

**THORNTON GROUNDWATER RECHARGE FACILITIES
TRIAL SITE PROJECT**

**CONTRACT DOCUMENTS
FOR
GENERAL CONSTRUCTION**

TECHNICAL SPECIFICATIONS

**Prepared For:
City of Thornton, Colorado**

**Prepared By:
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**September 2022
Issued For Bid
Not For Construction**

TECHNICAL SPECIFICATIONS

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PART 1 - GENERAL

1.1 PROJECT NAME:

- A. The project name shall appear on all project documentation as follows:

**Thornton Recharge Facilities
Trial Site Project**

1.2 OWNER:

- A. The Owner is the **City of Thornton, Colorado**.

1.3 ENGINEER:

- A. The Engineer is **Ecological Resource Consultants, Inc.**, Lakewood, Colorado, the Structural Engineer is **SM&RC Structural Engineers, Inc.**, Lakewood, Colorado, and the Hydrogeologist is **Hahn Water Resources**, Evergreen, Colorado.
- B. The Engineer's Representative shall be any duly authorized employee or agent of the Engineer.

1.4 CONTRACTOR:

- A. The following terms shall mean the Contractor or others engaged in the work on its behalf:
1. Installer
 2. Supplier
 3. Subcontractor
 4. Fabricator

1.5 PROJECT INFORMATION:

- A. The purpose of this project is to construct a trial recharge groundwater facility and provide the required supporting construction including cells, flumes, splitter boxes with gates, piping, equipment, rehabilitating existing ditches, providing new ditches, and installing ditch crossings. The project includes placing spoil in two existing ponds. Work shall include, but not be limited to, mobilization and demobilization of construction equipment and materials; providing erosion control and temporary dewatering for the construction site; clearing, grubbing, stripping, excavating, backfilling and performing other earthwork operations associated with the Work; constructing reinforced concrete walls and

slabs; providing a new earthen ditch, rehabilitating an existing earthen ditch, providing water for construction purposes; placing spoil in two existing ponds; installing riprap; providing new piping; installing ditch crossings; providing equipment; reseeding of disturbed areas; cleaning of the construction site; and performing any work indicated in the project Drawings and Specifications.

- B. The project site is located north of Greeley in Weld County, Colorado, northwest of the intersection of Weld County Roads WCR-41 and WCR-94.

1.6 PLANS AND SPECIFICATIONS:

- A. Approved plans and specifications shall not be changed without the prior written approval of the Engineer.
- B. The Owner's Engineer will monitor the quality of construction. However, it is the Contractor's responsibility to ensure full compliance with the plans and specifications.

1.7 PERFORMANCE OF WORK:

- A. Contractor will enter into a Contract with the Owner and shall perform the Work as an independent contractor and not as an employee or agent of Owner or Engineer.
- B. Contractor shall prosecute the Work with diligence and complete the Work within the applicable time set forth in the Contract. Contractor shall work overtime, extra shifts, or provide any other methods as required to meet the completion date at no extra cost to Owner.
- C. Contractor shall organize and execute the Work so as to comply at all times with the requirements of scheduling as set out in the Contract.
- D. The actual order of the Work and the method of prosecuting the Work shall be the responsibility of Contractor and shall be such as to ensure safety, satisfactory quality, and rapid and economical completion of the Work in harmony and cooperation with other parties. The Contractor shall note that the Owner will maintain complete control of the site throughout construction of the project.
- E. Contractor shall give full information in advance of its plans for carrying on each part of the Work, including copies of working drawings and information as to conditions, capacity, and capability of Contractor's facilities. If at any time before the commencement or

during the progress of the Work, any part of Contractor's facilities or any of its methods of executing the Work appear to the Owner to be inadequate to ensure the required quality, or rate of progress of the Work, Owner may require Contractor to change or improve its facilities or methods. Contractor shall promptly comply with requirements; but neither compliance with such requirements nor failure of Owner to issue such requirements shall relieve Contractor from its obligation to secure the degree of quality of work and the rate of progress required by the Contract. Contractor alone shall be responsible for the safety and adequacy of its methods. All work by the Contractor shall be carried out in strict accordance with OSHA requirements and the AGCA's "Manual of Accident Prevention in Construction,"

- F. Contractor shall confine its operations and material to the work areas as shown on the Drawings or as required by Owner. At no time during the performance of its work shall the Contractor prevent access to the project, including the delivery of materials and equipment that may be required for proper operation of the project, except as may be indicated otherwise in the Contract Documents. The Contractor shall also note that full access to the existing ditch maintenance road, except during critical construction activities, may be required during construction.
 - G. Contractor shall employ only competent and skillful workers on the Work.
 - H. During prosecution of the Work, Contractor shall not hire employees of Owner, Engineer, others in contract with Owner, or their subcontractors without written release from such employers. Contractor shall be solely responsible for employees leaving its employ for any reason until such employee has left the site.
 - I. Contractor shall be completely responsible for notifying its subcontractors and others engaged in the Work on its behalf of all requirements under the Contract. This applies to Technical Specifications and Drawing requirements, as well as contractual commitments.
- 1.8 DISCREPANCIES:
- A. If the Contractor, in the course of the Work, finds any discrepancies between Drawings and these Specifications or any errors or omissions in dimensions or instructions given by Drawings or Specifications, they shall immediately notify the Owner, in writing, and the Owner shall promptly do the same. Any work performed after such discovery,

unless authorized by the Owner in writing, shall be at the Contractor's expense.

PART 2 – PRODUCTS

(Not Used)

PART 3 – EXECUTION

(Not Used)

- END OF SECTION –

PART 1 - GENERAL**1.1 DESCRIPTION OF WORK:**

- B. The purpose of this project is to construct a trial recharge groundwater facility and provide the required supporting construction including cells, flumes, splitter boxes with gates, piping, equipment, rehabilitating existing ditches, providing new ditches, and installing ditch crossings. The project includes placing spoil in two existing ponds. Work shall include, but not be limited to, mobilization and demobilization of construction equipment and materials; providing erosion control and temporary dewatering for the construction site; clearing, grubbing, stripping, excavating, backfilling and performing other earthwork operations associated with the Work; constructing reinforced concrete walls and slabs; providing a new earthen ditch, rehabilitating an existing earthen ditch, providing water for construction purposes; placing spoil in two existing ponds; installing riprap; providing new piping; installing ditch crossings; providing equipment; reseeding of disturbed areas; cleaning of the construction site; and performing any work indicated in the project Drawings and Specifications.
- C. The recharge facility is owned and operated by the City of Thornton, Colorado.
- D. The Contractor shall obtain all necessary permits from regulatory authorities necessary to perform the proposed work.

1.2 SCOPE OF WORK:

- A. General:
 - 1. The work required to be performed by the Contractor consists of constructing and completing the Work, as defined in the Contract, in accordance with the Drawings, these Specifications, and all applicable provisions of the Contract.
 - 2. The work includes furnishing all parts, labor, tools, equipment, appliances, material, transportation, and services and performing all operations necessary for and properly incidental to the construction and proper completion of the project as shown and noted on the Drawings and as specified in these Specifications. The requirements specified herein are in addition to, and are not to negate, any requirements of the Contract.

- B. The Work shall include, but not be limited to, the following as shown on the Drawings and as specified in these Specifications:
1. Mobilization and demobilization of construction equipment and materials.
 2. Providing construction survey.
 3. Providing erosion control at the site.
 4. Clearing, grubbing and stripping the site.
 5. Providing temporary water diversion and/or dewatering facilities.
 6. Demolition of selected items.
 7. Stripping/stockpiling and replacing topsoil.
 8. Earth excavation and placing and compacting fill.
 9. Finish grading of berms and new channel.
 10. Constructing Parshall Flume structures
 11. Constructing 4-way and 2-way Splitter Boxes with Slide Gate Structures
 12. Constructing RCP culvert crossings.
 13. Constructing pond inlet structure.
 14. Constructing pond outlet structure.
 15. Installing recharge cell stilling wells.
 16. Installing pond stilling well.
 17. Installing monitoring wells.
 18. Reseeding of the construction site as required.
 19. Cleaning of the construction site.

1.3 WORK QUALITY

- A. All work shall be performed by workers skilled and experienced in the fabrication and installation of the work involved. All work required by the Contract Documents shall be performed in accordance with the best practices of the various trades involved and in accordance with the Drawings, and these Specifications.
- B. All work shall be erected and installed plumb, level, square and true or true to indicated angle, and in proper alignment. All finished work shall be free from defects and damage.
- C. The Owner and/or Engineer reserve the right to reject any materials and Work quality that are not considered to be up to the highest standards of the various trades involved. Such inferior material or work quality shall be repaired or replaced, as directed, at no additional cost to the Owner.

1.4 FIELD MEASUREMENTS AND TEMPLATES:

- A. Contractor shall secure all field measurements required for proper and accurate fabrication and installation of the Work. Exact measurements are the responsibility of the Contractor. The Contractor shall also furnish or obtain templates, patterns, and setting instructions required for the installation of the Work. All dimensions shall be verified by the Contractor in the field.
- B. The Owner will provide the location and elevation of a benchmark at the project to be used by the Contractor for establishing elevations.

PART 2 – PRODUCTS

(Not Used)

PART 3 – EXECUTION

(Not Used)

- END OF SECTION -

PART 1 - GENERAL**1.1 RELATED REQUIREMENTS SPECIFIED ELSEWHERE**

- A. Schedule of Contract Items & Prices.
- B. Summary of Work: Section 01110.

1.2 DESCRIPTION OF WORK

- A. Work under this Contract will be paid as designated herein. The Contractor will be paid on the basis of actual work accepted until the work item is completed. Upon completion and acceptance of the work item, 100 percent of the work item price may be paid less retainage, subject to the terms of the Contract Conditions.
- B. All units of measurement shall be standard United States convention as applied to the specific items of work by tradition and as interpreted by the Engineer.

1.3 SCOPE OF PAYMENT

- A. The Contractor shall accept the compensation, as herein provided, as full payment for:
 - 1. Furnishing all materials, labor, tools, equipment, and incidentals necessary to the completed Work and for performing all Work contemplated and embraced by the Contract.
 - 2. All loss or damage arising from the nature of the work, or from the action of the elements, or from any unforeseen difficulties which may be encountered during the execution of the Work and until its final acceptance by the Owner.
 - 3. All risks of every description connected with the execution of the Work, except as provided in the Contract Documents.
 - 4. All expenses incurred in consequence of the suspension of the Work as herein authorized.
- B. No extra payment shall be made to the Contractor for any delays caused by lack of progress, defective workmanship, or rescheduling of work by other contractors, subcontractors, or equipment and material

suppliers.

- C. No additional payment will be allowed because of differences between field dimensions and those shown on the Drawings.
- D. Additional costs caused by ill-timed or defective work, or work not conforming to Contract Documents, including costs for additional services of Engineer shall be paid for by the Contractor.
- E. Work done on written instructions of Engineer or Owner, other than defective or non-conforming work shall be paid for by the Owner.

1.4 INCIDENTAL WORK:

- A. Work items which are included in the Contract, but for which separate payment is not included shall be considered incidental to all items or the appropriate Items of the Contract. Incidental work items include, but are not limited to, the following:
 - 1. Bonds, insurance and permits.
 - 2. Installation and maintenance of temporary sanitary facilities.
 - 3. Clean-up.
 - 5. Project Record Documents.
 - 6. Provision of temporary power for Contractor equipment.

1.5 DESCRIPTION OF PAY ITEMS:

- A. The following pay items describe the measurement of and/or payment for work to be done under the respective items listed in the Bid Summary.
- B. Each price stated in the Bid Summary shall constitute full compensation, as herein specified, for each item of the Work completed.
- C. Pay Items:
 - 1. Item No. 1 - Mobilization/Demobilization:
 - a. Method of Payment: Lump Sum.
 - b. The work shall consist of:

1. Mobilization and demobilization of all construction equipment, materials, setting up the Contractor's construction plant and temporary facilities, and removing all nonpermanent materials, equipment, buildings, or other items at the completion of the Work.
 - a. No separate payment will be made for relocating or moving the construction facilities or equipment after initial setup.

2. Item No. 2 – Construction Survey:
 - a. Measurement and Payment: Lump Sum.
 - b. The work shall include the following:
 1. Providing construction surveys, layouts, and staking for horizontal and vertical control, including offset lines, necessary for construction.
 2. Providing measurement from established baselines and benchmarks.
 3. Providing quantity surveys, measurements, and computations for progress payment estimates and for final quantity determinations.

3. Item No. 3 – Erosion Control and Reclamation:
 - a. Measurement and Payment: Lump Sum.
 - b. The work shall include the following:
 1. Preparing Stormwater Management Plan (SWMP) in accordance with requirements to obtain Weld County Grading Permit.
 2. Establishing and maintaining temporary BMPs in accordance with the approved SWMP and permits to manage stormwater, prevent erosion, control dust, and prohibit the migration of sediment and pollutants from the site.
 3. Repair any damage caused by erosion or sedimentation resulting from the lack of appropriate

BMPs or BMPs in poor condition.

4. Reclaiming and reseeding areas disturbed by the new construction.
 5. Final stabilizations, including soil preparation and seeding, as defined in these Specifications and as shown in the Drawings.
4. Item No. 4 – Selective Site Demolition:
 - a. Measurement and Payment: Lump Sum.
 - b. The work shall include the following:
 1. Selective demolition and removal of items as noted on the drawings, including concrete, pipes, gates, riprap, miscellaneous metals, and any other items and incidentals required to complete the works as shown on the Contract Documents.
 2. Set aside the items identified in the drawings for haul-away by the Owner.
 5. Item No. 5 – Strip/Stockpile Topsoil:
 - a. Measurement and Payment: Cubic Yard. This quantity will be calculated by Contractor's survey of the removal area multiplied by the topsoil depth (4 inches).
 - b. The work shall include the following:
 1. Removing top six inches of soil material from areas denoted for disturbance by filling, roadbuilding, or excavation.
 2. Stockpiling removed material in approved locations shown on the Stormwater Management Plan (SWMP). Topsoil shall not be mixed with other materials.
 3. Providing temporary stockpile stabilization in accordance with the SWMP.

4. Any other items and incidentals required to complete the work as shown in the Contract Documents.
6. Item No. 6 – Earthwork:
 - a. Method of Payment: Cubic Yard. This quantity will be calculated by comparing Contractor's as-built survey of excavation and fill areas (recharge cells, recharge cell berms, new earthen channel, Section 8 Pond, East Pond) to the Engineer's pre-project survey.
 - b. The work shall include the following:
 1. Clearing, grubbing, stripping soil, and grading, as required.
 2. Temporary site drainage and stormwater control, including pumps or other means to maintain a dewatered condition.
 3. Temporary erosion, dust and sedimentation control.
 4. Removing, segregating, transporting, and stockpiling of materials (other than topsoil), as required.
 5. Excavation of subgrade materials, including recharge cells, to lines, grades, and dimensions shown on the Drawings.
 6. Furnishing, placing, and compacting fill, including cell berms and pond spoils, to lines, grades, and dimensions shown on the Drawings.
 7. Processing of excavated materials to meet requirements of these Specifications for structural fill and embankment fill including moistening of materials as required.
 8. Maintenance of excavated slopes and subgrades.
 9. Soils and compaction testing.
 10. Any other items and incidentals required to

complete the work as shown in the Contract Documents.

