an approved Denver Water metering device.
   3. Monthly water usage readings either from the vehicle or from a meter are to be provided to the Project Manager

3.2 APPLICATION

A. Pressure type distributors or a pipeline equipped with sprinkler system.

B. Moisture and Density Control: Ensure a uniform and controlled application of water without ponding or causing erosion for optimum moisture content.

C. Pre-wetting: Pre-wetting material in excavation areas prior to removal for placement in embankments will be allowed as approved by the Project Manager. Prior to excavation the Contractor shall drill, bore or dig test holes to the full depth of excavation to determine moisture requirements. The contractor will identify and confirm with the Project Manager the areas for pre-wetting, including equipment to be used for the pre-wetting operations.

D. Landscape Watering: The Contractor shall provide water for seeding, mulching, planting, transplanting, sodding, herbicide treatment, maintenance operations including watering during warranty periods or any other landscape related activities when called out on the Contract Drawings or Specifications.

E. If overwatering occurs during any of the above operations, de-water at no additional expense to the City.

~~PART 4 - MEASUREMENT AND PAYMENT~~

~~4.1 MEASUREMENT **[Consultant to select A or B]**~~

~~A. Measurement will be based on the percentage complete for the lump sum contract amount for Watering.~~

~~B. Measurement will be made by the contract unit specified for Watering. Measurement shall include the actual number of units of specified material(s) placed and accepted at the locations shown on the Contract Drawings, or as directed by the Project Manager, and in accordance with the Specifications.~~

~~4.2 PAYMENT~~

~~A. Payment will be made at the **[contract unit]** **[lump sum contract]** price, and shall include required materials, transportation, equipment, labor, excavation, stockpiling, disposing, hauling~~

~~off, dust control, erosion and sediment control, <**Insert additional items**> as required in accordance with the Contract Drawings and Specifications.~~

**END OF SECTION 31 32 50**

# SECTION 32 13 13 CONCRETE WALKS, CURBS, AND MISCELLANEOUS FLATWORK

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. This Section includes requirements for 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 Sections:
1. Division 01 Section “Layout of Work and Surveys”.
2. Division 01 Section “Submittals”.
3. Division 01 Section “Contractor Quality Control”.
4. Division 01 Section “Erosion and Sedimentation Control”.
5. Division 03 Section “Cast-In-Place Concrete”.
6. Division 31 Section “Earth Moving”.
~~7. Division 32 Section “Aggregate Base Course”.~~

### 1.3 REFERENCES

~~A. Project Geotechnical Report **[state date and author of report]**.~~

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

~~C.~~B. American Concrete Institute (ACI):
1. ACI 117 - Standard Tolerances for Concrete Construction and Materials.
2. ACI 301 - Specifications of Structural Concrete for Buildings.
3. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
4. ACI 305 and 306 - Hot and Cold Weather Protection for Concrete.
5. ACI 315 - Details and Detailing of Concrete Reinforcement.
6. ACI 318 - Building Code Requirements for Reinforced Concrete.
7. ACI 347 - Recommended Practice for Concrete Formwork.

~~D.~~C. American Society for Testing and Materials (ASTM):
1. ASTM A615 - Deformed and Plain Billet-Steel for Concrete Reinforcement.
2. ASTM C33 - Concrete Aggregates.
3. ASTM C94 - Ready-Mixed Concrete.
4. ASTM C150 - Portland Cement.
5. ASTM C260 - Air Entraining Admixtures for Concrete.
6. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.
7. ASTM C494 - Water Reducing Admixtures for Concrete.

8. ASTM C618 - Fly Ash Mineral Admixture for Concrete.
9. ASTM C672 - Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals.
10. ASTM-C800 - Curing Compound, Concrete, for New and Existing Surfaces.

~~E.~~D. CRSI - Manual of Standard Practice.

~~F.~~E. Colorado Department of Transportation (CDOT) – Standard Specifications for Road and Bridge Construction, latest edition

~~G.~~F. NRMCA: National Ready Mixed Concrete Association

1.4 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

B. Definitions: Refer to ACI 301 11.7 for definition of slab surface finishes.

1.5 QUALITY CONTROL

A. Reference Standards: Comply with following standards except where more stringent requirements are shown or specified:
1. American Concrete Institute (ACI) Publications: Comply with the following unless modified by requirements in the Contract Drawings. 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. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
k. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
l. ASTM A615 - Deformed and Plain Billet-Steel for Concrete Reinforcement.
m. ASTM C33 - Concrete Aggregates.
n. ASTM C94 - Ready-Mixed Concrete.
o. ASTM C150 - Portland Cement.
p. ASTM C260 - Air Entraining Admixtures for Concrete.
q. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.
r. ASTM C494 - Water Reducing Admixtures for Concrete.
s. ASTM C618 - Fly Ash Mineral Admixture for Concrete.
t. ASTM C672 - Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals.

2. ASTM-C800 - Curing Compound, Concrete, for New and Existing Surfaces.
3. Concrete Reinforcing Steel Institute (CRSI) - Manual of Standard Practice.

B. Pre-Construction Conference: Conduct conference at location approved by Project Manager.
   1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
      a. Contractor's superintendent.
      b. Independent testing agency responsible for concrete design mixtures.
      c. Ready-mix concrete manufacturer.
      d. Concrete subcontractor.
      e. Special concrete finish subcontractor.
   2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semi-rigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, concrete repair procedures, and concrete protection.

C. Testing: Refer to Part 3 QUALITY CONTROL for Contractor’s testing requirements.

1.6 SUBMITTALS

A. See Division 01 Section “Submittals” for submittal requirements.

B. Product Data: For each type of product indicated.

C. Material Certificates: For the following, from manufacturer:
   1. Cementitious materials.
   2. Steel reinforcement and reinforcement accessories.
   3. Fiber reinforcement.
   4. Admixtures.
   5. Curing compounds.
   6. Applied finish materials.
   7. Bonding agent or epoxy adhesive.
   8. Joint fillers.

D. Field quality control reports.

E. Qualification Data: For qualified ready-mix concrete manufacturer and testing agency.

F. Mix Designs:
   1. Submit substantiating data for each concrete mix design specified for use to the Project Manager not less than four (4) weeks prior to first concrete placement. Data for each mix shall, as a minimum, include the following per section 2.7.B:
      a. Mix identification designation (unique for each mix submitted).
      b. Statement of intended use for mix.
      c. Mix proportions.
      d. Aggregates.
      e. Admixtures (must be approved by the Project Manager)
      f. Wet and dry unit weight.
      g. Entrained air content.
      h. Design slump.

i. Strength qualification data.

1.7 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 from batch time, or three hundred (300) revolutions of the drum after the initial 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 Contractor's superintendent shall have the sole authority to authorize addition of water. Additional water shall not exceed one (1) gallon/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.

1.8 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. Concrete temperature shall maintained above fifty degrees (50°) F using concrete blankets or heating.
   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 be below minimum temperature of fifty degrees (50°) F.
   c. Subject to acceptance of the Project Manager 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 (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 Project Manager. 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.

C. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

D. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of forty degrees (40°) F for oil-based materials, fifty five degrees (55°) F for water-based materials, and not exceeding ninety five degrees (95°) F.

1.9 RIGHT OF WAY WORK

A. Contractor shall obtain all necessary permits when working with in the Right of Way.

B. Contractor shall preserve and protect all permanent land survey control markers. Per the General Contract Conditions Article 319 “Preservation of Permanent land Survey Control Markers”.

PART 2 - PRODUCTS

2.1 SUBGRADE MATERIAL

B. Dense, readily compactible material, free from organic matter, clay, and loose rock in excess of one and one half-inches (1-1/2”). Material excavated from on-site that meets this requirement may be used if approved by Project Manager. Material properties to be in conformance with project Geotechnical Report.

2.2 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. Staking shall be adequate to hold wet concrete while maintaining the desired radii.

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.

## 2.3 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.
   2. Cement: ASTM C150. Type II minimum of five hundred sixty four (564) pounds 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.
      a. Obtain from same source throughout project.
      b. All sand and aggregates to meet C-33 Table 3 for Class 4S “Severe Weathering Region”.
         1) Fine Aggregate: Clean, natural sand.
         2) Coarse Aggregate: Clean gravel or crushed stone.
   5. Water: ASTM C 94/C 94M, Clean and not detrimental to concrete.

## 2.4 STEEL REINFORCEMENT

A. Recycled Content: Provide steel reinforcement with an average recycled content of steel so postconsumer recycled content plus one-half of preconsumer recycled content is not less than twenty five percent (25%).

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

C. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 (Grade 420) deformed bars.

D. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420) plain-steel bars. Cut bars true to length with ends square and free of burrs.

E. Epoxy-Coated, Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars.

F. Tie Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

G. Hook Bolts: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

H. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

I. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

2.5 SLIP "SPEED" DOWELS

A. Slip Joints:
1. Speed Dowel Model PSD09/#4TX, 9" long sleeve to accommodate 18" smooth steel round bar. Manufactured by Sika/Greenstreak, (800)325-9504, or equal.
2. Dowel, 18" long smooth round steel bar, 5/8" diameter. De-bur cut ends.

2.6 ADMIXTURES

A. General: Unless specified, no admixtures may be used without specific approval of the Project Manager.

B. Prohibited Products: Calcium chloride or admixtures containing more than 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" by Euclid Chemical Co.
2. "Darex ARA" by W. R. Grace.
3. "Micro-Air" by Master Builders.
4. Or equal.

D. Water Reducing Admixture: ASTM C494, Type A. Subject to compliance with requirements, provide one of the following:
1. "Eucon WR-75" by Euclid Chemical Co.
2. "Rheobuild 1000" by Master Builders.
3. "Plastocrete 106" by Sika Chemical Co.
4. Or equal.

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" by Euclid Chemical Co.
2. "Pozzolith 400N" by Master Builders.
3. "Sikament" by Sika Chemical Co.
4. Or equal.

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.

H. Color Admixtures

1. Davis Colors chart or approved equal.

2.7 CONCRETE MIX

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

https://www.denvergov.org/rightofwayservices/RightofWayServices/EngineeringRegulatoryAnalytics/CapitalProjectsCoordination/tabid/442326/Default.aspx

B. All Concrete mixes from the approved list or submitted for approval shall meet the following criteria.
1. All concrete for flatwork shall be Class P (four thousand two hundred (4,200) PSI) unless otherwise requested by the Project Manager.
2. Mix concrete in accordance with ASTM C94 and ACI 301 Chapter 3.
3. Cement Content: Type II cement, minimum of five hundred sixty four pounds (564#) per cubic yard.
4. Maximum water-cement ratio: 0.44.
5. Slump: 4-inches maximum when hand placed.
6. Air Entrainment: fiver percent (5%) to eight percent (8%).
7. Aggregate Size: three quarter-inch (3/4") maximum.
8. 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 from batch time, or three hundred (300) revolutions of the drum after the initial mixing water has been added, whichever is earliest.
9. 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.
10. Concrete for Footings, Walls, and Interior Slabs-on-Grade shall be Class B, as approved by the Project Manager.
11. Concrete for Exterior Flatwork, including Pavement, Curb and Gutter, and Drainage Pans shall be Class P, as approved by the Project Manager.
12. Fly Ash: Per CDOT Standard Specifications for Road and Bridge Construction Section 701.02.

2.8 FIBROUS CONCRETE REINFORCEMENT

A. Shall be one hundred percent (100%) virgin polypropylene, fibrillated fibers containing no reprocessed olefin materials and specifically manufactured to an optimum gradation utilizing twenty five (25) individual fiber designs for use as concrete secondary reinforcement. Volume per cubic yard shall be one and one-half (1.5) pounds, or in accordance with manufacturer's recommendations. Fiber manufacturer must document evidence of five (5) year satisfactory performance history, compliance with applicable building codes and ASTM C1116 Type III 4.1.3 and ASTM C1116 Performance Level I.
1. Fibrous concrete reinforcement shall be utilized in all flatwork applications.

2.9 EXPANSION JOINT MATERIAL

A. Interior Use or Exterior Use where sealants are specified: Bituminous saturated fiber conforming to ASTM D1751, one half-inch (1/2") thick. Provide manufacturer's certification of compatibility with specified sealants where required.

B. Pre-molded closed cell polyethylene foam: Backer rod if required, equal to “Sonoflex F” by BASF, Provide half-inch (1/2”) thick by depth of the slab material, allow half-inch (1/2”) thickness for joint sealer.

C. Joint Sealant: 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.

2.10 CONTROL JOINTS

A. Shall be in conformance with current Denver Department of Public Works Traffic Engineering Standards and Details and as shown on Contract Drawings

https://www.denvergov.org/Portals/730/documents/PW%20TRANS%20STDS%20&%20DETAILS%20-%20FINAL%20MAY%202015.pdf

2.11 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately nine (9) oz./sq. yd. dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

1. Products: Subject to compliance with requirements, [**provide the following**]
   a. BASF Construction Chemicals, LLC; Confilm.
   b. Or approved equal.

E. White, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type two (2), Class B, dissipating.
1. Products: Subject to compliance with requirements, [**provide the following**]:
   a. Dayton Superior Corporation; Day-Chem White Pigmented Cure (J-10-W).
   b. Or approved equal.

2.12 RELATED MATERIALS

A. Chemical Surface Retarder: Water-soluble, liquid, set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of one eighth-inch (1/8”) to one quarter-inch (1/4”) to match Project Manager’s sample.
1. Products: Subject to compliance with requirements, [**provide the following**]:
   a. Conspec by Dayton Superior; Delay S.
   b. Or approved equal.

2.13 TRUNCATED DOME INSERTS FOR RAMPS

A. Shall be in conformance with current Denver Department of Public Works standards.

PART 3 - EXECUTION

3.1 QUALITY CONTROL

A. Requirements of Regulatory Agencies: Comply with all applicable provisions of the state and local building and safety codes.

B. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer, unless otherwise approved by Project Manager.

C. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

D. Testing: All testing shall be completed by the Contractor at their expense unless otherwise specified by the contract.

E. Testing Agency Qualifications: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures. Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

F. Testing Frequency: Obtain at least one composite sample for each one hundred (100) cubic yards, or fraction thereof of each concrete mixture placed each day.
a. When frequency of testing will provide fewer than five (5) compressive-strength tests for each concrete mixture, testing shall be conducted from at least five (5) randomly selected batches or from each batch if fewer than five (5) are used.
2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one (1) test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one (1) set of four (4) standard cylinder specimens for each composite sample.
5. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at twenty eight (28) days. and keep one for backup in the event a sample should break.
a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at twenty eight (28) days.

G. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than two-hundred (200) psi.

H. Test results shall be reported in writing to Project Manager, concrete manufacturer, and Contractor within forty eight (48) hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at twenty eight (28) days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both seven (7) and twenty eight (28) day tests.

I. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Project Manager.

J. Concrete work will be considered defective if it does not pass tests and inspections.

K. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

L. Prepare test and inspection reports.

M. Record of Work: A record shall be kept by the 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 Project Manager for examination at any time.

N. Mockups: If requested by the Project Manager, prior to starting any concrete work, provide a sample panel using materials indicated for project work. For each type, color and finish of concrete specified, build panel at the site of full thickness and approximately ten feet (10') by 10 feet (10'), including expansion joints, control joint, scales, fillers, and one radial edge. Provide the workmanship proposed for the work. Correct and replace sample panel until Project Manager's acceptance of the work. Retain panel(s) during construction as a standard for completed paving work.
   1. Build panel approximately one-hundred (100) sq. ft. in the location indicated or, if not indicated, as directed by Project Manager.
   2. Approved mockups may become part of the completed Work if approved prior to the construction of the mock up and is undisturbed at time of Substantial Completion.
   3. Notify the Project Manager a minimum of seven (7) days in advance of dates and times when mockups will be constructed.
   4. Obtain the Project Manager's written approval of the mockups before starting construction.
   5. If the Project Manager determines that the mockup does not meet the requirements, demolish and remove from the site and cast another until the mockup is approved.
   6. Maintain the mockups during construction in an undisturbed condition as a standard for judging the completed Work.
   7. Demolish and remove mockups when directed by Project Manager.

O. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semi-rigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, concrete repair procedures, and concrete protection.

3.2 PREPARATION OF SUBGRADE

A. Excavate to required depth in accordance with geotechnical report. Remove soft, yielding material and replace with select fill. Compact to minimum ninety five percent (95%) Standard Proctor within two percent (2%) of optimum moisture.

B. Refer to Division 31 Section: Earth Moving for requirements for subgrade testing and proof-rolling.

3.3 MAINTENANCE OF SUBGRADE

A. Maintain subgrade in a compacted condition until concrete is placed.

3.4 FORMS

A. Metal or uniform warp free lumber, coated with form release agent. Slope forms to give slabs positive drainage and stake securely. Obtain approval of Project Manager for alignment and grade of forms a minimum of forty eight (48) hours prior to placing concrete. Any concrete work installed without obtaining approval from the Project Manager shall be subject to removal and replacement at the discretion of the Project Manager, at no cost to the City.

B. 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 Project Manager.

3.5 STEEL REINFORCEMENT

A. Install steel reinforcement only in locations shown on Contract Drawings.

B. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

C. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

D. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

3.6 CONCRETE PLACEMENT

A. Prior to placing any new sections of asphalt or concrete pavement, the entire subgrade shall be scarified to a depth of 6-inches. In areas where existing pavement is to be removed and replaced the existing compacted subgrade may be reused if the subgrade meets specified compaction. In areas of existing subgrade that do not meet the specified compaction, materials shall be removed, replaced and compacted to meet the specified proctor density. Adjust moisture content and compact as hereinafter specified.

B. Before placing concrete, inspect and complete formwork installation, steel reinforcement (if present), and items to be embedded or cast-in.

C. Do not place concrete on frozen surfaces.

D. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

E. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

F. Do not add water to concrete during delivery.

G. Deposit and spread concrete in a continuous operation between transverse joints. Do not use vibratory equipment to move concrete into place.

H. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
   1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies**,** reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

I. Screed paving surface with a straightedge and strike off.

J. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

K. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.

L. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.
   1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

M. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
   1. When air temperature has fallen to or is expected to fall below forty degrees (40°) F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than fifty degrees (50°) F and not more than eighty degrees (80°) F at point of placement.
   2. If subgrade is frozen, as determined by Geotechnical Engineer and/or Project Manager, thaw subgrade to depth of eight (8”) prior to placing concrete.
   3. Do not use frozen materials or materials containing ice or snow.
   4. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

N. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
   1. Cool ingredients before mixing to maintain concrete temperature below ninety degrees (90°) F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

## 3.7 CONCRETE FINISHING

A. Allow time for bleed water to appear, then scrape or push off all bleed water. Do not work water into surface.

B. Final level, light bull float, but do not trowel surface.

C. After darbying or bullfloating, stop finishing until bleeding has ceased and until concrete can support foot pressure with only about one eighth-inch (1/8") indentation. During or after the first floating, check planeness of surface with a ten foot (10') 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 one eighth-inch (1/8") in ten feet (10').

D. Finishes:
1. Medium Broom Finish: Provide a medium broom finish for all exterior concrete unless otherwise noted. Immediately after float finishing and tool work, roughen surface with fiber-bristle broom to match the approved mockup panel. Confirm direction or pattern of broom finish with the Project Manager prior to commencing slab placement.
2. Monolithic Exposed-Aggregate Finish: Expose coarse aggregate in paving surface as follows:
    a. Immediately after float finishing, spray-apply chemical surface retarder to paving according to manufacturer's written instructions.
    b. Cover paving surface with plastic sheeting, sealing laps with tape, and remove when ready to continue finishing operations.
    c. Without dislodging aggregate, remove mortar concealing the aggregate by lightly brushing surface with a stiff, nylon-bristle broom. Do not expose more than one-third of the average diameter of the aggregate and not more than one-half of the diameter of the smallest aggregate.
    d. Fine-spray surface with water and brush. Repeat cycle of water flushing and brushing until cement film is removed from aggregate surfaces to depth required.

