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.

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,

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

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.

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.

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".

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Measurement for Erosion and Sediment Control will not be measured, but will be a lump sum item, in accordance with the Drawings and as directed by the Project Manager.

4.2 PAYMENT

A. Payment shall be made at the lump sum price and shall include full compensation for erosion and sedimentation control in accordance with the Drawings and Specifications. The lump sum price shall include all material, labor and equipment required to establish specified erosion and sedimentation controls prior and during construction, and to include removal of erosion and sedimentation controls at the end of the project and/or after final stabilization. The lump sum

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.

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 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.

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

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.

SECTION 01 74 19 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Salvaging nonhazardous demolition waste.
2. Recycling nonhazardous demolition and construction waste.
3. Disposing of nonhazardous demolition and construction waste.

B. Related Requirements, if applicable:

1. Division 02 Section "Selective Structure Demolition" for disposition of waste resulting from partial demolition of buildings, structures, and site improvements.
2. Division 31 Section "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.3 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

j. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:

1) Paper.
2) Cardboard.
3) Boxes.
4) Plastic sheet and film.
5) Polystyrene packaging.
6) Wood crates.
7) Plastic pails.

1.5 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 7 days of date established for the Notice to Proceed.

1.6 INFORMATIONAL SUBMITTALS

A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Include the following information:

1. Material category.
2. Generation point of waste.
3. Total quantity of waste in tons.
4. Quantity of waste salvaged, both estimated and actual in tons.
5. Quantity of waste recycled, both estimated and actual in tons.
6. Total quantity of waste recovered (salvaged plus recycled) in tons.
7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

B. Waste Identification: Indicate anticipated types and quantities of demolition, site-clearing, and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: (Not applicable)

D. Cost/Revenue Analysis: (Not applicable)

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

B. General Contractor's Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of Project.

C. Training: Train workers, subcontractors, and suppliers on appropriate separation, handling, and recycling to be used by all parties and proper waste management procedures, as appropriate for the Work occurring at Project site.

1. Distribute waste management plan to everyone concerned within three days of submittal return.
2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
2. Comply with Technical Specification Section 01500 "Temporary Facilities"" for controlling dust and dirt, environmental protection, and noise control.

E. Waste Management in Historic Zones or Areas: Hauling equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, by 12 inches or more.

O. Allied Waste	P. 10303 E. Dry Creek Rd #250 Q. Englewood, CO 80112	R. (720) 895-1500	S. Bill Kich
T. Waste-Not	U. 1065 Poplar Street V. Loveland, CO 80534	W. (970 669-9912	X. Gary Gettman
Y. Bunting Disposal	Z. 3315 State Street AA. Evans, CO 80620	BB. (970) 339-3023	CC. Bryan Bunting
DD. Phoenix Recycling	EE. 2501 Delwood Avenue FF. Durango, CO 81301	GG. (970) 375-1300	HH. Mark Thompson
II. Waste Chasers	JJ. 19 Oak Avenue KK. Eaton, CO 80615	LL. (970) 454-2497	MM. Jason Hawk
NN. Colorado All Waste	OO. 7247 E. County Line Rd PP. Longmont, CO 80504	QQ. (303) 702-9955	RR. Majori McDonald
SS. Patch Construction	TT. 12655 State Hwy 67 UU. Florence, CO 81226	VV. (719) 784-6236	WW. David Patch Jr.
XX. Pueblo Disposal	YY. 28900 E. Hwy 96 ZZ. Pueblo, CO 81001	AAA. (719) 948-0047	BBB.

F. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.

G. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.

H. Conduit: Reduce conduit to straight lengths and store by type and size.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Site-Clearing Wastes: Chip brush, branches, and trees on-site.

1. Comply with requirements in Division 32 Section "Plants" for use of chipped organic waste as organic mulch.

C. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

a. Comply with requirements in Division 32 Section "Plants." for use of clean sawdust as organic mulch.

D. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

3.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.

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.

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

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".

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.

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 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.

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:

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

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. 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".

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 crusher fines material as indicated on plans. 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.

5. Remove synthetic turf material as indicated on plans. Do not disturb sub-base and infrastructure. All synthetic turf and materials and including but not limited to mat and infill to be recycled. 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.

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, for mowband and footers at fence.

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.

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 ASSURANCE for Contractor's testing requirements.

D. Mockups: Cast concrete formed-surface panels to demonstrate typical joints, surface finish, texture, tolerances, color, details, and standard of workmanship.

1. Build panel approximately thirty (30) 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 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. Mockup may be a part of the completed work if approved prior to construction of the mockup by the Project Manager.
8. Demolish and remove mockups when directed by Project Manager.

1.6 SUBMITTALS

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

B. Mix Designs:

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.

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. ChemMasters.
      b. Davis Colors.
      c. Dayton Superior Corporation.
      d. Hoover Color Corporation.
      e. Lambert Corporation.
      f. QC Construction Products.
      g. Rockwood Pigments NA, Inc.
      h. Scofield, L. M. Company.
      i. Solomon Colors, Inc.
      j. Acceptable substitution.

   2. Color: Match Architect's sample.

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 ANTI-GRAFFITI COATING

A. Manufacturer: Rain Guard International

B. Product: VandlGuard™ Non-Sacrificial Anti-Graffiti Coating, or acceptable substitution.

2.8 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:

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. Form Tie Holes: Form tie holes are to be filled with grout and finished to match adjacent concrete surface.

F. 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.

G. 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.

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

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

J. 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.

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

L. 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.

M. During cold weather, remove ice and snow from forms. **Do not** use deicing salts. Do not use water to clean out completed forms unless formwork and construction proceed within heated enclosure. Use compressed air to remove foreign matter.

3.2 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. 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".

3.7 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.

whitens, rub surface with clean burlap and keep surface damp by spraying for at least thirty six (36) hours.

3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a one-to-one (1:1) mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

D. 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.

3.9 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. 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.

F. 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.

G. Concrete paving will be considered defective if it does not pass tests and inspections.

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

I. Prepare test and inspection reports.

J. 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.

END OF SECTION 03 30 00

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

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

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 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.

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

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".

3.4 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.

3.5 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.

3.6 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".

3.7 EXCAVATION

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

3.8 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.

3.9 EXCAVATION FOR WALKS AND PAVEMENTS

A. See project Geotechnical Report (N/A).

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 (N/A).

3.10 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.

3.11 SPECIAL CONDITIONS

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

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

3.18 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.

3.19 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.

3.20 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.

END OF SECTION 31 20 00

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 furnishing and placing crushed aggregate, bonded with fine aggregate, constructed on a prepared underlying 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 aggregate base course 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".
5. Division 32 Section "Concrete Walks, Curbs, and Miscellaneous Flatwork".

1.3 SUBMITTALS

A. See Division 01 Section "Submittals" for submittal requirements.

B. Certification: Contractor shall provide a certificate of compliance for any imported Aggregate Base Course materials.

C. Gradation and Standard Proctor Density Test Results: For imported backfill materials, at a minimum, submit results of gradation tests and standard proctor density test.

D. Sample: Provide a 1-pound (1#) sample of material(s) for approval.

PART 2 - PRODUCTS

2.1 AGGREGATE BASE COURSE

A. Aggregate base course shall meet the requirements of Item 703.03 of the Standard Specifications for Road and Bridge Construction of the Colorado Department of Highways, latest revision for Class five (5) or Class (6), or as specified by the Soils Engineer and on Contract Drawings.

B. ¾" Gravel: Material shall be generated from quarries where granite is mined and shall comply with ASTM C 136.

D. 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.

3.5 PROTECTION

A. Spreading of aggregate shall not take place when temperatures are below freezing. When the aggregate base course contains frozen material or the underlying subgrade is frozen, construction shall not occur.

3.6 MAINTENANCE

A. Following the completion of the base course, the Contractor shall perform all maintenance work necessary to keep the aggregate in a satisfactory condition until acceptance of the project. The surface shall be kept clean and free from foreign material. The base course shall be properly drained at all times. Any work, maintenance or necessary repairs shall be performed at the expense of the Contractor.

END OF SECTION 32 11 16

9. ASTM C672 - Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals.
10. ASTM-C800 - Curing Compound, Concrete, for New and Existing Surfaces.

E. CRSI - Manual of Standard Practice.

F. Colorado Department of Transportation (CDOT) – Standard Specifications for Road and Bridge Construction, latest edition

G. 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. Division 03 Section "Cast-In-Place Concrete".

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.

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.

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

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

http://www.denvergov.org/Portals/487/documents/CCD%202010%20Trans%20Standards%20and%20Details%20-%20Complete.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.