7. Item No. 7 – Finish Grading (berms):
 - a. Measurement and Payment: Square Foot. This quantity will be calculated from the Contractor's as-built survey of the pond berm area.
 - b. The work shall include the following:
 1. Grading fill placed for the cell berms to the lines, grades, and dimensions shown on the Drawings.
8. Item No. 8 – Finish Grading (new channels):
 - a. Measurement and Payment: Square Foot. This quantity will be calculated from the Contractor's as-built survey of the new channel area.
 - b. The work shall include the following:
 1. Grading the newly excavated channel to the lines, grades, and dimensions shown on the Drawings.
9. Item No. 9 – Clean and Shape Existing Channel:
 - a. Measurement and Payment: Square Foot. This quantity will be calculated from the Contractor's as-built survey of the existing channel area.
 - b. The work shall include the following:
 1. Clearing, grubbing, and grading, within the noted extents of the existing diversion channel, as required to achieve the lines, grades, and dimensions shown on the Drawings.
 2. Removing and disposing of trash and other debris within the noted extents of the existing channel.
 3. Temporary site drainage and stormwater control, including pumps or other means to maintain a dewatered condition.
10. Item No. 10 – Replace Topsoil:

- a. Measurement and Payment: Cubic Yard. This quantity will be calculated from the Contractor's survey of the disturbed area multiplied by the depth of topsoil (4 inches).
 - b. The work shall include the following:
 - 1. Placing topsoil from stockpiles in disturbed areas to achieve the lines, grades, and dimensions shown on the Drawings.
11. Item No. 11 – Construction Water:
- a. Measurement and Payment: Lump Sum.
 - b. The work shall include the following:
 - 1. Furnishing, transporting, and applying construction water to provide dust suppression, compaction/soil moisture and other water needs.
 - 2. Furnishing, placing, maintaining, and removing a portable water tank or other infrastructure, as needed.
12. Item No. 12 – Riprap:
- a. Measurement and Payment: Cubic Yard. This quantity will be calculated from delivery tickets provided by the Contractor.
 - b. The work shall include the following:
 - 1. Subgrade and foundation preparation.
 - 2. Furnishing and placing geofabric.
 - 3. Furnishing and placing riprap bedding.
 - 4. Furnishing and placing rock riprap for rundowns, aprons, and spillways to the lines, grades, and dimensions shown on the Drawings.
13. Item No. 13 – Headgate Structure:
- a. Measurement and Payment: Lump Sum.
 - b. The work shall include the following:

1. Subgrade and foundation preparation.
 2. Installing temporary shoring as required to protect structures and existing slopes on adjacent properties.
 3. Furnishing and placing all materials for the structure including concrete, reinforcing bars, joint materials, and waterstop.
 4. Forming, placing, and curing the concrete to the lines, grades, and dimensions shown on the Drawings.
 5. Backfilling the structure to the lines, grades, and dimensions shown on the Drawings.
 6. Furnishing, installing, and conducting operation checks of hydraulic gate.
14. Item No. 14 – 9-inch Parshall Flume Structure:
- a. Measurement and Payment: Lump Sum.
 - b. The work shall include the following:
 1. Subgrade and foundation preparation.
 2. Installing temporary shoring as required to protect structures and existing slopes on adjacent properties.
 3. Furnishing and placing all materials for the structure including concrete, reinforcing bars, joint materials, and waterstop.
 4. Forming, placing, and curing the concrete to the lines, grades, and dimensions shown on the Drawings.
 5. Backfilling the structure to the lines, grades, and dimensions shown on the Drawings.
 6. Furnishing, and installing Parshall flume insert, staff gage, intake pipe, stilling well and instrument box.

7. Furnishing and installing geofabric, bedding and rock riprap to the lines, grades, and dimensions shown on the Drawings.
15. Item No. 15 – 4-Way Splitter Box with Slide Gates:
 - a. Measurement and Payment: Lump Sum.
 - b. The work shall include the following:
 1. Subgrade and foundation preparation.
 2. Installing temporary shoring as required to protect structures and existing slopes on adjacent properties.
 3. Furnishing and placing all materials for the structure including concrete, reinforcing bars, joint materials, and waterstop.
 4. Forming, placing, and curing the concrete to the lines, grades, and dimensions shown on the Drawings.
 5. Backfilling the structure to the lines, grades, and dimensions shown on the Drawings.
 6. Furnishing, installing, and conducting operation checks of hydraulic gates.
 16. Item No. 16 – 2-Way Splitter Box with Slide Gates:
 - a. Measurement and Payment: Lump Sum.
 - b. The work shall include the following:
 1. Subgrade and foundation preparation.
 2. Installing temporary shoring as required to protect structures and existing slopes on adjacent properties.
 3. Furnishing and placing all materials for the structure including concrete, reinforcing bars, joint materials, and waterstop.
 4. Forming, placing, and curing the concrete to the

- lines, grades, and dimensions shown on the Drawings.
5. Backfilling the structure to the lines, grades, and dimensions shown on the Drawings.
 6. Furnishing, installing, and conducting operation checks of hydraulic gates.
17. Item No. 17 – Reinforced Concrete Pipe (RCP Culvert Crossing):
- a. Measurement and Payment: Lump Sum.
 - b. The work shall include the following:
 1. Subgrade and foundation preparation.
 2. Installing temporary shoring as required to protect structures and existing slopes on adjacent properties.
 3. Furnishing and placing all materials for the structure including reinforced concrete pipe, pipe bedding, gaskets, and flared-end sections.
 4. Backfilling the structure to the lines, grades, and dimensions shown on the Drawings.
 5. Furnishing and installing geofabric, bedding and rock riprap to the lines, grades, and dimensions shown on the Drawings.
18. Item No. 18 – Section 8 Pond Inlet Pipe Structure:
- a. Measurement and Payment: Lump Sum.
 - b. The work shall include the following:
 1. Subgrade and foundation preparation.
 2. Installing temporary shoring as required to protect structures and existing slopes on adjacent properties.
 3. Furnishing and placing all materials for the structure including concrete, reinforcing bars, joint

- materials, and waterstop.
4. Forming, placing, and curing the concrete to the lines, grades, and dimensions shown on the Drawings.
 5. Furnishing, and installing, CMP pipe, and pipe bedding.
 6. Backfilling the structure to the lines, grades, and dimensions shown on the Drawings.
 7. Furnishing, installing, and conducting operation checks of hydraulic gate.
 8. Furnishing and installing geofabric, bedding and rock riprap to the lines, grades, and dimensions shown on the Drawings.
19. Item No. 19 – Section 8 Pond Outlet Pipe Structure:
- a. Measurement and Payment: Lump Sum.
 - b. The work shall include the following:
 1. Subgrade and foundation preparation.
 2. Installing temporary shoring as required to protect structures and existing slopes on adjacent properties.
 3. Furnishing and placing all materials for the structure including concrete, reinforcing bars, joint materials, waterstop and handrail.
 4. Forming, placing, and curing the concrete to the lines, grades, and dimensions shown on the Drawings.
 5. Furnishing, and installing, submittals pipe, and pipe bedding.
 6. Backfilling the structure to the lines, grades, and dimensions shown on the Drawings.
 7. Furnishing, installing, and conducting operation checks of hydraulic gates.

20. Item No. 20 – Recharge Cell Stilling Well:
- a. Measurement and Payment: Each.
 - b. The work shall include the following:
 1. Subgrade and foundation preparation.
 2. Installing temporary shoring as required to protect structures and existing slopes on adjacent properties.
 3. Furnishing and placing all materials for the structure including concrete, reinforcing bars, CMP, PVC, steel pipe, staff gage, instrument box, nylon tubing and miscellaneous hardware to the lines, grades, and dimensions shown on the Drawings.
 4. Backfilling the structure to the lines, grades, and dimensions shown on the Drawings.
21. Item No. 21 – Section 8 Pond Stilling Well:
- a. Measurement and Payment: Each.
 - b. The work shall include the following:
 1. Subgrade and foundation preparation.
 2. Installing temporary shoring as required to protect structures and existing slopes on adjacent properties.
 3. Furnishing and placing all materials for the structure including concrete, reinforcing bars, CMP, PVC, steel pipe, staff gage, instrument box, nylon tubing and miscellaneous hardware to the lines, grades, and dimensions shown on the Drawings.
 4. Backfilling the structure to the lines, grades, and dimensions shown on the Drawings.
22. Item No. 22 – Monitoring Well:

- a. Measurement and Payment: Each.
- b. The work shall include the following:
 - 1. Drilling well holes to the depth provided in the specifications at locations provided by the Engineer.
 - 2. Furnishing and placing all materials for the structure including casing pipe, screen pipe, silica sand, bentonite, well protector, concrete pad, and well cap.
 - 3. Developing the well as described in the specifications.
 - 4. Restoring the well site as described in the specifications.

PART 2 – PRODUCTS

(Not Used)

PART 3 – EXECUTION

(Not Used)

- END OF SECTION -

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. The Contractor shall:

1. Comply with all requirements of all agencies having jurisdiction over construction, including Weld County regulatory authorities.
2. Make arrangements for any and all temporary utility requirements (electricity, water, telephone, sanitary facilities, first aid facilities, fire protection, and storage of materials and supplies) and for their timely delivery to the job site.
3. Make arrangements to and/or obtain the location of all underground utilities in the project area that may affect the construction and/or operation of the project. It shall be the Contractor's responsibility to notify the Utility Notification Center of Colorado with sufficient notice so as not to interrupt the progress of work.
4. Assist and cooperate with the Owner and Engineer as required in the review of construction.
5. Maintain up to date progress records and record drawings that shall be submitted to the Owner at the completion of the Work.
6. Maintain the project site in a neat condition.
7. No extra payment will be made to the Contractor for any delays caused by lack of progress, defective workmanship, or rescheduling of work by other contractors, subcontractors, or equipment and material suppliers.
8. Coordinate the work of subcontractors, equipment, and material suppliers.
9. Verify all field dimensions and coordinate with subcontractors and material suppliers. No additional payment will be allowed because of differences between field dimensions and those shown on the Drawings.
10. Coordinate all Work under this Contract.

PART 2 – PRODUCTS

(Not Used)

PART 3 – EXECUTION

(Not Used)

- END OF SECTION –

PART 1 - GENERAL**1.1 RELATED REQUIREMENTS SPECIFIED ELSEWHERE:**

- A. Project Record Documents: Section 01780.

1.2 DESCRIPTION:

- A. Submit to the Engineer and Owner shop drawings. Submit to the Owner manufacturer's certificates and project data required by the Contract Documents.

1.3 SHOP DRAWINGS:

- A. Detailed shop drawings, data, and literature for fabricated materials or equipment to be incorporated in the work shall be submitted to the Engineer for review for general compliance with the Contract Documents before fabrication. Prior to submittal to the Engineer, the Contractor shall obtain and check manufacturers' shop drawings, certified prints, and other pertinent data for conformance with all requirements of the Contract Documents and in ample time to permit satisfactory progress of the Work. As applicable to each submittal, the areas of the Contractor's review and approval responsibilities shall include, but not be limited to, checking dimensions, coordinating and correlating submittals with field conditions and measurements, fabrication processes, construction means, methods, procedures, and techniques and coordination of installation of work.
- B. The Contractor shall certify that the shop drawing or submittal has been appropriately checked for any errors, deficiencies or omissions with respect to those areas of the Contractor's responsibility and is ready for transmittal to the Engineer.
- C. All data, Drawings, and correspondence from subcontractors, manufacturers, or suppliers shall be routed through the Contractor. The Engineer will review only such data and details as are transmitted to him by the Contractor. All correspondence from the Contractor to the Owner or Engineer shall refer to the appropriate section of these specifications containing the subject matter of the inquiry.
- D. Each shop drawing shall be assigned a sequential number for purposes of easy identification, and shall retain its assigned number, with appropriate subscript, on required resubmissions. Equipment shall be identified by the number shown on the Drawings and schedules.

- E. All shop drawings shall be in conformity with all requirements of the Contract Documents. All Drawings, except diagrams, brochures, schedules, and illustrations shall be to an appropriate scale, no smaller than 1/4 inch = 1 foot, and shall give all dimensions necessary for installation and incorporation in the Work. All shop drawings shall be accurate and complete, showing outline and section views, details, materials, accessories, appurtenances and related items.
- F. The Contractor shall submit to the Engineer and Owner an electronic file of the shop drawings. The Engineer will provide a written response to the Contractor and Owner. The Engineer's notations of the action taken will be noted on all of the returned copies. At the time of each submission, the Contractor shall call to the Engineer's attention, in writing, any deviations that the shop drawings may have from the requirements of the Contract Documents.
- G. Only two submittals of each shop Drawing will be reviewed, checked, and commented upon without charge to the Contractor. It is therefore incumbent upon the Contractor to make all modifications and/or corrections as may be required by the Engineer in an accurate, complete, and timely fashion.
- H. Upon review by the Engineer of the above Drawings, lists, and other data, the same shall become a part of the Contract, and the fabrications furnished shall be in conformity with the same. Review of the above Drawings, lists, specifications, samples, or other data, however, shall in no way release the Contractor from his responsibility for the proper fulfillment, by any fabrication, of the requirements of this Contract.
- I. Corrections or comments made on the shop drawings during the Engineer's review do not relieve the Contractor from compliance with the requirements of the Contract Documents. This check is only for review of general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. The Contractor is responsible for confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; and in performing its work in a safe manner. If the shop drawings deviate from the Contract Documents, the Contractor shall advise the Engineer of the deviations, in writing accompanying the shop drawings, including the reasons for the deviations, and shall request a deviation from the Contract Documents.

- J. The shop drawings are intended to be utilized by the Contractor for additional fabrication, assembly, and erection data. The shop drawings do not change or supersede the Plans and Specifications except in specific cases when the Contractor requests in writing and receives approval in writing for a deviation from the Plans and Specifications. The Contractor's request for a change shall give, in detail, the specific change requested and shall state the reason for the change. Changes requested by the Contractor and approved by the Engineer shall not be construed to include approval of any change except the changed details specifically requested and approved.
- K. The Contractor's attention is specifically directed to the fact that no work shall be fabricated, nor equipment or materials ordered, nor any construction performed, prior to approval by the Engineer of shop drawings applicable thereto. Construction performed in violation of this requirement will be neither approved nor certified for payment until applicable shop drawings have been submitted and approved. If the Owner so directs, the Contractor shall disassemble and remove any such construction performed prior to approval by the Engineer of shop drawings applicable thereto, and the Contractor will be allowed no additional compensation or extension of contract time. If any equipment or materials are ordered by the Contractor prior to submission and approval of shop drawings, it is done at the Contractor's risk.
- L. It shall be the responsibility of the Contractor to make all the necessary changes in other items, which result from deviations or changes requested by the Contractor and approved by the Engineer, so that all items meet the requirements and intent of the Contract Documents.
- M. Shop drawings shall be of standardized sizes to enable the Owner to maintain a permanent record of the submissions. Approved standard sheet sizes shall be (a) 24 inches by 36 inches; (b) 11 inches by 17 inches; and (c) 8 1/2 inches by 11 inches. Provision shall be made in preparing the shop drawings to provide a binding margin of at least 3/4-inch on the left-hand side of the sheet. Shop drawings submitted other than as specified herein may be returned for resubmittal without being reviewed.

1.4 MANUFACTURER'S CERTIFICATES:

- A. The Contractor shall submit manufacturer's certificates for each item specified.

1.5 PROJECT DATA:

- A. Manufacturer's standard schematic drawings:
 - 1. Modify drawings to delete information that is not applicable to project.
 - 2. Supplement standard information to provide additional information applicable to project.
 - B. Manufacturer's catalog sheets, brochures, diagrams, schedules, illustrations, and other standard descriptive data.
 - 1. Clearly mark each copy to identify all pertinent materials, products or models, or information.
 - 2. Show dimensions and clearances required.
- 1.6 CONTRACTOR RESPONSIBILITIES:
- A. Review shop drawings and project data prior to submission.
 - B. Coordinate each submittal with requirements of work and of Contract Documents.
 - C. Contractor's responsibility for errors and omissions in submittals is not relieved by Owner's or Engineer's review of submittals.
 - D. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved by Owner's or Engineer's review of submittals, unless written acceptance of specific deviations is given.
 - E. Notify Owner and Engineer, in writing at time of submission, of deviations in submittals from requirements of Contract Documents.
 - F. Begin work which requires submittals after return of submittals with Engineer's stamp and initials or signature indicating review and approval.
 - G. After Owner's or Engineer's review, distribute copies.
- 1.7 SUBMISSION REQUIREMENTS:
- A. Schedule submissions at least 10 calendar days before dates reviewed submittals will be needed, except where longer lead-time is specified.