3. Seeded Exposed-Aggregate Finish:
    a. Immediately after initial floating, spread a single layer of aggregate uniformly on paving surface. Tamp aggregate into plastic concrete and float finish to entirely embed aggregate with mortar cover of one sixteenth-inch (1/16").
    b. Spray-apply chemical surface retarder to paving according to manufacturer's written instructions.
    c. Cover paving surface with plastic sheeting, sealing laps with tape, and remove sheeting when ready to continue finishing operations.
    d. Without dislodging aggregate, remove mortar concealing the aggregate by lightly brushing surface with a stiff, nylon-bristle broom. Do not expose more than one-third of the average diameter of the aggregate and not more than one-half (1/2) of the diameter of the smallest aggregate.
    e. Fine-spray surface with water and brush. Repeat cycle of water flushing and brushing until cement film is removed from aggregate surfaces to depth required.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a three eighths-inch (3/8") radius. Final concrete finish to completed following jointing. Surface/edging tool marks are not acceptable.

F. Handicap Ramps:
1. Provide score joints in handicap ramps, tooled in a pattern in accordance with standard Denver Public Works standards.
2. Install truncated dome inserts flush with the adjacent ramp surface in accordance with standard Denver Public Works standards, taking care to achieve a tight bond with the concrete, free of air pockets.
3. Detectable Warning Installer Qualifications: An employer of workers trained and approved by manufacturer of stamped concrete paving systems.

G. Do not use evaporative retarders as finishing aid.

## 3.8 CONCRETE CURING, PROTECTION AND SURFACE TREATMENTS

A. Refer to the list of curing materials in PART 2 - MATERIALS. Apply curing materials as specified by the manufacturer.

B. 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.

C. 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 4-inch 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 3-inches 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.

D. 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 JOINTS

A. Construct joints true to line with faces perpendicular to surface.

B. 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 Contract Drawings; 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 one hundred twenty foot (120') spacing.
7. As directed by Project Manager.
8. Thoroughly clean all surfaces prior to installation of sealant material.

C. Speed 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 eighteen-inches (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.
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.

D. Contraction (Control) Joints in Walks: Contraction joints shall be formed with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut one eighth-inch (1/8") 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 ten feet (10') unless approved by the Project Manager. Depth of joints shall be one-fourth (1/4) the slab thickness.

1. Tooled joints will not be allowed on concrete trails, unless directed by the Project Manager.

E. Curb and Gutter Contraction (Control) Joints: Space curb and gutter joints not more than twelve foot six-inches (12'-6") 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.

3.10 FORM REMOVAL

A. 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 high strength grout as per Project Managers direction. Plastering will not be permitted on exposed faces.

3.11 REPAIRS AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Project Manager.

B. Drill test cores, where directed by Project Manager, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

3.12 PAVING TOLERANCES

A. Comply with tolerances in ACI 117, the drawings, and as follows:
1. Elevation: In conformance with grading plans.
2. Thickness: Plus three eighths-inch (3/8"), minus one quarter-inch (1/4").
3. Surface: Gap below ten foot (10') long, unleveled straightedge not to exceed one eighty - inch (1/8").
4. Lateral Alignment and Spacing of Dowels: one-inch (1").
5. Vertical Alignment of Dowels: one quarter-inch (1/4").
6. Joint Spacing: three-inches (3").
7. Contraction Joint Depth: Plus one quarter-inch (1/4"), no minus.
8. Joint Width: Plus one eighth-inch (1/8"), no minus.

~~PART 4 - MEASUREMENT AND PAYMENT~~

~~4.1 MEASUREMENT **[Consultant to select A or B]**~~

~~A. Measurement will be based on the percentage complete for the lump sum contract amount for Concrete Walks, Curbs and Miscellaneous Flatwork.~~

B. Measurement will be made by the contract unit specified for Concrete Walks, Curbs and Miscellaneous Flatwork. Measurement shall include the actual number of units of specified material(s) placed and accepted at the locations shown on the Contract Drawings, or as directed by the Project Manager, and in accordance with the Specifications.

4.2 PAYMENT

A. Payment will be made at the **[contract unit]** [**lump sum contract**] price, and shall include required materials, transportation, equipment, labor, excavation, stockpiling, disposing, hauling off, watering, dust control, erosion and sediment control, compaction, sub-grade preparation, formwork, placing of concrete, reinforcing, joints, curing, finishing <**Insert additional items**> and all other items required to complete the work as required in accordance with the Contract Drawings and Specifications.

**END OF SECTION 32 13 13**

**SECTION 32 15 40 CRUSHED STONE PAVING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for demolition, earthwork, grading, furnishing, and placement of crushed stone paving.
   1. Furnish and place 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 Contract Drawings. The locations where crushed stone paving will be used are shown on the Contract Drawings.

B. Related Sections:
   1. Division 01 Section “Layout of Work and Surveys”.
   2. Division 01 Section “Contractor Quality Control”.
   3. Division 01 Section “Erosion and Sedimentation Control”.
   4. Division 31 Section “Earth Moving”.

1.3 REFERENCES

A. ASTM C117 – Test Method for Materials Finer than No. 200 (75-um) Sieve in Mineral Aggregates by Washing.

B. ASTM C136 – Method for Sieve Analysis of Fine and Coarse Aggregates.

C. ASTM D4318 – Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.

1.4 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. Samples: Provide a one (1) gallon sample of material for approval.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable.

B. Bulk Materials:
   1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas, plant materials or within critical root zones.
   2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
   3. Accompany each delivery of bulk materials with appropriate certificates.

C. Rejection of material.
   1. Evidence of inadequate protection or improper handling or storage shall be cause for rejection.
   2. Any product or material exhibiting signs of damage due to nonconformity to specifications or due to delivery, storage or handling shall be rejected by the Project Manager. Contractor shall be responsible for hauling off-site and disposing of according to general conditions and codes of the governing jurisdiction.

1.6 PROJECT CONDITIONS

A. Environmental requirements: Work shall occur only when weather and soil conditions permit in accordance with locally accepted practice.

B. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with proposed crushed stone paving areas by field measurements before proceeding with work.

C. Interruption of Existing Services or Utilities: Do not interrupt services or utilities to facilities occupied by Owner or others.

D. Existing Conditions:
   1. Utilities: Determine location of existing and proposed underground utilities. Perform work in a manner to avoid damage. Hand excavate, as required.
   2. Excavation: Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.

E. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained.

1.7 MAINTENANCE SERVICE

A. General: Maintain Work in accordance with Division 01.
   1. Maintenance Period: Begin maintenance immediately after Work is completed. Maintain areas until the end of the Warranty period.

1.8 WARRANTY

A. See Division 01 Section “Warranty”.

PART 2 - PRODUCTS

2.1 CRUSHED STONE PAVING

A. Type: Crushed granite stone or gravel. Shall be unused material free of shale, lay, friable materials, organics and debris.
1. Size Range: 3/8 inch maximum

| Sieve Size | Percent Passing |
|---|---|
| 2 inch | 100 |
| 3/8 inch | 100 |
| No. 4 | 85 |
| No. 8 | 63 |
| No. 16 | 50 |
| No. 30 | 39 |
| No. 50 | 29 |
| No. 100 | 18 |

2. Color: Uniform tan-beige.

2.2 SOIL STABILIZER

A. Soil stabilizer or binder: Natracil by Gail Materials or approved equal.
1. Local supplier:
2. Swell volume: 35 ml/gm minimum in accordance with USP procedures.
3. 90% minimum shall pass a No. 40 mesh screen.

B. Factory blended stabilized crushed stone paving. Provide in all locations shown on the drawings.
1. Mix crushed stone paving material with Natracil with a pug mill that includes a weigh-belt feeder.
a. Mix fourteen (14) pounds of binder per two thousand (2,000) pounds of aggregate.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where the Work of this Section will be performed for compliance with requirements and conditions affecting installation and performance.
1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within the work area.
2. Verify that final grades are completed in accordance with the drawings.

B. Proceed with installation only after unsatisfactory conditions have been corrected and approved by Project Manager.

3.2 QUALITY CONTROL

A. Mock-up: Provide field constructed sample installation of crushed stone paving, and prepared subgrade.
   1. Mock-up to be ten foot (10') x ten foot (10') and located where directed by Project Manager. Mock-up shall include proposed edge and banding, and surface stabilization if specified.
   2. Project Manager shall review mock up within forty eight (48) hours of notification by the contractor.
   3. Make necessary adjustments as directed by Project Manager.
   4. Obtain approval from Project Manager before proceeding with the Work.
   5. Retain and protect mock-up during construction as a standard for judging completed crushed stone paving work. Do not remove or destroy mock-up until work is completed.
   6. Accepted and properly maintained sample installations may remain in completed work if approved in writing by Project Manager.
   7. All work shall match accepted field mock-up.

3.3 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, turf areas, existing landscape areas, and trees from damage.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of

C. Install edging of type and in locations shown on drawings. Obtain acceptance of layout by Project Manager before excavating or installing. Make minor adjustments as required.

3.4 PLACEMENT OF CRUSHED STONE PAVING

A. Cut earthwork to width of trail/area to receive crusher fines paving to approximate depth section as specified on the Contract Drawings. Remove, haul and dispose of excess material off site, or use on-site with approval of Project Manager.

B. Complete excavation required in sub-grade before fine grading and final compaction of sub-grade is performed. Extend sub-grade compaction one foot (1') beyond proposed edge of crushed stone paving or as indicated on drawings.
   1. Where earth moving is required the sub-grade shall be compacted to ninety five percent (95%) standard proctor within two percent (2%) of the optimum moisture.
   2. Keep areas being graded or compacted shaped and drained during construction. Ruts greater than or equal to 1 inch deep in sub-grade shall be graded out and reshaped as required, and re-compacted before crushed stone paving placement.
   3. If the trail 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.

C. 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 trail 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 (250) lineal feet of trail or proof roll. Treat and compact sub-grade, leaving it 5-inches below final grade for placement of Crushed Stone Paving. Compact material and retest by proof rolling to achieve approval of Project Manager.

D. Install crushed stone paving only after excavation and construction work which might injure it have been completed, and after edging has been completely installed on the compacted sub-grade. Install crushed stone paving, over compacted base course in areas indicated on plan.

E. Spread crushed stone evenly to fifty percent (50%) of specified depth. Avoid segregation of aggregate and contamination with lower courses or sub-grade.

F. Compact to ninety five percent (95%) of maximum density as determined by ASTM D1557.
1. Maintain surface course moisture content within plus/minus three percent (± 3%) of optimum. Add water to quarry fines paving as required to achieve optimum moisture content and a uniform, compacted surface conforming to the finish grades indicated.
2. Compact areas inaccessible to rolling by mechanical tamping.

G. Protect crushed stone paving from soil or other contaminates during and following installation.

H. Spread and compact additional crushed stone paving to achieve the required minimum compacted thickness. Compact per 3.3.F above.

3.5 PLACEMENT OF STABILIZED CRUSHED STONE PAVING

A. Complete items 3.3.A through H above using specified crusher fines material with pre-incorporated specified binder at specified application rates.

B. Do not allow traffic on stabilized crushed stone paving for two days.

3.6 MAINTENANCE AND REPAIRS:

A. Crusher Fines Paving:
1. Areas that do not compact, become eroded or are degraded in visual quality and/or performance as determined by the Project Manager are to be removed and/or repaired. Obtain approval of repair methods from Project Manager prior to affecting repairs.

B. Stabilized Crusher Fines Paving:
1. To repair, excavate damaged area leaving a minimum one inch depth of existing stabilized crushed stone paving. Apply stabilized crusher fines to existing surface as described above. Compact per 3.3.F above.
2. Do not allow traffic on repaired stabilized crushed stone paving for two days or until paving has fully cured.

3.7 CLEANUP AND PROTECTION

A. All areas shall be clean at the end of each workday.

B. The contractor shall maintain protection during installation, curing, and maintenance periods.
1. Erect temporary fencing or barricades and warning signs as required protecting newly installed Crushed Stone Paving areas from traffic, other trades, and trespassers. Maintain fencing and barricades throughout initial maintenance period and remove with approval of Project Manager.

C. Project completion: All debris, soil, trash, and excavated and/or stripped material resulting from Crushed Stone Paving operations and unsuitable for or in excess of requirements for completing work of this Section shall be disposed of off-site.

D. Maintain protection during installation and maintenance periods. See Division 1. Treat, repair or replace damaged work as required.

3.8 QUALITY ASSURANCE

A. Refer to Division 1 Section “Quality Assurance”.

~~PART 4 - MEASUREMENT AND PAYMENT~~

~~4.1 MEASUREMENT **[Consultant to select A or B]**~~

~~A. Measurement will be based on the percentage complete for the lump sum contract amount for Crushed Stone Paving.~~

~~B. Measurement will be made by the contract unit specified for Crushed Stone Paving. Measurement shall include the actual number of units of specified material(s) placed and accepted at the locations shown on the Contract Drawings, or as directed by the Project Manager, and in accordance with the Specifications.~~

~~4.2 PAYMENT~~

~~A. Payment will be made at the **[contract unit]** **[lump sum contract]** price, and shall include required materials, transportation, equipment, labor, excavation, grading, stockpiling, disposing, hauling off, watering, dust control, erosion and sediment control, landscape renovation <**Insert additional items**> as required in accordance with the Contract Drawings and Specifications.~~

**END OF SECTION 32 15 40**

**SECTION 32 80 00 IRRIGATION SYSTEMS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the requirements for the 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, sensors, backflow preventer(s), Automatic Irrigation Controller(s) and final adjustments to insure complete coverage.
3. Water connections.
4. Replacement of unsatisfactory materials.
5. Cleanup, inspections, and approval.
6. Testing.

B. Related Sections:
1. Division 01 Section “Contractor Quality Control”.
2. Division 01 Section “Erosion and Sedimentation Control”.
3. Division 01 Section “Tree Retention and Protection”.
4. Division 31 Section “Earth Moving”
5. Division 31 Section “Excavation and Backfilling of Trenches”.
6. Division 32 Section “Concrete Walks, Curbs, and Miscellaneous Flatwork”.
7. Division 32 Section “Soil Preparation”.
8. Division 32 Section “Topsoil”.
9. Division 32 Section “Automatic Irrigation Controllers”
~~10. Division 32 Section “Turfgrass Seeding”.~~
~~11.~~10. Division 32 Section “Native Seeding”.
~~12. Division 32 Section “Sodding”.~~
~~13.~~11. Division 32 Section “Trees, Plants, and Groundcovers”.

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 Contract Drawings and specifications.
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 and/or new site features done under other Sections during Work associated with installation of irrigation system at no additional cost to the City.
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 the City. This includes boxes, manifolds, valves, angle valves, risers, wire, heads, pipe, and autom.
6. Water Delivery Interruption: When working on an existing irrigation system, the Irrigation Contractor shall contact the Project Manager 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 all points 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 10 AM to 6 PM. The signs are to be used are available from Denver Water.
8. Permits: Work involving plumbing for installation of copper piping, ductile iron 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
9. Refer to maintenance requirements for water during construction, 1.9.B.1.

B. Pre-Construction Conferences and Site Meetings:
1. Contractor shall schedule and conduct a pre-construction conference to review in detail quality control and 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 Project Manager, Denver Parks Superintendent, Operations Supervisor, Water Conservation, Contractor's Superintendent, and Installer.
2. Prior to commencement of Work, Contractor shall schedule an on-site conference with Project Manager, Denver Forestry and any other parties designated by Project Manager 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. Contractor shall schedule on-site conferences the frequency of which is to be determined by the Project Manager and any other parties designated by the Project Manager to review project progress.
4. Contractor shall record Minutes of each conference and distribute to all parties in attendance within three (3) days of conference.

1.5 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 furthermost 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 the Project Manager. 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 Project Manager prior to backfilling and paving operations.
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 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 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. Walk-Through for Substantial Completion:
1. Arrange for the Project Manager to be present. Provide 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 Project Manager 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, filter fabric, gravel bedding, wire splices, 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, Christy's valve marker tags or equal 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 Automatic Irrigation Controller and spare conduit/sleeving as required for wiring.

f. Review trench and related excavation repair including backfill, compaction, fine grade, seed and sod installation.

g. Review appropriate use of purple valve lids and other product as required for reuse water applications.

h. Generate a punch list of items to be corrected prior to Final Completion.

i. Furnish all materials and perform all work required to correct all inadequacies of coverage due to deviations from Contract Documents.

D. Walk-Through for Final Completion:

1. Arrange for Park Operations Supervisor, the Project Manager and Consultant to be present a minimum of seventy two (72) hours in advance of walk-through.
2. Show evidence to the Project Manager that the City has received all maintenance items and accessories, charts, record Contract Drawings, equipment, backflow certification reports and Automatic Irrigation Controller grounding assembly certificates as required before Final Completion walk-through is scheduled.
3. Operate each zone, in its entirety for the Project Manager at time of walk-through to insure correction of all incomplete items.
4. Items deemed not acceptable by the Project Manager shall be reworked to complete satisfaction of the Project Manager.
5. If after the walk-through for Final Completion of irrigation system the Project Manager finds items which have not been properly adjusted, reworked, or replaced per the previous punch list, the Contractor shall be charged for all subsequent walk-throughs. Funds will be withheld from final payment and/or retainage to Contractor, in amount equal to additional time and expenses required to conduct and document additional walk throughs by Project Manager to ensure compliance with Contract Documents.

## 1.6 SUBMITTALS

A. Prepare and make submittals in accordance with conditions of the Contract prior to installation of any irrigation equipment:

B. Material List: Submit a PDF file of 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.

C. Shop Contract Drawings: If applicable, submit shop Contract Drawings for pumps, backflows and assemblies. Include plumbing and foundation/support systems if the installation differs from the manufacturer's recommended installation.

D. Mock Ups:
   1. Valve clusters: Provide a completely built electrical valve cluster. This mockup, 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 assembly for each detail shown (eg. - quick coupler, rotors) or as directed by the Project Manager
   3. Drain valves: Provide a mock up including the service tee, and required fittings, and drain valve.
   4. Other: Mock ups that may be requested by the Project Manager.

E. Operation and Maintenance Manual: Coordinate scheduling/precipitation instructions with the City's operations staff. Submit three (3) bound manuals and one (1) digital copy to the Project Manager including:
   1. Winterization and spring start-up procedures.
   2. Cut sheets of products.
   3. Manufacturer's maintenance and checking instruction for backflow preventer (if applicable).
   4. Manufacturer's maintenance and operation instruction for pump station (if applicable).

F. Warranty: Submit two year written warranty, in accordance with WARRANTY/GUARANTY section.

## 1.7 CONTRACT RECORD DRAWINGS

A. Prior to the installation of irrigation system, the Contractor will provide on-site copies of original irrigation design Contract Drawings "Record Contract Drawings". Contractor to revise Record Contract Drawings in red ink as Work progresses to show any changes to the plan and include field dimensions.. Record Contract Drawings shall be brought up-to-date prior to any Pay Application Submittals that contain irrigation installation. Should the Contractor choose to utilize GPS for the purposes of documenting Work in progress, a hard copy print will need to be provided prior to Pay Application Submittal. A print of Record Contract Drawings shall be available at Project Site for review by the Project Manager at any time during the project.

B. Record Contract Drawings shall encompass entire scope of work including any altered existing equipment and altered zones, and notate the Automatic Irrigation Controller zone number, type of irrigation, GPM, operating PSI for any altered or added zone.

C. Preparation of Contract Record Drawings: Dimension from two permanent points of reference (building corners, sidewalk, road intersections or permanent structures) the location of the following items:
   1. Point of connection.
      a. Meters and vault dimensions
      b. Curb Stops
      c. Isolation Valves
      d. Drain Valves
      e. Pumps
      f. Backflows
      g. Bypass lines
      h. Service lines

2. Routing of irrigation mainline. Provide dimensions for each one-hundred linear feet (100 L.F.) maximum along each routing and for each change of direction.
3. Routing of non-pressure lateral lines, layout and size.
4. Sprinkler control valves.
5. Quick coupling valves.
6. Drain valves
7. Master valves
8. Flow sensors
9. Rain sensors/weather station
10. Wire splice boxes
11. Control wire routing if not with pressure mainline.
12. Gate valves.
13. Air relief valves.
14. Sleeves.
15. Flush valves.
16. Power service drop.
17. Other related equipment as directed.
18. Two-wire grounding rods

D. Make dimensions accurately at the same scale used in the original Contract Drawings, or larger. Notes and dimension lettering must be legible.

E. 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.

F. The Project Manager will not certify any pay request submitted by the Contractor if the Contract Record Drawings are not current, and processing of pay request will not occur until Contract Record Drawings are updated.