G. ACI Publications: Comply with ACI 301 unless otherwise indicated.

H. Sample Panel(s): If requested by the Project Manager, prior to starting any concrete paving, 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. The approved sample panel may be a portion of the work and remain in place. Locations as directed by the Project Manager.

I. Record of Work: A record shall be kept by the Contractor listing the time and date of placement of all concrete for paving. Such record shall be kept until the completion of the project and shall be available to the Project Manager for examination at any time.

J. All testing shall be completed by the Contractor at their expense unless otherwise specified by the contract.
   1. Testing Frequency: Obtain at least one composite sample for each one hundred (100) cu. yd. or five thousand (5,000) sq. ft. 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 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 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.

K. Strength of each concrete mixture will be satisfactory if average of any three (3) 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.

L. 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.

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.

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.

F. 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.

G. 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.

H. 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 section 2.11. 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.

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.

3.13 QUALITY ASSURANCE

A. Refer to Division 1 Section "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. This Section includes, but is not limited to preparation of the site and installation of the new synthetic grass system, in-fill materials, in-laid markings, perimeter termination and maintenance equipment.

B. Related Sections:
1. Division 32 Section: "Synthetic Turf Systems".

1.3 SUBMITTALS

A. Synthetic Grass Sample: Within 5 calendar days of the Notice to Proceed, the Contractor shall submit an eighteen inch square sample of un-filled synthetic grass (in-fill in separate bags with sieve analysis) proposed for this contract for approval of colors, in-fill, seaming materials and layout of the system. The sample shall be reviewed as the product intended for use on the field.

B. Seaming diagram: submit a seaming diagram indicating the layout of the grass panels and seam locations one month prior to installation.

C. Maintenance and Operating Data: Submit a copy of Maintenance and Operating Data for the synthetic grass system. Provide descriptions of all equipment recommended for the maintenance, repair, citing grass and activities not recommended relative to the warranty. Include maintenance recommendations including coverings for special events, small repair procedures, minor seam repair, discussion of the precautions to be practiced, general maintenance and uses to avoid to protect the grass system.

D. Washed Screened fines for sub-base: Provide a one gallon sample of material for approval.

E. Antistatic treatment for rubber infill.

F. Sub-base compaction test results.

1.4 QUALITY ASSURANCE

A. Testing and Quality Control: As a part of their proposal, the bidders must submit all testing data for the synthetic grass. The Contractor shall submit to the Project Manager a copy of the results certified by an independent testing laboratory for the following tests performed on the synthetic grass to be installed in the project.

4. Conditions exist or are pending that will be unsuitable to the installation of the system

1.7 WARRANTY

A. Each bidder shall include as part of their bid showing, the Contractor shall have a warranty per Section titled Synthetic Turf Warranty and Guarantee.

B. The Contractor is required under this guarantee to supply and install all in-fill materials and synthetic grass to maintain the performance levels of this guarantee.

PART 2 - PRODUCTS

2.1 GENERAL

A. The field surfacing system shall be a vertically draining permeable synthetic grass system consisting of a synthetic grass like pile that shall be tufted into a triple layer synthetic backing.

B. Approved Synthetic Turf Systems Manufacturers:
1. Astro Turf
2. Desso
3. Field Turf
4. Shaw

C. The entire system shall be resistant to weather, insects, rot, mildew, fungus growth and be non- allergenic and non-toxic. The entire system shall be constructed to maximize dimensional stability, to resist damage and normal wear and tear from its designated uses and to minimize the ultra-violet degradation.

D. Include all labor, materials, equipment, transportation and services to install complete all-weather synthetic grass system.

2.2 INFILL MATERIAL

A. The dynamic cushioning of the combined grass and in-fill system (and pad if required) shall not exceed a maximum of 120G's at 70 degrees F. per ASTM 1936-98, F355, Procedure A at any location within 30 days of the installation. The system shall not exceed 120 G's over the warranty period. Any testing below 95 G's shall not be allowed.

B. Infill shall be free of all metal and produced of 100% recycled truck and/or automobile tires. The material shall have a size not to exceed 14 mesh nor smaller than 20 mesh. The fine particles shall not exceed 10% by volume. The bulk density of the rubber materials shall not be less than 29.75 lbs/cubic feet. All infill material shall be treated with an anti-static material before brushing. The anti-static material shall be applied at the rate of 0.10 gallon per square yard of undiluted material. Anti-static material shall be as manufactured by Bristol- Meyer, Lever Brothers or equal.

C. If a combination of sand and rubber are used as the in-fill system, the rubber content shall be not less than 3 pounds per square foot and the sand shall not be less than 3 pounds per square

F. All seams shall not have any adhesive applied to any exposed fibers. All graphics or markings can be in-laid or cut-in.

G. The synthetic grass shall be perforated for surface drainage after the final backing coating.
   1. The perforations shall be not less than 3/8" in diameter and have a uniform spacing of not more than 2.5" on center.
   2. Perforations shall be complete and full diameter for a minimum of 95% of the each roll.
   3. Perforations shall be tested by passing a 3/8" drill bit through the holes with no more than 4 1bs. pressure.

H. Fabric surface shall be constructed and installed in minimum widths of 15 feet with no longitudinal or transverse seams, except for inlaid lines with a finished roll assembly. Each panel shall be delivered for installation across the full width (perpendicular to the playing direction) of the field. Butt and or head seams shall not be allowed within the field of play. The seams shall be 15'-0" apart, except for end panels and markings. Rolls that do not comply with the proper length or conform to the seaming diagram as submitted prior to installation, shall be rejected from the site. No fitted pieces shall be allowed to true alignment.

2.7 PERFORMANCE AND TEST REQUIREMENTS

A	Melting Point	ASTM D789	135 degrees F.
B.	Specific Gravity	ASTM D792	.950 to .960
C.	Breaking Strength	ASTM D5034	Length 283 lbs./ft. Width 208 lbs. /ft.
D.	Coefficient of Friction	ASTM D5034	Dry 1.15 Wet 1.00
E.	Pill Burn Test	ASTM D2859	8 Passed/0 Failed
F.	Tuft Bind (without in-fill) Tuft Bind (with in-fill) Single Fiber Grab	ASTM D1335 ASTM D1335 ASTM D1335	11 lbs. pull 221bs. pull 8 lbs. pull
G.	Pile Height	ASTM D418	2-1/4" minimum- 2-1/2" maximum
H.	Fiber Face Weight	ASTM D418	FORTY (40) oz./sq. yard minimum
I.	Fiber Construction	ASTM D418	100% Polyethylene mono-ribbon non-fibrillated pattern, not less than 120 microns in thickness. Ultrablade or XPS or NexGen. Mono filaments (2mm x 115 microns are acceptable. Monoribbons are acceptable. Fiber shall be a combination of 1mm and 2mm blade widths. Monoribbons are acceptable.
J.	Fiber Gauge Width	ASTM D418	0.375" between tufted rows

M.	Secondary Backing	ASTM D418	Oven cured Polyurethane or latex
N.	Secondary Backing	ASTM D418	28 ounces of finished weight per square yard
O	Perforations	Visual	3/8" spaced a maximum of 4" on center, max.

2.8 MARKINGS

A. The complete field lining, marking and field boundary system with team areas limits, etc. shall be provided with the initial installation. Layouts shall be accurately surveyed and marked prior to installation.

B. All lines and field markings are to be tufted or inlaid with the specific colored turf. All markings shall be uniform in color, providing a sharp contrast with the turf color and shall have sharp and distinct edging. Markings shall be true and shall not vary more than 1/2" from specified width and location.

C. Manufacturer is to guarantee that the synthetic fiber is adaptable to painted lines. D. Minimum Lining and Markings (see Plan):

1. All incidental markings required by UEFA, FIFA and NFSHSA2.
2. All lines to be 4" width.
3. Main field Soccer: All soccer lines, goals and boxes shall be in-laid with white turf.
4. Small field Soccer: All soccer lines, goals and boxes shall be in-laid with blue turf.
5. Lacrosse field: All lines, goals and boxes shall be in-laid with blue turf.

2.9 TERMINATION NAILER

A. The nailer board shall be a 2" x 6" "Trex" synthetic or recycled materials or equal

2.10 SCREENED FINES

A. Washed screened fines shall be ¼" max. dia.

2.11 ADDITIONAL MATERIALS AND EQUIPMENT

A. The Contractor shall be required to supply and deliver an additional 100 lineal feet of standard width material as specified for the fields for each project.

B. The Contractor is required to supply and deliver an extra 2,000 pounds of rubber in-fill material as specified for the field.