- B. Each submittal shall contain the following information:
1. Date.
 2. Project name, contract number, and location.
 3. Submittal number, and subscript on resubmissions.
 4. Contractor's name, address and job number.
 5. The number of copies, description, specifications section number and manufacturer/ designer's name for each shop drawing, project data and sample submitted.
 6. Contractor signature and title.
 7. Notification of deviations from Contract Documents.
 8. Other pertinent data.
- C. Submittals shall include:
1. Date and revision dates.
 2. Project title and number.
 3. The names of:
 - a. Engineer.
 - b. Contractor.
 - c. Subcontractor.
 - d. Supplier.
 - e. Manufacturer.
 - f. Separate detailer when pertinent.
 4. Identification of product or material.
 5. Relation to adjacent structure or materials.
 6. Field dimensions, clearly identified as such.
 7. Specification section number.
 8. Applicable standards, such as ASTM number or Federal

Specification.

9. A blank space, 4" x 4", for the Engineer's stamp.
10. Identification of deviations from Contract Documents.
11. Contractor's stamp, initialed or signed, certifying to review of submittal, verification of field measurements and compliance with Contract Documents.

1.8 RESUBMISSION REQUIREMENTS:

- A. Shop Drawings:
 1. Revise initial Drawings as required and resubmit as specified for initial submittal.
 2. Clearly indicate on Drawings any changes which have been made other than those requested by Engineer.
- B. Project Data: Submit new data as required for initial submittal.

1.9 DISTRIBUTION OF SUBMITTALS AFTER REVIEW:

- A. Distribute copies of shop drawings and Project Data that carry Engineer's stamp, to the following as applicable.
 1. Contractor's file.
 2. Job site file.
 3. Record Documents file.
 4. Other contractors.
 5. Subcontractors.
 6. Supplier.
 7. Fabricator.

1.10 ENGINEER'S DUTIES:

- A. Review submittals with reasonable promptness.
- B. Review for:
 1. Conformance to design concept of project.
 2. Compliance with information given in Contract Documents.

- C. Review of separate item does not constitute review of an assembly in which item functions.
- D. Affix stamp and initials or signature certifying review of submittal.
- E. Return submittals to Owner's Representative for distribution.

PART 2 – PRODUCTS

(Not Used)

PART 3 – EXECUTION

(Not Used)

- END OF SECTION –

PART 1 - GENERAL**1.1 APPLICABLE CODES AND STANDARDS**

A. The latest applicable specifications, standards, tests, and recommended methods from the trade, industry, and professional organizations listed below shall determine the quality and methods of design, fabrication and testing, unless specified otherwise. Comply with current edition of all local state, and national codes applicable to the proposed construction including but not limited to the following. Additional Code listings are provided in each specification as appropriate.

1. OSHA - National Occupational Safety and Health Act.
2. ASTM – ASTM International.
3. AGCA - Associated General Contractors of America - “Manual of Accident Prevention in Construction.”
4. AASHTO - American Association of State Highway and Transportation Officials
5. IBC – International Building Code

PART 2 – PRODUCTS

(Not Used)

PART 3 – EXECUTION

(Not Used)

- END OF SECTION -

PART 1 - GENERAL**1.1 DESCRIPTION OF WORK:**

- A. The Contractor shall provide such temporary enclosures and facilities as the Work may warrant at the construction site, and any offsite areas that may be utilized by the Contractor. Facilities shall include, as required:
1. Contractor's office and storage facilities.
 2. Shelter for crews including sanitary facilities conforming to local codes and requirements.
 3. Temporary light and power.
 4. Fire protection.
 5. Safety equipment.
 6. Construction warning, protection, and control devices for maintenance and safety of pedestrian and vehicular traffic.
 7. Temporary fencing, gates, barriers, locks, signage and security guards during non-working hours, required to secure the work areas against vandalism and prevent entry of unauthorized parties.

1.2 TEMPORARY LIGHT AND POWER:

- A. Contractor Responsibilities:
1. Furnish, install and remove temporary electrical power, metering, and lighting systems required to perform the Work, and pay for all labor, materials and equipment required, therefore.

PART 2 - PRODUCTS**2.1 FACILITIES:**

- A. Contractor's facilities shall be of size and content for its adequate administration of the contract, and storage of materials required for installation.

PART 3 - EXECUTION**3.1 FIELD OFFICE AND STORAGE FACILITIES:**

- A. Field office and storage trailers or buildings shall be sited in locations approved by the Owner and properly set up for all potential weather conditions.

3.2 SANITARY FACILITIES:

- A. Sanitary conveniences, in sufficient numbers, for the use of all persons employed on the work including the Owner and Engineer, and properly screened from public observation, shall be maintained at suitable locations, in accordance with state and local ordinances. When no longer required, they shall be removed from the site and the contents disposed of in a satisfactory manner.

3.3 DRINKING WATER:

- A. The Contractor shall provide sufficient drinking water for all its employees. The Contractor shall also obey and enforce other local sanitary regulations and orders, taking such precautions against infectious diseases as may be deemed necessary.

3.4 OPERATIONS:

- A. The Contractor shall conduct its operations in a manner which, with the use of proper equipment, will provide maximum safety for workmen.

- END OF SECTION -

PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS: The general provisions of the Contract, including General Conditions, Supplementary Conditions (if any), and General Requirements, apply to the work specified in this Section.
- 1.2 RELATED WORK SPECIFIED ELSEWHERE:
- A. Clearing, Grubbing and Stripping: 02110.
 - B. Earthwork: 02300.
 - C. Erosion Control: 02370.
- 1.3 DESCRIPTION OF WORK: This work shall consist of furnishing and applying water or calcium chloride on earth moving operation areas and along access roads for dust control as required.

PART 2 - PRODUCTS

- 2.1 WATER:
- A. The water shall not be salt or brackish and shall be free from oil, acid, and injurious alkali or vegetative matter.
- 2.2 CALCIUM CHLORIDE:
- A. Calcium chloride shall conform to the requirements of AASHTO M144 (ASTM D 98), except that the requirements for total alkali chloride and impurities shall not apply.

PART 3 - EXECUTION

- 3.1 SPRINKLING:
- A. Water shall be applied by approved methods and with equipment including a tank with a pressure pump and a nozzle-equipped spray bar.
- 3.2 CALCIUM CHLORIDE:

- A. Calcium chloride shall be used when and where authorized for controlling dust on the earth moving operations areas and where dust constitutes a hazard to traffic. Calcium chloride shall be applied by mechanical spreaders or by hand at a rate of 1 pound per square yard.

- END OF SECTION -

PART 1 - GENERAL**1.1 RELATED REQUIREMENTS SPECIFIED ELSEWHERE:**

- A. Summary of Work: 01110.
- B. Project Coordination: 01310.
- C. Project Closeout: 01770.

1.2 DESCRIPTION OF WORK:

- A. Maintain premises and public properties free from accumulations of waste, debris, and rubbish, caused by operations.
- B. At completion of Work, remove waste materials, rubbish, tools, equipment, machinery, and surplus materials, and clean all sight-exposed surfaces; leave project clean and ready for usage.

1.3 SAFETY REQUIREMENTS:

- A. Standards: Maintain project in accordance with normal safety and insurance standards.
- B. Hazards Control:
 - 1. Store volatile wastes in covered metal containers and remove from premises daily.
 - 2. Prevent accumulation of wastes which create hazardous conditions.
 - 3. Provide adequate ventilation during use of volatile or noxious substances.
- C. Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws:
 - 1. Do not burn or bury rubbish and waste materials on project site unless permits are obtained from agencies having jurisdiction.
 - 2. Do not dispose of volatile wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.
 - 3. Do not dispose of wastes into streams or waterways.

PART 2 - PRODUCTS

2.1 PRODUCTS

- A. Use only cleaning materials recommended by manufacturer of surface to be cleaned.
- B. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

PART 3 - EXECUTION

3.1 DURING CONSTRUCTION:

- A. Execute cleaning to ensure that structures, grounds and public properties are maintained free from accumulations of waste materials and rubbish.
- B. Wet down dry materials and rubbish to lay dust and prevent blowing dust.
- C. At reasonable intervals during progress of Work, clean site and dispose of waste materials debris, and rubbish.
- D. Remove waste materials, debris and rubbish from site and legally dispose of at public or private dumping areas off Owner's property.
- E. Handle materials in a controlled manner with as few handlings as possible; do not drop or throw materials from heights.

3.2 FINAL CLEANING:

- A. In preparation for substantial completion, conduct final inspection of structures and the site area.

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS SPECIFIED ELSEWHERE:

- A. Project Coordination: 01310.
- B. Cleaning: 01740.
- C. Project Record Documents: 01780.

1.2 FINAL REVIEW:

- A. Requirements Preparatory to Final Review:
 - 1. Contractor shall remove all temporary facilities from the site, except as otherwise specified or directed by Owner.
 - 2. All rubbish and waste material from and about the Work area and all his tools, and surplus material shall be removed by the Contractor.
- B. Contractor shall submit written certification that:
 - 1. Contract Documents have been reviewed.
 - 2. Project has been completed in accordance with Contract Documents.
 - 3. Work has been completed in accordance with Contract Documents.
 - 4. Project is completed, and ready for final review.
- C. Engineer will make final review and recommendation to Owner within ten calendar days after receipt of certification on those areas indicated in Engineer's contract with Owner.
- D. Should Engineer consider that Work is finally complete in accordance with requirements of Contract Documents, the Engineer will request Contractor to make project closeout submittals.
- E. Should the Engineer consider that work is not finally complete:
 - 1. Engineer shall notify Contractor, in writing, stating reasons.

2. Contractor shall take immediate steps to remedy the stated deficiencies and send second written notice to Engineer certifying that work is complete.
3. Engineer will again review the Work.

1.3 CLOSEOUT SUBMITTALS:

- A. Deliver evidence of compliance with requirements of governing authorities, as applicable:
 1. Certificates of Acceptance.
- B. Deliver Certificate of Insurance for Products and Completed Operations.
- C. Applicable requirements of governmental agencies having jurisdiction.

1.4 EVIDENCE OF PAYMENTS, AND RELEASE OF LIENS:

- A. Contractor's Affidavit of Payment of Debts and Claims.
- B. Contractor's Affidavit of Release of Liens with:
 1. Consent of Surety to Final Payment.
 2. Contractor's release or waiver of liens. (To be reviewed by Owner prior to final payment certification.)
 3. Separate releases or waivers of liens for subcontractors, suppliers, and others with lien rights against property of Owner, together with list of those parties.
- C. All submittals shall be duly executed before delivery to Owner.

PART 2 PRODUCTS

(Not Used)

PART 3 – EXECUTION

(Not Used)

- END OF SECTION –

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS SPECIFIED ELSEWHERE:

- A. Project Coordination: 01310.
- B. Project Closeout: 01770.

1.2 DESCRIPTION:

- A. Keep accurate record documents for all additions, substitution of material, variations in Work, and any other revisions to the Contract Documents.

1.3 MAINTENANCE OF DOCUMENTS:

- A. Maintain at job site, at least one copy of:
 - 1. Contract Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders.
 - 5. Other Modifications to Contract.
 - 6. Engineering Change Notice.
 - 7. Field Test Records.
 - 8. Certificates of Compliance.
 - 9. Other documentation as required by agencies having jurisdiction.
- B. Store documents in a safe dry place, apart from documents used for construction.
- C. Do not use record documents for construction purposes.
- D. Make documents available at all times for inspection by Engineer and authorized representative of governmental agencies.

1.4 MARKING DEVICES:

- A. Use ball point pen or similar permanent marker for all marking.

1.5 RECORDING:

- A. Contractor shall ensure that changes are being recorded and, the name of the person identifying an error or change as well as the error and change itself is properly recorded and incorporated on the record Drawings.
- B. Contractor shall instruct all employees to record all changes which they discover.
- C. Designated individual(s) from the Contractor's company shall be assigned the task of recording and tracking all changes made to Drawings and will be responsible for compiling a complete and accurate account of all changes.
- D. Label each document "PROJECT RECORD" in printed letters.
- E. Keep record documents current.
- F. Do not permanently conceal any work until required information has been recorded.
- G. Contract Drawings: Legibly mark to record actual construction as applicable:
 - 1. Depths of various elements of excavation in relation to survey datum.
 - 2. Field changes of dimension and detail.
 - 3. Changes made by Change Order or Engineering Change Notice.
 - 4. Details not on original contract Drawings.
- H. Specifications and Addenda: legibly mark up each section to record:
 - 1. Manufacturer, trade name, catalog number, and Supplier or each product and item of work.

2. Changes made by Change Order or Engineering Change Notice.
 3. Other items not originally specified.
- I. Changes:
1. All work shall be performed in accordance with the plans and specifications, except as described herein.
 2. Engineering Change Notices (ECN) may be issued by the Engineer at any time, and shall form a part of the Contract, modifying or superseding the Drawings or Specifications. When the ECN constitutes a change in work scope, the Contractor shall notify the Owner's Representative in writing within five calendar days of the receipt of the ECN, and prior to the start of affected work.
- 1.6 SUBMITTAL:
- A. At completion of project, deliver record documents to Owner.
 - B. Accompany submittal with transmittal letter, in duplicate, containing:
 1. Date.
 2. Project title and number.
 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 Contractor or Contractor's authorized representative.

PART 2 – PRODUCTS

(Not Used)

PART 3 – EXECUTION

(Not Used)

- END OF SECTION –

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This Section describes the work included in clearing, grubbing, stripping, and preparing the project site for construction operations.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

- A. Earthwork: 02300.

1.3 PROTECTION:

- A. Protect existing utility lines that are to remain from damage. Notify the Owner immediately of damage to or an encounter with an unknown existing utility line.
- B. The Contractor shall be responsible for the repairs of damage to existing utility lines that are indicated or made known to the Contractor prior to start of clearing and grubbing operations.

PART 2 - PRODUCTS

2.1 TREES AND SHRUBBERY:

- A. Existing trees, shrubbery, and other vegetative material may not be shown on the Drawings. Inspect the site as to the nature, location, size, and extent of vegetative material to be removed or preserved, as specified herein. Preserve in place trees that are specifically shown in the drawings and designated to be preserved.

2.2 PRESERVATION OF TREES, SHRUBS, AND OTHER PLANT MATERIAL:

- A. Save and protect plant materials (trees, shrubbery, and plants) beyond the limits of clearing and grubbing from damage resulting from the work. No filling, excavating, trenching, or stockpiling of materials will be permitted within the drip line of these plant materials. The drip line is defined as a circle drawn by extending a line vertically to the ground from the outermost branches of a plant or group of plants. To prevent soil compaction within the drip line area, no equipment will be permitted within this area.
- B. When trees are close together, restrict entry to area within drip line by fencing. In areas where no fence is erected, protect the trunks of trees 2 inches or greater in diameter by encircling the trunk entirely with

boards held securely by 12-gauge wire and staples. This protection shall extend from ground level to a height of 6 feet. Cut and remove tree branches where necessary for construction. Remove branches other than those required to effect the work to provide a balanced appearance of any tree. Treat cuts with a tree sealant of standard manufacture specially formulated for tree wounds.

PART 3 - EXECUTION**3.1 CLEARING AND GRUBBING LIMITS:**

- A. Clear and grub excavation and embankment areas associated with the new cells, structures, ditches, fencing, roads, and any other areas required for the new construction shown on the Drawings.

3.2 CLEARING:

- A. Remove and dispose of trees, snags, stumps, shrubs, brush, limbs, and other vegetative growth. Remove all evidence of their presence from the surface including sticks and branches greater than 1 inch in diameter or thickness.
- B. Remove and dispose of trash piles and rubbish. Protect structures and piping above and below ground, trees, shrubs, and vegetative growth and fencing which are not designated for removal.

3.3 GRUBBING:

- A. After clearing, remove and dispose of wood or root matter, including stumps, trunks, roots, matted roots or root systems greater than 1 inch in diameter or thickness.
- B. Material to be grubbed, together with other organic or metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 18 inches below the original surface level of the ground in areas indicated to be grubbed and in areas indicated as construction areas under this contract.
- C. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform to the original adjacent surface of the ground.