G. Final Submittal: Upon completion of Project, prior to final acceptance, secure digital copy of irrigation design from the Project Manager and record installation information that reflects all changes made over the course of the construction project, prepared by a qualified draftsperson. Contract Record Drawings shall include details, including any revisions as per actual installation. Deliver and submit to the Project Manager for review the following items:
1. Digital Contract Record Drawings in both PDF and AutoCAD release 2007 bound format (include any related X-ref files, plot files and pen settings.) Make any additional changes to the file as directed by the Project Manager prior to final submittal and approval.

H. Request for final payment will not be certified or processed until all Contract Record Drawing prints and digital files have been received and approved.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: 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.

B. Handling, Storage, and Delivery of PVC Pipe:

1. Exercise care in handling, loading and storage of PVC pipe.
2. Provide forty eight (48) hours advance notice of delivery to the Project Manager for observation of unloading and handling of PVC materials during delivery.
3. 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.

C. Storage and Protection: 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.

D. Only materials and equipment meeting project specifications and to be used as part of Project shall be stored on site. Project Manager to may verify at any time during construction period.

1.9 JOBSITE CONDITIONS

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

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 the City. Restore disturbed areas to original condition.
2. The Contractor is responsible for potholing of all existing utilities, irrigation lines or any other underground improvements that may be damaged due to the installation of Irrigation Systems.

C. Protection of Existing Trees:
1. Refer to Division 01 Section “Tree Retention and Protection”.
2. Consult with the Denver City Forester as requested by the Project Manager 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 Project Manager 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 inches (36”) below grade and may not take place anywhere within four feet (4’) of the drip line. Any exception must be agreed upon by the Denver City Forester or the Project Manager.

D. Protection and Repair of Underground Lines:
1. Request utility locates seventy two (72) hours in advance of any excavations by calling the Utility Notification Center of Colorado at 811. Take whatever precautions are

necessary, including pot holing to verify location and depth to protect these underground lines from damage. If damage does occur, all damage shall be repaired by the Utility Owner. All costs of such repairs shall be paid by Contractor.

2. The Contractor is required to contact all private utility companies including Denver 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 at 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: 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 the Project Manager.

1.10 WARRANTY/GUARANTY

A. Provide a two year written warranty for material and installation from date of Substantial Completion.

B. Expenses due to vandalism before Final Acceptance shall be the Contractor's 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. Once final acceptance is granted, the City will maintain turf and planting areas during warranty period, unless maintenance by Contractor is specified in the contract. Contractor is responsible to monitor and coordinate Automatic Irrigation Controller scheduling and maintenance with Project Manager for any seeding, sodding or planting areas under Contractor's warranty.

E. Project Manager reserves the right for his staff 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.

F. 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.

1.11 TURN OVER ITEMS

A. Where applicable, furnish the following maintenance items to City prior to Final Acceptance:
1. Two (2) sprinkler heads for each size and type specified.
2. Two (2) nozzles for each type of head.
3. Two (2) head adjustment tools for each type of head installed.
4. Two (2) valve keys for operating each type of manual valve. (Manual drain valves, isolation valves).
5. Two (2) valve keys and hose swivels for each type of quick coupling valve.

1.12 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 Automatic Irrigation Controller scheduling and maintenance operations with Project Manager for portions of City property unaffected by construction.

C. Additional Maintenance During Warranty Period:
1. Make repairs and replacements needed due to defective workmanship and materials.
2. Winterization: Include cost in bid for 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 Project Manager. Coordinate with the Denver Parks Operations Supervisor and the Project Manager to be present during the winterization procedures. The Contractor shall notify all persons that are to be present at the winterization a minimum of forty eight (48) hours prior to the winterization of the system.
3. 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 Operations Supervisor and the Project Manager to be present during the spring start up procedures. The Contractor shall notify all persons that are to be present at the spring start up a minimum of 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 Contract 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. Ductile Iron Pipe and Fittings:
1. Ductile Iron Pipe: Centrifugal cast ductile iron in metal molds for water pipe In accordance with ANSI C151 and AWWA A21.51 with asphaltic exterior coating and interior lining and coating in accordance with ANSI C151 and AWWA A21.51. Rubber-Gasket joints shall conform to ANSI/AWWA C111/A2.11. Fittings - Fittings shall be available in three inches (3") through twelve inches (12") sizes and shall be cast from ductile iron in accordance with ANSI/AWWA C153/A21.53 with mechanical join bells. Glands, bolts, nuts and gaskets shall be in accordance with requirements of ANSI/AWWA C153/A21.53. The working pressure rating shall be 350 PSI. Fittings shall have an asphaltic outside coating in accordance with ANSI/AWWA C153/A21.53.

Secure mechanical joint fittings to piping via installation of Meg mechanical joint restraints as manufactured by EBBA or approved equal.

B. Copper Pipe and Fittings:
   1. Pipe: Type K, rigid, hard tempered.
   2. Fittings - Wrought copper, solder joint type. Joints - Soldered with solder, forty five percent (45%) silver, fifteen percent (15%) copper, sixteen percent (16%) zinc, and twenty four percent (24%) cadmium and solidus at 1125° F and liquids at 1145° F.

C. Main and Lateral Lines:
   1. Main Lines (pressurized, downstream of backflow prevention units):
   2. Class 200 PVC BE, size one inch (1") to two and one half inch (2-1/2").
   3. Class 200 PVC RT/Gasketed, size three inches (3") and greater).
   4. Velocities in PVC mainline shall not exceed five feet (5') per second.
   5. All PVC pipe shall conform to the requirements of the United States Department of Commerce commercial standard Type 1-ASTM-D-2241.
   6. HDPE pipe, pressure rating DR 11 (200 PSI) may be used by approval of Project Manager 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.
   7. 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 (7-1/2) feet per second.

D. Sleeving:
   1. Horizontal sleeves under paved surfaces: Class 200 PVC.
   2. Vertical sleeves for access to drains and valves: Class 200 PVC.
   3. Horizontal sleeving for boring applications: HDPE.

E. Brass Pipe and Fittings:
   1. Brass Pipe: Eighty five percent (85%) red brass, ANSI Schedule 40 screwed pipe.
   2. Fittings: Medium brass, screwed one hundred twenty five (125) pound class.
      a. Mainline larger than 3" to be installed using tapping saddles, per CPS.

F. 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. Class 200 PVC Pipe (pressurized main line two and one-half inches (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 concrete thrust blocks as per Details.

3. Gasketed End Pipe (pressurized main line 3-inches 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, three inches (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.

4. Flexible Plastic Pipe (non-pressure lateral lines):
   a. Manufactured from virgin polyethylene in accordance with ASTM D2239, designated as PE 3408. Maximum size two inches (2"); minimum size one inch (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 two (2) clamps per joint on all insert fittings.
   d. Non-Potable water systems – Install Christy's TA-DT-3-PRW marking tape in all trenches containing polyethylene lateral piping. Install at six inch (6") depth.
   e. Risers for Pop-up Heads: Shall be swing pipe, 0.49 ID, operating pressure of eighty (80) PSI, manufactured by Rainbird or approved equal.

## 2.3 VALVES

A. Gate Valve or Isolation Valve:
   1. Valve for two and one-half inch (2-1/2") and smaller mainline (solvent-weld): Shall be cast iron body, threaded ends, left-hand opening, square nut operated, rubber resilient seated, FIPT joint AWWA gate valve with clear waterway equal to full diameter of pipe. Able to withstand continuous working pressure of one hundred fifty (150) PSI. Wheel type handle is unacceptable. Matco Norca 10RS series.
   2. 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 one hundred fifty (150) PSI. Wheel type handle is unacceptable. Martco-Norca 10RT series

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 (10) pounds 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.

4. Install one flexible marker tag on each valve. Mark each tag with inedible ink indicating zone number. Tags shall be: Potable water systems (yellow Christy's ID-MAX-Y1-PW014), Non-potable systems (purple Christy's ID-MAX-P1-NP011)

C. Manual Drain Valve:
1. Drain Valve: Mueller Oriseal #H-10283 or MacDonald AY, one inch (1") 3061 with brass swing joint assembly, or approved equal.

D. Quick Coupling Valves:
1. Buckner "Wing Thing" Q44LCAR10 brass two-piece body with winged stabilizer, designed for working pressure of one hundred fifty (150) PSI; one inch (1") FIP.. Size as shown on drawing.
2. 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 smaller than two inch (2"), Master Valve shall be Superior 3100 normally open valve.
2. Mainline two inch (2"), and larger, Master Valve shall be Bermad 410 normally open valve.

F. Flow Sensor Assembly:
1. Mainline one inch (1"), flow sensor shall be Data Industrial IR-250B .
2. Mainline one and one-half inch (1-1/2") through four inch (4"), flow sensor shall be Data Industrial - IR-220P, sized according to mainline size.
3. Mainline larger than four inch (4"), flow sensor shall be Data Industrial 220-B mounted with Harco tapping saddle sized according to mainline size.

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"
      8) Grounding Rod "GR"
      9) Filter "FIL"

3. Electric Control Valve Box: Shall have locking cover branded with the zone numbers.
   a. Single valve location only, three-quarter inch (3/4") through two inch (2"): Carson Brooks, Model #1220 jumbo box with bolt down T-cover.
   b. Multiple valve clusters, maximum three (3) control valves per box: Carson Brooks, Model #1730-18 box with bolt down T-cover.

4. Box color for valves:

a. Green for potable systems.
b. Purple for non-potable systems.

5. Gravel Leveling Bed and Drainage Sump in Valve Boxes: three quarters inch (3/4") crushed gravel lined in geo-textile, as indicated on Contract 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 2-inch or smaller, as manufactured by Febco Model 825YA or approved equal. Resilient gate valves on units larger than two inch (2"); as manufactured by Febco Model 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 Division 03 Section "Cast-in-place Concrete".

I. Air Relief Valve: On mainlines three inches (3") or larger, as per plan: Bermad 4415 (all cast iron) 2-inch double purpose vacuum air release valve or approved equal.

J. Pressure Reducing Valve: Watts #223 Hi-Capacity commercial grade or equal required where system pressures exceed one-hundred (100) PSI.

2.4 SPRINKLER HEADS

A. Heads: Provide fabricated riser units of the type and size as indicated on the Contract 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 MPR Series nozzle. Strip series, rotary, and VAN nozzles may be used for specific approved applications at the direction of the Project Manager.
4. Gear Driven Heads: Hunter I-20, I-25, I-40 or Rain Bird 5000 Plus, or 8005 series with stainless steel risers, internal check valve, PRS and MPR as specified per Contract Drawings. Riser height shall be six inches (6") in turf areas, and twelve inches (12") stainless steel in native areas.

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 PVC swing joints as per detail, connected to lateral pipe with PVC insert fittings.

2.5 LOW VOLUME IRRIGATION

A. Valve: Rain Bird XCZ-100-PRB-COM, size per Contract 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 Sub-paragraph 2.2.D.4, above. All lateral piping shall be installed at an eighteen inch (18") depth, or as directed by the Project Manager.

C. Sub-surface Irrigation: Landscape Dripline manufacturer, emitter spacing and flow as per Contract Drawings. All sub surface laterals to be buried at a four inch (4") depth minimum or as directed by the Project Manager.
1. Requires Netafim 120 mesh disc filter, Rain Bird PEB valve and bronze angle valve in Carson 1324-12 valve box with corner hex bolt down cover. Brand lid with "FIL".
2. Flush valve in Carson round ten inch (10") valve box with bolt down T-cover as per Contract Drawings. Brand lid with "FV".
3. Rain Bird 1812 spray head with closed 6 series (orange) VAN nozzle shall be installed adjacent to flush valve furthest from the control zone valve to act as zone operational indicator.

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 Contract Drawings or as directed by Project Manager or Forestry.
1. Precipitation rate of the bubblers must not exceed soil infiltration rate.

E. Supplemental tree watering systems in native areas: Two twelve inch (12") pop up sprinkler heads with Rotary nozzles shall be used at each tree in a native areas.
1. Install two heads on opposite sides of the trees dripline.
2. Precipitation rate of the nozzles must not exceed soil infiltration rate.

2.6 AUTOMATIC CONTROL SYSTEM

A. See Division 32 Section "Automatic Irrigation Controllers".

B. Electrical Control Wiring:
1. Standard Low Voltage Wire Systems:
   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 0.045-inch thickness.
   b. Electrical Common Wire: Golf Course Sprinkler Wire - #12 AWG UL approved direct burial solid conductor copper wiring with polyethylene insulation 0.045-inch thickness.
   c. 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) Master Valve Wires – Green and Blue.
      6) Tracer Wire – Yellow.

2. Two Wire Systems:
   a. Two-Wire Decoder Cable – Two twelve (12) ga. twisted-pair wires each with single, solid copper conductors with polyethylene insulation. Wires shall be contained within separate polyethylene jacket. Cable shall be Paige Electric P7350D cable (NO EQUALS).
   b. Two-wire single station decoders Toro ESB-BLD-1 to be installed in each valve box, one per valve in each box. Decoders shall have a serial number engraved on each decoder for future identification.
   c. Two-wire decoder cable shall have surge arrestors Toro ESB-DLTSLA installed every five hundred (500) ft. along two-wire path or every eight decoders whichever is the shortest distance. Surge arrestors are to be place in valve box containing valve cluster or in separate ten inch (10") round valve box.
   d. Surge arrestor Ground rods are to have a minimum diameter of five-eighths of an inch (5/8") and a minimum length of eight feet (8'). Ground rod shall be located a minimum of 9 feet from two-wire cable located in mainline trench such that six (6) gauge copper wire connecting surge arrestor to ground rod is perpendicular to tow-wire cable in mainline trench.
   e. Copper wire shall be six (6) gauge bare solid copper wire connected to the ground rod using a Cadweld GR1161GPLUS "Plus One Shot" welding kit.
   f. Two-Wire Splice Box: Carson #1419-12 box with bolt-down lid, branded "SB."

C. Miscellaneous control wiring materials:
1. Materials for both standard and two wire systems.

   a. Data Wires: Paige 7171D-A direct burial shielded and armored signal cable with polyethylene jacket (NO SUBSTITUTIONS)
      1) Data Wire connections and splices shall be made with Ranger Servi-Seal.
   b. Control Wire and Two-Wire Decoder Cable connections and splices shall be made with 3M DBR/Y-6M direct bury splice, or similar UL listed dry splice methods.
   c. Spare Wire and wire ends shall be capped with 3M DBR/Y-6Y or DBR direct bury splice, or similar UL listed dry splice methods to prevent wire corrosion.
   d. Mainline Tracer Wire: Install one continuous AWG UL No. 10 (#10) tracer wire as detailed above all mainline. Loop wire into each valve cluster valve, gate valve and drain valve control boxes. Color shall be yellow.
   e. Splice Box: Carson Brooks 10-inch round box, branded "SB."
   f. High Voltage: Type required by local codes and ordinances, of proper size to accommodate needs of equipment serviced.

## 2.7 MISCELLANEOUS MATERIALS

A. Rain Sensor: Hunter wireless Rain Clik with by-pass 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 at or 8-1-1 or 1-800-922-1987 prior to any excavation, for the marking of underground member utilities. The indication of

utilities on the Contract Drawings does not relieve the Contractor of the responsibility for utility location. Contractor is responsible for potholing all utility locations to verify the depth and locations. Potholing related to irrigation installation shall be considered incidental to irrigation installation and will not be paid for separately. Route trenches to avoid existing utilities. Verify with the Project Manager 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 Project Manager. 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 Project Manager 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 Project Manager forty eight (48) hours in advance and request review of staking. The Project Manager 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.
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 Project Manager, do not install irrigation equipment in these areas until the Project Manager has reviewed equipment staking.
4. The Project Manager may request the City Foresters approval of proposed trenching prior to start of trenching.
5. Review backflow prevention device location and operation with the Project Manager 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 at bore pits around the 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, the 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. Refer to Division 01 "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 inches (3") and larger: Minimum clearance of piping three inches (3") or larger shall be five inches (5") horizontally on both sides of the trench.
2) Piping two and one-half (2-1/2") and smaller: Trenches shall have a minimum width of four inches (4").
3) Line Clearance: Provide minimum six inches (6") of clearance between each line, and minimum 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 horizontal clearance between each line, and not less than twelve inches (12") of clearance between lines of other trades.
6) Installation of multiple runs of piping in common trench is prohibited. .

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 two inches (2").
5) Non-pressure Piping (pop-up heads): turf zones: eighteen inches (18") from top of pipe, native seed zones: twenty four inches (24") from top of pipe, maximum variation two inches (2")
6) Control Wiring and Two-Wire Decoder Cable: Side of pressure main when installed in the same trench; twenty-four (24) inches from the top of wire bundle where installed separately from mainline trench.

3. Vibratory Plow: Not permitted without written authorization of the Project Manager.

## 3.3 INSTALLATION OF IRRIGATION EQUIPMENT

A. Locate all equipment as near as possible to locations designated. Deviations shall be reviewed and approved by the Project Manager prior to installation.

B. Service Line Piping (copper or ductile iron piping from water meter to connection to backflow prevention device) - When pipe installation is not in progress, or at the end of each day, close pipe ends with tight plug or cap.
   1. Ductile Iron Pipe – Provide and install full pipe length protective polyethylene factory-formed sleeves around all piping to be buried. Pipe shall be bedded per Denver Water current standards and specifications.
   2. Copper piping – Installation shall match specifications for copper service line as required by Denver Water and in accordance with City and County of Denver Building Codes.

C. 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 (24) inches 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. Where cutting of asphalt and/or concrete is necessary, it shall be done per the Contract Drawings and Details and or per the City and County of Denver Right of Way Standards. Where cutting of concrete is necessary remove the entire concrete section or “stone”. Obtain permission to cut walks from the Project Manager.
   6. Compact backfill material in three uniform lifts at ninety five percent (95%) determined in accordance with ASTM D698 using mechanical tamping devices under pavement.
   7. Do not allow sleeves to become filled with soil or other undesirable material. Tape ends of sleeves until commencement of pipe installation.
   8. Mark sleeves on hard surfaces with a three inch (3”) by three inch (3”) “X” as per plans in a manner to ensure easy location in the future.
   9. 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)
      g. Two-Wire Decoder Cable: 2” PVC (1)

   10. 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 twenty four inches (24”) away from any hard surface or tree drip line.

c. Fittings to be used as couplings between HDPE and PVC shall be fusion welded by straight PVC pipe and shall be installed as specified per the Contract Drawings, Specifications and Manufactures recommendations. The following are pipe size requirements and coupling types:
   1) Pipe sizes two and one-half inches (2-1/2") and less 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.
   2) Pipe sizes three inches (3") and up 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.

D. 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 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. Install Drain Valves at all low points of the system.
      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 (2-1/2") or less): 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°) F.
      e. Gasketed End Pipes (required on all pipes three inches (3") or larger): Lay pipe and make pipe-to-fitting or pipe-to-pipe joint, following the manufactures installation recommendations. Install joint restraint fittings and pipe restraints on all fittings and adjacent pipe runs per manufacturer's recommendations and per approved plan.

E. Thrust Blocks on all PVC mainline two and one-half-inches (2-1/2") and smaller: Construct thrust blocks per Contract Drawings and Details.
   1. Concrete thrust blocks shall be a minimum of one (1) cubic foot of cast in place concrete in compliance with Division 03 Section "Cast-in-place Concrete". Contact the Project Manager 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:

| Soil Type | lbs./SF |
|---|---|
| Mulch, Peat, etc. | 0 |
| Soft Clay | 500 |
| Sand | 1,000 |
| Sand and Gravel | 1,500 |
| Sand and Gravel with Clay | 2,000 |
| Sand and Gravel Cemented with Clay | 4,000 |
| Hard Pan | 5,000 |

F. Joint restraints on all gasketed PVC mainline pipe three inches (3") and larger: Install joint restraints per the plans and or manufactures recommendations.

1. Joint restraints shall be installed as shown on the plans or per the manufacturer's recommendations. Prior to backfilling any joint restraints the Project Manager 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.

G. Flexible Plastic (Polyethylene) Pipe: Lay pipe and assemble fittings according to manufacturer's recommendations and per Contract Drawings and details.