C. The Contractor is required to supply an additional 200 lineal feet of nylon or Mylar seaming tape (12" width) and two additional 5-gallon pails of adhesive.

1. Sub- base Acceptance: As a part of this contract, the contractor shall be responsible to review the installation of the base and drainage and to comment on any problems or conflicts that may be discovered. Upon completion of this review of the base work, submit a letter confirming the site inspection has been performed, noting any discrepancies, problems and/or conflicts. A final summary of certification of the acceptance and approval of the base and drainage shall be submitted.

3.4 INSTALLATION OF SYNTHETIC TURF

A. Synthetic Turf: Contractor to install synthetic turf per manufactures requirements.

B. Installation of Termination Nailer
   1. The nailer shall be installed and fully secured to the concrete curbing per Turf Manufacturer's specifications. The turf material shall be anchored or nailed to the nailer board per Turf manufacturer's specifications.

C. Edges and Termination
   1. All edges and ends of the grass shall be secured to the termination nailer. This termination shall be as detailed in the drawings and as specified herein.

D. Seams:
   1. All panel seams shall be securely sewn using a double stitch bagger seam and/or glued to a backing material of nylon or Mylar.
   2 All panel seams spacing are to be held to a minimum of 15 feet unless prior approval of seaming diagram indicates a lesser panel.
   3. All inlaid areas shall have full fastenings and no loose areas. At no time can pulling on the section separate the material.
   4 All seams and inlaid areas shall be brushed thoroughly before infill materials are installed.

E. Lines, Markings, and In-laid Grass
   1. All markings and lines shall be in-laid using the accepted color grass.
   2. All lines and markings shall be accurately set and surveyed to within 1/2" tolerance.

F. In-fill
   1. The contractor is responsible for the supply and installation of all in-fill materials and shall be required to return to the site after not less than 30 days to inspect and add in-fill materials as needed.

   2. No in-fill materials shall be installed until the grass system is fully installed with all lines and markings.

   3. The synthetic grass shall be thoroughly brushed prior to any in-fill materials to remove any wrinkles and defibrillate the slit film.
   4. The in-fill materials shall be installed in layers not to exceed 0.30 pounds per square foot per layer. If sand is added this will be performed as a mixture with the rubber prior to installation at the manufacturer's recommendations.

SECTION 32 18 05 SYNTHETIC TURF WARRANTY GUARANTEE

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 the Warranty/Guarantee to cover the usability of the turf system; accessories, use, characteristics, and suitability, of the installation. All items covered by the warranty are to be replaced or repaired with new materials, including installation at the sole expense of the warranting manufacturer/surface supplier for a minimum period of eight (8) years from the date of substantial completion. The field materials shall be guaranteed for the designated uses as follows:

1. Football
2. Soccer
3. Physical Education exercises
4. Physical Education activities
5. Lacrosse
6. Field Hockey
7. Rugby
8. Pneumatic rubber tired maintenance service equipment
9. Pedestrian traffic and other similar uses

B. A principal of the applicable firm, duly authorized to make contracts shall sign the turf contractor warranty. The term "Contractor" contained herein shall mean the firm that is furnishing the warranty. If the turf manufacturer of the synthetic turf system is not the same entity as the contractor, the warranty shall be co-signed by the manufacturer and the contractor.

C. Related Sections:
1. Division 32 Section "Synthetic Turf Systems".

1.3 FORM OF WARRANTY OF THE SYNTHETIC TURF SYSTEM

A. Contractor hereby warrants to the City, subject to the limitations and conditions set forth below, that its synthetic turf system and the adhesives used in the installation, are free from defects in material and workmanship and shall, for a minimum period of eight (8) years from the date of acceptance by the City, remain serviceable for the activities as listed above.

B. Contractor warrants to the City that its synthetic turf materials shall not fade, fail, shrink, wrinkle or reflect excessive wear. Contractor shall, at their sole expense and cost, replace such areas of the synthetic turf system not performing to these standards for the life of the warranty.

2. The City maintaining and properly caring for the synthetic turf system in accordance with the Contractor's maintenance manual and instructions.

3. The City complying with the dynamic and static load specifications established by the Contractor.

G. The warranty is not to cover any defect, failure, damage or undue wear in or to the synthetic turf system caused by or connected with abuse, neglect, deliberate acts, acts of God, casualty, and static or dynamic loads exceeding Contractor's recommendations.

H. Contractor shall examine the synthetic turf system at least once per year or in regards to any claim that the City makes to be present at any time, to analyze the results of all tests conducted by the Athletic Field Operations Supervisor or others, and to conduct such tests of their own. Contractor shall not be responsible for any costs or expenses incurred by the Athletic Field Operations Supervisor or others with respect to such tests, except the Contractor shall pay for costs of all tests and analysis conducted or directed by their representative. The annual testing shall be at the expense of the Contractor and the results delivered to the Athletic Field Operations Supervisor or his designee within 60 days of the testing.

I. In the event the Contractor does not respond to the Owner's written notice within 10 days of receipt of the notice or does not submit, schedule and execute corrective work within 60 days (weather permitting), the City has the option of having the work performed at the expense of the Contractor.

J. The Contractor will be given 7 days notice in the form of a certified letter notifying the Contractor of the end of the 60 day scheduling period.

K. Manufacturers to provide a standard form of warranty may be used provided conditions specified herein are incorporated. All claims by the City under this warranty must be made in writing to the Contractor's address.

1.4 QUALITY ASSURANCE

A. The City will notify the contractor in writing of any issues that require remedial work on the field area.

B. The Contractor shall respond to the notification within 48 hours of receipt and schedule any major defect or repair within 72 hours or as weather permits.

C. The warranty requires that the contractor shall be required to perform all required repairs in a permanent and suitable manner as deemed necessary to maintain a safe playing condition at all times.

D. The warranty requires that in case of any major repair or replacement, the contractor is to schedule such work as to not interfere with the City's primary use or schedule.

E. Any replacement or repair area shall match (as close as possible) the appearance of the existing turf.

8. Insurance coverage shall not exclude heavily trafficked areas or related uses such as team practices or multiple sports use.
9. Insurance coverage shall not exclude any colored turf fibers such as inlays, numbers, marking, lettering, etc.
10. Insurance coverage offers a minimum claim limit of $5 million in the aggregate per annum.
11. Insurance coverage offers a minimum claim limit of $300,000 per field of 100,000 square feet or less. Larger field areas or multiple fields shall be separately insured under the same terms of this specification.

3. In either option, final documents shall be submitted to the City prior to final payment.

4. Warrant documents and terms of warranty shall be in accordance with this section.

H. The Contractor will be responsible for all tests that fail the specification. The City reserves the right to submit the surface to the above tests at any time during the length of the guarantee. Consideration will be given to the time and use of the surface.

I. This warranty does not cover excessive wear of the surface caused by misuse. The Athletic Field Operations Supervisor will be given instructions and care-taking procedures before final acceptance. The Athletic Field Operations Supervisor is to follow the maintenance guidelines as specified by the surfacing manufacturer.

END OF SECTION 32 18 05

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design chain-link fences and gates, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Chain-link fence and gate framework shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to ASCE/SEI 7:
   1. Minimum Post Size: Determine according to ASTM F 1043 for framework up to twelve feet (4') high, and post spacing not to exceed ten feet (8').
   2. Minimum Post Size and Maximum Spacing: Determine according to Chain Link Fence Manufactures Institute (CLFMI WLG 2445), based on mesh size and pattern specified and on the following:
      a. Fence Height: Four feet (4')
      b. Material Group: IA, ASTM F 1043, Schedule 40 steel pipe.

1.5 SUBMITTALS

A. For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for chain-link fences and gates.
   1. Fence and gate posts, rails, and fittings.
   2. Chain-link fabric, reinforcements, and attachments.
   3. Gates and hardware.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Show accessories, hardware, and operational clearances.

C. Samples for Initial Selection: Color and finish samples for components with factory-applied color finishes.

D. Samples for Verification: Prepared on Samples of size indicated below:
   1. Polymer-Coated Components: In six inch (6") lengths for components and on full-sized units for accessories.

E. Delegated-Design Submittal: For chain-link fences and gate framework indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

F. Operation and Maintenance Data: For the following to include in emergency, operation, and maintenance manuals:
   1. Polymer finishes.
   2. Gate hardware.