SECTION 02110 CLEARING, GRUBBING, AND STRIPPING

3.4 STRIPPING:

- A. Remove and dispose of all organic sod, grass and grass roots, and other objectionable material remaining after clearing and grubbing from the areas designated to be stripped.
- B. In vegetated areas, strip excavation and embankment areas associated with new structures, slabs, and embankment to the minimum depths shown or noted on the Drawings. Also strip all stockpile areas.

3.5 DISPOSAL OF CLEARING AND GRUBBING DEBRIS:

- A. Do not burn combustible materials. Remove cleared and grubbed material from the worksite and dispose outside the limits of Owner-controlled land at the Contractor's responsibility.

3.6 DISPOSAL OF STRIPPINGS:

- A. Remove stripped material and dispose offsite, except topsoil which shall be stockpiled on site for reuse.

- END OF SECTION –

PART 1 - GENERAL**1.4 DESCRIPTION:**

- A. This Section describes the installation and maintenance of all dewatering sumps, including piping, pumps, sump pits and backfill, and other facilities for the control, collection, and disposal of groundwater for the proper construction of all contract Work.
- B. Maintain the foundations and other parts of the Work free from water as required for constructing each part of the Work.
- C. Comply with all applicable environmental protection laws and requirements in operation of the dewatering system.
- D. Collection and disposal of surface water is provided for in Section 02300.

1.5 SUBMITTALS:

- A. Submit a Dewatering Plan in accordance with Section 01330 at least 7 calendar days prior to excavation activity:
- B. The plan shall include details regarding the types of various dewatering facilities and design calculations, if necessary, required to substantiate the dewatering plan.
- C. If the Contractor purchases, rents, installs, or mobilizes to the site any elements of the dewatering system prior to the Engineer's acceptance of the submittal, it does so at its own risk, and will not be due any additional compensation from the Owner if such elements are not subsequently used for the Work.
- D. Acceptance by the Engineer of the dewatering system proposed by the Contractor will only be with respect to the basic principles of the methods the contractor intends to employ. Approval by the Engineer does not relieve the Contractor of the full responsibility for the adequacy of the dewatering system.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION**3.1 GENERAL:**

- A. The Contractor shall review the available subsurface data and weather records for the project site. It shall be the Contractor's responsibility to evaluate the conditions at the project site with respect to required dewatering facilities, including any additional groundwater monitoring data obtained by the Contractor.
- B. The Contractor shall, at all times during construction, provide ample means and devices to remove promptly and dispose of properly all water entering excavations and keep the bottoms of the excavations firm and free of standing water until the structures to be built thereon are completed and/or the backfill to be placed therein has been placed.
- C. The pumping and dewatering operations shall be carried out in such a manner that no disturbance to the bearing soil or to soil supporting any other work will result from the dewatering operations.
- D. The dewatering discharge shall not cause siltation or other negative environmental impact on natural waterways or other property; such discharge shall be in accordance with applicable Federal, State, and local regulations. At dewatering discharge locations, haybale, silt barriers or other control measures, as approved by the Engineer, shall be installed to control and prevent siltation.
- E. The dewatering system shall be operated continuously as necessary to prevent flotation of partially completed structures or other work.

3.2 DEWATERING REQUIREMENTS

- A. Design, furnish, install, maintain, and operate a dewatering system which shall prevent loss of fines, boiling, quick conditions, or softening of foundation strata and maintain stability of bottoms of excavations so that every phase of the work can be performed in the dry.
- B. The dewatering operations shall be such that the bottoms of all excavations shall be kept at all times firm, and in all respects acceptable to the Engineer as good foundation.
- C. The groundwater level below excavations at any given time shall be at least two (2) feet below excavation subgrade. The Engineer may request the Contractor to install temporary observation wells to verify compliance to this requirement if there are uncontrollable groundwater

conditions in the excavation. Uncontrollable groundwater conditions shall include standing or flowing water from groundwater seepage, "pumping ground" under equipment loads, and progressively softening of the subgrade caused by groundwater seepage.

3.3 INSTALLATION AND OPERATION

- A. The location of every element of the dewatering system shall be such that interference with excavation and construction activity is minimized. Locations shall be subject to approval by the Engineer.
- B. When the dewatering system does not meet the specified requirements, and as a consequence loosening or disturbance of the foundations strata, instability of the slopes or damage to the foundations or structures occur, the Contractor shall supply all materials, labor, and perform all work for restoration of foundations soil, fill soils, slopes, foundations, or structures, to the satisfaction of the Engineer, at no additional cost to the Owner.

3.4 REMOVAL

- A. All elements of the dewatering system(s) shall be removed from the site at the completion of the dewatering work.
- B. All sand and gravel materials placed in temporary dewatering pits and trenches shall be excavated and backfilled with compacted earthfill materials to design foundation subgrades, and in accordance with Section 02300.

-END OF SECTION-

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This Section includes materials, testing, and installation of the following:
1. Earthwork for excavations, structures, grading, embankments, and any other earthwork shown on the Drawings and as specified herein.
 2. Road base.

1.2 REFERENCES:

A. AASHTO:

- | | | |
|----|-------------|---|
| 1. | AASHTO T 89 | Standard Method of Test for Determining the Liquid Limit of Soils |
| 2. | AASHTO T 90 | Standard Method of Test for Determining the Plastic Limit and Plasticity Index of Soils |
| 3. | AASHTO T 99 | Standard Method of Test for Moisture–Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop |

B. ASTM International (ASTM):

- | | | |
|----|------------|--|
| 1. | ASTM C 33 | Standard Specification for Concrete Aggregates |
| 2. | ASTM C 131 | Standard Test Methods for Resistance to Degradation of Small-Sized Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine. |
| 3. | ASTM C 136 | Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates |

4. ASTM D 698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600kN-m/m³))
5. ASTM D 1140 Standard Test Methods for Determining the Amount of Material Finer than 75- μ m (No. 200) Sieve in Soils by Washing
6. ASTM D 1556 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
7. ASTM D 2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
8. ASTM D 4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
9. ASTM D 6938 Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

C. Colorado Department of Transportation (CDOT):

1. Standard Specifications for Road and Bridge Construction

1.3 SUBMITTALS:

A. Submit the following in accordance with Section 01330:

1. Test Reports:
 - a. Embankment fill material tests.
 - b. Backfill material tests.
 - c. Road base surfacing material tests.

1.4 DELIVERY AND STORAGE:

- A. Deliver and store materials in a manner to prevent contamination or segregation.

1.5 SITE CONDITIONS:

- A. Dewatering Plan: Base dewatering plan on site surface and subsurface conditions and available soils and hydrological data.
- B. Utilities: Contact the Owner 72 hours prior to starting construction for the location of all existing underground utilities. Movement of construction machinery and equipment over pipes and utilities during construction shall be at the Contractor's risk. Contact the utility companies for location(s) of their utilities. Perform work adjacent to privately owned utilities in accordance with procedures outlined by the utility company. Excavation made with power-driven equipment is not permitted within two feet of known utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work as affected by the contract excavation until approval for backfill is granted by the Owner. Report any damage to utility lines or subsurface construction immediately to the Owner.

PART 2 - PRODUCTS**2.1 EARTH MATERIALS**

- A. Provide materials free from debris, roots, wood, scrap materials, vegetable matter, refuse, and frozen material. Use excavated material from the site for the work indicated when material falls within the requirements specified herein. The on-site excavated material may require processing to obtain the required gradations specified herein.
- B. Type I Fill Material: Material shall be generated from on-site sources and shall conform to the following table (as confirmed by laboratory testing):

<u>Sieve Size</u>	<u>Mass Percent Passing Square Mesh Sieves</u>
3/4 inch	100
No. 10	40 - 100
No. 20	35 - 100
No. 200	20 - 50
D10	< 0.001 mm

1. Typical material that would meet this criteria (USCS SC Classification).

Upon compaction, Type 1 material shall be suitable for use as subgrade beneath concrete flatwork (i.e., non-swelling or sandy material)

- C. General Fill: Material shall be generated from on-site sources and may consist of a variety of soil classifications. General fill is intended to be generated from cell excavation and used for berms or other fill not adjacent to concrete flatwork.
- D. Spoil: Material shall be generated from on-site sources and may consist of a variety of soil classifications. Spoils are intended to be generated from cell excavation and used for fill in existing ponds.
- E. Topsoil: Provide salvaged topsoil material or imported material complying with topsoil requirements specified in Section 02950.
- F. Road Base Surfacing: Aggregates for road base surfacing material shall be crushed stone, crushed gravel, or natural gravel which conforms to the quality requirements of CDOT Class 6. Aggregates for road base shall meet the following grading requirements, unless otherwise specified. The liquid limit (AASHTO T 89) and the plasticity index (AASHTO T 90 shall not exceed six and 30, respectively..

Classification for Road Base Material	
Mass Percent Passing Sieve Sizes	Per Class 6 (CDOT Standard Specification)
Percent Passing No. 200 Sieve	3 min- 12 max
Liquid Limit	<30 (AASHTO T 90)
Plasticity Index	<6 (AASHTO T 89)

2.2 WATER FOR COMPACTION:

- A. Water for compaction shall be free of organic materials and shall have a pH of 7.0 to 9.0, a maximum chloride concentration of 500 mg/l, and a maximum sulfate concentration of 500 mg/l.
- B. Provide all water needed for earthwork and temporary piping and valves to convey the water from the source to the point of use.

PART 3 - EXECUTION

3.1 DRAINAGE AND DEWATERING

- A. General: Plan for and provide the structures, equipment, and construction for the collection and disposal of surface and subsurface water encountered during construction.
- B. Drainage: Dispose of surface water that may accumulate in open excavations, unfinished fills, or other low areas. Remove water by trenching where approved, pumping, or other methods to prevent softening of exposed surfaces. Surface dewatering plan shall include rerouting of any storm water runoff or natural drainage if necessary.
- C. Dewatering: Groundwater flowing toward or into excavations shall be controlled to prevent sloughing or excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in-situ material. While the excavation is open, the water level shall be

maintained continuously, at least 3 feet below the working level. Operate the dewatering system continuously, 24 hours per day, 7 days per week until construction work below existing water levels is complete. Measure and record the performance of the dewatering system at the same time each day by use of observation wells and piezometers installed in conjunction with the dewatering system. Have a back-up pump and system available for immediate use.

3.2 PROTECTION AND RESTORATION OF SURFACES:

- A. Protect newly graded areas from traffic, erosion, and settlements. Repair and reestablish damaged or eroded slopes, elevations or grades and restore surface construction prior to acceptance of the Work. Protect existing streams and ditches from water-borne soil by means of straw bale dikes.

3.3 DISPOSAL OF EXCESS OR UNSUITABLE EXCAVATED MATERIAL:

- A. Dispose of excess or unsuitable excavated material where directed in such a manner that it will not obstruct the flow of runoff, streams, endanger a partly finished structure, impair the efficiency or appearance of facilities, or be detrimental to the completed Work.

3.4 SURFACE PREPARATION:

- A. Clearing, Grubbing, and Stripping: Perform as specified in Section 02110.

3.5 EXCAVATION:

- A. General: Perform excavation to the lines and grades indicated on the drawings. Keep excavations free from water while construction is in progress. Notify the Owner immediately in writing if it becomes necessary to remove rock, hard material, or other material defined as unsatisfactory to a depth greater than indicated and an adjustment in contract price will be considered. Refill excavations cut below the depths indicated with appropriate fill material and compact as specified herein. Excavate soil disturbed or weakened by construction operations or soils soften from exposure to weather. Refill with appropriate fill material and compact as specified herein.
- B. Excavation for Structures: Excavate to depth indicated. If excavation is deeper than indicated, then fill overexcavation to subgrade with compacted Type I fill material prior to placement of concrete.

3.6 SUBGRADE PREPARATION FOR FILLING AND BACKFILLING:

- A. Scarify the underlying subgrade surface to a minimum depth of 6 inches and recompact as specified for the adjacent or overlying fill.
- B. Compact with equipment well suited to the soil being compacted. Moisten or aerate material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction.
- C. Step, bench, or break up sloped surfaces steeper than one vertical to 4 horizontal so that the fill material will bond with or be securely keyed to the existing material.

3.7 BACKFILL AGAINST STRUCTURES:

- A. Place Type I backfill material adjacent to structures and compact in a manner that prevents wedging action or eccentric loading upon or against the structures. Step or serrate slopes bounding or within areas to be backfilled to prevent sliding of the fill. Moisten or aerate material as necessary to obtain the specified moisture content. Do not place material on surfaces that are muddy, frozen, or contain frost. Do not use equipment for backfilling against structures that will overload the structure. Backfilling against concrete shall be done only after approval has been obtained from the Engineer.

3.8 CELL BERM:

- A. Construct Cell berms using General Fill to lines and grades indicated. Use only approved materials in constructing fill on the prepared subgrade. Place material in horizontal lifts not exceeding 9 inches in loose depth. Do not place material on surfaces that are muddy, frozen, or contain frost. Compact with sheepsfoot rollers or other approved equipment well suited to the soil being compacted. Moisten or aerate material as necessary to obtain the required moisture content. Compact each lift as specified before placing the overlaying lift.

3.9 ROAD BASE SURFACING:

- A. The road base surfacing shall be placed at the locations and to the thickness shown on the Drawings. The Contractor shall mix the aggregate materials by methods that will ensure a thorough and homogenous mixture.

- B. The subgrade on which road base is placed shall be free from depressions and soft spots and shall conform to the grades shown on the Drawings.
- C. Compaction of the surfacing shall continue until a density of not less than 95 percent of the maximum density determined in accordance with ASTM D 698/AASHTO T 99 has been achieved. The surface shall be maintained during the compaction operations so that a uniform texture is produced and the aggregates are firmly keyed.
- D. Water shall be uniformly applied during compaction in the quantity necessary for proper compaction.

3.10 PLACING SPOIL IN EXISTING PONDS:

- A. Spoil shall be placed in the Section 8 and East Ponds as shown on the Drawings.
- B. The subgrade surface shall be prepared as described in Section 3.4 and 3.6.
- C. Place satisfactory material in horizontal lifts not exceeding 9 inches in loose depth.
- D. Compact each layer or lift of the spoil so that the in-place density tested is not less than 90 percent relative compaction unless otherwise specified or indicated. The spoil shall have a placement water content within 2% above and 2% below optimum moisture per ASTM D 698.

3.11 WEATHER LIMITATIONS:

- A. Fill and backfill shall not be constructed when weather conditions detrimentally affect the quality of the finished course. Place fill and backfill only if the atmospheric temperature is above freezing in the shade and is rising. Do not construct fill and backfill in the rain or on saturated subgrades. If weather conditions are windy, hot or arid, with high rate of evaporation, the placement may need to be scheduled in cooler portions of the day. Additional moisture may be needed during these times to prevent the backfill drying out during and after placement.

3.12 COMPACTION:

- A. "Relative Compaction" is defined as the ratio, expressed as a percentage, of the in-place dry density to the laboratory maximum dry density.
- B. Determine the density of soil in place by the sand cone method, ASTM D 1556 and by nuclear methods, ASTM D 6938. Compaction tests will be performed for each lift or layer. Multiple tests in a lift or work area may be performed at the direction of the Engineer.
- C. At a minimum, stockpile samples shall be taken once a week from the stockpile for laboratory testing or each time the stockpile source or material type changes.
- D. Determine laboratory moisture-density relationship of materials per ASTM D 698.
- E. Compact Type I, General Fill and Roadbase to a minimum of 95 percent of the maximum dry density and to a moisture content within 2% of the optimum moisture per ASTM D 698. Compact spoil material to a minimum of 90 percent of the maximum dry density and to a moisture content within 2% of the optimum moisture per ASTM D 698.