H. Control Wiring - Low Voltage Wiring:
1. Bury control wiring between Automatic Irrigation 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 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 per Details.
3. Provide an expansion loop at every mainline change of direction, 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 quarters inch (3/4") pipe and withdrawing pipe.
4. Make all splices and electric control valve connections using 3M DBR/Y-6 connectors
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 1-inch high letters minimum.
6. Install one control wire for each control valve.
7. Install a total of five spare #14 AWG UFUL control wires and one spare common wire from Automatic Irrigation Controller pedestal to the end of each and every leg of mainline. Label spare wires at Automatic Irrigation Controller and wire stub box.
8. Two-wire control wiring:
   a. Bury two-wire decoder cable between Automatic Irrigation Controller and electric valves in pressure supply line trenches, strung as close as possible to main pipe lines with such cable to be consistently located below and to one side of pipe, or in separate trenches. Lay with pressure supply line pipe to one side of the trench.
      1) Lay with pressure supply line pipe to one side of trench.
   b. 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 coiling thirty-six inches (36") of cable.
   c. Make wire/cable splices at electric control valve connections as follows:
      1) Two-wire cable to two-wire cable - 3M Co. DBR/Y-6 watertight connectors.
      2) Two-wire cable to electric valve solenoid wires - 3M Co. DBR/Y-6 watertight connectors.
   d. Install all two-wire decoder cable splices not occurring at control valve in a separate Carson Industries Model #1419-12 body with bolt down T-cover wire splice valve box with branded with "SB" in one inch (1") high letters minimum.
9. Wire Testing:
   a. Existing wiring indicated to remain on documents is to be ohm-tested for continuity prior to construction. Contractor to produce report and copy Project Manager of the results of such testing.

b. New wiring: All new wiring to be ohm-tested prior to connection to valves and controller(s) for continuity. Contractor to produce report and copy Project Manager of the results of such testing.

I. Installation of Valves:

1. Electric Control Valves: Install electric control valves as detailed on the Contract Drawings.
   a. Electric Control Valves for two-wire system: Install electric control valves as detailed on the Drawings. Install one valve decoder module (Toro ESB-BDC series) per valve box, sized to operate all valves located within same box.

2. Quick Coupling Valves: Install quick coupling valves as detailed on the Contract Drawings.
3. Drain Valves: Install manual drain valves as detailed on the Contract 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 Contract Drawings.
5. Valve Boxes: Install one valve box for each type of valve or manifold as detailed. Install compacted gravel leveling bed after compaction of subgrade and prior to setting of valve box.
   a. Install filter fabric over gravel prior to setting valves boxes. Ensure that filter fabric extends a minimum of six inches (6”) from the bottom and no more than 6” from the top of box. Secure the filter fabric to the side of box with grey tape.
   b. Install valve boxes flush with finish grade and square to adjacent surface features and one another
   c. When valve boxes are grouped together, allow at least twenty four inches (24”) between valve box sides.
   d. Install valve boxes a minimum of eighteen inches (18”) off of any hard surface.
   e. Cutting of valve box to give clearance for piping or valves is not allowed.

## 3.4 BACKFLOW PREVENTION

A. Backflow Prevention Device: Contractor must meet all applicable laws, rules and codes, including but not limited to Uniform Building codes and applicable amendments 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.

1. 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.
2. 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 Project Manager.
3. Request for final payment will not be certified or processed until certification reports have been filed with Denver Water and received by the Project Manager.

## 3.5 INSTALLATION OF SPRINKLER HEADS

A. Install sprinkler heads where designated after the Project Manager has approved staking. Set to finish grade as detailed.
   1. Spacing of heads shall not exceed the maximum indicated on Drawing(s) unless re-staked or as directed by the Project Manager. In no case shall the spacing exceed maximum recommended by manufacturer.
   2. Install gear driven heads on swing-joint risers as detailed. Swing joints to non-pressure lines shall be set at no more than forty five degrees (45°) or less than ten degrees (10°).
   3. Install pop-up heads on swing pipe as detailed.
   4. 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 Project Manager may request nozzle changes or adjustments without additional cost to the City.

## 3.6 BACKFILLING

A. Do not begin backfilling operations unless authorized by the Project Manager and all required systems tests have been completed. Backfilling shall not be done in freezing weather unless authorized by the Project Manager. Leave trenches slightly mounded to allow for settlement after backfilling is completed. Trenches shall be finish graded and sodded or seeded prior to walk-through of system by the Project Manager.
   1. 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 2-inches in maximum dimension. 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.
   2. 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.
   3. 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’) of building or foundation walls.

## 3.7 RAIN SENSOR

A. Rain Sensor: Install in accordance with manufacturer’s instructions, and as shown on the Contract 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 (15) feet 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 inch (1/8”) inch prior to being installed or irrigation begins.

3.8 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 Project Manager or Consultant 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 Contract 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.

3.9 CLEANING

A. 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. Contractor shall clear all debris, including, soil, from all paths, walks, roads, and other hard surface areas.

~~PART 4 - MEASUREMENT AND PAYMENT~~

~~4.1 MEASUREMENT **[Consultant to select A or B]**~~

~~A. Measurement will be based on the percentage complete for the lump sum contract amount for Irrigation Systems.~~

~~B. Measurement will be made by the contract unit specified for Irrigation Systems. Measurement shall include the actual number of units of specified material(s) placed and accepted at the locations shown on the Contract Drawings, or as directed by the Project Manager, and in accordance with the Specifications.~~

~~4.2 PAYMENT~~

~~A.~~B. ~~Payment will be made at the **[contract unit]** [**lump sum contract**] price, and shall include required materials, transportation, equipment, labor, earthwork, trenching, stockpiling, disposing, hauling off, watering, dust control, erosion and sediment control, fine grading, <**Insert additional items**> as required in accordance with the Contract Drawings and Specifications.~~

**END OF SECTION 32 80 00**

**SECTION 32 84 33 AUTOMATIC IRRIGATION CONTROLLERS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for the installation of automatic landscape irrigation controllers including the following:
1. Trenching, stockpiling excavation materials, refilling and compacting excavations.
2. Irrigation system components including but not limited to Automatic Irrigation Controller(s), associated wiring, timing and final adjustments.
3. Testing.

B. Related Sections:
1. Division 01 Section “Contractor Quality Control”.
2. Division 01 Section “Erosion and Sedimentation Control”.
3. Division 01 Section “Tree Retention and Protection”.
4. Division 31 Section “Earth Moving”
5. Division 31 Section “Excavation and Backfilling of Trenches”.
6. Division 32 Section “Concrete Walks, Curbs, and Miscellaneous Flatwork”.
7. Division 32 Section “Soil Preparation”.
8. Division 32 Section “Topsoil”.
9. Division 32 Section “Irrigation Systems”
10. Division 32 Section “Turfgrass Seeding”.
11. Division 32 Section “Native Seeding”.
~~12. Division 32 Section “Sodding”.~~
~~13.~~12. Division 32 Section “Trees, Plants, and Groundcovers”.

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.
2. Compaction: Settlement of excavations is cause for removal of concrete controller pads, 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 and/or new site features done under other Sections during Work associated with installation of irrigation system at no additional cost to the City.
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 the City. 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 Project Manager and inform him 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 all points 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 10 am to 6 pm. The signs are to be used are available from Denver Water.
8. Permits: 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.
9. Pre-Construction Conferences and Site Meetings:
    a. Contractor shall schedule and conduct a pre-construction conference to review in detail quality control and 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 Project Manager, Denver Parks Superintendent, Operations Supervisor, Water Conservation, Contractor's Superintendent, Toro factory representative, and Installer.
    b. Prior to commencement of Work, Contractor shall schedule an on-site conference with Project Manager, Parks Forestry and any other parties designated by Project Manager 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.
    c. The Contractor shall schedule on-site conferences, the frequency of which is to be determined by the Project Manager, and any other parties designated by the Project Manager to review project progress.
    d. The Contractor shall record Minutes of each conference and distribute to all parties in attendance within three (3) days of conference.

1.5 FIELD QUALITY CONTROL

A. 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 Project Manager to arrange Central Control Certification meeting.

2. Required attendees are the Toro Factory Representative, Water Conservation, Denver Parks Operations Supervisor and the Project Manager.
3. 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.

B. System Operations Orientation:
1. System Operation Training Session: A training and orientation session for City staff shall be required.
a. The Contractor, the irrigation subcontractor, a representative of the manufacturer or distributor, and representatives of the City's maintenance and Water Conservation shall be present. The date and time of the session and attendees present shall be subject to approval by the Project Manager.
b. The completed Record Drawings, Automatic Irrigation Controller Zone Maps and Automatic Irrigation Controller Program Schedule shall be reviewed for approval by Water Conservation.
c. Automatic Irrigation Controller features, flow sensing, alarms and programming shall be reviewed.
d. Hand held operation of field units shall be demonstrated.

C. Walk-Through for Substantial Completion:
1. A project inspection walk through shall include but is not limited to the following:
a. Confirm quality of controller enclosure and mounting (there must be no gap between Automatic Irrigation Controller and concrete), grounding, high voltage installation, low voltage wiring, ID tagging of wires in Automatic Irrigation Controller, and communication set up. Each controller must have a color-coded zone chart and programming chart as per specifications.
b. Contractor shall submit to the Owner written certification of testing that proper grounding for all controllers has been installed per the manufactures recommendations.

2. Certify Central Control Operation: Central control operation will be verified by Denver Parks' **Certification of Central Control Checklist**.

1.6 SUBMITTALS

A. Prepare and make submittals in accordance with conditions of the Contract prior to installation of any irrigation equipment.

B. Material List: Submit a PDF file of 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.

C. Shop Drawings: If applicable, submit shop drawings for Automatic Irrigation Controllers indicating electrical wiring design, and assembly. Include shop drawings for Automatic Irrigation Controller foundation/support systems.
1. Operation and Maintenance Data: Coordinate scheduling/precipitation instructions with the City's Operations Staff. Submit three (3) bound manuals and one (1) digital copy to the Project Manager including:
2. Cut sheets of products.
3. Manufacturer's maintenance and checking instruction for Automatic Irrigation Controller.
4. Manufacturer's maintenance and operation instruction for weather station and any other water conservation equipment.

D. Warranty: Submit two (2) year written warranty, in accordance with Paragraph 1.10 below.

1.7 CONTRACT RECORD DRAWINGS

A. Prior to the installation of irrigation system, the Contractor will provide on-site copies of original irrigation design drawings "Record Drawings". Contractor to revise Record Drawings in red ink as Work progresses to show any changes to the plan and include field dimensions.. Record Drawings shall be brought up-to-date prior to any Pay Application Submittals that contain irrigation installation. Should the Contractor choose to utilize GPS for the purposes of documenting Work in progress, a hard copy print will need to be provided prior to Pay Application Submittal. A print of Record Drawings shall be available at Project Site for review by the Project Manager at any time during the project.
1. Record Drawings shall encompass entire scope of work including any altered existing controllers and/or wiring.
2. Preparation of Record Drawings: Dimension from two permanent points of reference (building corners, sidewalk, road intersections or permanent structures) the location of the following items:
3. Automatic Irrigation Controller location.
   a. Rain sensors/weather station
   b. Power service drop.
   c. 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. The Project Manager will not certify any pay request submitted by the Contractor if the Record Drawings are not current, and processing of pay request will not occur until Record Drawings are updated.
6. Final Submittal: Upon completion of the Automatic Irrigation Controller installation, prior to final acceptance, secure digital copy of documents associated with the Automatic Irrigation Controller design from the Project Manager and record as installed information that reflects all changes made over the course of the construction project, prepared by a qualified draftsperson. Record Drawings shall include details, including any revisions as

per actual installation. Deliver and submit to the Project Manager for review the following items:

a. Digital Contract Record Drawings in both PDF and Auto CAD release 2007 bound (include any related X-ref files, plot files and pen settings.) Make any additional changes to the file as directed by the Project Manager prior to final submittal and approval.

7. Request for final payment will not be certified or processed until all Record prints and digital files have been received and approved.
8. Controller Zone Maps and Programming Schedule:
9. Do not prepare zone maps or irrigation controller charts until record drawings have been reviewed and approved by the Project Manager. The Project Manager shall provide an example of Automatic Irrigation Controller Charts and zone map required.
10. Provide one controller zone map for each Automatic Irrigation 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 Automatic Irrigation Controller on one sheet.
    c. Identify Automatic Irrigation 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 Automatic Irrigation 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 Project Manager

11. 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 Automatic Irrigation 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 Project Manager

12. The contractor is responsible for programming new and modified Automatic Irrigation Controllers to operate the irrigation system in conformance with all Denver Water restrictions and establishment rules for new landscapes per Denver Water, rules and regulations at: http://www.denverwater.org.
13. The Contractor shall be responsible for providing an Establishment Watering Schedule, Transition Watering Schedule and a Maintenance Watering Schedule to the Project Manager, 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 Project Manager and Operations Supervisor. The water schedule templates are available from Water Conservation and the Project Manager. Contractor shall make any modifications to the programming as requested by Project Manager 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 Project Manager, Operations 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.

1) It is the responsibility of the Contractor to coordinate with Project Manager, Operations Staff, and local Toro Field Representative. The local Toro Field Representative will assist the Contractor in the setup of the controller(s), but Contractor is responsible for the actual programming of Automatic Irrigation Controllers as needed to properly irrigate plant materials and turfgrass.

2) Provide Toro Field Representative with the following:

a) Zone gallons-per-minute (GPM)w schedule from documents.

b) Zone map to compare GPMs when setting up system flows.

14. 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 inch (1-1/2") of water per day for the first two to three days. Probe the soil to determine if the moisture has penetrated down to a minimum of four inches (4"). During the next three 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.
15. Provide one Programming Schedule for each Automatic Irrigation Controller installed, one page maximum, 8-1/2- by 11-inches. Project Manager shall provide an example of Controller Programming Schedule required and the scheduling templates.
16. Following review of Zone Maps and Schedules by the Project Manager, provide two additional color duplicates of Zone Maps and Schedules. One set of Zone Maps and Schedules shall be laminated between two layers of 3-mil plastic sheet. Provide digital copies of Zone Maps and Schedules in PDF format.
17. Zone Maps and Schedules shall be completed and reviewed prior to final review of irrigation system.
18. 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.

## 1.8 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Deliver all components to job site in original unopened packaging containers prominently displaying manufacturer's name, contents, instructions, and conformance to local, state, and federal law. Remove and replace damaged items or elements prematurely exposed to moisture, inclement weather, snow, ice, temperature extremes, fire, or jobsite damage.

B. Storage and Protection: 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.

C. Only materials and equipment meeting project specifications and to be used as part of Project shall be stored on site. Project Manager to may verify at any time during construction period.

1.9 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, unless approved by the Project Manager.
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 Project Manager within twenty four (24) hours of discovery. Commencement of installation means acceptance of existing conditions by the Contractor.

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 the City. Restore disturbed areas to original condition.
2. Preserve and protect all trees and plants as shown on plans or as directed by the Project Manager or the Denver City Forester. In the event damage does occur, all damage to plant material shall be brought to the attention of the Project Manager 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 the City.

C. Protection of Existing Trees:
1. Refer to Division 01 Section “Tree Retention and Protection”.

D. Protection and Repair of Underground Lines:
1. Request utility locates seventy-two (72) hours in advance of any excavations by calling the Utility Notification Center of Colorado at 811. Take whatever precautions are necessary, including pot holing to verify location and depth to protect these underground lines from damage. If damage does occur, all damage shall be repaired by the Utility Owner. All costs of such repairs shall be paid by Contractor.
2. The Contractor is required to contact all private utility companies including Denver 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: 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 the Project Manager.

1.10 WARRANTY/GUARANTY

A. Provide a two (2) year written warranty for material and installation from date of Substantial Completion.

B. Expenses due to vandalism before Final Acceptance shall be the contractor's responsibility.

C. Any settling or displacement of concrete support pad for Automatic Irrigation Controller that occurs during warranty period shall be repaired at no expense to the City, including complete restoration of damaged property.

D. Once final acceptance is granted, the City will maintain turf and planting areas during warranty period, unless maintenance by Contractor is specified in the contract. Contractor is responsible to monitor and coordinate Automatic Irrigation Controller scheduling and maintenance with Parks' maintenance staff and or the Automatic Irrigation Controller factory certified technician for any seeding, sodding or planting areas under Contractor's warranty.

E. Project Manager 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. The City reserves the right to change Automatic Irrigation Controller schedules should the contractor not respond within seventy two (72) hours of a written request to make changes to programming. Doing so does not relieve the contractor of their contractual obligations.

F. Contractor shall make repairs and replacements within three (3) days of notification. If Contractor fails to make repairs within three (3) days, the City will make such repairs at Contractor's expense.

1.11 MAINTENANCE

A. Where applicable, furnish the following maintenance items to City prior to Final Acceptance:
1. Four (4) Automatic Irrigation Controller cabinet keys. (If applicable).
2. One (1) remote control device for each Automatic Irrigation Controller installed on the project. (If applicable).

1.12 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 Automatic Irrigation Controller scheduling and maintenance operations with Project Manager for portions of City property unaffected by construction.

C. Additional Maintenance During Warranty Period:
1. Make repairs and replacements needed due to defective workmanship and materials.
2. Winterization and Spring Start Up: See Division 32 Section “Irrigation Systems”.

## 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 Contract 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 AUTOMATIC CONTROL SYSTEM

A. Automatic Irrigation 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 Automatic Irrigation 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. 450 MHz radio communication shall be fully compatible with Denver Parks and Recreation frequency required by the Operations District.

2. If variance is granted, Automatic Irrigation 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 Automatic Irrigation Controller features.
   f. Flow sensing capability with automatic shut-down or alarm signal.
   g. Minimum 40 VA transformer rating.

h. Automatic Irrigation 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. Automatic Irrigation Controller and cabinet require grounding per manufacturer recommendations, outside disconnect, inside fused disconnect, interior duplex GFI outlet.
j. Automatic Irrigation Controller shall have capability to interface with normally-open master valve.

3. Automatic Irrigation 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 Division 31 Section “Concrete Walks, Curbs, and Miscellaneous Flatwork”.

B. Electrical Control Wiring: See Division 32 Section “Irrigation Systems”.

## PART 3 - EXECUTION

### 3.1 PREPARATION

A. Utility Locates: Contact Utility Notification Center of Colorado at or 8-1-1 or 1-800-922-1987 prior to any excavation, for the marking of underground member utilities. The indication of utilities on the Contract Drawings does not relieve the Contractor of the responsibility for utility location. Contractor is responsible for potholing all utility locations to verify the depth and locations. Potholing related to irrigation installation shall be considered incidental to irrigation installation and will not be paid for separately. Route trenches to avoid existing utilities. Verify with the Project Manager any required relocation prior to installation.

B. Automatic Irrigation Controller Location: Contractor will be held responsible for coordination between existing and proposed landscape improvements, Automatic Irrigation Controller location, and installation. Landscape material locations shown on the Landscape Plan shall take precedence over the location of the Automatic Irrigation Controller location(s). If Automatic Irrigation Controller is installed in conflict with the landscape material locations shown on the landscape plan, the Contractor will be required to relocate the Automatic Irrigation Controller, as necessary, at Contractor’s expense.

C. Inspection:
1. 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.
2. Grading operations, with the exception of fine grading, shall be completed and approved by Project Manager before staking or installation of any irrigation system equipment begins.
3. Layout: Stake Automatic Irrigation Controller location before beginning installation and obtain Project Manager’s approval prior to installation.

### 3.2 INSTALLATION OF IRRIGATION EQUIPMENT

A. High Voltage Wiring for Automatic Irrigation Controller:

1. Provide one hundred twenty (120) volt power connection to Automatic Irrigation 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.

B. 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, Denver Parks Operations Supervisor, and the Project Manager.
      b. All irrigation schedules during establishment period and warranty period are to be submitted via email to the Toro Factory Representative, Water Conservation, Denver Parks Operations Supervisor and Project Manager. Upon approval of the schedule the Toro Factory Representative will input schedules and make all changes, corrections or updates within 48-hours.