1.6 QUALITY CONTROL

A. Contractor is responsible for Quality Control procedures.

B. Testing Agency Qualifications: For testing fence grounding. Member company of NETA or an NRTL.

PART 2 - PRODUCTS

2.1 GENERAL

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

2.2 FENCE FABRIC

A. Galvanized Fabric: hot dip galvanized after weaving in accordance with ASTM A116.
   1. Fabric Height: As indicated on Contract Drawings.
   2. Steel Wire Fabric: Wire with a diameter of nine (9) gauge (0.1144").
      a. Mesh Size: two inches (2").
      b. Zinc-Coated Fabric: ASTM A 392, Type II, Class 1, one and two-tenths (1.2) oz./sq. ft. with zinc coating applied after weaving.

B. Selvage: Knuckled at both selvages, top and bottom.

C. Vinyl Coated Fabric: Galvanized fabric as specified above, with Polyvinyl Chloride (PVC) coating. PVC coating to be Class 2B (thermally fused and bonded to metallic coated steel wire). Color in accordance with ASTM F934, as shown on the Contract Drawings.

2.3 FENCE FRAMEWORK

A. Galvanized Posts and Rails: Hot dip galvanized HT-25 Fence Pipe, conforming to ASTM F1043, of sizes noted on the drawings.

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

2.4 TENSION WIRE

A. Metallic-Coated Steel Wire: 0.177-inch diameter, marcelled tension wire complying with ASTM A 817 and ASTM A 824, with the following metallic coating:
   1. Type II, zinc coated (galvanized) by hot-dip process, with the following minimum coating weight:
      a. Matching chain-link fabric coating weight.

   2. Type III, Zn-5-Al-MM alloy with the following minimum coating weigh:
      a. Matching chain-link fabric coating weight.

B. Polymer-Coated Steel Wire: 0.177-inch [0.148-inch diameter, tension wire complying with ASTM F 1664, Class 1 over aluminum -coated steel wire.
   1. Color: Match framing members, chain-link fabric, and approved sample, complying with ASTM F 934.

2.5 TIE WIRES

A. Steel Wire: Six (6) gauge, wire complying with ASTM A 817 and ASTM A 824. Coating to match fence fabric and structure. Aluminum tie wires are not acceptable.

PART 3 - EXECUTION

3.1 SITE CONDITIONS

A. Existing Conditions:
   1. Examine areas and conditions, with Installer present, for compliance with requirements for a verified survey of property lines and legal boundaries, site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.
   2. Soil Conditions: Investigate the type of soil and conditions in which lines are to be installed and allow for same in proposal. No extra payment will be allowed due to difficulty in excavating, unless approved by the Project Manager.
   3. 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.
   4. Report unsatisfactory conditions in writing to the Project Manager. Commencement of installation means acceptance of existing conditions by the Contractor.
   5. Do not begin installation before final grading is completed unless otherwise permitted by Project Manager.

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

C. Protection of Existing Trees:
   1. Consult with Denver City Forester as requested by Project Manager prior to digging within critical root zones. All digging or work within critical root zones of any tree shall be dug by hand or by other methods as directed by the City Forester or Project Manager so as to prevent damage to limbs or branches and root system. See 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. Contractor is required to contact all private utility companies including City departments to locate all private utilities. 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 by the City at no cost to the contractor. If Contractor damages staked or located private utilities, they shall be repaired by Utility Owner at Contractor's expense.

5. Minimum width of fabric on fences shall be no less than the distance between two panels or posts.
6. Fabric on high fences shall lap or splice only at intermediate rails.
7. Bottom knuckled selvage of fabric shall be in contact with top of mowing strips – no gaps allowed.
8. Fasten fabric to top rail, line post, braces and bottom tension wire/bottom rail with tie wire at maximum twelve inches (12") on center.
9. Attach fabric to end, corner and gate posts with tension bars and tension bar clips. The tension bars shall be of lengths two inches (2") less than the full height of the fabric with which they are to be used. Bars shall be attached to the fabric by threading through the fabric, by bands or other mechanical means, and installed at all terminal or corner posts and gate posts.

G. Install gates with fabric, structure and ties to match fence.

3.4 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Lubricate hardware and other moving parts.

3.5 TOLERANCES

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

B. Variation in line of posts: one quarter inch (1/4") in twenty feet (20') horizontal; one half inch (1/2") maximum overall.

3.6 CLEAN UP

A. Maintain a neat and orderly work site at all times.

B. Upon completion of site work, clean up area, remove tools, equipment, materials and debris.

END OF SECTION 32 31 13

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

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. Temporary irrigation plan: Submit a temporary irrigation plan to the Project Manager for approval prior to construction, to establish how the existing site will be irrigated during construction.

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

K. Make dimensions accurately at the same scale used in the original Contract Drawings, or larger. Notes and dimension lettering must be legible.

L. 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.

M. 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.

N. 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.

O. Request for final payment will not be certified or processed until all Contract Record Drawing prints and digital files have been received and approved.

1.7 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,

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.

1.9 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.

1.10 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.

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.

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.

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. Low Voltage:
      a. Electrical Control Wire for 24VAC solenoid: Golf Course Sprinkler Wire - #14 to #10 AWG UL approved direct burial solid conductor copper wiring with polyethylene insulation 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. Data Wires: Paige 7171D-A direct burial shielded and armored signal cable with polyethylene jacket (NO SUBSTITUTIONS).
      d. 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).

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. 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.

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.

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.

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 sodding operations.
   1. Soil preparation consists of ripping, fertilizing, soil conditioning and fine grading the topsoil. Soil preparation as specified herein MUST precede all sodding.

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 "Sodding".

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 1.9 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:

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.

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.

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.

END OF SECTION 32 91 13

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.

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 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").

3.3 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.

END OF SECTION 32 91 20

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, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Weed, Bent Grass, Wild Garlic, Perennial Sorrel, and Broom Grass.

1.4 SUBMITTALS

A. See Division 01 Section "Submittals" for submittal requirements.

B. Product Data: For each type of product indicated.
   1. Pesticides: Include product label and manufacturer's application instructions specific to this Project.

C. Sod Certificates:
   1. State, Federal and other inspection certificates for sod shall be provided to the Project Manager a minimum of 10 working days prior to anticipated date of sod delivery.
   2. Submit a list of varieties contained in the sod, and include the source and origin for approval by the Project Manager.

D. Qualification Data: For qualified landscape Installer.

E. Product Certificates: For soil amendments and fertilizers, from manufacturer.

F. Material Test Reports: For existing-in-place surface soil.
   1. Soil analysis for each topsoil to be used.
   2. Analysis for manufactured topsoil.
   3. Analysis for each soil amendment.
   4. Analysis for each amended planting soil.

G. 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.

H. Planting schedule: Submit in writing two copies of proposed planting schedule, indicating dates for topsoil placing, site preparation, pesticide treatments, soil preparation, sodding, and seeding. Schedule all Work during specified planting seasons. Once accepted, revise dates only as approved in writing, after documentation of reasons for delays.

I. Maintenance Instructions: Recommended procedures for maintenance of turf and dryland grasses during a calendar year. Submit before expiration of required initial maintenance periods.

J. Contract Closeout Submittals:
   1. Operating and Maintenance Data: At completion of work, submit one digital copy and two 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 Turfgrass Sod Areas: At completion of work, furnish written warranty to Project Manager based upon specified requirements.

2. Inspection will be made periodically during sodding, at completion and at end of warranty period by the Project Manager. Primarily for quality; however, other requirements are not waived even though visual inspection results in acceptance.
3. Promptly remove rejected sod from site.

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

1.6 DELIVERY, STORAGE, AND HANDLING

A. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver on pallets properly loaded on vehicles with root system protected from exposure to sun, wind, and heat in accordance with standard practice. Sod that has been damaged by poor handling or improper storage is subject to rejection by the Project Manager.
1. Protect from dehydration, contamination, freezing and heating at all times. Keep stored sod moist and under shade or covered with moistened burlap.
2. Do not drop sod rolls from carts, trucks or pallets.
3. Do not deliver more sod than can be installed within twenty four (24) hours.

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

C. 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. 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.

D. Material will be inspected upon arrival at project site. Project Manager will reject any opened or unacceptable materials as described above.

E. Immediately remove unacceptable material from job site.

B. Re-sod in a manner to achieve quality as originally specified per the Project Manager's direction

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil: See Division 32 Section "Topsoil".