3.13 FINISH OPERATIONS:

- A. Site Grading: Existing grades that are to remain but are disturbed by the Contractor's operations shall be restored as specified herein.
- B. Finishing Subgrades Under Structures: Finish surface of top lift of fill or top of subgrade to the elevation and cross section indicated. Finished surface shall be smooth and of uniform texture. Lightly scarify or blade the finished surface to bring the finished surface to within 0.05 foot of the indicated grade and to eliminate imprints made by compaction and shaping equipment. Surface shall show no deviations in excess of 3/8 inch when tested with a 10-foot straightedge. The Contractor shall be responsible for maintaining the condition of the subgrade until overlying construction is complete.

3.14 SPREADING TOPSOIL:

- A. Clear areas indicated or specified to receive topsoil of materials interfering with seeding and maintenance operations. Do not place topsoil when subgrade is frozen, extremely wet or dry, or in other conditions detrimental to seeding or grading. Spread topsoil to a uniform depth of 6 inches over the designated area.

3.15 DISPOSITION OF EXCESS MATERIAL:

- A. Excess or other soil material not required or suitable for filling, backfilling, or embankment shall be wasted on site as directed by the Owner.

3.16 FIELD QUALITY CONTROL:

- A. Tests:
 - 1. Test fill using ASTM C 136 and ASTM D 1140 to determine the particle distribution of the materials and to assess conformance to the gradation requirements.
 - 2. Test fill and backfill for liquid limit, plastic limit, and plasticity index using ASTM D 4318 (AASHTO T89 and T90).
 - 3. Test fill and backfill for moisture/density relationship using ASTM D698.
 - 4. Perform a minimum of two of each of the above-required tests A1 through A3 for each stockpile of material used. Perform additional test when directed. Provide additional tests as specified above for each fill source change.
 - 5. Perform density tests in randomly selected locations using ASTM D 6938 as follows:
 - a. One test per 10,000 square feet in each layer of lift or 500 cubic yards placed whichever results in the greater amount of tests. A minimum of one set of three tests shall be performed each day fill or backfill is placed.
 - b. Determine moisture content of soil material in place at every location where in-place density is tested.
 - c. Perform at least three tests at various times over the course of the project using ASTM D1556 (sand cone moisture/density test) to verify results performed via ASTM D 6938 (nuclear methods). Prior to perform an ASTM D 1556 test, the spot shall be tested via ASTM D 6938.
 - d. Collect a record sample of fill materials for particle size analysis and Atterberg limits testing in the laboratory every 5,000 cubic yards of materials placed or when the

materials type changes. Proctor testing shall be completed as necessary to capture the different material types.

- B. The locations of field density testing shall be distributed through the different lift layers and laterally throughout the project. Additional testing may be required at the onset of fill operations to determine methods and procedures.
- C. Acceptance: Acceptance of the compacted materials shall be determined by the results of the field tests described in the paragraph "Tests" above. To be accepted, all test results must equal or exceed the specified density and moisture requirements.

- END OF SECTION –

SECTION 02370 SOIL EROSION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. Construct, maintain, and remove temporary drainage facilities as necessary to control surface water runoff, groundwater seepage, dewatering system discharges, and stream flows at the construction site so that water from these sources does not disturb the constructed facilities or cause erosion of the existing topography.
- B. Furnish all materials and labor to construct silt fences, place erosion bales and erosion control mats, and construct other sediment control methods required for prevention of water pollution of the lake and downstream drainage channels and areas, including wetlands.
- C. Maintain and remove sediment controls when no longer required.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

- A. Clearing, Grubbing, and Stripping: 02110.
- B. Earthwork: 02300.

1.3 SUBMITTALS:

- A. Submit the following in accordance with Section 01330.
- B. At least 10 calendar days prior to beginning any site clearing, stripping, grubbing, excavation, stockpiling, or other earthwork, submit a plan showing the Contractor's methods for control of surface water runoff.
- C. The plan shall also address sediment and erosion control as required by project permits and by Federal, State and local laws regarding prevention of water pollution.
 - 1. In the plan, address as a minimum, the following issues:
 - a. Sequence of construction of temporary drainage facilities relative to other construction activities.
 - b. Provisions for limiting sedimentation or other water quality effects on downstream channels and drainage areas.

SECTION 02370 SOIL EROSION AND SEDIMENT CONTROL

- c. Sequence for removal of temporary facilities.
 2. At least 10 calendar days prior to construction of the silt fences, submit product data and method of fence construction for silt fences.
 3. At least 10 calendar days prior to installation of erosion bales and erosion control mats, provide method of erosion bale and erosion control mat installation.
- 1.4 DELIVERY, STORAGE, AND HANDLING:
 - A. Erosion control mats shall be furnished in rolls with suitable wrapping to protect against moisture and extended ultraviolet exposure prior to placement.
 - B. Erosion control mat rolls shall be labeled to provide identification sufficient for inventory and quality control purposes.

PART 2 - PRODUCTS

- 2.1 EROSION BALES:
 - A. Material for erosion bales shall consist of Certified weed free hay or straw. The hay or straw shall be certified under the Colorado Department of Agriculture Weed Free Forage Certification Program and inspected as regulated by the Weed Free Forage Act, Title 35, Article 27.5., CRS. Each certified weed free erosion bale shall be identified by one of the following:
 1. One of the ties binding the bales shall consist of blue and orange twine, or
 2. One of the ties binding the bale shall consist of specially produced shiny galvanized wire, or
 3. The bale shall have a regional Forage Certification Program tag indicating the Regional Forage Certification Program Number.
 - B. Erosion bales shall be inspected for and Regionally Certified as weed free based on the Regionally Designated Noxious Weed and Undesirable Plant List for Colorado, Wyoming, Montana, Nebraska, Utah, Idaho, Kansas, and South Dakota.

SECTION 02370 SOIL EROSION AND SEDIMENT CONTROL

- C. The Contractor shall not unload certified weed free erosion bales or remove their identifying twine, wire or tags until the Owner has inspected and accepted them.
- D. The Contractor shall provide a certificate of compliance showing the transit certificate number or a copy of the transit certificate as supplied from the forage producer.
- E. The Contractor may obtain a current list of Colorado Weed Free Forage Crop Producers who have completed certification by contacting the Colorado Department of Agriculture, Division of Plant Industry, 700 Kipling Street, Suite 4000, Lakewood, Co 80215, (303) 239- 4149.
- F. Bales shall be approximately 5 cubic feet of material and weigh not less than 35 pounds.

2.2 SILT FENCES:

- A. Silt fences for sediment control shall consist of fabric and posts suitable for sedimentation control application.
- B. Silt fence posts shall be metal or wood with a minimum length of 36 inches. Metal posts shall be “studded tee” or “U” type with minimum weight of 1.33 pounds per linear foot. Wood posts shall have a minimum diameter or cross section dimension of 2 inches.
- C. Silt fence geotextile shall conform to the following:
 - 1. Fibers used in the manufacture of the geotextile, and the threads used in joining geotextiles by sewing, shall consist of long chain synthetic polymers composed of at least 95 percent by weight polyolefins, polyesters, or polyamides. They shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including selvages.
 - 2. Geotextiles for silt fence applications shall be UV (ultra-violet) protected and shall conform to the following physical requirements:

SECTION 02370 SOIL EROSION AND SEDIMENT CONTROL

Property	Wire Fence Supported Requirements	Self Supported Requirements	Test Method
Tensile Strength, (lbs)	90 Minimum	90 Minimum	ASTM D 4632
Elongation at 50% minimum tensile strength	N/A	50 Maximum	ASTM D 4632
Permittivity ¹ s-1	0.01 Minimum	0.01 Minimum	ASTM D 4491
Apparent Opening Size (AOS), mm	0.84 Maximum	0.84 Maximum	ASTM D 4751
Ultraviolet Degradation at 500 hours	Minimum 70% Strength Retained	Minimum 70% Strength Retained	ASTM D 4355

¹ Permittivity and AOS do not relate directly to filtration performance of silt fence fabrics. Values presented reflect minimum criteria of products currently used. Performance tests such as VTM-51 (from Virginia Highway Research Council) may be used to evaluate silt fence performance if deemed necessary by the Engineer.

2.3 EROSION CONTROL MATS:

- A. Erosion control mats shall be used for erosion control and vegetation establishment on roadside embankments where natural vegetation will provide long term stabilization.
- B. The erosion control mat shall be a machine-produced mat of 100 percent agricultural straw with a functional longevity of 12 months. The matting shall be of consistent thickness with the straw evenly distributed over the area of the mat. The matting shall be covered on the top and bottom sides with 100% biodegradable woven natural fiber netting. The netting shall consist of machine directional strands interwoven through the twisted machine strands to form an approximate 0.50 x 1.0 inch mesh. The blanket shall be sewn

SECTION 02370 SOIL EROSION AND SEDIMENT CONTROL

together on 1.50 inch centers with degradable thread. The blanket shall be manufactured with colored thread stitched along both outer edges approximately 2 to 5 inches from the edge as an overlap guide for the mat. The mat shall meet Type 2D specification requirements established by the erosion control technology Council and Federal Highway Administration FP-03 Section 713.17

C. Material Content:

Matrix:	100% Straw Fiber (0.50 lb/yd ²)
Top Side Netting:	Leno Woven 100% biodegradable organic jute (9.0 lbs/1,000 ft ² approximate weight)
Bottom Side Netting:	100% biodegradable organic jute (7.7 lbs/1,000 ft ² approximate weight)
Thread:	Degradable

D. Anchorage: Stakes or staples for anchorage of the mats shall be as recommended by the erosion control mat manufacturer.

E. Product and Manufacturer: S150N Erosion Control Blanket by North American Green, Evansville, IN 47725; or equal.

2.4 WATTLES:

A. Wattles shall be 9 inch or 12 inch diameter biodegradable wattles of agricultural straw and shall be wrapped in tubular organic, woven jute net. The netting weight shall be approximately 1.28 ounces/linear ft. and shall be made from Leno woven, lightweight woven jute netting. The netting shall have aperture openings measuring 0.50 x 1.0 inches. The wattle ends will be secured with wire closures. They shall be installed on contours and staked with 18 to 24 inch long wood stakes at four foot on centers.

B. Material Content

Matrix:	100% Straw Fiber (2.88 lb/linear ft.)
Netting:	Tubular, diamond-shaped woven jute netting (1.28 oz./linear ft approximate weight)
Wire Closure	Industrial grade ring wire (3.75 inches)

SECTION 02370 SOIL EROSION AND SEDIMENT CONTROL

2.5 TEMPORARY BERMS:

- A. Temporary berms shall be constructed of compacted soil.

2.6 VEHICLE TRACKING CONTROL

- A. Vehicle Tracking Control pad shall be as shown on the Drawings.

PART 3 - EXECUTION

3.1 SEDIMENT AND EROSION CONTROLS:

- A. Install sediment and erosion controls in accordance with approved drawings and permits.
- B. Install sediment and erosion controls prior to work involving site clearing, stripping and excavation.
- C. Silt fence fabric shall be attached to posts with a minimum of three staples per post. The silt fence shall be installed as shown on the Drawings to prevent silt-laden runoff water from running beneath the fence and over the ground surface.
- D. Erosion bales shall be placed embedded into the soil and shall be anchored securely to the ground with wood stakes. Stakes shall have a minimum diameter or cross section dimension of 2 inches. Re-bars shall not be used. Gaps between bales shall be filled with certified weed free mulch or loose straw to obtain tight joints. Galvanized wire or twine shall be tied around individual erosion bales and to the stakes to provide additional stability.
- E. Maintain and repair sediment and erosion controls during the course of construction, as required. Sediment shall be removed from behind the silt fence when it accumulates to one half the exposed geotextile height.
- F. Before placing the erosion control mats, ensure the subgrade has been graded smooth; has no depressed, void areas; is free from obstructions, such as tree roots, projecting stones or other foreign matter. Vehicles shall not be permitted directly on the mats.
- G. Erosion control mats shall be installed in accordance with manufacturer's recommendations. Erosion mats shall be installed on

SECTION 02370 SOIL EROSION AND SEDIMENT CONTROL

slopes steeper than 2H:1V and as required to establish vegetation.

- H. Erosion control mats shall be oriented in vertical strips and anchored with stakes or staples. Adjacent strips shall be abutted to allow for installation of a common row of stakes or staples. Horizontal joints between erosion control mats shall be overlapped sufficiently to accommodate a common row of stakes or staples with the uphill end on top.
- I. Where terminating in a channel or ditch containing an installed mat, the erosion control mat shall overlap installed mat sufficiently to accommodate a common row of stakes or staples.

3.2 REMOVAL OF TEMPORARY FACILITIES:

- A. Do not remove silt fences, erosion bales, or other temporary erosion control facilities without written approval from the Owner.
- B. Silt fence and erosion bales shall remain the property of the Contractor and shall be removed offsite after all Work is complete.
- C. Sediment removed during maintenance of erosion control features shall be wasted at locations directed by the Owner that will not contribute sediment offsite and can be permanently stabilized.
- D. Restore disturbed areas to the satisfaction of the Engineer.

- END OF SECTION -

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. The work of this Section includes furnishing and placing rock riprap and riprap bedding at the locations shown on the Drawings.

1.2 REFERENCES:

A. American Association of State Highway and Transportation Officials (AASHTO):

- 1. AASHTO T 24 Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

B. ASTM International (ASTM):

- 1. ASTM C 535 Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

- 2. ASTM D 7012 Standard Test Method for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens Under Varying States of Stress and Temperatures

C. Urban Drainage and Flood Control District:

- 1. Drainage Criteria Manual, Volume 1,

1.3 SUBMITTALS:

- A. Submit the following in accordance with Section 01330.

- B. Trip tickets showing source, type, and weight of each load of material delivered to site.

- C. Quality Control Submittals:

Certified Test Results:

Riprap: Provide the following test results prior to importing to the project site and during production on request of Engineer:

- 1) Gradation.
- 2) Abrasion Resistance: ASTM C 535.
- 3) Unconfined Compressive Strength: ASTM D 7012.

Submit certified test results for riprap within 14 days after award of contract.

1.4 QUALITY ASSURANCE:

- A. Riprap Source: Rock for riprap shall be procured from a quarry that has produced riprap and has performed satisfactorily on other projects for at least 3 years.

PART 2 - PRODUCTS

2.1 RIPRAP:

- A. Rock for riprap shall be of the size noted on the Drawings and shall consist of hard, dense, durable quarry stone, angular in shape, well-graded, and resistant to weathering. Rounded stone or boulders will not be accepted as riprap material. The stone shall have a specific gravity of at least 2.5.
- B. Do not use flat or elongated shapes unless the thickness of the individual pieces is at least one-third the length.
- C. Material shall be clean and free from deleterious impurities including alkali, earth, clay, refuse, and adherent coatings.
- D. Riprap material shall meet the following requirements for abrasion resistance and compressive strength:

<u>Test Description</u>	<u>Test Method</u>	<u>Specification Requirement</u>
Abrasion Resistance by Los Angeles Machine	ASTM C 535	50% loss, max.

Unconfined Compressive Strength of Drilled Core Specimen	AASHTO T 24	2500 psi, min.
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PART 3 -- EXECUTION

- 3.1 SUBGRADE PREPARATION:
- A. Prepare subgrade to receive riprap in accordance with Section 02300.
- 3.2 PLACING RIPRAP:
- A. Place riprap to the lines, grades, and thicknesses shown on the Drawings. Stones with typical stone dimensions that are equal to d_{50} and larger shall be placed at the top surface with faces and shapes matched to minimize voids and form as smooth a surface as practical.
- B. Dumping and backhoe placement alone is not sufficient to ensure a properly interlocked system. The material may be machine-placed and then arranged as necessary by use of equipment such as a Gradall with multi-prong gapple device or by hand to interlock and form a substantial bond. Riprap shall be placed with smaller rock fragments used to fill in the voids between larger rock fragments in such a manner as to form a smooth, uniform, well-graded layer of riprap that is stable and not susceptible to sliding. Riprap shall also be placed to form smooth transitions to embankment slopes, channel slopes, and channel side slopes. No distinct horizontal, vertical or angular joints will be allowed in the riprap that would reduce the interlocking capability of the riprap.
- C. After final placement to line and grade and before grouting, the riprap shall be plated by mechanical means so there are no protruding angular surfaces above finish grade.