C. Field Wiring Testing Requirements:
   1. Contractor shall provide a pre installation Ohm test report of all field wires located within an existing controller prior to removing any wires from the terminals in the Automatic Irrigation Controller. Provide a report to the Project Manger of each zone wire tested, the Ohm readings for each wire, date of test, Automatic Irrigation Controller location. Please indicate in the report any wires or solenoids that do not meet standards for the operating ranges of the specified or existing materials.
   2. Contractor shall provide an Ohm test report of all field wires prior to installing any wires at the Automatic Irrigation Controller terminals. Provide a report to the Project Manger of each zone wire tested, the Ohm readings for each wire, date of test, Automatic Irrigation Controller location. Please indicate in the report any wires or solenoids that do not meet standards for the operating ranges of the specified or existing materials. The report shall include the Ohm readings prior to removal of the existing controller and after relocation or installation of new Automatic Irrigation Controllers.
   3. All field wiring issues must be resolved prior to the connection of wires at the Automatic Irrigation Controller terminal strips.
   4. Install Automatic Irrigation Controller and enclosure in accordance with the Contract 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.
   5. Provide Automatic Irrigation Controller to earth ground as per manufacturer recommendations. Central Control Satellite: Provide Automatic Irrigation Controller to earth ground in accordance with Article 250 of the National Electrical Code (NEC). Earth ground shall be ten (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 Denver Parks Operations Staff and Project Manager.
      a. Ground rods are to have a minimum diameter of five-eighths-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.

6. Install above ground wiring in rigid conduit in accordance with applicable codes.

D. Coordinate installation with electrical work to insure electrical power supply line(s) are provided to Automatic Irrigation Controller location(s).
1. Permanently engrave date of installation and Xcel service pole number inside Automatic Irrigation Controller enclosure.

E. Wire control valves in a logical zone sequence or as shown on Contract Drawings.

~~PART 4 - MEASUREMENT AND PAYMENT~~

~~4.1 MEASUREMENT **[Consultant to select A or B]**~~

~~A. Measurement will be based on the percentage complete for the lump sum contract amount for Automatic Irrigation Controllers.~~

~~B. Measurement will be made by the contract unit specified for Automatic Irrigation Controllers. Measurement shall include the actual number of units of specified material(s) placed and accepted at the locations shown on the Contract Drawings, or as directed by the Project Manager, and in accordance with the Specifications.~~

~~4.2 PAYMENT~~

~~A. Payment will be made at the **[contract unit]** [**lump sum contract**] price, and shall include required materials, transportation, equipment, labor, earthwork, stockpiling, disposing, hauling off, watering, dust control, erosion and sediment control, fine grading, temporary protection by fencing or other means, all maintenance required, specified controller charts, zone maps, Record Drawings and verification checklist until Final Acceptance of the work <**Insert additional items**> as required in accordance with the Contract Drawings and Specifications.~~

**END OF SECTION 32 80 00**

**SECTION 32 91 13 SOIL PREPARATION**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for the preparation of soil for the purpose of seeding, sodding, or planting operations.
   1. 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 Sections:
   1. Division 01 Section “Erosion and Sedimentation Control”.
   2. Division 31 Section “Clearing and Grubbing”.
   3. Division 31 Section “Earth Moving”
   4. Division 32 Section “Topsoil”.
   ~~5. Division 32 Section “Turfgrass Seeding”.~~
   ~~6.~~5. Division 32 Section “Native Seeding”.
   ~~7. Division 32 Section “Sodding”.~~
   ~~8.~~6. Division 32 Section “Trees, Plants, and Groundcovers”.

1.3 DEFINITIONS

A. Fertilizer: A substance that is added to soil to help the growth of plants.

B. Soil Amendment: Any substance which is intended to improve the physical, chemical, or other characteristics of the soil

C. Soil Conditioner: Combination of slow-release fertilizer, hummate, and Mycorrhiza

1.4 SUBMITTALS

A. See Division 01 Section “Submittals” for submittal requirements.

B. Soils Test Data: See Sections 1.6 through 1.11 of this specification.

C. Product Data: For each type of product.
   1. Include recommendations for application and use.
   2. Include test data substantiating that products comply with requirements.
   3. Material Certificates: For each type of soil conditioner, soil amendment and fertilizer before delivery to the site, according to the following:
      a. Manufacturer's qualified testing agency's certified analysis of standard products.

D. Samples: For each bulk-supplied material, one (1) quart volume of each in sealed containers labeled with content, source, and date obtained. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of composition, color, and texture.

E. 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 months prior to delivery to site.

1.5 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.

1.6 PROJECT/SITE CONDITIONS

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

B. Vehicular site access shall be limited to the area(s) indicated on the Contract Drawings or as defined by the Project Manager.

C. Damage to turf, natural areas, pavements, irrigation systems, underground utilities, and other improvements shall be repaired by the contractor at no additional cost to the City.

1.7 QUALITY CONTROL

A. Testing Agency Qualifications: Retain an independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.
   1. Laboratories: Subject to compliance with requirements, provide testing of materials in the Section by a qualified testing laboratory approved by the Project Manager. Submit Testing Agency qualifications to Project Manager for approval prior to construction.
   2. Multiple Laboratories: Work may be divided among qualified testing laboratories specializing in physical testing, chemical testing, and fertility testing. Submit Testing Agency qualifications to Project Manager for approval prior to construction.

1.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Contractor is responsible for specified tests.

C. Perform the following tests[ **and inspections**]:
   1. <**Insert name of test**>: <**Insert requirement**>.
   2. <**Insert name of inspection**>: <**Insert requirement**>.

D. Soil will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

F. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

G. Inspection: Provide notice to the Project Manager requesting inspection at least seventy-two (72) hours prior to anticipated date of completion.

H. 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.

I. Deficiencies: The Project Manager will specify deficiencies to Contractor who shall make satisfactory adjustments and shall again notify Project Manager for final inspection.

1.9 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency, approved by the Project Manager, to perform preconstruction soil analyses on existing, on-site soil, imported topsoil and pre-amended imported soil.
   1. Notify Project Manager seventy-two (72) hours in advance of the dates and times when laboratory samples will be taken.

B. Preconstruction Soil Analyses: For each unamended soil type, perform testing on soil samples and furnish soil analysis and a written report containing soil-amendment, soil-conditioner and fertilizer recommendations by a qualified testing agency performing the testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.
   1. Have testing agency identify and label samples and test reports according to sample collection and labeling requirements.

1.10 SOIL-SAMPLING REQUIREMENTS

A. General: Extract soil samples according to requirements in this article.

B. Sample Collection and Labeling: Have samples taken and labeled by Contractor in presence of Project Manager and under the direction of the testing agency.

   1. Number and Location of Samples: Minimum of five (5) samples per acre collected randomly throughout the areas to receive similar soil preparation, including seed/sod, native seeding, planting beds, and gardens. Provide a map to the Project Manager of sampling locations prior to sampling for approval.
   2. Procedures and Depth of Samples: Collect samples to a depth of six inches (6”) and combine in a clean plastic container.
   3. Mixing of Samples: Mix samples together thoroughly, removing plant debris and breaking up clods.

4. Labeling: Label each sample with the date, location keyed to a site plan or other location system, visible soil condition, and sampling depth.

1.11 TESTING REQUIREMENTS

A. General: Perform tests on soil samples according to requirements in this article.

B. Physical Testing:
1. Soil Texture: Soil-particle, size-distribution analysis by the following methods according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods":
   a. Sieving Method: Report sand-gradation percentages for very coarse, coarse, medium, fine, and very fine sand; and fragment-gradation (gravel) percentages for fine, medium, and coarse fragments; according to USDA sand and fragment sizes.
   b. Hydrometer Method: Report percentages of sand, silt, and clay.

C. Fertility Testing: Soil-fertility analysis shall , include the following:
1. Percentage of organic matter.
2. CEC, calcium percent of CEC, and magnesium percent of CEC.
3. Soil reaction (acidity/alkalinity pH value).
4. Buffered acidity or alkalinity.
5. Lime estimate.
6. Soil texture estimate.
7. Nitrogen ppm.
8. Phosphorous ppm.
9. Potassium ppm.
10. Manganese ppm.
11. Zinc ppm.
12. Iron ppm.
13. Boron ppm.
14. Copper ppm.
15. Sodium ppm**,**and sodium absorption ratio.
16. Soluble-salts ppm.
17. Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problem materials are present, provide additional recommendations for corrective action.
18. Other deleterious materials, including their characteristics and content of each.

D. Recommendations: Based on the test results, state recommendations for soil treatments, soil amendments, and soil conditioners to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants indicated. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients.
1. Fertilizers and Soil Amendment Rates: State recommendations in weight per one thousand (1,000) sq. ft. for six inch (6”) depth of soil.
2. Soil Reaction: State the recommended liming rates for raising pH or sulfur for lowering pH according to the buffered acidity or buffered alkalinity in weight per one thousand (1,000) sq. ft. for six inch (6”) depth of soil.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.

B. Bulk Materials:
1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Do not move or handle materials when they are wet or frozen.
4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil: Shall be as specified under Division 32 Section “Topsoil”.

B. Soil Amendments:
1. For the purpose of bidding the Contractor shall assume all areas to receive soil amendments will be at four (4) cubic yards per one thousand (1,000) square feet. Once soils tests have been received and determination is made on the proper amount to be added the site specific soils the rate to be applied may be adjusted per the price based on the Schedule of Values for Soil Amendment.
2. 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 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: 7.5, maximum.
   d. Carbon to nitrogen ratio shall be less than 20:1.
3. Mountain peat, aspen humus, gypsum and sand will not be accepted.
4. Acceptable product: Class I compost, such as Ecogro or Bio-comp, as produced by A1 Organics, Eaton, CO, or approved equal.

C. Soil Conditioners:
1. For the purpose of bidding the Contractor shall assume all areas to receive Soil Conditioners will be applied at the rate specified by the manufacturer for each specific planting type. Once soils tests have been received and determination is made on the proper amount to be added the site specific soils the rate to be applied may be adjusted per the price based on the Schedule of Values for 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 Fungi: Dry, granular inoculant containing at least 5300 spores per lb (0.45 kg) of vesicular-arbuscular mycorrhizal fungi and 95 million spores per lb (0.45 kg) of ectomycorrhizal fungi, thirty three percent (33%) hydrogel, and a maximum of five and one half percent (5.5%) inert material.
d. Mycorrhizal Inoculant: AM-120, as manufactured by Reforestation Technologies International, locally available from Pawnee Buttes Seed, Greeley, CO, (970)356-7002.
e. Acceptable substitution.

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.

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. Fertilizer shall not be applied to areas to receive native grass seeding.

2.3 PESTICIDE

A. Post Emergent Pesticide: 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 Contract Drawings before beginning work under this Section.
1. Grades: Inspect to verify rough grading is within +/-one tenth of one foot (0.1’) of grades indicated and specified.
2. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within the work area.
3. Damaged Earth: If, upon inspection, the soil is found to be unfit to support planting as described in article 2. above, it is to be removed and replaced with clean soil from a source approved by the Project Manager.

B. Unsatisfactory Conditions: Report in writing to General Contractor with copy to Project Manager.

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.

B. Weed Control: Perform pesticide treatment over the entire area to be planted. Allow sufficient time to successfully complete the entire pesticide treatment process before proceeding with planting. Repeat procedure as needed as weed growth becomes evident throughout the duration of construction.

1. Pesticide treatment must be completed during the growing season.
2. Water surface one half inch (1/2") per week for two weeks prior to application if natural precipitation does not supply this amount to encourage weed seed germination.
3. Treat site with pesticide in accordance with manufacturer's recommendations.
a. Two days after application water surface one half inch (1/2") per week if natural precipitation does not supply this amount to encourage weed seed germination.
b. Ten (10) days after the first Pesticide application, review surface for evidence of plant growth.
c. Repeat steps 2, 3, 4, and 5, up to three (3) applications, until there is no evidence of plant growth after a ten (10) day period.
d. Obtain Project Manager approval of surface conditions fourteen (14) days after last pesticide application.
e. Pesticide treatments beyond the three (3) applications shall be considered additional to the contract and will be performed at the directed of Project Manager after the City has approved the cost. Additional pesticide treatments required for imported topsoil shall be borne solely by the Contractor.
f. Remove plant debris from treated area.
g. Contact Project Manager forty eight (48) hours in advance to review the site after each pesticide treatment. Do not proceed with additional planting until the results are approved and accepted by the Project Manager.

4. Surface Grade: Establish grades as indicated on Contract Drawings, and as required in Division 31 Section "Earth Moving".
5. Remove weeds, debris, clods and rocks larger than one inch (1"). Remove and dispose of accumulated materials at direction of Project Manager.
6. Erosion Control: Take measures and furnish equipment and labor necessary to control the flow, drainage and accumulation of water, and prevent soil erosion, blowing soil and accumulation of wind-deposited material on the site throughout duration of work. Insure that all excess water will run off the grades or will percolate within twelve (12) hours.
7. Soil Testing: Soil Amendments, Soil Conditioners and Fertilizersshall meet the minimum amounts as specified in Article 3.3, "Installation", below. Unless determined by the Project Manager 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 Division 32 Section "Topsoil", Article 1.4, "Quality Control" for soil analysis report information. Soil test will be used to determine the type

and amount of Soil Amendment, Soil Conditioner, and Fertilizer to be applied prior to seeding, sodding and planting. Locations for testing shall be approved by the Project Manager.

8. Timing: Perform soil preparation just prior to planting operations and in accordance with final planting schedule. Coordinate with irrigation system installation to avoid damage.

C. Areas of Compacted Topsoil: Areas within the work limits or as defined on Contract Drawings or by the Project Manager 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 8-inch depth minimum to loosen topsoil.

D. Areas of Disturbed Topsoil: Areas disturbed but not severely compacted as determined by the Parks Project Manager, shall be deep tine aerated or shattered to prepare the soil for revegetation.

E. Areas of Undisturbed Natural Topsoil: Undisturbed sites that are or were supporting healthy plant growth need only surface seedbed preparation prior to sowing seed.

3.3 INSTALLATION

A. Install topsoil as required in Division 31 section “Earth Moving” and Division 32 Section “Topsoil”.

B. Soil Preparation in Turf Grass and Planting Bed Areas:

1. Apply Soil Amendments at the following rates:
   a. Soil Amendments: Bid quantity to be four (4) cubic yards per one thousand (1,000) square feet, or per soil test recommendations.
   b. Soil Conditioners: Apply per manufactures recommendations for the type of planting area, or per soil test recommendations.
   c. Fertilizer: Diamonium phosphate, Bid quantity to be two (2) pounds of nitrogen per one thousand (1,000) square feet. Apply per manufactures recommendations for the type of planting area, or per soil test recommendations.
   d. Mycorrhizal inoculants: Apply per manufacturer’s instructions and quantities appropriate to the planting type.

2. After applying Soil Amendments, thoroughly till area to depth of six inches (6”) minimum by plowing, rototilling, harrowing, or disking until soil is well pulverized and thoroughly mixed. Soil Conditioners and Fertilizer shall be applied topically once final grade has been established and just prior to sodding or seeding.

C. Soil Preparation in Native Grass Areas:

1. Soil Conditioners: Apply per manufactures recommendations for the type of planting area, or per soil test recommendations.
2. Mycorrhizal inoculants: Apply per manufacturer’s instructions and quantities appropriate to the planting type.
3. 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 over the surface of the soil and not tilled into the soil.
4. Soil Conditioner Installation:

a. Apply Soil Conditioner only as directed by per soils tests performed for the areas to be seeded. Apply topically once fine grade has been established and just prior to seeding per the manufactures recommendations for native seed areas.

D. 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 (0.10') foot 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 inches (1-1/2") for sod.
   b. Seeding Areas: Allow one inch (1") for seed.
   c. Planting 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 CLEANING

A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.

B. 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 Project Manager.

## 3.5 PROTECTION

A. Provide and install barriers as required and as directed by Project Manager to protect completed areas against damage from pedestrian and vehicular traffic until acceptance by City.

B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:
1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Vehicle traffic.
4. Foot traffic.
5. Erection of sheds or structures.
6. Impoundment of water.

7. Excavation or other digging unless otherwise indicated.

C. If planting soil or subgrade is overcompacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by Project Manager and replace contaminated planting soil with new planting soil.

~~PART 4 - MEASUREMENT AND PAYMENT~~

~~4.1 MEASUREMENT **[Consultant to select A or B]**~~

~~A. Measurement will be based on the percentage complete for the lump sum contract amount for Soil Preparation.~~

~~B. Measurement will be made by the contract unit specified for Soil Preparation. Measurement shall include the actual number of units of specified material(s) placed and accepted at the locations shown on the Contract Drawings, or as directed by the Project Manager, and in accordance with the Specifications.~~

~~4.2 PAYMENT~~

~~A. Payment will be made at the **[contract unit]** **[lump sum contract]** price, and shall include required materials, transportation, equipment, labor, eathwork, stockpiling, disposing, hauling off, watering, dust control, erosion and sediment control, fine grading, <**Insert additional items**> as required in accordance with the Contract Drawings and Specifications.~~

**END OF SECTION 32 91 13**

**SECTION 32 91 20 TOPSOIL**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for furnishing, stockpiling, and placing topsoil on a previously prepared subgrade.

B. Related Sections:
1. Division 01 Section “Erosion and Sedimentation Control”.
2. Division 31 Section “ Earth Moving”
3. Division 32 Section “Soil Preparation”.
~~4. Division 32 Section “Turfgrass Seeding”.~~
~~5.~~4. Division 32 Section “Native Seeding”.
~~6. Division 32 Section “Sodding”.~~
~~7.~~5. Division 32 Section “Trees, Plants, and Groundcovers”.

1.3 DEFINITIONS

A. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.

B. Finish Grade: Elevation of finished surface of planting soil.

C. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

D. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

E. Planting Area: Areas to be planted.

F. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

G. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

H. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

I. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.4 SUBMITTALS

A. See Division 01 Section “Submittals” for submittal requirements.

B. Soil Analysis Report: As indicated in Article 1.5 “Quality Control”, below.

1.5 QUALITY CONTROL

A. Existing On-Site Topsoil:
1. Submit soil analysis report for stockpiled on-site 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.
2. A minimum of five (5) sample locations per acre are required, with individual tests completed for each sample.
3. A map of the site illustrating the locations of each sample location is to be submitted to Project Manager for approval prior to collecting samples.
4. Follow instructions from soil testing laboratory when collecting samples.
5. Testing will be at the expense of the Contractor.
6. Submit a one (1) quart sample along with analysis results.

B. Imported Topsoil:
1. Submit source location for topsoil to be imported to site for approval by Project Manager.
2. Submit soil analysis report for topsoil imported to site, 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.
    a. One 1-quart sample per five hundred (500) cubic yards of imported soil is required, with individual tests completed for each sample.
    b. Follow instructions from soil testing laboratory when collecting samples.
3. Testing will be at the expense of the Contractor.
4. Submit a one (1) quart sample along with analysis results.

C. Manufactured Topsoil:
1. Submit source of manufactured topsoil to be imported to site for approval by Project Manager.
2. Submit soil analysis report for stockpiled on-site 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).
    a. Test is to be completed within sixty (60) days preceding delivery to site. Report shall cover soil textural classification (percentages of sand, silt, and clay), pH, percentage organic matter, and soluble salts (electric conductivity in millimos/centimeter).

b. Submit a one (1) quart sample along with analysis results.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver or place topsoil in a frozen, wet, or muddy condition.

B. Protect stored and placed topsoil from vehicular traffic, equipment storage, material storage, or from contaminants or pollution sources. Topsoil that is compacted or tainted during construction is to be removed from site and disposed of at a licensed landfill at no additional cost to the City.

PART 2 - PRODUCTS

2.1 ON-SITE TOPSOIL

A. Topsoil previously stripped and stockpiled prior to earthwork operations. See Division 31 Section “Earth Moving”.

2.2 IMPORTED TOPSOIL

A. All topsoil shall be a loam or sandy loam conforming to ASTM D 5268. At least ten (10) days prior to topsoil delivery, notify Project Manager 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.

B. It shall be obtained from the top six-inches (6”) of well drained areas.

C. 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 6.5 and 7.5.

D. Soil Texture:
1. Sand: thirty percent (30%) – fifty percent (50%)
2. Silt: thirty percent (30%) – fifty percent (50%)
3. Clay: five percent (5%) – thirty percent (30%)

E. Additives: As determined by soil fertility tests.

F. Percent Organic Content:
1. Turf grass shall be three percent (3%) maximum after amending or conditioning.
2. Native grass shall be one percent (1%) maximum after amending or conditioning.

G. Soluble Salts: Electric conductivity (EC) shall be less than two (2.0) mmhos/cm for turfgrass areas, dryland areas, and planting beds.