B. Soil Preparation: See Division 32 Section "Soil Preparation.

C. Sod:

1. Colorado grown Kentucky Bluegrass blend having a healthy, vigorous root system. Blend shall contain a minimum of three (3) improved varieties, of which at least one variety is an aggressive type.
2. Sod to be produced in accordance with requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in TPI's "Guideline Specifications to Turfgrass Sodding."
3. Harvesting: Sod shall be fertilized 2–3 weeks prior to harvesting. Mow sod to a height of one and one-half inches (1-1/2") before the sod is lifted. Sod shall be harvested in rolls, and shall not be cut more than 24 hours prior to planting.
4. Size: Machine cut to a minimum pad thickness of three quarters inch (3/4), excluding top growth and thatch. Provide sod of uniform pad sizes eighteen inches (18") maximum width by twenty four (24") minimum length, with maximum five percent (5%) deviation in either length or width. Broken pads or pads with uneven ends will not be acceptable. Sod pads incapable of supporting their own weight when suspended vertically from upper ten percent (10%) of pad will be rejected. Sod which has dried out, sod with adhering soil which breaks, tears, or crumbles away will not be accepted. Sod cut for more than twenty-four (24) hours will not be accepted.
5. Plastic netting: Sod to be free of plastic netting used during establishment by sod grower.

D. Fertilizer: Inorganic mixture with following chemical composition: (20-5-10) with fifty percent (50%) sulfur coated urea (no iron), or as recommended by testing lab based on soil sample results.

E. Water: Contractor to utilize the existing irrigation system and or quick coupler(s) when available. If irrigation or quick coupler(s) are not available then the contractor is responsible for watering. Refer to Division 31 Section "Watering". Water shall be free of substances that may be harmful to sod growth. Hoses and other watering equipment necessary to water the sod to be furnished by Contractor.

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.

3. Remove stones larger than one-half (½") inch in any dimension and sticks, roots, trash, and other extraneous matter.
4. Legally dispose of waste material, including grass, vegetation, and turf, off City property.

E. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

F. Verify that all areas are graded to drain at a minimum of two percent (2%) or as indicated on the Contract Drawings. Verify that subsurface drainage system and drain inlets if any, are operative.

G. Verify that irrigation system is operable and provides adequate coverage prior to planting.

H. Adjustment: Adjust irrigation heads to proper watering height according to depth of sod material but lower than compacted blade height to enable lawn mowers to cut grass freely without damage to the sprinkler system.

I. When completed, the soil shall be firmed by float dragging, followed by steel raking, to provide for the proper sodded subgrade. The sod bed shall be totally free from rock or clay clods over one-half inch (1/2") inch in diameter.

J. Repair: Re-establish grade and specified conditions to damaged sod areas prior to placing sod.

3.3 INSTALLATION

A. Sodding:
1. Sod within twenty-four (24) hours after preparation of bed.
2. If plastic netting is present within sod, remove all netting during sod installation and discard from site.
3. Subgrade on which sod is laid shall be slightly moist during installation.
4. Lay sod with longest dimension parallel to contours and in continuous rows.
5. Tightly butt ends and sides of sod together. Stagger and compact vertical joints between sod strips.
6. Sod shall not be overlapped or stretched during placement. Exposed joints due to shrinkage will require replacement of sod in affected areas.

B. Topsoil: Where new sod abuts an existing turf area topsoil shall be placed along seams and or joints to provide a smooth transition.

C. Rolling: Sod shall be rolled after installation to ensure proper contact with the subgrade, and to ensure tight joints between adjacent pieces. Sod shall be moist prior to rolling. Once rolling is complete additional watering shall occur. Roller shall weigh one-hundred (100) pounds.

D. Drainage: Contractor shall ensure that finished areas are graded so that positive drainage of storm and irrigation water is achieved.

E. Water thoroughly with a fine spray as laying progresses and immediately after planting. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches (1-1/2 ") below sod.

removed and clippings from mowed turf areas shall be removed to the satisfaction of Project Manager.

D. Fertilizing: Within thirty (30) days of sodding and every sixty (60) days thereafter until Final Acceptance, apply specified fertilizer to maintain optimal turf vigor or per the direction of the Project Manager.

E. Weed Control: Control annual weeds by mowing. Do not use pesticides unless approved by the Project Manager and Denver Parks Operations Supervisor.

F. Insect and Disease Control: As needed, apply insecticide and fungicide approved by the Project Manager and the Parks Operations Supervisor.

3.7 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.

END OF SECTION 32 92 23

LOWRY SYNTHETIC FIELD REPLACEMENT
BID CONSTRUCTION DOCUMENTS
NOVEMBER 16, 2015

GENERAL NOTES

1. BASE SITE INFORMATION (LOWRY RECORD DRAWINGS FROM 2009) WAS PROVIDED BY CITY AND COUNTY OF DENVER. CONTRACTOR SHALL BE RESPONSIBLE FOR NOTIFYING THE PROJECT MANAGER OF ANY DISCREPANCIES BETWEEN EXISTING CONDITIONS AND THESE PLANS PRIOR TO CONSTRUCTION ACTIVITY.
2. THE SIZE, TYPE AND LOCATION OF ALL KNOWN UNDERGROUND UTILITIES ARE APPROXIMATE WHEN SHOWN ON THESE DRAWINGS, AND ARE INCLUDED ONLY FOR THE CONVENIENCE OF THE CONTRACTOR. CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATING UTILITIES. THE CONTRACTOR SHALL NOTIFY THE APPROPRIATE UTILITY COMPANIES/ OWNER TO DETERMINE THE LOCATION OF EXISTING UNDERGROUND UTILITIES PRIOR TO PROCEEDING W/ CONSTRUCTION ACTIVITY. WORK PERFORMED IN THE AREA OF THE UTILITIES SHALL BE PERFORMED ACCORDING TO THE REQUIREMENTS OF THESE AGENCIES. THE CONTRACTOR SHALL NOTIFY THE OWNER'S REPRESENTATIVE OF ANY EXISTING UTILITIES WHICH MAY INTERFERE WITH THE PROPOSED WORK PRIOR TO ANY CONSTRUCTION ACTIVITY. THE CONTRACTOR SHALL REPAIR ALL EXISTING UTILITIES DAMAGED DURING CONSTRUCTION AT NO ADDITIONAL COST TO THE OWNER.
3. CONTACT UTILITY NOTIFICATION CENTER OF COLORADO 1-800-922-1987, PRIOR TO ANY CONSTRUCTION ACTIVITY
4. 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 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 CCDD REQUIREMENT.
5. THE CONTRACTOR SHALL BE SOLELY AND COMPLETELY RESPONSIBLE FOR THE CONDITIONS AT AND ADJACENT TO THE JOB SITE, INCLUDING SAFETY OF PERSONS AND PROPERTY DURING PERFORMANCE OF THE WORK. THE CONTRACTOR SHALL PROVIDE LIGHTS, SIGNS, BARRICADES, FLAGMEN, OR OTHER DEVICES NECESSARY TO PROVIDE FOR PUBLIC SAFETY. THIS REQUIREMENT SHALL APPLY CONTINUOUSLY AND NOT BE LIMITED TO NORMAL WORKING HOURS.
6. CONTRACTOR SHALL OBTAIN PROJECT MANAGER'S APPROVAL PRIOR TO REMOVAL OF ANY OBSTRUCTION INTERFERING WITH PROPOSED IMPROVEMENTS.
7. CONTRACTOR IS RESPONSIBLE FOR REPLACEMENT OF ANY EXISTING MATERIALS THAT ARE DAMAGED DURING CONSTRUCTION WITHIN LIMITS OF CONSTRUCTION, AT NO ADDITIONAL COST TO THE OWNER.
8. CONTRACTOR SHALL OBTAIN, AT ITS OWN EXPENSE, ALL APPLICABLE CODES, LICENSES, STANDARDS, SPECIFICATIONS, PERMITS, BONDS, ETC. NECESSARY TO PERFORM THE PROPOSED WORK 72 HOURS PRIOR TO THE START OF ANY CONSTRUCTION
9. CONTRACTOR SHALL NOT WILLFULLY PROCEED WITH CONSTRUCTION AS DESIGNED WHEN IT IS OBVIOUS THAT PREVIOUSLY UNKNOWN OBSTRUCTIONS AND/OR GRADE DIFFERENCES EXIST THAT MAY NOT HAVE BEEN KNOWN DURING DESIGN. SUCH CONDITIONS SHALL BE IMMEDIATELY BROUGHT TO THE ATTENTION OF THE OWNER FOR DECISION. THE CONTRACTOR SHALL ASSUME FULL RESPONSIBILITY FOR ALL NECESSARY REVISIONS DUE TO FAILURE TO GIVE SUCH NOTIFICATION.
10. ANY CONSTRUCTION DEBRIS OR MUD DROPPED INTO MANHOLES, PIPES, OR TRACKED ONTO EXISTING ROADWAYS SHALL BE REMOVED IMMEDIATELY BY CONTRACTOR. CONTRACTOR SHALL REPAIR ANY EXCAVATIONS OR PAVEMENT FAILURES CAUSED BY CONSTRUCTION WITHIN OR IN THE VICINITY OF THE LIMITS OF CONSTRUCTION. THE CONTRACTOR SHALL BE RESPONSIBLE FOR DAMAGE DUE TO CONSTRUCTION AT NO ADDITIONAL COSTS TO OWNER.
11. LAYOUT AND STAKING OF ALL IMPROVEMENTS SHALL BE APPROVED BY THE PROJECT MANAGER PRIOR TO INSTALLATION OF ALL IMPROVEMENTS. DISCREPANCIES IN THE BASE INFORMATION SHALL BE BROUGHT TO THE ATTENTION OF THE PROJECT MANAGER FOR A DECISION PRIOR TO COMMENCING WITH THE WORK. NOTIFICATION OF REQUEST FOR FIELD REVIEW SHALL BE MADE A MINIMUM OF 72 HOURS IN ADVANCE.
12. ANY PRUNING, PLANT REMOVAL, OR OTHER LANDSCAPE MAINTENANCE DEEMED NECESSARY FOR THE CONSTRUCTION OF PROPOSED IMPROVEMENTS SHALL BE PRESENTED TO AND AUTHORIZED BY THE OWNER PRIOR TO COMMENCING WITH WORK (PER 01 56 39 TREE RETENTION AND PROTECTION).
13. MAINTAIN ALL WALKING, BICYCLING AND DRIVING SURFACES IN A DIRT/MUD FREE USABLE CONDITION. LOCATE ACCESS ROUTES TO CONSTRUCTION SITE SO THAT MINIMAL IMPACT IS CAUSED TO SURROUNDING WALKS, BIKE PATHS AND STREETS.
14. PROVIDE ADEQUATE FLAG PERSONS AND TEMPORARY SIGNAGE WHEN CONDITIONS INTERFERE WITH VEHICULAR, BIKE OR PEDESTRIAN TRAFFIC.
15. IT IS THE CONTRACTOR'S RESPONSIBILITY TO RETURN ALL CONSTRUCTION STAGING SITES TO THEIR ORIGINAL CONDITION UPON COMPLETION OF THE CONSTRUCTION PROJECT.
16. IF UNKNOWN/UNIDENTIFIED UNDERGROUND STORAGE TANKS, DRUMS, ODOROUS SOIL, STAINED SOIL, ASBESTOS-CEMENT PIPE, TRANSITE, BUILDING DEBRIS OR WASTE MATERIALS ARE ENCOUNTERED DURING THE PROJECT, CONTRACTOR SHALL IMMEDIATELY STOP WORK IN THE AREA OF THE DISCOVERY UNTIL DENVER ENVIRONMENTAL HEALTH (DEH) MAKES A DETERMINATION OF HOW TO PROCEED. CONTRACTOR SHALL IMMEDIATELY NOTIFY DEH OF THE DISCOVERY VIA THE DEH DUTY OFFICER PAGER NUMBER 303-206-6001