- END OF SECTION -

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section includes selective demolition of concrete, miscellaneous metals and any other items required to complete the work shown on the Drawings and as specified herein.

PART 2 - MATERIALS

(Not Used)

PART 3 - EXECUTION

3.1 GENERAL

- A. Perform removal and salvage work specified herein and indicated on the Drawings in a manner that will not damage parts of the existing systems not intended to be removed and parts that are to be removed and salvaged. Items to be salvaged, which are damaged by the Contractor, shall be repaired or replaced with new undamaged items at the expense of the Contractor and as approved by the Engineer.
- B. If, in the opinion of the Engineer, the method of demolition used may endanger or damage parts of the existing systems to remain, parts of existing systems to be removed and reinstalled, or affect the satisfactory operation of the existing facilities, promptly change the method when so notified by the Engineer.
- C. Blasting will not be allowed as a method of demolition.
- D. Protect utilities and existing improvements that are not to be removed from injury or damage resulting from the Contractor's operation.
- E. During demolition supply safeguards required by applicable codes or regulations, including warning signs and lights, barricades, and the like, for protection of the public and Contractor's employees.
- F. The City of Thornton wants to keep the pipes, staff gage, gates and anything else salvageable. The Contractor shall coordinate with the City of Thornton about what items are to be salvaged. Items should be removed in such a manner that they are not damaged and can be re-used.

3.2 REMOVING EXISTING CONCRETE

- A. The concrete shall be removed in a manner acceptable to the Engineer.
- B. In general remove materials as follows:
 - 1. Locate and identify reinforcing bars in concrete prior to drilling and cutting, and protect structural integrity of existing work.
 - 2. Use removal methods that will not crack or structurally affect adjacent concrete construction.
 - 3. Cut back concrete to clean, straight lines by saw cutting a minimum of 1-inch deep; remainder of concrete may be jack-hammered.
 - 4. Where the cut end of concrete reinforcement or other metal embedded items are exposed by demolition that will not be protected by new concrete, coat the exposed surface with an epoxy paste or remove the exposed metal item 1.5" below the surface of the concrete and patch with a cement grout.

3.3 DISPOSAL

- A. All salvageable items shall be set aside for the City of Thornton to haul off.
- B. All other removed materials shall become the property of the Contractor and be removed from the project site.

- END OF SECTION -

SECTION 02950
OF DISTURBED AREAS

SEEDING, AND RECLAMATION

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. The work of this Section includes seeding embankment slopes and reclaiming disturbed areas resulting from required construction, including Contractor staging and stockpile areas, areas shown on the Drawings and other disturbed areas as directed by the Engineer.

1.2 PROTECTION:

- A. The Contractor shall protect areas outside the limits of site disturbance from damage. Any disturbance of vegetation or native ground outside of the limits of site disturbance shown on the Drawings shall be reclaimed by the Contractor at no additional expense to the Owner.

1.3 SEEDING PERIOD:

- A. Seeding shall be performed during the time period from November 1st through April 30th.

1.4 QUALITY ASSURANCE:

- A. Grass seed shall meet the tolerance for germination and purity in accordance with the U.S. Department of Agriculture Federal Seed Act (53 Stat. 1275) Rules and Regulations, as amended to date.

1.5 GUARANTEE:

- A. All seeded areas shall be guaranteed for 12 months after the date of final acceptance.
- B. Any seeded areas showing indication of probable non-survival or lack of health and vigor, or which do not exhibit the characteristics to meet the specifications, shall be reseeded after notice from the Owner. All replacement seeding shall be furnished and installed at no additional cost to the Owner and shall be guaranteed for 12 months from the date of reseeded. All replacements shall meet the original specifications.
- C. The Contractor shall notify the Owner 10 calendar days prior to the end of the guarantee period and such guarantee shall be extended until notification is received.

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- D. At the end of the guarantee period, all seeded areas that are dead or in unsatisfactory growth shall be replaced.

PART 2 - PRODUCTS

2.1 GRASS SEED MIX:

- A. Grass seeds shall be supplied by the Contractor and be Thornton Native Seed Mix (38.5 lbs/acre). Mixture shall consist of the following:
- 30% Western Wheatgrass
 - 30% Sand Dropseed
 - 20% Sideoats Grama
 - 10% Green Needlegrass
 - 10% Blue Grama

The Contractor shall furnish to the Owner a signed statement certifying that the seed is from a lot that has been tested by a recognized laboratory for seed testing within six months prior to the date of seeding.

- B. Each bag shall be tagged or labeled as required by the Colorado Seed Law.
- C. Grass seeds shall be delivered to the site in bags or containers that are unopened and clearly labeled to show the name and address of the supplier, the seed name, lot number, net weight of seed, the percentage of weed seed, the guaranteed percent purity, and the guaranteed percent germination.
- D. All seed furnished shall be free from such noxious seeds such as Russian or Canadian thistle, European bindweed, Johnson grass, and Leafy Spurge.
- E. Seed that has become wet, moldy, or otherwise damaged in transit or storage will not be accepted.
- F. Seed and seed labels shall conform to all current State and Federal regulations and will be subject to the testing provisions of the Association of Official Seed Analysis.
- G. Computations for quantity of seed required on the project shall include the percent of purity and percent of germination. If seed available on

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the market does not meet the minimum purity and germination percentages specified, the Contractor shall compensate for a lesser percentage of purity or germination by furnishing sufficient additional seed to equal the specified product. Product comparison shall be made on the basis of pure live seed (PLS) in pounds, stated on each seed bag. The formula used for determining the quantity of PLS shall be:

$$\text{Pounds of Seed} \times (\text{Purity} \times \text{Germination}) = \text{Pounds of PLS}$$

2.2 MULCH:

- A. Mulch shall be clean rice, barley, or wheat straw.
1. Materials for hay or straw mulching shall consist of Certified Weed Free field or marsh hay or straw of oats, barley, wheat, rye or triticale certified under the Colorado Department of Agriculture Weed Free Forage Certification Program and inspected as regulated by the Weed Free Forage Act, Title 35, Article 27.5, CRS.
 2. Each certified weed free mulch bale shall be identified by one of the following:
 - a. One of the ties binding the bale shall consist of blue and orange twine, or
 - b. One of the ties binding the bale shall consist of specially produced galvanized shiny wire, or
 - c. The bale shall have a regional Forage Certification Program tag indicating the Regional Forage Certification Program Number.
 3. Mulch shall be inspected for and Regionally Certified as weed free based on the Regionally Designated Noxious Weed and Undesirable Plant List for Colorado, Wyoming, Montana, Nebraska, Utah, Idaho, Kansas and South Dakota.
 4. The Contractor shall not unload certified weed free mulch bales or remove their identifying twine, wire, or tags until the Engineer has inspected and accepted them.
 5. The Contractor shall provide a transit certificate that has been

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filled out and signed by the grower and by the Department of Agriculture inspector.

6. The Contractor may obtain a current list of Colorado Weed Free Forage Crop Producers who have completed certification by contacting the Colorado Department of Agriculture, Division of Plant Industry.
7. Straw or hay in an advanced stage of decomposition or old, dry straw that breaks in the crimping process will not be accepted.

2.3 EROSION CONTROL

- A. In accordance with Section 02370.

2.4 TOPSOIL:

- A. Topsoil shall be suitable material, as determined by the Engineer, removed from areas required to be stripped under these Specifications or imported material complying with the following requirements.
- B. Topsoil shall be loose, friable, and organic loamy soil free from large roots, sticks, weeds, brush, or stones larger than 1 inch, or other litter and waste products. At least 90 percent shall pass through the No. 10 sieve.

PART 3 - EXECUTION

3.1 PREPARATION:

- A. All areas to be seeded or reclaimed shall receive topsoil, grass seed, and either erosion control mats or mulch as specified herein.
- B. Prior to reclaiming any disturbed areas, remove all Contractor's equipment, debris, construction materials, office facilities, temporary fences or gates, and all other Contractor's properties. Final grade all disturbed areas with a smooth blade grader, bulldozer, or other approved equipment, to the lines and grades as directed.
- C. Soil Preparation: Place 4 inches of topsoil on tops and slopes of embankments and other areas to be seeded. Preparatory to seeding, the topsoil shall be tilled into an even and loose seedbed 4 inches

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deep. Existing slopes shall be free of clods in excess of 3 inches in diameter and brought to the desired line and grade prior to placing topsoil.

3.2 SEEDING

- A. Seeding shall follow behind tilling to make special seed bed preparation unnecessary. The seeding application rate shall be as specified. Seeded areas shall be moist before seeding by drilling. Seeding shall provide a full stand of grass.
- B. All slopes flatter than 2:1 shall be seeded by mechanical power drawn drills followed by packer wheels or drag chains. Mechanical power drawn drills shall have depth bands set to maintain a planting depth of at least 1/4 inch and shall be set to space the rows not more than 7 inches apart. Seed that is extremely small shall be sowed from a separate hopper adjusted to the proper rate of application. If strips greater than 7 inches between the rows have been left unplanted or other areas skipped, the Engineer will require additional seeding at the Contractor's expense.
- C. When requested by the Contractor and approved by the Engineer, seeding may be accomplished by broadcast or hydraulic type seeders at twice the rate specified at no additional cost to the Owner.
- D. Seed shall not be drilled or sown during windy weather or when the ground is frozen or otherwise untillable.
- E. All seed sown by broadcast-type seeders shall be "raked in" or covered with soil to a depth of at least 1/4-inch. Broadcasting seed will be permitted only on small areas not accessible to machine methods.

3.3 PLACING EROSION CONTROL MEASURES

- A. The erosion control measures shall be placed in accordance with the approved drawings, permits, and the requirements of Section 02370.

3.4 MULCHING

- A. Hay or Straw Mulching: Hay or straw mulching shall be placed on seeded areas at locations other than where erosion control mats are required.

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- B. Mulching shall require anchoring or some type such as tacking, matting, hand punching, roller punching, crimper punching, or hydro-seeding to prevent blowing or washing away. Mulch application rate shall be two tons per acre or one 74 pound bale per 800 square feet. Areas not mulched and crimped within 24 hours after seeding and prior to precipitation on site shall be reseeded with the specified seed mix at the Contractor's expense, prior to mulching and crimping.

3.5 MAINTENANCE:

- A. Maintain grassed areas between substantial completion and final acceptance.

- END OF SECTION

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This Section covers the furnishing of all labor, equipment, material and services to:
 - 1. Obtain from an approved source and/or furnish, calibrate, maintain, and operate a satisfactory concrete batching plant with central mixer and/or truck-mixer to deliver properly mixed concrete mix type AA to the required point of placement at the site, in accordance with the requirements of these specifications.
 - 2. Furnish throughout the duration of the concrete work, certified material test reports for cement used for this project.
 - 3. Furnish concrete mix designs and supporting test data in accordance with paragraph 2.7, herein.
 - 4. Provide heating of the water and/or aggregates for mixing concrete during cold weather.
 - 5. Provide cooling of the water and/or aggregates for mixing concrete during hot weather.
 - 6. Obtain NRMCA certification and submit a copy of the Certificate to the Engineer. Provide periodic equipment checks and recertification as required by the NRMCA program.
 - 7. Deposit rejected material in an approved disposal area.
 - 8. Deposit wash water in an on-site disposal area designated by the Engineer.

1.2 REFERENCES:

- A. American Concrete Institute (ACI):
 - 1. ACI 301 Specifications for Structural Concrete
 - 2. ACI 304R Guide for Measuring, Mixing, Transporting, and Placing Concrete
 - 3. ACI 305R Guide to Hot Weather Concreting

4. AC3 306R Guide to Cold Weather Concreting
- B. ASTM International (ASTM):
1. ASTM C 33 Specification for Concrete Aggregates
 2. ASTM C 94 Specification for Ready-Mixed Concrete
 3. ASTM C 150 Specification for Portland Cement
 4. ASTM C 260 Specification for Air-Entraining Admixtures for Concrete
 5. ASTM C 494 Specification for Chemical Admixtures for Concrete
 6. ASTM C 618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
- C. Concrete Plant Manufacturer's Bureau:
1. Concrete Plant Standards of the Concrete Plant Manufacturer's Bureau
 2. Concrete Plant Mixer Standards of the Plant Mixer Manufacturers Division
- D. National Ready Mixed Concrete Association (NRMCA):
1. NRMCA Certification of Ready Mixed Concrete Production Facilities Certification Program
- E. Truck Mixer Manufacturer's Bureau:
1. Truck Mixer Truck And Agitator Standards Mixer Manufacturers' Bureau

1.3 SUBMITTALS:

- A. Submit the following in accordance with Section 01330.

- B. Pre Construction - Provide the following submittals:
1. NRMCA certificate (See paragraph 1.3.B.8, below).
 2. Prequalification test data and manufacturer's literature on proposed cement and admixtures for proposed concrete mixes (See paragraph 2.2 and paragraph 2.3, herein.)
 3. Dates of most recent calibration of weighing and measuring equipment. (See paragraph 1.4, herein.)
 4. Proposed concrete mix design proportions with supporting test data. (See paragraph 2.7, herein.)
 5. Listing of sources and full technical identification of proposed cement, aggregates, admixtures, and water.
 6. Description of proposed batching, mixing, and delivering operation.
 7. Uniformity tests results for stationary and truck mixers.
 8. A current certificate from the National Ready Mix Concrete Association (NRMCA) which certifies that concrete batching equipment and facilities conform to the NRMCA Certification Program requirements.
 9. A certificate stating that the concrete batching equipment and facilities bear a rating plate issued by the Truck Mixer Manufacturer's Bureau.

1.4 QUALITY ASSURANCE REQUIREMENTS:

A. Hold Points:

The following are the mandatory hold points for which prior notification is required:

1. Receipt by the Engineer of the equipment certifications as required in this Section and paragraph 1.3, above.
2. Approval by the Engineer of the concrete materials and mix proportions.

1.5 TESTING CONCRETE AND CONCRETE MATERIALS

- A. Routine testing of concrete materials and of concrete will conform to ACI 301.
- B. Provide access for and cooperate with the Owner's testing agency. The Owner's testing agency shall be allowed access to the concrete plant as appropriate to conduct the testing.
- C. Test results for concrete will be evaluated in accordance with ACI 301.

PART 2 - PRODUCTS**2.1 STORAGE OF MATERIALS:**

- A. Materials shall be stored in accordance with ACI 301.

2.2 CEMENT:

- A. All cement shall conform to ASTM C 150, Type II, low alkali and low heat. Air-entraining cement shall not be used.
- B. Certified mill test reports for the cement used on this project shall be retained for the duration of the concrete work.
- C. The mill test reports for cement shall show, in addition to physical and chemical properties, the date delivered to the batching plant, the date of manufacture and lot number, and controlling ASTM specification and type.
- D. Cement that has become caked, partially set, deteriorated, damaged or contaminated shall not be used. The temperature of the cement as delivered to the Contractor's concrete plant shall not exceed 150 °F.

2.3 ADMIXTURES

- A. An air-entraining agent shall be used in concrete mix type AA to entrain the specified percentage of air, by volume, in the concrete. This agent shall conform to the requirements of ASTM C 260. Air entraining agents shall be one of the following: Darex or Daravair by W.R. Grace; MBVR or MB-AE10 by Master Builders; Protex Air Entraining Solution by Protex Industries, Inc.; or Engineer approved equal. In the batching process, the air entraining solution shall be added to the batching water.

- B. Mineral fillers and calcium chloride shall not be used. Chemical admixtures except water reducing and retarding agents shall also not be used. Water reducing agents and retarders shall only be used as noted herein or as approved by the Engineer.

2.4 AGGREGATES

- A. Fine and coarse aggregates shall conform to ASTM C 33. Aggregate shall come from an Engineer approved source.