2.3 MANUFACTURED TOPSOIL

A. "Amended Topsoil" as manufactured by A1 Organics, 16350 WCR 76, Eaton, CO 80615 Ph: (970) 454-3492, (800) 776-1644 Fax: (970) 454-3232 www.a1organics.com, or substitution as approved by Project Manager.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where the Work of this Section will be performed for compliance with requirements and conditions affecting installation and performance.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within the work area.
2. Verify that final grades are completed in accordance with the Contract Drawings.

B. Proceed with installation only after unsatisfactory conditions have been corrected and approved by Project Manager.

3.2

3.3 PLACING TOPSOIL

A. Scarify compacted subgrade to a six-inch (6") depth to bond topsoil to subsoil. Place topsoil to a minimum depth of six-inches (6") after settlement. Topsoil shall be free from weeds, sod, and material larger than 1-inch (1"), toxic substances, litter or other deleterious material. Spread evenly and grade to elevations and slopes shown on Contract 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.

C. Utilize manufactured topsoil as the top layer, placing over scarified subgrade to a depth of six-inches (6").

3.4 PROTECTION AND REPAIR

A. Protect completed areas where topsoil has been spread from traffic which will compact the soil volume. Any areas that, as determined by Project Manager, become compacted due to Contractor's construction traffic shall be reconstructed to specified requirements and approved by Project Manager.

PART 4 - MEASUREMENT AND PAYMENT

**4.1** MEASUREMENT **[Consultant to select the type of topsoil used and measurement used for each]**

**A. [On-Site Stockpiled Topsoil:] [Measurement will be based on the percentage complete for the lump sum contract amount for Topsoil.] [Measurement will be made by the contract unit specified for Topsoil. Measurement shall include the actual number of units of specified material(s) placed and accepted at the locations shown on the Contract Drawings, or as directed by the Project Manager, and in accordance with the Specifications.]**

**B. [Imported Topsoil:] [Measurement will be based on the percentage complete for the lump sum contract amount for Topsoil.] [Measurement will be made by the contract unit specified for Topsoil. Measurement shall include the actual number of units of specified material(s) placed and accepted at the locations shown on the Contract Drawings, or as directed by the Project Manager, and in accordance with the Specifications.]**

**C. [Manufactured Topsoil:] [Measurement will be based on the percentage complete for the lump sum contract amount for Topsoil.] [Measurement will be made by the contract unit specified for Topsoil. Measurement shall include the actual number of units of specified material(s) placed and accepted at the locations shown on the Contract Drawings, or as directed by the Project Manager, and in accordance with the Specifications.]**

4.2 PAYMENT

A. Payment will be made at the **[contract unit]** [**lump sum contract**] price, and shall include required materials, transportation, equipment, labor, earthwork, stripping, stockpiling and placing of topsoil, loading, transporting, re-transporting to new locations (from onsite or off site stockpiles) spreading to specified depth disposing of unusable materials, hauling off, watering, dust control, erosion and sediment control, finish grading, <**Insert additional items**> required to bring the site to the required lines and grades as required in accordance with the Contract Drawings and Specifications.

**END OF SECTION 32 91 20**

**SECTION 32 92 20 NATIVE SEEDING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for the installation of native seed, mulch, erosion control material (if applicable), and maintenance of the seeded areas, to be achieved as outlined in the "Maintenance" section below.

B. Related Sections:
1. Division 01 Section "Erosion and Sedimentation Control".
2. Division 01 Section "Tree Retention and Protection".
3. Division 31 Section "Earth Moving".
4. Division 31 Section "Watering".
5. Division 32 Section "Irrigation System".
6. Division 32 Section "Soil Preparation".
7. Division 32 Section "Topsoil".
8. Division 32 Section "Trees, Plants, and Groundcovers".

1.3 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, herbicide, defoliant, or desiccant.

C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

D. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

E. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.

F. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

G. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.

H. Weeds: Including but not limited to Goathead, Bindweed, Twitch, Dandelion, Jimsonweed, Knapweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnsongrass, Poison Ivy, Nut Sedge, Nimble Weed, Bent Grass, Wild Garlic, Perennial Sorrel, and Broom Grass.

1.4 REFERENCES

A. 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.

1.5 SUBMITTALS

A. See Division 01 Section “Submittals” for submittal requirements.

B. Materials: The Contractor shall submit to the Project Manager for approval a complete list of all materials to be used during this portion of the work prior to delivery of any materials to the site. Include complete data on source, amount and quality. This submittal shall in no way be construed as permitting substitution for specific items described on the plans or in these specifications unless approved in writing by the Project Manager.
1. Certification of Seed: From seed vendor for each seed monostand or mixture stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
2. Native Grass Species (supplied as pure live seed): Submit lab germination test results for all grass species. Submit an affidavit that describes estimated purity for all forb species that are not typically tested.
3. Pesticides: Include product label and manufacturer's application instructions specific to this Project.
4. Product Certificates: For soil amendments and fertilizers, from manufacturer.

C. Qualification Data: For qualified landscape Installer.

D. Material Test Reports: For existing in-place surface soil.
1. Soil Analysis: See Division 32 Section “Soil Preparation”
2. Analysis for each soil amendment.
3. Analysis for each amended planting soil.

E. Analysis and standards: Wherever applicable, for non-packaged materials, provide two copies of analysis by recognized laboratory made in accordance with methods established by the Association of Official Agriculture Chemists.

F. Seeding schedule: Submit, in writing, two (2) copies of proposed seeding schedule, indicating dates for site preparation, seeding, mulching, erosion control, and coordination with plant

procurement, planting soil preparation, plant delivery and planting. Schedule all Work during specified planting seasons. Once accepted, revise dates only as approved in writing, after documentation of reasons for delays.

G. Maintenance Instructions: Recommended procedures for maintenance of irrigated and dryland grasses during a calendar year. Submit before expiration of required initial maintenance periods.

H. Contract Closeout Submittals:
1. Operating and Maintenance Data: At completion of work, submit one (1) digital copy and two (2) hard copies to the Project Manager in accordance with Division 01 Section “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 Native Seed Areas: At completion of work, furnish written warranty to Parks Project Manager based upon specified requirements.

I. The Project Manager reserves the right to reject the seed at any time prior to acceptance and that fails to meet specification requirements. Promptly remove rejected seed from the site.

1.6 QUALITY CONTROL

A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful turf and dryland grass establishment.

1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
2. Experience: Five years' experience in turf installation in addition to requirements in Division 01 Section “Quality Control”.
3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
4. Sod Producer: Company specializing in sod production and harvesting with minimum 5 years’ experience, and certified by the State of Colorado Department of Agriculture.
5. Personnel Certifications: Installers shall have certification the following categories from the Professional Landcare Network:
   a. Certified Landscape Technician - Exterior, with installation maintenance irrigation specialty area(s), designated CLT-Exterior.
6. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
7. Pesticide Applicator: State licensed, commercial.

B. Soil-Testing Laboratory Qualifications: An independent laboratory or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

C. Preinstallation Conference: Conduct conference at Project site to coordinate the process with other trades, to coordinate equipment movement within planting areas and to avoid soil compaction, to review proposed methods of installation, performance criteria, and maintenance procedures. Review underground utility location maps and plans. This meeting shall be coordinated by the Contractor, and comply with requirements in Division 01.

D. Standards: All materials and methods used during this portion of the work shall meet or exceed applicable federal, state, county, and local laws and regulations. All seed shall be free from insects and disease. Species shall be true to their scientific name as specified.

1.7 DELIVERY, STORAGE, AND HANDLING

A. 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. Seed that has become wet, moldy or damaged in transit or in storage will not be acceptable.

B. Other Packaged Materials: Deliver packaged materials in original unopened containers bearing weight, analysis and name of supplier.

C. 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.

D. Bulk Materials:
1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.
4. Seed: Deliver seed materials in original unopened containers, showing bearing weight, analysis and name of supplier.
5. 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.

E. Material will be inspected upon arrival at project site. Project Manager will reject any opened or unacceptable materials as described above. Store all materials in a manner to prevent wetting and deterioration.

F. Immediately remove unacceptable material from job site.

1.8 PROJECT/SITE CONDITIONS

A. Work scheduling: Proceed with and complete landscape work rapidly, as portions of the site become available, working within the specified planting season and approved schedule.

B. Planting Restrictions: Planting is preferred in spring but may be performed during one of the periods noted below. Variance from the schedule shall be permitted only with written approval from the Project Manager. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of Substantial Completion**.**

C. Vehicular accessibility on site shall be as directed by 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.

D. Do not drill or sow seed during windy, rainy weather or when ground is frozen or otherwise unable to be tilled.

E. Seeding Season: Seeding shall occur as specified below. The following are typical Colorado schedules. Modify the following for appropriate region. Verify with local producers and contractors prior to finalizing.

| Seed Type | Irrigated Areas Only | Non-irrigated Areas |
|---|---|---|
| Dryland Grasses | April 15-Sept.1 | April 1-May 15<br>Oct 15-Nov15 |

F. Existing conditions:
1. Existing Plants: Install sod only after all other landscape and irrigation items have been installed and accepted by the Project Manager.
2. Utilities: Determine location of underground utilities. Perform work in a manner to avoid possible damage. Hand excavate, as required.
3. Excavation: Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned. When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, noxious materials or obstructions, notify Project Manager before planting.
4. If weeds are present on site, treat with pesticide prior to preparing soil for installing seed or sod as specified below.

G. Coordination:
1. Coordinate with construction of utilities on site. Do not begin placing topsoil until underground work is completed in the area.
2. Coordinate with seeding and landscape Contractor(s) approved schedule. Limit construction access to areas where topsoil has been placed if placement is completed more than three (3) days prior to commencement of landscaping in the area. Limit fine grading to areas that can be prepared for planting within twenty-four (24) hours after fine grading.
3. Coordinate with Contractors work requiring access to site over seeded areas.
4. Coordinate with installation of underground irrigation system.

1.9 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 two (2) years from date of substantial acceptance 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 Project Manager.
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 the Project Manager's opinion are unhealthy.
2. Reseeding will not be allowed in any season considerable unfavorable for seeding by the Project Manager.

3. Reseed in a manner to achieve quality as originally specified.

B. Warranty for Native Seed in Non-irrigated Areas: No warranty will be required unless otherwise specified under Division 01 Section “Warranties and Bonds”.

1.10 MAINTENANCE

A. General: The maintenance period shall begin immediately after each area is seeded and continue until Final Acceptance of entire project. Final Acceptance of seeded areas will not be given until Project Manager 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. After Final Acceptance, maintenance shall become the responsibility of the City.

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 the Project Manager and the Contractor. Any areas (as determined by the Project Manager) 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 one (1) square foot, do not exceed five percent (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 four inches (4”) in height. Remove clippings from adjacent pavement or irrigated turf areas and remove from site.

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 Project Manager.

F. Weed Control: Control annual weeds by mowing prior to seed development. Control perennial weeds through use of selective pesticides approved by the Project Manager only after grass stand has matured sufficiently that it will not be harmed by application of pesticides. Any plant material that is harmed due to over spraying, wind drift or improper application shall be replaced by the Contractor at no cost to the City.

G. Insect and Disease Control: As needed, apply insecticide and fungicide approved by the Project Manager.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil: See Division 32 Section "Topsoil".

B. General:

1. The selected seed mix must be approved by the City Naturalist, and the Parks Project Manager prior to its incorporation into the project.
2. All seed brands shall be free from Colorado prohibited noxious weed seeds such as Russian or Canada Thistle, Field Bindweed, Johnsongrass, and Leafy Spurge. The Contractor shall furnish to the Project Manager a signed statement certifying that the seed is from a lot that has been tested by a recognized laboratory for seed testing within six months prior to the date of delivery.
3. Computation for quantity of seed required on the project is based on Pure Live Seed (PLS).
4. The formula used for determining the quantity of PLS shall be:
*Pounds of Seed x (Purity x Germination) = Pounds of PLS.*
5. 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.

C. Seed Mixes: See drawings for scheduled mix and location(s).

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 scopari-um | 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:

| 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 | Schoenoplectus maritimus | 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

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 encelliodes | 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: 23.350 PLS#/Acre
Hand Broadcast Areas Rate: 46.700 PLS#/Acre

D. Mulch: Comply with Section 213 – Mulching of the CDOT Standards and Specifications for Road and Bridge Construction.

E. Fertilizer: None required unless otherwise specified by soils test.

F. 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.

G. Tackifier: Comply with Section 213 – Mulching of the CDOT Standards and Specifications for Road and Bridge Construction.

2.2 PESTICIDES

A. General: Pesticide, registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by Project Manager and authorities having jurisdiction.

B. Pre-Emergent Pesticide (Selective and Non-Selective): Journey pesticide, as manufactured by BASF, 800-545-9525, or equal as approved by Project Manager. Use only with approval by Project Manager and in strict compliance with manufacturer's instructions.

C. Post-Emergent Pesticide: "Round-up" by Monsanto, or approved equal.

2.3 EROSION-CONTROL MATERIALS

A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6inches long.

B. Erosion-Control Fiber Mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb/sq. yd., with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches (6") long.

C. Erosion-Control Mats: Cellular, non-biodegradable slope-stabilization mats designed to isolate and contain small areas of soil over steeply sloped surface, of 3 inch (3") nominal mat thickness. Include manufacturer's recommended anchorage system for slope conditions.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Invisible Structures, Inc.; Slopetame 2.
   b. Presto Products Company, a business of Alcoa; Geoweb.
   c. Tenax Corporation - USA; Tenweb.

2.4 SUBSTITUTIONS

A. All substitutions shall be submitted to and approved by the Project Manager prior to construction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to be seeded for compliance with requirements and other conditions affecting performance.
1. Verify that finish grades are consistent with the slopes and grades indicated on the Contract Drawings. Verify grades are in conformance with Division 31 Section "Earth Moving". Obtain Project Manager's approval of finished grade prior to proceeding with seeding operations.
2. Verify soil prepare of all areas to be seeded is in accordance with the requirements of Division 32 Section "Soil Preparation". 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 inch (1") in diameter.
3. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a seeding area. If contamination is present in soil, remove the soil and contamination as directed by the Project Manager and replace with new soil.

B. Verify that irrigation system is operable and provides adequate coverage prior to seeding.

C. Proceed with seeding only after unsatisfactory conditions have been corrected and approved by the Project Manager.

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

3.2 PREPARATION

A. Notify the Project Manager at least seven (7) working days prior to start of seeding operations.

B. Protect existing utilities, paving, planting and other facilities from damage caused by seeding operations. Contractor shall repair any damage 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. Utilize equipment having low unit pressure ground contact within seeding areas.

E. Limit preparation to areas that can be seeded within twenty-four (24) hours of preparation.

F. Moisten prepared area before seeding if soil is dry. Water thoroughly and allow surface to dry before seeding. Do not create muddy soil.

G. 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 SEEDING

A. Seed within twenty-four (24) hours after preparation of seed bed. Seeding at other times may only be done if approved by the Project Manager.

B. Areas outside Contract Limits disturbed as a result of construction operations shall be restored at Contractor's expense.

C. Seed shall be uniformly applied at the specified rate, (half in one direction and the other half perpendicular to the first application). The direction of the final application shall always be perpendicular 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"). Accomplish seeding by a rangeland grass drill with double disk openers and depth bands.

D. Areas that are too small or steep for mechanical seeding may be hand seeded. Seed shall be uniformly applied at the specified rate utilizing a broadcast spreader and then hand raked in to a depth of no more than one-half inch (1/2"), then roll seed bed to ensure proper contact to the soil.

E. Dormant Seeding: Upon approval of the Project Manager, 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 specification.

3.4 EROSION CONTROL MATERIALS

A. Review erosion control measures with Project Manager prior to installation.

B. For erosion control mats, install planting soil in two lifts, with second lift equal to thickness of erosion control mats. Install erosion control mat and fasten as recommended by material manufacturer.

C. Fill cells of erosion control mat with planting soil and compact before planting.

D. Install erosion control blanket on slopes exceeding 4:1, and in swales or other areas of concentrated runoff. As shown on the Contract Drawings or as directed by the Project Manager. Install in accordance with manufacturer's instructions.

E. For erosion-control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.

3.5 MULCHING

A. Straw Mulch Application: Comply with Section 213 – Mulching of the CDOT Standards and Specifications for Road and Bridge Construction.

B. Hydromulch Application: Utilize an approved hydromulcher to apply cellulose fiber at a rate of two-thousand (2,000) pounds per acre. Apply tackifier to comply with CDOT Section 213.02 – Mulching. Contractor shall provide verification of application rates in the form of ship tickets.

C. Mulching shall not be installed when surface water is present resulting from rains, melting snow irrigation or other causes.

D. 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 its own expense.

E. 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.

F. Contractor shall remove all hydromulch from surface areas 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 Project Manager.

3.6 PROTECTION

A. Restrict vehicular and pedestrian traffic from seeded areas until vegetation is established. Erect signs and barriers as required or directed by the Project Manager at no additional cost to the City.

3.7 DRYLAND GRASS MAINTENANCE

A. Maintain and establish dryland grass seed areas by weeding, mowing, trimming, replanting, watering and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a full coverage stand of grass. Provide materials and installation the same as those used in the original installation.
   1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and meadow damaged or lost in areas of subsidence.
   2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
   3. Apply treatments as required to keep meadow and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Install and maintain temporary piping, hoses, and watering equipment to convey water from sources and to keep soil uniformly moist.
   1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas. Obtain approval of Project Manager of irrigation system and schedule proposed for use.
   2. Water dryland grasses with fine spray at a minimum rate of one-half inch (1/2 ”) per week for six (6) weeks after planting unless rainfall precipitation is adequate.
   3. Do not over-water in a manner which kills drought-tolerant components of the seed mix.

C. Watering: Utilize watering trucks to supplement natural moisture levels during dry periods.
   1. Apply water in a manner that prevents wilting, puddling, erosion, and displacement of seed or mulch. Obtain approval of Project Manager of truck/application type and schedule proposed for use.
   2. Do not over-water in a manner which kills drought-tolerant components of the seed mix.
   3. This frequency and rate of irrigation is to be approved by the Project Manager. Contractor will be paid through a separately negotiated Change Order for this work.

D. Mowing: Allow to grow to a minimum height of twelve inches (12”) prior to mowing. Cut no more than four inches (4”) at a cutting. Monitor weed growth and mow to prevent seed distribution. Mow monthly during the first season.
   1. Year One: Mow the planting area 2-4 times during the early growing season to a height of six inches (6”) to eight inches (8”). Mowing prior to or when non-native and weedy species are flowering to prevent seed-set. Control undesirable plant species by hand-pulling prior to the development and maturation of the plant. Hand-removal shall include the removal of all above-ground and below-ground stems, roots and flower masses prior to the development of seed. If necessary, Round-up pesticide may be selectively applied by a licensed applicator trained in plant identification at no additional cost to the City. Obtain Project Manager’s approval prior to applying pesticide. Apply per manufacturer’s instructions.

2. Year Two, or longer period as arranged with Project Manager: Control undesirable plant species as necessary by mowing, hand-pulling, selective pesticide application, and/or prescribed burning.
3. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
4. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

## 3.8 SATISFACTORY DRYLAND GRASSES

A. Dryland grass seed installations shall be minimally established to meet the following criteria by Substantial Completion as determined by Project Manager:
1. Within three (3) months, total vegetation cover in all zones seeded with cover crop shall exceed seventy percent (70%) by aerial cover. Dryland grass shall be free of weeds, foreign grasses, disease and harmful insects.
2. By the end of the first full growing season after seeding, total vegetation cover including cover crop shall exceed ninety percent (90%) by aerial cover and ten percent (10%) of all species present shall be native.
3. By the end of the first full growing season, seedling from twenty percent (20%) of planted forb species shall be present.
4. At any time during the contract period no more than ten percent (10%) by aerial cover of the seeded area should be dominated by aggressive exotic species such as, but not limited to, red clover (*Trifolium* spp.), white or yellow sweet clover (*Melilotus* spp.), Canada thistle (*Cirsium arvense*), tall fescue (*Festuca elatior*), bindweed*( Convolvulus arvensis*) etc. At the end of the fifth year no more than fifty percent (50%), by aerial cover, of the seeded area shall be dominated by non-natives.
5. Until final acceptance seeded areas that fail after having been replaced previously, shall be replaced until it meets establishment as required above. Replacement materials shall be identical to those originally specified. Provide seed tags to the Project Manager for verification.
6. Remedial action: If seeded areas greater than ten (10) square feet fail to meet the terms of the guarantee shown above, the Landscape Contractor will develop and submit to the Owner's Representative a remedial action plan that takes into consideration the site goals and specific deficiencies causing the remedial action. Contractor will implement the remedial action plan and submit a report that describes the remedial action taken. If remedial seeding or planting is required, Contractor will not be required to perform additional remedial seeding or planting in the same area for a minimum of two growing seasons. After two growing seasons following the remedial planting, the performance criteria must be met for the second growing season or additional remedial action must be taken. This guarantee remains in effect until all zones meet the third growing season criteria.
7. Seeded areas will not be accepted in parts. Each time any portion or section of the entire seeded area requires replacement or remedial action, the maintenance period shall extend until all seeded areas meet the minimum establishment requirements stated above.
8. All expense incurred including repairs from vandalism for the replacement and or establishment of the seed areas are the responsibility of the Contractor.
9. If seeded in the fall, review for establishment shall be no later than June 15 of the following year.