SITE LOCATION

PROJECT LOCATION

17. IF CONTRACTORS ARE ANTICIPATING THE NEED TO WORK OUTSIDE OF EXEMPTED HOURS FOR CONSTRUCTION, WHICH 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 (B)A, B AND C OF DENVER'S NOISE ORDINANCE, CHAPTER 36 "NOISE CONTROL," DENVER REVISED MUNICIPAL CODE (DRMC):
   - THE CONTRACTOR WILL NEED TO MAKE A REQUEST FOR A NIGHTTIME NOISE VARIANCE AS ALLOWED FOR IN SECTION 36-7 (B)C OF THE DRMC.
   - THE VARIANCE PROCESS NEEDS TO BE STARTED A MINIMUM OF TWO TO THREE MONTHS PRIOR TO THE DESIRED START DATE OF ANY WORK NEEDING TO OCCUR OUTSIDE OF EXEMPTED HOURS.
   - ANY NOISE VARIANCE QUESTIONS SHOULD BE DIRECTED TO PAUL RIEDESEL, DEPARTMENT OF ENVIRONMENTAL HEALTH, DENVER COMMUNITY NOISE PROGRAM, (PHONE 720-865-5410, FAX 720-865-5537) A MINIMUM OF THREE MONTHS PRIOR TO THE START OF THE PROJECT
18. IF ELEMENTS OF THE FINISHED PROJECT WILL PERMANENTLY CAUSE THE NOISESCAPE OF THE AREA'S ACOUSTIC ENVIRONMENT TO BE ELEVATED:
   - THE NOISE SOURCE(S) MUST MAINTAIN COMPLIANCE WITH DENVER'S NOISE ORDINANCE, CHAPTER 36 "NOISE CONTROL" OF THE DRMC.
   - ANY NOISE COMPLIANCE QUESTIONS SHOULD BE DIRECTED TO PAUL RIEDESEL, DEPARTMENT OF ENVIRONMENTAL HEALTH, DENVER COMMUNITY NOISE PROGRAM, (PHONE 720-865-5410, FAX 720-865-5537) PRIOR TO THE START OF THE PROJECT
19. ELEVATIONS SHOWN ARE TOP OF FINISH GRADE. PROVIDE SUBGRADE ELEVATIONS AS REQUIRED.
20. PERMIT REQUIREMENTS (INSPECTIONS)
   A. DENVER WASTEWATER MANAGEMENT CONSTRUCTION ACTIVITIES STORM WATER DISCHARGE PERMIT: (IF REQUIRED) CONTACT (303) 446-3759, DENVER WASTEWATER MANAGEMENT BUILDING, 2000 W. 3RD AVE.
   B. CITY OF DENVER, PARKS AND RECREATION TEMPORARY CONSTRUCTION ACCESS PERMIT (IF REQUIRED)
   C. SEWER USE AND DRAINAGE PERMIT (IF REQUIRED) CONTACT (303) 446-3759, 2000 W. 3RD AVE., ROOM 107
   D. CONTACT CONSTRUCTION ENGINEERING DEPARTMENT AT (303) 446-3469 TO BE DIRECTED TO DISTRICT INSPECTOR AND CHIEF INSPECTOR IF NEEDED.

SHEET INDEX

2- (L1):	SITE PREPARATION AND EROSION CONTROL PLAN- WEST
3- (L2):	SITE PREPARATION AND EROSION CONTROL PLAN- EAST
4- (L3):	LAYOUT AND MATERIALS PLAN- WEST
5- (L4):	LAYOUT AND MATERIALS PLAN- EAST
6- (L5):	DETAILS
7- (L6):	DETAILS
APPENDIX	2008 IRRIGATION AS-BUILTS

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Lgardner@sparch.com

LANDSCAPE ARCHITECT
StudioCPG
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Contact: Cricey Ree
Cricey@StudioCPG.com