2.5 WATER

- A. Mixing water for all concrete work shall be clean and clear and free from injurious amounts of oil, acids, alkalies, organic matter, or other deleterious substances, and shall conform to the requirements of ASTM C 94.

2.6 FLYASH

- A. All concrete mixes shall make use of flyash in the mix design. Flyash shall be ASTM C 615, Class F.

2.7 TECHNICAL REQUIREMENTS

- A. Proportioning: The concrete supplied shall have the following properties:

MIX TYPE AA:

Mix Parameter:	Reinforced Structural Concrete
Slump:	4 inches ± 1 inch (In accordance with ACI 301)
Maximum Coarse Aggregate Size:	3/4 in.
Coarse Aggregate Gradation:	ASTM C 33, Size No. 67
Required Percent Range Air Entrainment:	5-8
Design Strength (28 Days):	4,500 psi
Maximum Water/Cementitious	

Ratio

0.42

- B. Mix type AA shall be used for the reinforced concrete work on the project.
- C. The Contractor shall use established and tested concrete mix proportions based on the provisions of ACI 301, to obtain a mix that satisfies the above requirements. The Contractor shall not deliberately overdesign the concrete mix 28-day compressive strength without written approval of the Engineer. Actual mixes used shall be based on the results of test mix data submitted by the Contractor for evaluation by the Engineer. In no case shall concrete achieve a compressive strength at 28 days greater than 2,000 psi above the minimum specified compressive strength.

2.8 SLUMP REQUIREMENTS

- A. The slump for each delivery shall meet the specified slump. Concrete that fails to meet the specified slump within the tolerances permitted in ASTM C 94.

2.9 REJECTION OF CONCRETE

- A. Any concrete that does not meet the requirements of the mix type as specified above shall be rejected.
- B. Any concrete that has not been discharged from the delivery vehicle within 1 1/2 hours after batching shall be rejected except during periods of hot weather as defined by ACI 305. The time limit shall be 45 minutes or commencement of initial set, whichever occurs first.
- C. The Owner's testing agency will immediately notify the Engineer when any concrete is rejected.

PART 3 - EXECUTION**3.1 INSTALLATION:**

- A. Batching, Mixing and Delivery:
 - 1. Basic Requirements:
 - a. Concrete materials shall be batched, mixed, and transported in accordance with ASTM C 94.

- b. The temperature of cement shall not exceed 150 °F at the time of batching.
 - c. Starter grout mixtures shall be uniform and controlled to the same temperature and time requirements as specified for concrete mixes.
 - d. Where truck mixers are used to transport concrete, a suitable portion of the allowable water may be withheld until the truck reaches the point of discharge. Also, slump adjustments must be made at the placement site not exceeding the slump range specified herein, in accordance with ACI 301.
 - e. For concrete batched on-site, three batching tickets shall be provided for each concrete batch that is mixed. The ticket shall include the date, quantity of concrete mixed, the mix designation, location of concrete placement, and any other pertinent information required by the Engineer.
 - f. For concrete batched off-site, three batching tickets shall be provided and shall accompany each delivery truck to the point of discharge. Each record ticket shall have the name of the Contractor and supplier/subcontractor, the job location and the mix designation.
 - g. The Engineer shall specifically approve the method of batching, mixing and delivering the concrete to the point of discharge.
2. Batching:
- a. Batching shall conform to the Concrete Plant Manufacturers Bureau standards and shall meet the following additional requirements:
 - b. Hot weather conditions may require partial or total replacement of mixing water with ice. Ice shall be weighed to within 1 percent by weight.
 - c. Adequate equipment shall be provided at the batch plant for heating concrete materials and protecting the

concrete in transit during freezing or near freezing weather. The heating equipment shall have sufficient capacity so that the concrete produced meet the temperature limitations given in ACI 301.

- d. Batch admixtures in accordance with the manufacturer's instructions and the provisions of ACI 301.
3. Truck Mixers:
 - a. Truck mixers shall comply with the requirements of the Truck Mixer and Agitator Standards.
 - b. The suitability of these units as mixers shall be demonstrated by making a mixer uniformity test in accordance with ASTM C 94 for each mixer of different design and blade conditions initially and thereafter whenever requested by the Engineer.
 - c. Each truck shall have a revolution counter and an automatic water-measuring device in good working order.
 4. Central Mixers:
 - a. Central mixers shall conform to Concrete Plant Mixer Standards. Mixer uniformity tests shall be made in conformance with ASTM C 94 in addition to requirements of the NRMCA Certification program.
 - b. Mixing time established by mixer uniformity tests shall not be less than 1 min. The mixing time established by these tests shall be used for all concrete mixes produced.
 5. Delivery:
 - a. Modern truck mixers conforming to ASTM C 94 shall be provided for transporting the concrete.
 - b. Trucks shall comply with the requirements of the Truck Mixer and Agitator Standards.
 - c. Freshly mixed concrete and starter grout shall be delivered to the point of placement in accordance with

ASTM C 94 and in a thoroughly mixed, homogeneous condition, with uniform consistency from batch to batch. Discharge of concrete from trucks shall be completed within 90 minutes, or before the truck drum has revolved 300 revolutions, after the introduction of mixing water to the cement and aggregates.

- d. Rejected concrete shall be removed from the site.
 - e. Slump adjustment shall be in conformance with ASTM C 94. Once discharge of concrete to placement has started, no further adjustment of water content shall be permitted.
 - f. Evidence of premature setting, or of unusual heating-up of the concrete in the truck shall be cause for rejection of the load at the Contractor's expense.
 - g. Concrete delivery trucks shall not have aluminum chutes. All chutes shall be round-bottomed.
 - h. Wash water for cleaning concrete delivery trucks shall be collected in approved sediment pit. The Contractor shall periodically remove and dispose of collected waste concrete offsite.
- B. Cold Weather Requirements:
- 1. Cold weather requirements for concreting shall conform to ACI 301. No frozen materials or materials containing ice shall be used.
 - 2. Concrete materials shall be heated sufficiently to compensate for heat loss and allow placement of the batch within 90 minutes after mixing, at or above the placing temperatures listed in ACI 301.
- C. Hot Weather Requirements:
- 1. Hot weather requirements for concreting shall conform to ACI 301. All concrete shall be delivered to the forms at all times at the coolest temperature that is practicable under the existing conditions.
 - 2. Concrete will not be acceptable if it has a temperature in

excess of 90 °F at time of placement.

3.2 COMMUNICATION SYSTEM:

- A. A radio communication system shall be provided and maintained between the batch plant and each delivery vehicle.

- END OF SECTION -

PART 1 - GENERAL

1.2 DESCRIPTION:

- A. This Section covers work necessary for the detailing, furnishing, cutting, bending, bundling, tagging, mill testing, providing placing drawings, and delivering all reinforcing steel, including dowels, used in the Work.

1.3 REFERENCES:

A. American Concrete Institute (ACI):

1. ACI 315R Guide to Presenting Reinforcing Steel Design Details
2. ACI 318 Building Code Requirements for Structural Concrete

B. ASTM International (ASTM):

1. ASTM A 615 Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement
2. ASTM A 706 Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement

C. Concrete Reinforcing Steel Institute (CRSI):

1. CRSI Manual of Standard Practice

1.4 SUBMITTALS:

- A. Submit the following in accordance with Section 01330.
- B. Pre-Construction: Provide the following submittals:
1. Shop Drawings: Prepare and submit detail and placing drawings.
 2. Test Reports: Submit mill test reports as required in paragraph 1.4.A., herein.

1.5 QUALITY ASSURANCE REQUIREMENTS:**A. Tests of Reinforcing Steel:**

1. Physical and chemical tests shall be performed for deformed bars for each heat of reinforcing in accordance with ASTM A 615.
2. Copies of certified mill test reports (CMTR's) for the chemical ladle analyses and mill physical tests shall be furnished for each heat.

1.6 DELIVERY, STORAGE, AND HANDLING:**A. Shipping Requirements:**

1. The reinforcing steel shall be free from contamination of grease, oil, dirt, and other foreign matter during fabrication and delivery. Any foreign matter on the reinforcing steel shall be removed prior to shipment.
2. Bars shall be bundled and tagged for ready identification in the field. A fabrication identification tag shall be placed at one end of each bundle. Tags and tag markings shall be weatherproof and securely attached to each bundle to provide positive identification at delivery. Bundles received without tags shall be returned to the supplier/subcontractor at no expense to the Owner.
3. No bundle may include more than one grade, size, and length or configuration of reinforcing steel.

B. Delivery:

1. All reinforcing steel shall be delivered to the jobsite as directed by the Contractor to satisfy the construction schedule.

PART 2 - PRODUCTS**2.1 MATERIALS:**

- A. Reinforcing Bars: Reinforcement shall be new deformed reinforcement having a minimum yield strength of 60,000 psi conforming to ASTM A 615, Grade 60 and the supplementary requirements. Reinforcement that is to be welded as required per the Drawings shall be new and

have a minimum yield strength of 60,000 psi and shall conform to ASTM A 706.

B. Dowel Bars and Expansion Caps:

1. Dowel bars shall be plain steel bars of the size shown on the Drawings conforming to ASTM A 615 and shall be free from burring or other deformation restricting slippage in the concrete.
2. Expansion caps for dowel bars shall be metal, PVC, or other type of an approved design to cover 2 to 3 inches of the dowel, with a closed end and with a suitable stop to hold the end of the cap at least the width of the joint plus 1/4 inch away from the end of the dowel bar. Caps shall be of such design that they will not collapse during construction. The cap shall be fitted on the trailing end of the dowel bar as shown on the Drawings.

C. Bar Couplers:

1. Reinforcing steel bar splicing couplers shall be a mechanical type as manufactured by BarSplice Products Inc., or equal. Couplers shall develop 125% of the specified yield strength of the reinforcing bars. Make field demonstrations and sample splicing prior to splicing bars being included into the work.

D. The required mill physical and chemical tests are delineated in paragraph 1.4.A., herein.

E. Tie Wire

1. Tie Wires for Reinforcement shall be 16-gauge or heavier, black annealed wire.

F. Steel Accessories:

1. Plastic Protected Bar Supports: CRSI Bar Support Specifications, Class 1 Maximum Protection.
2. Stainless Steel Protected Bar Supports: CRSI Bar Support Specifications, Class 2 Moderate Protection.
3. Precast Concrete Block Bar Supports: CRSI Bar Support Specifications, Precast Blocks. Blocks shall have equal or greater strength than the surrounding concrete.

PART 3 - EXECUTION**3.1 DETAILING AND FABRICATION:**

- A. Unless otherwise indicated, all reinforcing steel shall be detailed and fabricated in accordance with ACI 315. The Contractor shall supply placing drawings and bar lists in accordance with ACI 315.
- B. Details of concrete reinforcement not covered in ACI 315 shall be in accordance with the CRSI Manual.

3.2 ACCESSORIES:

- A. Determine, provide and install accessories such as chairs, chair bars and the like in sufficient quantities and strength to adequately support the reinforcement and prevent its displacement during the erection of the reinforcement and the placement of concrete.
- B. Use precast concrete blocks where the reinforcing steel is to be supported over soil. Precast blocks shall not be used at exposed formed surfaces.

- END OF SECTION -

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This Section covers the furnishing of all labor, equipment, material and services to:

1. Furnish, unload, handle, assemble, erect, strip, and clean all required formwork, including necessary scaffolding, for placement of concrete, formwork and reinforcing.
2. Furnish, unload, handle, store, and properly install all waterstop.
3. Furnish store, and install all form materials, curing compounds, curing papers, curing blankets, form release agents, inserts, sleeves and pipe, bar support and centering accessories.
4. Unload, store, handle, and install all reinforcing steel including necessary field fabricating and including all accessories for positioning and supporting reinforcement against displacement.
5. Maintain proper conditions for working at the site and for placing reinforcing steel and concrete in the dry.
6. Weld reinforcing steel if required, and only with specific written approval of the Engineer.
7. Clean and prepare surfaces of construction joints and existing concrete surfaces against which new concrete is to be placed as required.
8. Drill holes in existing concrete for, and epoxy grout, reinforcing bars in place.
9. Schedule, order, place, vibrate, finish and cure concrete mix type AA, including patching, mortar, and bonding paste.
10. Unload, handle, store and properly install all embedded items.

1.2 REFERENCES:

A. American Concrete Institute (ACI):

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1. ACI 301 Specifications for Concrete Construction
 2. ACI 304R Guide for Measuring, Mixing, Transporting and Placing Concrete
 3. ACI 305R Hot Weather Concreting
 4. ACI 306R Cold Weather Concreting
 5. ACI 309R Guide for Consolidation of Concrete
 6. ACI 318 Building Code Requirements for Structural Concrete and Commentary
 7. ACI 350 Code Requirements for Environmental Engineering Concrete Structures and Commentary
 8. ACI 347 Formwork for Concrete
- B. ASTM International (ASTM):
1. ASTM A 615 Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 2. ASTM A 706 Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement
 3. ASTM C 33 Specification for Concrete Aggregates
 4. ASTM C 94 Standard Specification for Ready-Mixed Concrete
 5. ASTM C 109 Test Method for Compressive Strength of Hydraulic Cement Mortars (using 2 in. or 50 mm Cube Specimens)
 6. ASTM C 150 Standard Specification for Portland Cement
 7. ASTM C 171 Specification for Sheet Materials for Curing Concrete
 8. ASTM C 309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete

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9. ASTM D1752 Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction

C. American Welding Society (AWS):

1. AWS D1.1 Structural Welding Code-Steel, Twelfth Edition
2. AWS D1.4 Structural Welding Code-Reinforcing Steel

D. Bureau of Reclamation (USBR):

1. M-30 Specifications for Concrete Curing Compound.

1.3 SUBMITTALS:

A. Submit the following in accordance with Section 01330.

B. Pre-Construction: Provide the following submittals:

1. Submit material lists of items to be provided under this Section.
2. Submit manufacturer's specifications, instructions, and other product data needed to prove compliance with the specified requirements.
3. Submit placing drawings and shop drawings of other items provided under this section showing material designations, shop and field welds and protective coating.
4. Submit, if applicable, drawings showing alternative location of construction joints.
5. Submit construction plan.
6. Submit air and concrete curing temperature records as required in paragraph 3.8, herein.

1.4 QUALITY ASSURANCE REQUIREMENTS:

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- A. Construction Tolerances:
 - 1. Variation in alignment, grade, and dimensions of the structures from the established alignment, grade, and dimensions shown on the Drawings shall conform to ACI 301, Section 4.3.
 - 2. Level and grade tolerance measurements of slabs and lining shall be made as soon as possible after finishing. When forms or shoring are used, the measurements shall be made prior to removal.

- B. Surface Requirements:
 - 1. The surface requirements for the classes of finish required by paragraph 2.10, herein, shall be as hereinafter specified.
 - 2. Allowable irregularities are designated “abrupt” or “gradual” for purposes of providing for surface variations.
 - 3. Offsets resulting from displaced, misplaced, or mismatched forms, or sheathing, or by loose knots in sheathing, or other similar form defects, shall be considered “abrupt” irregularities.
 - 4. Irregularities resulting from warping, unplaneness, or similar uniform variations from planeness or true curvature, shall be considered “gradual” irregularities. “Gradual” irregularities will be checked for compliance within the prescribed limits with a 5-foot template, consisting of a straightedge for plane surfaces and a shaped template for curved or warped surfaces.
 - 5. In measuring irregularities, the straightedge or template may be placed anywhere on the surface in any direction, with the testing edge held parallel to the intended surface.

Class of Finish	Irregularities	
	Abrupt, inches	Gradual, inches
All concrete	1/4	1/2

6. Appearance:
 - a. Permanently exposed surfaces shall be cleaned, if stained or otherwise discolored, by a method that does not harm the concrete and that is approved by the Engineer.

7. Testing and Inspection:
 - a. Concrete, reinforcement and embedded items will be tested and/or inspected by the Owner's testing agency.
 - b. The activities of the Owner's testing agency shall in no way relieve the Contractor of the responsibility to furnish materials and construction in full compliance with these specifications. The Contractor shall perform those tests as required to document compliance with the specification requirements.
 - c. Should materials, or final products or work be determined as unsuitable or not in conformity with the requirements of these specifications, they shall be rejected at the discretion of the Engineer. The removal and disposal of rejected materials is the responsibility of the Contractor.