3.9 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.

B. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

C. Remove non-degradable erosion-control measures after grass establishment period.

~~PART 4 - MEASUREMENT AND PAYMENT~~

~~4.1 MEASUREMENT **[Consultant to select A or B]**~~

~~A. Measurement will be based on the percentage complete for the lump sum contract amount for Native Seeding.~~

~~B. Measurement will be made by the contract unit specified for Native Seeding. Measurement shall include the actual number of units of specified material(s) placed and accepted at the locations shown on the Contract Drawings, or as directed by the Project Manager, and in accordance with the Specifications.~~

~~4.2 PAYMENT~~

~~A. Payment will be made at the **[contract unit]** [**lump sum contract**] price, and shall include required materials, transportation, equipment, labor, earthwork, stockpiling, disposing, hauling off, watering, dust control, erosion and sediment control, fine grading, <**Insert additional items**> furnishing and installation of seeds and mulches installation and maintenance of temporary protection by fencing or other means, watering and all maintenance required until Final Acceptance of the work as required in accordance with the Contract Drawings and Specifications.~~

**END OF SECTION 32 92 20**

**SECTION 32 93 00 TREES, PLANTS, AND GROUNDCOVERS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for furnishing, installing, and maintaining live woody plant material.

B. Related Sections:
1. Division 01 Section “Tree Retention and Protection”.
2. Division 31 Section “Clearing and Grubbing”.
3. Division 31 Section “Earth Moving”
4. Division 32 Section “Watering”.
5. Division 32 Section “Irrigation System”.
6. Division 32 Section “Automatic Irrigation Controllers”
7. Division 32 Section “Soil Preparation”.
8. Division 32 Section “Topsoil”.
9. Division 32 Section “Landscape Maintenance”.

1.3 DEFINITIONS

A. ANSI: American National Standards Institute. Z60.1 is the national standard for nursery stock.

B. Backfill: The earth used to replace or the act of replacing earth in an excavation.

C. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.

D. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than the minimum root spread according to ANSI Z60.1 for type and size of plant required.

E. Caliper: Trunk diameter is measured six-inches (6”) from the ground; if the caliper is greater than four-inches (4”), the measurement is taken at twelve-inches (12”) from the ground.

F. 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 (1/4) the height of the plant, and which reaches the minimum height stated in the plant size specification.

G. 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.

H. Circling root(s): One or more roots whose diameter is greater than ten percent (10%) of the trunk caliper circling more than one-third of the trunk. Circling roots are unacceptable.

I. Clear Trunk: The portion of the trunk below the main crown which may include shortened temporary branches.

J. 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.

K. Container-Grown: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

L. Critical Root Zone (CRZ): Shall be defined as the tree protection area encompassing from 1.5 (minimum) to 2.0 times the distance between the trunk and drip line, or one linear foot away from the trunk base for every-inch diameter of the trunk, whichever is greater.. Review the extent of the CRZ for impacted trees with Project Manager prior to start of work.

M. 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.

N. Cultivar: A named plant selection from which identical or nearly identical plants can be produced, usually by vegetative propagation or cloning.

O. Drip Zone: The outermost edge of the tree's canopy or branch spread. The area within a tree's drip line is all the ground under the total branch spread.

P. Finish Grade: Elevation of finished surface of planting soil.

Q. 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.

R. Kinked Root: A main root that is sharply bent. Kinked roots are unacceptable.

S. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.

T. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

U. Root Collar: Also referred to as the root flare. The base of a tree where the main roots and trunk meet.

V. Scaffold Branches: Large main branches that form the main structure of the crown.

W. 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. Stem-girdling roots are unacceptable.

X. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

Y. Temporary Branch: A small branch that is temporarily retained along the lower trunk of young trees.

Z. Trunk: The main stem of a tree, beginning at the root collar and ending at the lowest main scaffold branch.

AA. Taper: The thickening of a trunk or branch toward its base.

1.4 SUBMITTALS

A. See Division 01 Section “Submittals” for submittal requirements.

B. Product Data: For each type of product.
1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.

C. Product Samples: At a minimum provide the following samples for approval by the Project Manager, additional product samples may be required at the direction of the Project Manager.
1. Mulch: one(1) gallon bag minimum of each type of mulch.
2. Tree Stakes: one(1) of each type.
3. Tree Straps: one(1) each.
4. Guy Material: one(1) linear foot.
5. Guy Signal: one(1) linear foot.
6. Tree Wrap: one(1) linear foot.

D. Pesticides: Product label, Safety Data Sheet (SDS) labels and manufacturer's application instructions specific to Project.

E. Proper Identification: All plants 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).

F. Contractor shall provide a complete list of all plant material for approval by the Project Manager 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 Project Manager for approval.

G. Contractor shall provide the following certificates:
1. State Inspection Certificate from the origin nursery.
2. Certificate from origin state.
3. Quarantine Certificate from origin state.
4. Any Certificates required by the USDA Animal and Plant Health Inspection Service (APHIS) and ANSI-Z-160 and accompanying Rules and Regulations.

H. Analysis of existing soil shall be per Division 32 Sections “Topsoil” and “Soil Preparation”.

I. Contract Close Out Submittals:

1. Operating and Maintenance Data: At completion of work, submit One (1) digital copy and two (2) hard copies to the Project Manager in accordance with Division 01 Section "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 Project Manager based upon specified requirements.

1.5 QUALITY CONTROL

A. The Project Manager 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 Project Manager'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 twenty-four (24) hours.

1.6 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 Project Manager reserves the right to inspect containers before or after installation to verify compliance with Specifications.

B. Bulk Materials:
1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants or critical root zone.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

C. Trees: Nursery stock shall be harvested and planted during the same growing season. Do not prune, except as approved by the City Forester and Project Manager. 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 Project Manager.

D. Deliver bare-root stock plants within twenty-four (24) hours of digging. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting. Transport in covered, temperature-controlled vehicles, and keep plants cool and protected from sun and wind at all times.

E. Store bulbs, corms, and tubers in a dry place at sixty degrees to sixty-five degrees (60° to 65°) F until planting.

F. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
   1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again (2) two weeks after planting.

G. Handle planting stock by the root ball only.

H. Deliver trees after preparations for planting have been completed and install immediately. If planting is delayed more than six (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.

1.7 PROJECT/SITE CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Vehicular accessibility on site shall be as directed by 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.

C. 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 Project Manager.

D. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify the Project Manager before planting.

E. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

F. 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.

1.8 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 Project Manager. 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 to the City, refer to Division 32 Section “Watering”.

B. Plant trees after final grades have been accepted and prior to seeding or sodding, unless otherwise authorized by Project Manager.

1.9 WARRANTY

A. Warranty: The warranty specified in this Article shall not deprive the City of other rights the City 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 (1) year after date of Substantial Completion, against defects including death, structural failures, dieback as determined by the City Forester and or Project Manager. 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. The warranty shall not be enforced should any plant die due to vandalism after Final Acceptance.

D. Remedial Actions:
1. Replace any plant materials that have been excessively pruned, more than twenty percent (20%) percent dead, or in an unhealthy or declining condition immediately upon notice from the Project Manager during warranty period.
2. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.

E. 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.

1.10 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.

PART 2 - PRODUCTS

2.1 PLANT MATERIALS

A. General: Furnish and install nursery-grown trees and shrubs conforming to the requirements of ANSI-Z-160, 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 Project Manager. 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 genus, species, and variety designated on the Contract Drawings. No substitutions will be accepted without the prior written approval of the City Forester and or the Project Manager. Contractor must provide proof of non-availability.

2.2 TREES

A. 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.

B. 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, unless noted on plans to be “Multi-trunk” or “Clump”. 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 evenly 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 one-half the diameter of the central leader measured one-inch (1”) 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 one-inch (1”) in caliper. These branches should be no greater than three-eighths-inch (3/8”) diameter. Clear trunk shall be no more than thirty percent (30%) of the total height of the tree, unless otherwise noted

C. 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 three-quarters-inch (3/4”) 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).
1. Trunk caliper and taper shall be sufficient so that the tree will remain vertical without a stake. Trunk caliper at six-inches (6”) 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 five-inches (5”), 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.

D. Roots: The root system shall be substantially free of injury from biotic (e. g., insects and pathogens) and abiotic (e. g., pesticide toxicity and salt injury) agents.
1. The uppermost roots or root collar shall be within the upper two-inches (2”) 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 one-eighth-inch (1/8") diameter.
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. 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.
5. As a general rule for young nursery-grown trees, there should be two or more structural roots within one- to three-inches (1" – 3") of the soil surface. "First order lateral roots" is another term that has been used for these roots. If the roots are deeper than three-inches (3") , the stock shall be rejected.
6. Root-balls that are undersized as specified in current edition of ANSI Z60.1. shall be rejected. Field grown trees for balled and burlap delivery shall have the roots pruned at least six-inches (6") 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.

E. 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.

F. 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.

G. 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.

H. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated, and only if approved by the City Forester and or the Project Manager.

## 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** |
|---|---|---|
| fifteen-inches (15”) | three (3) canes | Nine-inches (9”) |

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** |
|---|---|---|
| fifteen-inches (15”) | four (4) canes | Nine-inches (9”) |

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** |
|---|---|---|
| Two feet (2’) | four (4) canes | twelve-inches (12”) |

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** |
|---|---|---|
| four feet (4’) | six canes (6) | twenty-inches (20”) |

## 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, and be in conformance with ANSI Z60.1. 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. Top growth is to be in conformance with established nursery standards.

## 2.5 TREE-STABILIZATION MATERIALS

A. Trunk-Stabilization Materials:
1. Deciduous Tree Stakes: Rough-sawn, sound, new softwood with specified wood preservative treatment by pressure process, free of knots, holes, cross grain, and other defects, two-inch (2”) diameter by six feet (6’), pointed at one end.
2. Evergreen Tree Stakes: Two foot (2’) steel T-posts; green color.
3. Guys and Tie Wires: ASTM A 641/A 641M, Class 1, #14 galvanized-steel wire, two-strand, twisted.
4. Tree-Tie Webbing: UV-resistant nylon webbing with brass grommets, size as indicated.

5. Safety signals for guy and staking wire: one-half-inch (1/2") diameter PVC pipe, length as indicated.

B. Tree-Wrap:
1. Two layers of crinkled paper cemented together with bituminous material, four-inches (4") wide minimum, with stretch factor of thirty-three percent (33%).
2. Tree wrap tape: Tape as approved by the City Forester and or the Project Manager.

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 to Project Manager for approval. Mulch is to be weed-free.

2.7 PLANT PIT BACKFILL MATERIAL

A. Unless otherwise directed by the Project Manager, the plant pit backfill material shall consist of the following, thoroughly mixed:
1. Soil originally excavated from the pit: two thirds (2/3) proportion of total mix.
2. Soil Amendment as specified in Division 32 Section "Soil Preparation"; one-third (1/3) proportion of total mix.

B. If imported topsoil is required, it shall meet the requirements specified in Division 32 Section "Topsoil", Article 2.2.

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 from a water truck or other approved source. Hoses and other watering equipment shall be supplied by Contractor.
1. Watering Amount: Ten (10) gallons per caliper-inch.

B. Watering: Refer to Division 32 Section "Watering".

C. Maintenance: Refer to Division 32 Section "Landscape Maintenance".

2.9 MISCELLANEOUS MATERIALS

A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees, as approved by the City Forester and or the Project Manager. Deliver in original, sealed, and fully labeled containers. Mix and apply according to manufacturer's instructions.

B. Pre-Emergent Pesticide: As approved by the City Forester and or the Project Manager.

C. Pesticides: EPA registered and approved, and as approved by the City Forester and the Project Manager.

D. Subdrainage: See Division 33 Section "Subdrainage Systems".

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.
   1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within the work area.
   2. Verify that adequate overhead clearance exists to planting locations.
   3. Suspend planting operations during periods of excessive moisture until acceptable planting conditions exist.
   4. Uniformly moisten excessively dry soil that is not workable.

B. If contamination is present in the soil within a planting area, notify Project Manager immediately.
   1. If contamination is discovered during Construction the Project Manager will determine the best course of action to remediate the contamination, which may include requesting the Contractor perform the removal of contamination and replacement of clean material.
   2. If contamination is determined to be the result of construction operations, Contractor is to remove contaminated material and replace with clean material at the direction of the Project Manager.

C. Proceed with installation only after unsatisfactory conditions have been corrected and approved by Project Manager.

D. Cooperate with any other contractors and trades, who may be working in and adjacent to the landscape work areas. Examine Contract 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. See Division 31, Sections “Earth Moving and 32 Sections “Soil Preparation” and “Topsoil”.

3.3 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, turf areas and existing plants from damage caused by planting operations. Repair damage to surrounding areas and site elements noted above resulting from planting operations at no additional cost to the City.

B. Layout, stake and label all individual tree locations for approval by the Project Manager prior to installing trees.

C. Outline planting beds and mark plant locations within the bed(s) for approval by the Project Manager prior to installing any plant material or mow bands. Make adjustments as directed at no additional cost to the City.

1. If formal arrangements or consecutive order of plants is indicated on Contract Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

D. Prepare planting area for soil placement and mix planting soil according to Division 32 Section "Soil Preparation".

3.4 WEED CONTROL

A. Do not proceed with landscape work until weed growth has been controlled and eliminated, per Division 32 Section "Soil Preparation".

B. See Division 32 Section "Soil Preparation" for detailed weed control measures.

C. Use pesticides only with the written approval of Project Manager, and in strict accordance with manufacturer's instructions.

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.
3. Do not excavate deeper than depth of the root ball, measured from the base of the root flare to the bottom of the root ball.
4. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly compact the added soil to prevent settling.

B. Obstructions:
1. Utilities: Notify Project Manager immediately of utilities that conflict or may potentially conflict with proposed plant locations. In such cases, alternative plant locations will be determined by Project Manager.
2. Notify the Project Manager prior to planting if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavation.

C. Drainage: Notify the Project Manager 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.
2. If water does not drain out of pit within twenty-four (24) hours, notify Project Manager.

3.6 PLANTING TREES AND SHRUBS

A. Balled and Burlapped Stock:
1. Set balled and burlapped stock plumb and in center of pit with base of root flare three-inches (3") above adjacent finish grades as indicated.
2. Remove burlap from top two-thirds (2/3) of balls and partially from sides, but do not remove from under balls. Remove wire baskets and all twine 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 one-inch (1") above adjacent finish grades or 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, then place remainder of backfill. Repeat watering until no more is absorbed. Water again after placing and tamping final layer of backfill.

C. Bare-Root Stock: Set and support each plant in center of planting pit or trench with root flare two-inches (2")above adjacent finish grade.
1. Backfill: As specified in Part 2 of this Section.
2. Spread roots laterally without tangling or turning toward surface. Plumb before backfilling, and maintain plumb while working.
3. Carefully work backfill in layers around roots by hand eliminating air pockets. Bring roots into close contact with the soil.
4. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
5. Continue backfilling process. Water again after placing and tamping final layer of soil.

D. Tree Staking: Stake trees as shown on the Contract Drawings.

E. Wrapping tree trunks: Wrap trees with tree 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. Use specified tape to secure. 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 or per the direction of the City Forester and or the Project Manager. 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

A. Prune only damaged or dead branches as directed by the City Forester and or the Project Manager.

## 3.8 TREE STABILIZATION

A. Trunk Stabilization by Staking: Install trunk stabilization as follows unless otherwise indicated on Contract Drawings.
1. Site-Fabricated Staking Method: Stake trees as indicated on Contract Drawings.

a. Drive stakes into undisturbed grade outside tree pit as indicated. Avoid penetrating root balls or root masses.
b. Securely attach specified wire to stakes.
c. Support trees with specified wire and tree tie webbing at contact points with tree trunk, reaching to specified stake. Allow enough slack to avoid rigid restraint of tree.
d. For guyed trees: Attach thirty-six-inch (36”) long x one-half-inch (1/2”) diameter PVC pipe flagging to each wire.
e. For staked trees: Attach twenty four-inch (24”) long x one-half-inch (1/2”) diameter PVC pipe flagging to each wire.

3.9 MULCHING

A. Trees: Create a forty-eight-inch (48”) diameter formed soil berm around tree and fill with three-inch (3”) deep specified wood mulch. Mulch shall be kept four to six-inches (4”-6”) away from tree trunk.

B. Shrubs:
1. Mulch backfilled surfaces of pits, planting beds areas, and other areas indicated or as directed by the Project Manager.
2. Mulch in shrub bed areas: Apply three-inch (3”)thick layer of mulch and finish level with adjacent finish grades. Do not place mulch against stems of plants.

3.10 INSTALLATION OF MISCELLANEOUS MATERIALS

A. Apply antidesiccant using power spray to provide an adequate film over trunks, branches, stems, twigs, and foliage.

B. When deciduous plants are moved in full-leaf, Project Manager may direct the use of an antidesiccant at nursery before moving and again two (2) weeks after planting. Antidessicant to be supplied and applied by Contractor at no additional cost to the City.

3.11 QUALITY CONTROL

A. 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.

B. Inspection: Contractor shall arrange for the Project Manager to select and/or inspect plant material at the nursery/.,/grow site 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 Project Manager and/or Forestry.
1. 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.
2. The Contractor shall pay all expenses for the Project Manager and City Forester to visit the source for plants including airfare, taxi, hotels and meals.

C. Measurements: Measure trees according to the requirements of the ANSI Z-160, with branches and trunks in their normal position. Do not prune to obtain required sizes. Measure main body of tree for height and spread; do not measure branches or roots tip-to-tip.

3.12 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 planted areas. Erect signs and barriers as required or directed by the Project Manager 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.

E. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.

3.13 CLEANING

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

3.14 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.

~~PART 4 - MEASUREMENT AND PAYMENT~~

~~4.1 MEASUREMENT **[Consultant to select A or B]**~~

~~A. Measurement will be based on the percentage complete for the lump sum contract amount for Trees, Plants, and Groundcovers.~~

~~B. Measurement will be made by the contract unit specified for Trees, Plants, and Groundcovers. Measurement shall include the actual number of units of specified material(s) placed and accepted at the locations shown on the Contract Drawings, or as directed by the Project Manager, and in accordance with the Specifications.~~

~~4.2 PAYMENT~~

~~A. Payment will be made at the **[contract unit]** **[lump sum contract]** price, and shall include required materials, transportation, equipment, labor, earthwork, loading, transporting,~~

~~stockpiling, disposing, hauling off, watering, dust control, erosion and sediment control, fine grading, <**Insert additional items**> maintenance of temporary protection by fencing or other means, watering and all maintenance required until Final Acceptance of the work as required in accordance with the Contract Drawings and Specifications.~~

**END OF SECTION 32 93 00**

**SECTION 32 97 00 LANDSCAPE MAINTENANCE**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for furnishing of all supervision, labor, materials, equipment and transportation required to maintain the landscape areas called for under this contract for the time period specified. 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 Sections:
1. Division 01 Section "Erosion and Sedimentation Control".
2. Division 31 Section "Watering".
3. Division 32 Section "Irrigation Systems".
4. Division 32 Section "Automatic Irrigation Controllers".
5. Division 32 Section "Trees, Plants, and Groundcovers".