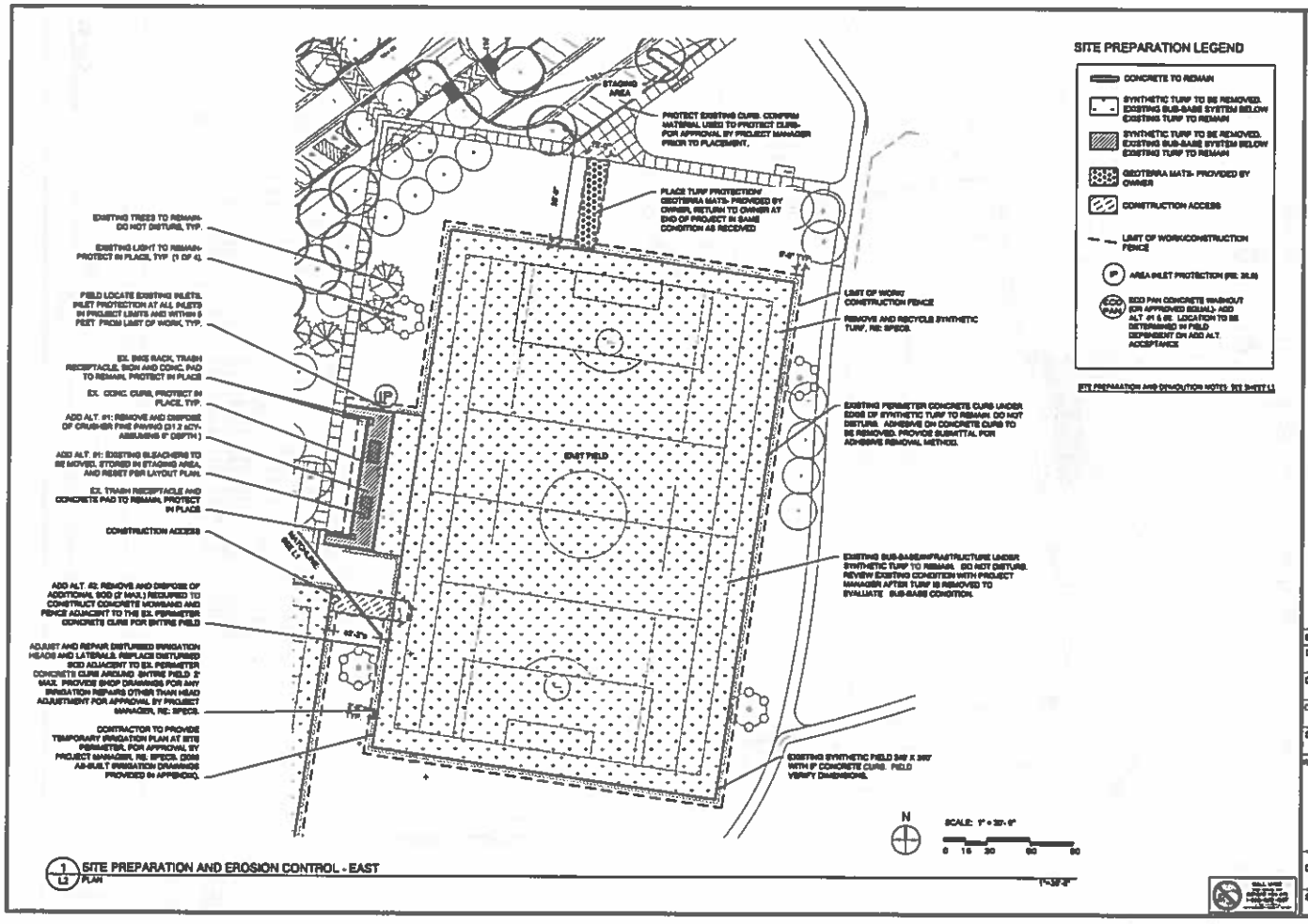
PROJECT MANAGER
City and County of Denver
720.865.3809
Contact: David Brown
David.Brown@denvergov.org

CITY AND COUNTY OF DENVER
DEPARTMENT OF PUBLIC WORKS

DENVER

SLATERPAULL

STUDIO CPG



1 L2 SITE PREPARATION AND EROSION CONTROL - EAST
PLAN

1"=30'-0"

CITY & COUNTY OF DENVER DEPT. OF PARKS & RECREATION

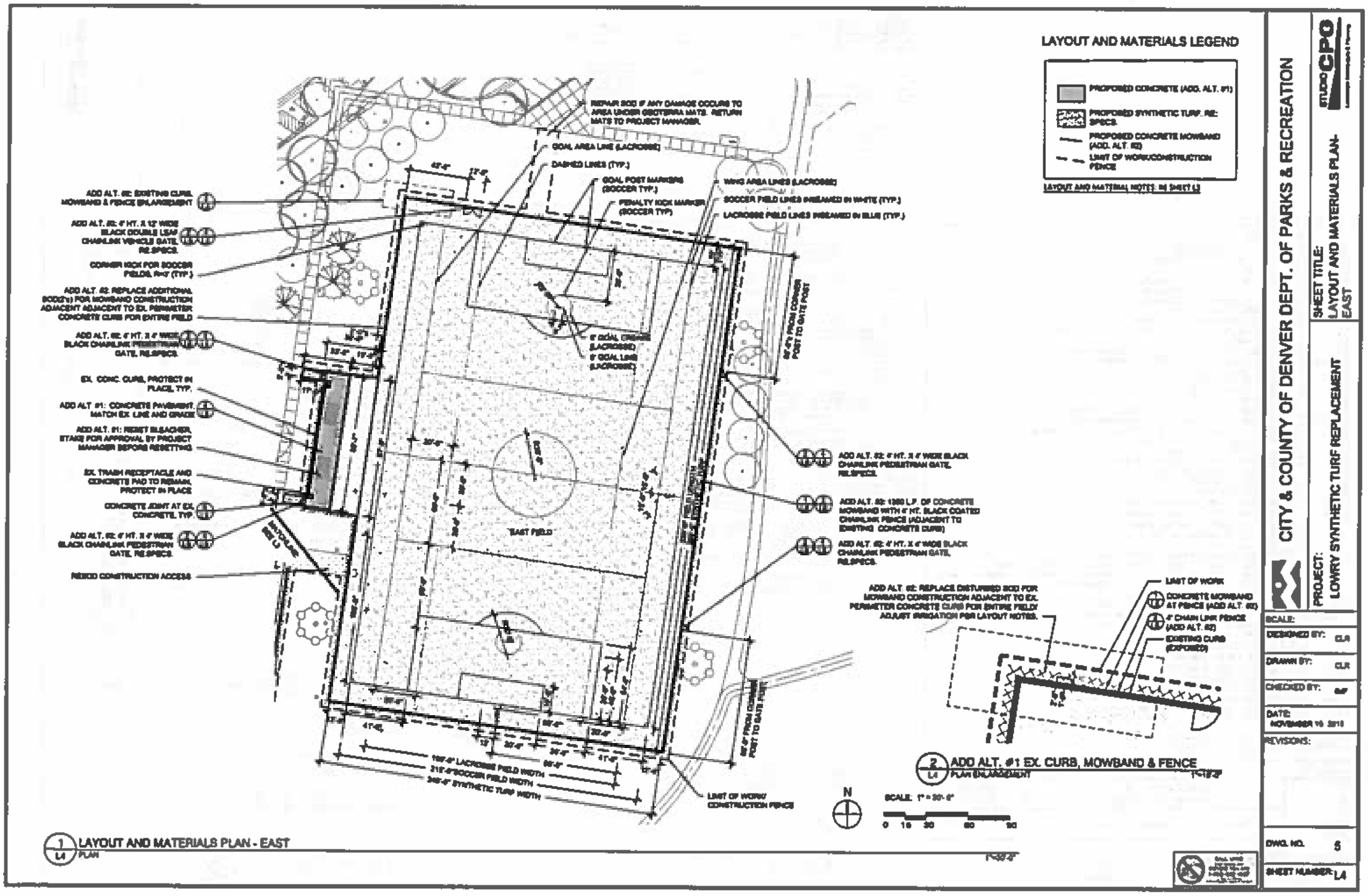
studio CPG

PROJECT: LOWRY SYNTHETIC TURF REPLACEMENT

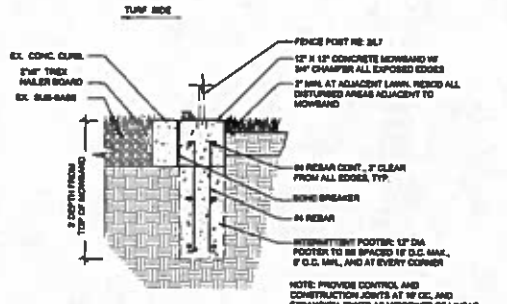
SHEET TITLE: SITE PREPARATION AND EROSION CONTROL PLAN- EAST

SCALE:
DESIGNED BY: CLR
DRAWN BY: CLR
CHECKED BY: BMP
DATE: NOVEMBER 16 2018
REVISIONS:

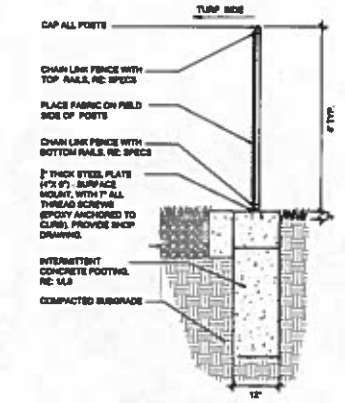
DWG. NO. 3
SHEET NUMBER L2



LAYOUT AND MATERIALS LEGEND
PROPOSED CONCRETE (ADD. ALT. #1)
PROPOSED SYNTHETIC TURF. RE: SPECS
PROPOSED CONCRETE MOWBAND (ADD. ALT. #2)
LIMIT OF WORK/CONSTRUCTION FENCE
EAST FIELD
ADD ALT. #1 EX. CURB, MOWBAND & FENCE
PLAN ENLARGEMENT
LAYOUT AND MATERIALS PLAN - EAST
PLAN
N
CITY & COUNTY OF DENVER DEPT. OF PARKS & RECREATION
STUDIO CPO
SHEET TITLE:
LAYOUT AND MATERIALS PLAN-EAST
PROJECT:
LOWRY SYNTHETIC TURF REPLACEMENT
SCALE:
DESIGNED BY:
DRAWN BY:
CHECKED BY:
DATE:
REVISIONS:
DWG. NO. 5
SHEET NUMBER: L4



1 CONCRETE MOWBAND AT FENCE (ADD ALT. #2)
SECTION
1"= 1'-0"



2 6' CHAIN LINK FENCE (ADD ALT #2)
SECTION
1"= 1'-0"

FENCE AND GATE NOTES:
1. INTERMEDIATE FENCE POST ARE TO BE 2-7/8" O.D @ EQUAL SPACING BETWEEN END POSTS (6' MAX' MAX.); GATE POSTS, CORNER AND END POSTS ARE TO BE 4" O.D.; TOP AND BOTTOM RAILS ARE TO BE 1-5/8" O.D.. PROVIDE DOME CAP FOR ALL POSTS.

2. INSTALL FABRIC TIES- ONE (1) PER VERTICAL FOOT OF HEIGHT 24" O.C. ON RAILS.

3. FABRIC SHALL BE KNUCKLED ON TOP AND BOTTON OF ALL CHAIN LINK, REFER TO SPECS FOR ADDITIONAL INFORMATION.

4. ALL FENCE POSTS, POST DOME CAP, FABRIC PIPE ELBOW, MOUNTING ACCESSORIES, GATE FRAME AND TENSION BAR SHALL RECEIVE BLACK VINYL COATING . REFER TO SPECS.

5. ALL GATE ACCESSORIES, INCLUDING LATCH, STRAP AND HINGE SHALL BE GALVANIZED STEEL, PAINTED BLACK COMPONENTS.

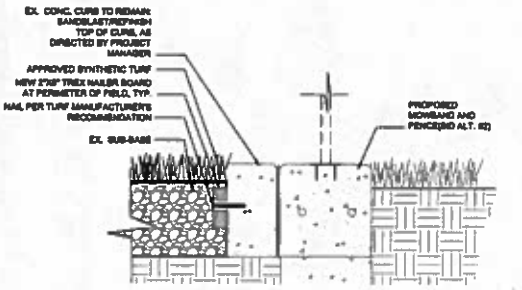
6. PROVIDE AND INSTALL POST & RAILS, FASTENERS & FITTINGS, AS PER MANUFACTURES SPECIFICATIONS. PROVIDE & INSTALL GATE HINGES & LOCK MECHANISMS.

7. GATE JOINTS SHALL BE OF ALL WELDED CONSTRUCTION.

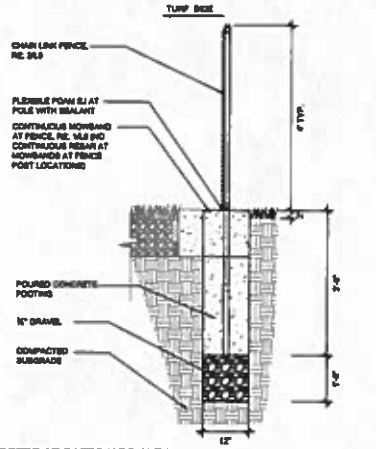
8. VEHICULAR DOUBLE GATE TO HAVE TWO (2) 6' WIDE GATES AND PEDESTRIAN GATES TO BE 4' WIDE.

9. ALL GATES TO HAVE HEAVY DUTY FORK LATCH THAT ACCEPTS HEAVY DUTY LOCK (TO BE PROVIDED BY OWNER)

10. SUBMIT SHOP DRAWINGS FOR FENCE AND POST LAYOUT AND TO INCLUDE POST & RAILS, FASTENERS & FITTINGS INFORMATION, PEDESTRIAN AND VEHICULAR GATES, AND ALL ASSOCIATED HARDWARE.



3 SYNTHETIC TURF INSTALLATION DETAIL
SECTION
1/2"= 1'-0"



4 FOOTER AT GATES (ADD ALT #2)
SECTION
1"= 1'-0"

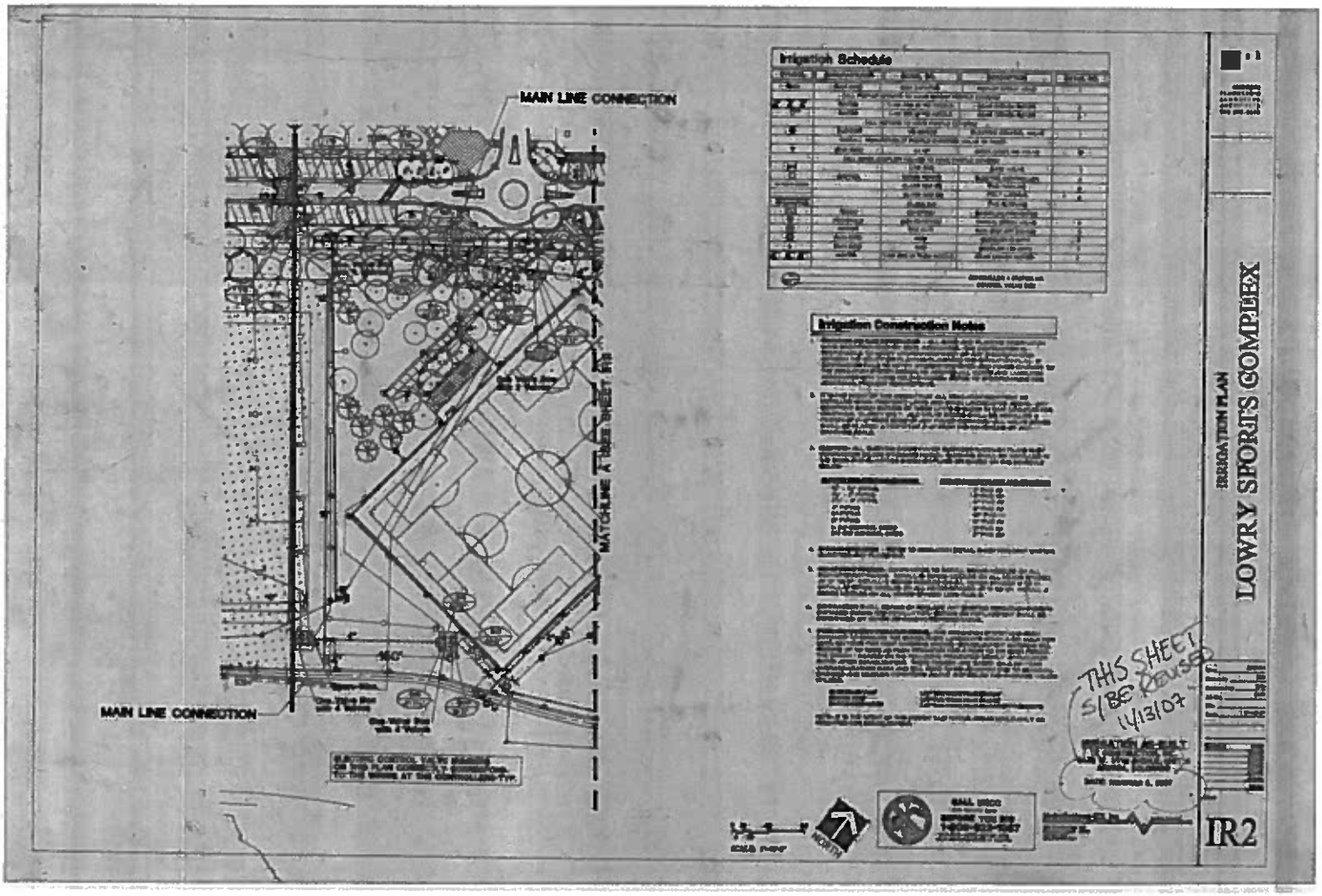
CITY & COUNTY OF DENVER DEPT. OF PARKS & RECREATION

PROJECT: LOWRY SYNTHETIC TURF REPLACEMENT

SHEET TITLE: DETAILS

SCALE: AS SHOWN
DESIGNED BY: CLR
DRAWN BY: CLR
CHECKED BY: BMF
DATE: NOVEMBER 16 2016
REVISIONS:

DWG. NO. 7
SHEET NUMBER: L8


MAIN LINE CONNECTION
MATCHLINE A TREE SHEET R1R
MAIN LINE CONNECTION
Irrigation Schedule
Irrigation Construction Notes
THIS SHEET IS BEING REVISED 1/13/07
IRRIGATION PLAN
LOWRY SPORTS COMPLEX
IR2