1.3 INSPECTION AND ACCEPTANCE

A. Formal Inspections: The project will be inspected during the Maintenance and Guarantee Period at the following points:
1. Substantial Completion Inspection
2. Establishment Inspection
3. Quarterly Inspections
4. Final Inspection

B. Additional inspections and observations to monitor maintenance and landscape conditions will be done throughout the Maintenance and Guarantee Period by the Project Manager, City Forester, and City Naturalist.

C. Substantial Completion Inspection: At the completion of operations under this contract, and prior to the beginning of the maintenance and guarantee period, the substantial completion inspection will be performed. 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. Also see Division 01 Section "Contract Closeout".

D. Establishment Inspection: Shall occur approximately ninety (90) days after Substantial Completion. The review will consist of a review of sodded and seeded areas 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. Quarterly Inspections: Shall occur quarterly from the date of Substantial Completion. The review will consist of a review of all maintenance contract responsibilities. The Contractor shall keep a quarterly 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 seven (7) days notice to the Project Manager requesting a Final Inspection in conformance of Division 1 requirements. 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 the Contractor. If in the opinion of the Project Manager that all work has been completed or performed per the contract documents the Project Manager will provide the Contractor with written notice of Final Acceptance. Final acceptance by the Project Manager will not be given until all deficiencies are corrected.

1.4 SUBMITTALS

A. See Division 01 Section "Submittals" for submittal requirements.

B. Maintenance Reports: Submit detailed maintenance quarterly reports and schedules for the Maintenance and Guarantee Period for review and approval by the Project Manager, Denver City Forester, and Denver City Naturalist.

C. Material List: Submit a detailed list of materials, to be used for seeding, fertilization, pesticides, pesticides that are to be used for seeding, weed control, plant health and mulching.

D. 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.

E. 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.

1.5 CONTRACTUAL REQUIREMENTS

A. Maintenance and Warranty Period: The maintenance and Warranty period shall commence from the date of work startup of the contract work in accordance with these Specifications and continue for the period of two (2) years from Date of Substantial Completion.

B. Limits of Work Area: All improvements and maintenance within the project work area are included unless otherwise indicated on the Contract Drawings or directed by the Project Manager. Areas outside defined areas, as illustrated on the Contract Drawings, will be maintained by the City.

C. Performance of Work: The Contractor's work force and equipment shall be accepted by Project Manager prior to the commencement of the maintenance period. The Contractor shall submit to the Project Manager an outline of the equipment and crew sizes to be utilized throughout the maintenance period. Maintenance work shall not be divided among several Contractors but shall be done by one entity. In the event that Project Manager finds any items identified as

unacceptable, Contractor shall make the revisions noted by the Project Manager at no cost to the City.

D. Scheduling / Progress Reports:
1. Scheduling: Prior to the beginning of the Maintenance and Warranty Period, Contractor shall submit for approval to the Project Manager a detailed schedule identifying all activities which are to be performed. Examples of such commitments include the regular intervals for weed control, fertilization, pesticide applications and mowings and other operations and the month and week which are scheduled for other major activities such as reseeding and mulching. It is not the Project Manager's intent to require the Contractor to meet each deadline on a specific day, but merely to identify the general time periods for such activities. The Contractor may modify the schedule due to weather conditions, providing that Project Manager is notified in advance of any changes.
2. Notification: Contractor shall be required to notify the Project Manager a minimum forty-eight (48) hours in advance of all major work so the Project Manager has 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 Project Manager shall have the right to require the Contractor to reschedule any such work until such time that the Project Manager is available. The above provision applies only to work which could be perceived as normal or regularly scheduled maintenance, emergency repairs do not apply.
3. Progress Reports: The Contractor shall submit quarterly progress reports during the growing season and quarterly progress reports through the winter. The written progress reports shall be sent to the Project Manager outlining work completed, damage incurred, and problems encountered. Progress reports shall contain digital photo documentation of work.
4. Site Meetings: Contractor shall meet, on site, with the Project Manager and City staff on a quarterly basis to review the project status.
5. After Hours Contact: Contractor shall provide one afterhours contact and telephone number.

E. Maintenance Coordination: Contractor shall coordinate maintenance operations and activities with Project Manager. Failure to Perform: In the event that, in the Project Manager's opinion, action has not been taken on the part of the Contractor to properly maintain the project, the Project Manager may take whatever action that is deemed necessary to affect such repairs and any costs incurred will be deducted from the Contract amount.

F. Licenses, Taxes, and Insurance:
1. 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. pesticide application).
2. Taxes: Contractor shall pay all applicable taxes, including sales taxes on materials supplied.
3. Insurance: Contractor shall maintain all insurance policies in accordance with the General Conditions of the contract through the entire term of the maintenance and guarantee period.

G. Payment Schedule: Payments shall be made as indicated in Measurement and Payment section.

PART 2 - PRODUCTS

2.1 Pesticides:

A. For Native Grass areas: "Milestone", as manufactured by Dow AgroSciences.

B. For cultivated landscape areas: As approved by Project Manager.

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 pesticides 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 pesticide applications. No pesticides will be allowed until seedlings are at least three months old. After establishment, pesticide applications shall be done as required and directed by the Project Manager during the maintenance 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.
1. 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 Denver Park's organic material specifications.
2. Topdressing is to be used in non-athletic fields when soil tests or leveling needs determine the application.
3. Filling Low Spots: Fill low spots with matching existing soil when filling noticeable depressions or holes. Compact per Division 31 Section "Earth Moving".

F. Repair all bare areas or dead areas of grass greater than 1 square foot. Repairs shall occur within five (5) calendar days of notice to repair the condition. Upon the Project Manager's written approval, the Contractor may repair turf at a later date mutually agreed upon.
1. Seeding: If the original installation was by seed, repairs to such areas are to be reseeded. Replacement products and installation shall comply with specifications for original seeding.
2. Sodding: If the original installation was sodded, repairs to such areas are to be resodded. Replacement products and installation shall comply with specifications for original sodding.

G. Mowing, Trimming and Edging:

1. Contractor shall be responsible for mowing of all areas defined by the contract and Contract Drawings until final acceptance.
2. When turfgrasses reach three and one-half-inch (3-1/2") height, begin weekly mowing and trimming program to maintain turf at 3-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.
3. 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 pesticides six- to twelve-inch (6"-12") radius kept clear, and base of shrubs and trees require twenty-four (24)-inch minimum radius clear of turf (bare soil/mulch).
4. 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.

## 3.2 NATIVE SEEDING AREAS

A. Watering: All watering shall be done in such a way as to encourage establishment, deep root growth and drought tolerance. See Article 3.4 "Irrigation & Water Management", 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. Refer to Division 31 Section "Watering" for requirements.

B. Weed Control:
   1. Weed Control Prior to Initial Installation per Division 32 Section "Soil Preparation".
   2. Weed control shall be done for the duration of the Maintenance and Warranty 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 2-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 pesticide 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 pesticides 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 pesticide applications. Contractor shall use pesticides for specific species as recommended by CSU Agricultural Extension Service or City Naturalist.
      d. Spot Application Chemical Control: Apply pesticide by hand applicator directly to invasive annual and perennial weeds. Allow a minimum two weeks between application and any seeding activities.

C. Reseeding:

1. Evaluate native grass areas every ninety (90) days during the Maintenance and Warranty Period as to success of germination and coverage. Use the following criteria:
   a. Reseed all areas that meet the following conditions:
      1) Areas of bare or dead grass greater than twenty-four inches (24") by twenty-four inches (24") square.
      2) Areas of weed density greater than twelve (12) plants per square foot.
      3) Areas with general density of specified grasses less than twelve (12) plants per square foot.

2. Reseed unacceptable areas as defined above. Reseeding, soil preparation and mulching shall comply with Division 32 Sections "Turfgrass Seeding" and "Soil Preparation". Seed mixes may be revised (% of species) to better suit site conditions. If requested by Project Manager or Denver City Naturalist, 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 1/4- to 1/2-inch 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.
3. Timing of reseeding shall be as specified herein. Upon the Project Manager's written approval, the Contractor may reseed at a later date mutually agreed upon.

## 3.3 TREE, SHRUB, AND PLANT CARE

A. Pruning: Refer to Division 32 Section "Trees, Shrubs, and Groundcovers" for maintenance requirements.

B. Replacement of Plants: Remove and replace dead, diseased, dying or damaged plants (including material damaged by vehicles or vandalism) within fourteen (14) calendar days of notification by Project Manager or Denver City Forester. Upon Project Manager's written approval, the Contractor may replace rejected plants at a later date, mutually agreed upon, provided that the Contractor removes all rejected plants within fourteen (14) calendar days of the notice to replace such plants. If the rejected plants are not removed in fourteen (14) calendar days, the City may remove and replace these plants and any costs associated with the removal and replacement shall be deducted from the Contract price. All areas damaged by replacement operations are to be fully restored to their original condition as specified. Plant material damaged by vehicles or vandalism shall be replaced by the Contractor at no cost to the City. Guarantee all plantings to be true to name and to meet all conditions of these specifications. Any plant which is not true to name as indicated by leaf, flower form or fruiting characteristics revealed within maintenance period shall be replaced by Contractor at Contractor's expense.

C. Transplanted Material: Refer to Division 32 Section "Tree Transplanting".

D. 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 maintenance and guarantee period. Water all plant material at a rate of ten (10) gallons per inch of tree caliper (e.g. a two-inch (2") tree requires twenty (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, but most not promote or cause erosion or displacement of mulch or erosion control items.

3.4 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 to City.

B. 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. Contractor shall be responsible for providing an Establishment Watering Schedule, Transition Watering Schedule and a Maintenance Watering Schedule to the Project Manager, Operation Supervisor and the Toro Field Representative (when applicable).
1. 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.
2. Prior to any plant material being installed all schedules shall be provided to the Project Manager and Operations Supervisor.
3. The water schedule templates are available from Water Conservation and the Project Manager.
4. Contractor shall make any modifications to the programming as requested by Project Manager.
5. Initial 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.
   a. Exact timing of irrigation cycles will depend on weather conditions, soil conditions, and speed of emergence of grass seed.
   b. Short, frequent irrigation cycles shall be used.
   c. Split cycles or the 'cycle and soak' feature must be employed to reduce erosion or run off in seeded areas.
   d. Do not exceed three inches (3") of total water per week.
   e. Coordinate with irrigation system schedule and programming with the Project Manager, and City staff. Project Manager may choose to involve other parties from the City or irrigation equipment manufacturer..
   f. Do not over-water native seeded areas in a manner which adversely impacts germination and growth of any components of the seed mix.
   g. Contractor shall submit a meter reading before and after establishment to verify water use.

6. Transition Irrigation (Days 21-60):
   a. 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.
   b. Allow the surface soils to dry slightly between watering to encourage deeper rooting.
   c. Watering shall be done utilizing historic evapotranspiration rates for the current watering month(s).
   d. Do not over-water native seeded areas in a manner which adversely impacts germination and growth of any components of the seed mix.

7. Maintenance Irrigation (Days 61 – End of Maintenance Period):
   a. Irrigate as needed to maintain an optimum stand of turf while minimizing water use.
   b. Irrigation frequency shall be adjusted at a minimum, based on monthly historical evapotranspiration rates and plant (turf and tree) water requirements.
   c. It is the responsibility of the Contractor to coordinate with Project Manager, Operations Staff, and local Toro Field Representative the programming of irrigation controllers, to properly irrigate plant materials and turfgrass.
   d. Do not over-water native seeded areas in a manner which adversely impacts germination and growth of any components of the seed mix.

8. Once sod has been laid, begin watering to build up the sub-soil moisture. This will be the most critical time to apply water.
   a. Water up to one and one-half inches (1-1/2") of water per day for the first two (2)- to three (3)-days.
   b. Probe the soil to determine if the moisture has penetrated down to a minimum of four inches (4").
   c. 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.
   d. 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 City and Denver Water-allowed water window. Coordinate times with the Project Manager.

F. Winterization of Irrigation System: Under the maintenance period, the Contractor shall be responsible for winterizing irrigation pumps, if applicable, and draining irrigation system for the full maintenance period.
   1. Remove water from system by use of compressed air.
   2. Remove water from drip lines by opening flushing plugs.
   3. Submit a meter reading after winterization of the system has occurred to Parks Water Conservation.
   4. Winterization shall occur no later than October 15th unless a variance has been granted from the Project Manager.

G. Spring Start-Up: The Contractor shall be responsible for starting up the irrigation system in the spring (April 15).
   1. Fully activate the system including controller start-up, in order to demonstrate that it is in full working order.
      a. Any repairs that are needed as a result of improper winterization shall be corrected by the Contractor at no additional cost to the City.

   2. Correct all deficiencies and make any adjustments to ensure proper system function.
   3. Submit a meter reading prior to spring start-up to the Project Manager.

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 7 calendar days of notification by the Project Manager.

1. Contractor shall replace any materials with manufacturer's defects at no additional cost to City.
2. Replacement of any equipment shall match that installed and designed on the irrigation plans unless a variance is granted from Project Manager.
3. Problems resulting in leakage or water waste shall be repaired within 12 hours of notification.
4. Contractor is responsible for emergency repairs and or shut downs.
    a. If Contractor neglects to perform these duties within the specified time, the City may make such repairs at the Contractor's expense.
    b. In the case of an emergency, where in the judgment of the City, delay would cause serious loss or damage, repairs or replacement may be made by verbal communication and without notice being sent to the Contractor, and the Contractor shall pay the cost thereof.

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

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

~~PART 4 - MEASUREMENT AND PAYMENT~~

~~4.1 MEASUREMENT **[Consultant to select A or B]**~~

~~A. Measurement will be based on the percentage complete for the lump sum contract amount for Landscape Maintenance.~~

~~B. Measurement will be made by the contract unit specified for Landscape Maintenance. Measurement shall include the actual number of units of specified material(s) placed and accepted at the locations shown on the Contract Drawings, or as directed by the Project Manager, and in accordance with the Specifications.~~

~~4.2 PAYMENT~~

~~A.~~K. ~~Payment will be made at the **[contract unit]** [**lump sum contract**] price, and shall include required materials, transportation, equipment, labor, excavation, stockpiling, disposing, hauling off, watering, dust control, erosion and sediment control, installation of pipes, wires, heads, valves, boxes, soil amendments and fertilizers, weed control, plant materials, disking, raking, spreading, fine grading, mowing, furnishing and installation of seeds, mulch installation and maintenance of temporary protection by fencing or other means, <**Insert additional items**> as required in accordance with the Contract Drawings and Specifications~~.

**END OF SECTION 32 97 00**

**SECTION 33 44 00 STORM SEWERAGE**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section includes requirements for 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:

B. http://www.denvergov.org/wastewatermanagement/WastewaterManagement/EngineeringandPermits/WastewaterDetailandTechnicalSpecifications/tabid/442699/Default.aspx

C. Related Work:
1. Division 01 Section “Layout of Work and Surveys”.
2. Division 01 Section “Contractor Quality Control”.
3. Division 01 Section “Erosion and Sedimentation Control”.
4. Division 01 Section “Materials and Equipment”.
5. Division 01 Section “Tree Retention and Protection”.
6. Division 31 Section “Earth Moving”.
7. Division 31 Section “Excavation and Backfilling of Trenches”.
~~8. Division 32 Section “Sodding”.~~

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

~~PART 4 - MEASUREMENT AND PAYMENT~~

~~4.1 MEASUREMENT **[Consultant to select A or B]**~~

~~A. Measurement will be based on the percentage complete for the lump sum contract amount for Storm Sewerage.~~

~~B. Measurement will be made by the contract unit specified for Storm Sewerage. Measurement shall include the actual number of units of specified material(s) placed and accepted at the locations shown on the Contract Drawings, or as directed by the Project Manager, and in accordance with the Specifications.~~

~~4.2 PAYMENT~~

~~A. Payment will be made at the **[contract unit]** [**lump sum contract**] price, and shall include required materials, transportation, equipment, labor, earthwork, stockpiling, disposing, hauling off, fittings, joints, joint materials, trenching, bedding materials, connections to other pipes or structures, compaction watering, dust control, erosion and sediment control, fine grading, <**Insert additional items**> as required in accordance with the Contract Drawings and Specifications.~~

**END OF SECTION 33 44 00**

**SECTION 33 46 00 SUBDRAINAGE SYSTEMS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for furnishing and installation of sub-drainage systems as shown on the Contract Drawings, as specified herein, or as required to complete the work.

B. Related Work:
1. Division 01 Section “Layout of Work and Surveys”.
2. Division 01 Section “Contractor Quality Control”.
3. Division 01 Section “Erosion and Sedimentation Control”.
4. Division 01 Section “Materials and Equipment”.
5. Division 01 Section “Tree Retention and Protection”.
6. Division 31 Section “Earth Moving”.
7. Division 31 Section “Excavation and Backfilling of Trenches”.
~~8. Division 32 Section “Sodding”.~~
~~9. Division 33 Section “Storm Sewerage”.~~

1.3 SUBMITTALS

A. See Division 01 Section “Submittals” for submittal requirements.

B. Product Data: For each type of product for approval prior to construction.
1. Piping: Submit twelve inch (12”) length of each type of underdrain piping to be used.
2. Geotextile Fabric: Submit twelve inch (12”) by twelve inch (12”) sample.
3. Bedding material: Submit one (1) quart sample.
4. Filter material: Submit one (1) quart sample.

1.4 QUALITY CONTROL

A. Installer Qualifications: Engage an experienced Installer who has completed subdrainage work similar in material, design, and extent to that indicated for this Project and with a record of successful project completion and operation.

1.5 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 Project Manager reserves the right to inspect containers before or after installation to verify compliance with Specifications.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.
4. Protect piping and geotextile fabric from damage or contamination with soil or other construction materials from time of deliver to installation.

1.6 PROJECT/SITE CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and related construction contiguous with proposed subdrainage installations by field measurements before proceeding with planting work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. PVC under drain: ASTM D2729, minimum 4-inch diameter, plain or perforated type as indicated on the Contract Drawings, with required fittings. Perforated pipe shall comply with requirements of ASTM 272a, with 2 rows of evenly spaced three eighths inch (3/8”) diameter perforations, one hundred twenty (120)-degrees apart, providing a minimum number of holes of four (4) per foot.

B. Geotextile Fabric: Non-woven fabric “140N” by Tencate-Mirafi or acceptable substitution.

C. Bedding Material: Solid pipe bedding material to be three quarters inch (3/4”) crushed stone. Perforated pipe, refer to manufacturers specifications or drawings for required bedding material.

D. Filter Material: Three quarters inch (3/4”) crushed washed stone.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine areas where the Work of this Section will be performed for compliance with requirements and conditions affecting installation and performance.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within the work area.
2. Verify that final grades are completed in accordance with the drawings.

B. Proceed with installation only after unsatisfactory conditions have been corrected and approved by Project Manager.

C. PVC under drain: Install pipe under drains as shown on the Contract Drawings. Pitch shall be a minimum of one half of one percent (0.5%) or as shown on Contract Drawings. Contractor is responsible to immediately notify the Project Manager of any discrepancies.

D. 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/WastewaterManagement/EngineeringandPermits/WastewaterDetailandTechnicalSpecifications/tabid/442699/Default.aspx

E. 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 Contract 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 Project Manager at no additional cost to the City. Fabric edges shall overlap at least 6-inches for the full width of the trench.

3.2 CLEANING

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

3.3 RESTORATION

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

~~PART 4 - MEASUREMENT AND PAYMENT~~

~~4.1 MEASUREMENT **[Consultant to select A or B]**~~

~~A. Measurement will be based on the percentage complete for the lump sum contract amount for Subdrainage Systems.~~

~~B. Measurement will be made by the contract unit specified for Subdrainage Systems. Measurement shall include the actual number of units of specified material(s) placed and accepted at the locations shown on the Contract Drawings, or as directed by the Project Manager, and in accordance with the Specifications.~~

~~4.2 PAYMENT~~

~~A. Payment will be made at the **[contract unit]** **[lump sum contract]** price, and shall include required materials, transportation, equipment, labor, excavation, stockpiling, disposing, hauling off, associated fittings, joints, joint materials, trenching, bedding materials, connections to other pipes or structures, compaction watering, dust control, erosion and sediment control, fine grading, <**Insert additional items**> as required in accordance with the Contract Drawings and Specifications.~~

**END OF SECTION 33 46 00**