8. Mandatory Hold Points:

The following procedure will be followed for each and every individual placement of concrete:

- a. The Contractor shall notify the Engineer of the Contractor's intention to place concrete 48 hours prior to schedule placement.
- b. Upon notification, the Engineer will furnish a Concrete Placement Card (Attachment 1 at end of this Section) to the Contractor. The Placement Card will reference the particular structure and the specific limits of the placement, and the concrete strength to be used.
- c. Prior to placement, the Contractor shall return the Placement Card to the Engineer with Contractor signatures verifying that all the preparatory items shown

on the Placement Card are complete and ready for inspection. Cleanup is an essential item.

- d. The Engineer will inspect the following items and initial each applicable item when found acceptable:
 - 1) Forms
 - 2) Reinforcing
 - 3) Drain Pipe
 - 4) Miscellaneous
 - 5) Engineering

The Engineer will then sign "Released for Placement".

- e. The Engineer will inspect and initial the Quality Control item when found acceptable, and sign "Released for Placement". The Placement Card constitutes a release for the Contractor to proceed with the placement when completely signed off.
- f. The Contractor shall return the top half of the Placement Card along with copies of all concrete truck tickets associated with the placement to the Engineer. The Engineer will keep copies of these items and file the originals offsite.
- g. The Engineer reserves the right to establish other hold points.

1.5 HANDLING AND STORAGE:

A. Product Handling:

- 1. Material covered by this section shall be packaged, shipped, received, handled and stored to provide protection from exposure to the environment and to prevent damage to the material.

B. Provisions for Storage:

- 1. Materials covered by this Section are to be stored at the jobsite in accordance with the manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. All materials furnished in accordance with this section shall conform to the requirements indicated below.
- B. Materials that are subject to additional requirements such as design, workmanship, fabrication, welding, surface preparation, painting, erection, or others, shall conform to the applicable terms of this section.
- C. All materials shall be prepared for shipment and shipped using the manufacturer's standard packaging.

2.2 FORM RELEASE AGENTS:

- A. General purpose form release agents shall be nonstaining products such as Formshield as manufactured by A. C. Horn Inc., Duogard by W. R. Meadows, Inc., Nox-crete by The Nox-crete Company, Magic Kote by Symons Manufacturing Company, or equal, as approved by the Engineer.

2.3 SURFACE RETARDERS:

- A. Surface retarders for construction joint preparation shall be Rugasol for horizontal surfaces by Sika Corporation of Lyndhurst, New Jersey; EAC-S Retarder for horizontal surfaces, or Super Tuf-Cote for vertical surfaces by Preco Industries, Ltd., of Plainview, New York; Control Set for horizontal surfaces, or Control Set Form for vertical surfaces by AH Products Division, Anti-Hydro Waterproofing; or equal, as approved by the Engineer.

2.4 CURING MATERIALS (PAPER OR PLASTIC FILM):

- A. Paper or plastic film for curing concrete shall conform to ASTM C 171 and shall be Sisalkraft, Orange Label, or Sisalkraft SK-30 manufactured by St. Regis Paper Company, Attleboro, Massachusetts, unless otherwise approved by the Engineer.
- B. Polyethylene sheeting, manufactured by Monsanto Company, Kenilworth, New Jersey, or Rex Plastics of Thomasville, North Carolina, or by Polytech, Division of U.S. Industries Inc., Minneapolis,

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Minnesota, or Griffolyn Type 55, manufactured by Griffolyn Company, Inc., Houston, Texas.

2.5 CURING MATERIALS (LIQUID APPLIED COMPOUNDS):

- A. Curing compounds shall be one of the following or consist of commercially available preparations that satisfy requirements of ASTM C309, Type I; Horncure 30C by A. C. Horn Inc.; Clear Bond by Guardian Chemical Corporation; Kure-N-Seal by Sonneborn Division of Contech, Inc., or equal, as approved by the Engineer.

2.6 PREMIXED NON-SHRINK GROUT:

- A. Proprietary, premixed, non-shrink grout shall be one of the following:
 - 1. F-100 Grout manufactured by Saurereisen Cements, Co., Pittsburgh, Pennsylvania;
 - 2. Five Star Special Grout 100 manufactured by Five Star Products Corporation, Fairfield, Connecticut;
 - 3. Masterflow 928 manufactured by Master Builders Co., Cleveland, Ohio
- B. Minimum grout strength shall be 5,000 psi at 28 days when tested as 2-inch cubes made in accordance with ASTM C 109, using procedures recommended by the grout manufacturer.

2.7 EPOXY GROUT:

- A. Epoxy grout for grouting reinforcing bars in drilled holes in existing concrete shall be SET-XP Structural Epoxy-Tie Anchoring Adhesive manufactured by Simpson Strong Tie.

2.8 WELD FILLER METALS:

- A. All weld filler metals shall conform to AWS D1.1, Section 4, or AWS D1.4, Section 5. Certified mill test reports showing results of all tests required to show conformance with AWS filler metal specifications and typical of the filler metal material furnished herein shall be furnished by the electrode manufacturer for each lot or heat. Electrode containers shall be hermetically sealed and shall be marked to fully identify contents.

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2.9 WATERSTOP:

- A. Hydrophilic seed
- B. :

1. Hydrophilic waterstop shall be a strip type compound of polymer modified chloroprene rubber that swells upon contact with water. The waterstop shall have an embedded stainless steel wire mesh to direct expansion in the thickness direction and to restrict expansion in the longitudinal direction.
2. Hydrophilic waterstop shall comply with ASTM D 412; and shall have a tensile strength of 420 psi, minimum; an ultimate elongation of 600 percent, minimum; a Durometer hardness of 50, minimum; and a volumetric expansion ratio in distilled water at 70 °F of 3 to 1, minimum.
3. Hydrophilic waterstop shall be equal to Adeka Ultra Seal USA 2010MN distributed by Mitsubishi International Corp., Spearfish, SD.
4. Single component hydrophilic paste shall be equal to Adeka Ultra Seal P-201, distributed by Mitsubishi International Corp., Spearfish, SD.

2.10 REINFORCEMENT:

- A. Reinforcement shall be furnished under Section 03200.

2.11 FORM MATERIALS:

- A. Formwork shall generally be steel or smooth-sanded plywood, unless otherwise required herein or on the Drawings. Form surfaces shall be a smooth form finish as specified in ACI 301, Paragraph 10.2.2.
- B. Form materials shall provide a finish as specified in paragraph 3.10, below.
- C. Formwork materials, sizes and thickness of members, accessories, hardware, supports, and attachments shall satisfy requirements of ACI 347 and the manufacturer's printed recommendations.

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2.12 FORM TIES

- A. Form ties shall be steel with conical or spherical inserts. Form ties shall be designed to maintain positive contact with forming material. Furnish units that will leave no metal closer than 1-inch to concrete surfaces when forms, inserts, and tie ends are removed. Wire ties are not permitted. Use flat bar ties for panel forms. Furnish plastic or rubber inserts with minimum 1-inch depth and sufficient dimensions to permit patching of tie holes.

2.13 CONCRETE

- A. Concrete shall be furnished under Section 03100.

2.14 JOINT SEALANT AND BOND BREAKER TAPE:

- A. Joint sealant shall be a multipart, gray, nonstaining, nonsagging, polyurethane sealant, which cures at ambient temperature to a firm, flexible, resilient, tear-resistant rubber. Sealant shall meet ASTM C 920, Type M, Grade P, Class 25 for horizontal joints and shall be recommended by the manufacturer for continuous immersion in water. Sealant shall be Dualthane by W. R. Meadows, Vulkem 227 by Mameco International, Sikaflex-2c by Sika Corporation, or equal.
- B. Bond breaker tape shall be an adhesive-backed glazed butyl or polyethylene tape that will adhere to the concrete surface of the joint. The tape shall be the same width as the joint and shall be compatible with the joint sealant.

2.15 STARTER GROUT:

- A. Starter grout shall be cement grout of similar proportions to the mortar of the concrete to be placed thereon.

2.16 WATER:

- A. Water for all concrete work shall be clean and clear and free from injurious amounts of oil, acids, alkalies, organic matter, or other deleterious substances, and shall conform to ACI 301.

PART 3 - EXECUTION

3.1 FOUNDATION PREPARATION:

- A. No concrete shall be placed until all formwork, installation of items to be embedded, and preparation of surfaces involved in the placement have been approved.
 - B. All surfaces of forms and embedded materials shall be free from curing compound, dried mortar from previous placements, and other foreign substances before the adjacent or surrounding concrete placement is begun.
 - C. Prior to beginning concrete placement, the Contractor shall make ready a sufficient number of properly operating vibrators and operators, and shall have readily available additional vibrators to replace defective ones during the progress of the placement.
 - D. All surfaces upon or against which concrete is to be placed shall be free from frost, ice, water, mud, and debris. All ponded water shall be removed from the excavations prior to and during concrete placing operations.
 - E. Prepare surfaces of existing concrete against which new concrete is to be placed as a construction joint.
 - F. Earth foundations shall be damp when concrete is placed against them. Surfaces shall be thoroughly moist but not muddy to a depth of 6 inches, or to impermeable material, whichever is less.
- 3.2 FORMWORK:
- A. General:
 - 1. Formwork shall conform to the requirements of ACI 301 and ACI 347 except as herein specified.
 - 2. All formwork shall be removed.
 - B. Form Tolerances:
 - 1. Formwork shall be constructed to ensure that the finished concrete surfaces will conform to the tolerances and finish requirements of Section 4.3 of ACI 301.
 - C. Preparation of Form Surfaces:

1. The forms shall provide a smooth, plain concrete surface free from form or joint markings and equivalent to a plywood finish as specified in ACI 301.
 2. The contact face of removable forms, except where otherwise specified, shall be coated with a nonstaining form release agent or mineral oil or other material suitable for this application.
- D. Beveled Edges (Chamfer):
1. Form beveled edges on exposed concrete edges and corners and elsewhere where indicated on the Drawings. Bevels shall be 3/4-inch except as otherwise shown on the Drawings. Reentrant corners in concrete members shall not have fillets, unless otherwise shown in the Drawings. The top edges of slabs, walkways, beams, and walls may be beveled with an edging trowel in lieu of using chamfer strips.

3.3 REMOVAL OF FORMS:

- A. Removal of forms shall conform to ACI 301.
- B. No shoring, bracing, supports or other formwork shall be loosened or removed until the concrete supported thereby has acquired sufficient strength to support safely their own weight and any other probable loads.
- C. Forms shall be left in place a minimum of three days after placement of concrete.

3.4 PLACING REINFORCEMENT:

- A. Reinforcement and approved detailed placing drawings of reinforcing steel shall be furnished under Section 03200. Reinforcing steel shall be placed in conformance with ACI 301, Sections 5.6 and 5.7, and ACI 318 unless otherwise noted herein. Tolerances for cover given in ACI 301 and ACI 312 shall be applied to the minimum concrete protective covers given in those standards or herein. All accessories for positioning and maintaining reinforcement in its required location shall be furnished and installed.
- B. Locations and lengths of laps, splices, and embedments shall be as indicated on the Drawings. Otherwise, the requirements of ACI 312,

chapter 12 for tension splices and embedments shall govern.

- C. Install reinforcing steel to be epoxy grouted in drilled holes of existing concrete in accordance with the epoxy grout manufacturer's instructions.
- D. Welding of reinforcing steel shall be performed only when specific written approval has been obtained from the Engineer. Tack welding of embedded items to reinforcing will not be permitted.
- E. Field fabrication of reinforcing steel shall meet the requirements of Section 03200, and shall require the approval of the Engineer. All field fabrication operations are subject to review and approval by the Engineer.
- F. Field bending of reinforcing steel shall be avoided wherever possible and shall require the approval of the Engineer. Bending or straightening of reinforcing steel partially embedded in set concrete shall be permitted only if the following provisions are met:
 - 1. Reinforcing steel shall be bent as gently and in as gradual an arc as possible. Bending practices shall conform to ACI 315.
 - 2. Bar sizes to No. 8 may be bent cold only once at any location and then straightened, or straightened once to remove an inadvertent bend so long as the temperature of the bar in the area of the bend is greater than 60 °F. No bend shall exceed 105 degrees. Subsequent straightening or bending shall be preheated as specified below.
 - 3. All sections of reinforcing steel containing any breaks, cracks, or splitting shall be removed. Portions of reinforcing steel removed shall be replaced by either welding or mechanical splicing in accordance with the requirements specified herein.
 - 4. Bars of all sizes bent less than 10 degrees embedded in hardened concrete may be straightened at ambient temperatures.

3.5 JOINTS:

A. Control Joints:

- 1. Control joints shall be constructed at the locations and in

accordance with the details shown on the Drawings.

2. Control joints shall be either tooled joints or saw cut joints constructed to the dimensions shown on the Drawings. Saw cutting shall be accomplished by use of a diamond saw as soon as the concrete has hardened sufficiently to permit cutting without chipping, spalling, or tearing. Water used for saw cutting shall meet the requirements of paragraph 2.16, above.
3. After construction of the joint and immediately prior to installing the joint sealant, clean the joint cavity by sandblasting or power wire brushing. Install bond breaker tape in accordance with the sealant manufacturer's recommendations.
4. Application criteria for the sealant materials, such as temperature and moisture requirements and primer cure time, shall be in accordance with the recommendations of the sealant manufacturer.
5. Apply masking tape along the edges of the exposed surface of the exposed joints. Trowel the joints smooth with a tuck-pointing tool wiped with a solvent recommended by the sealant manufacturer.
6. After the sealant has been applied, remove the masking tape and any sealant spillage.
7. Surfaces of control joints shall be thoroughly cleaned prior to installation of joint sealant in accordance with the joint sealant manufacturers' recommendations.

B. Contraction Joints:

1. Contraction joints are placed in concrete to provide for volumetric shrinkage of a monolithic unit or movement between monolithic units. The joints shall be constructed at the locations and in accordance with the details shown on the Drawings so that there will be no bond between the concrete surfaces forming the joint. Reinforcement shall not be continuous across a contraction joint.
2. Contraction joints shall be made by forming the concrete on one side of the joint and allowing it to set before concrete is placed on the other side of the joint. The surface of the

concrete first placed at a contraction joint shall be coated with white wax-based curing compound conforming to Type I wax base curing compound in accordance with the USBR "Specifications for Concrete Curing Compound."

3. The dowel bars to be placed in contraction joints shall be cleaned and the trailing end of the dowel shall be uniformly coated with a film of clean oil or grease. The bars shall be spaced as shown on the Drawings and placed across the joints so that the end of the bar without the expansion cap is embedded in the first placement. The end of the bar with the expansion cap installed shall be embedded in the second placement. The dowels shall be positioned parallel to each other and to the surfaces of the concrete slab. Special care shall be taken to maintain the dowels accurately in position during placement operations.

C. Construction Joints:

1. Surfaces of construction joints shall be roughened by cutting with either an air-water jet or by application of a surface retarder, and then thoroughly cleaned.
2. Air-water cutting of a construction joint shall be performed after the initial concrete set has occurred but before the concrete has reached its final set. The concrete surface shall be cut with the jet to remove all laitance and to expose clean, sound aggregates to a 1/4 -inch amplitude.
3. Commercial surface retarders used to delay the set of concrete surfaces may be applied to the surfaces of construction joints to expose aggregate, or to facilitate cutting by jet. Retarded mortar shall be removed within 24 hours. After surface treatment involving a surface retarder, the surface shall be washed and rinsed as long as there is any trace of cloudiness in the wash water.
4. Before placing concrete against any construction joint, the surfaces of the existing concrete shall be cleaned of any laitance or foreign material, thoroughly dampened but not saturated, standing water removed, and then covered with starter grout. Horizontal joint surfaces shall be covered with a minimum 1/2-inch thick coat of starter grout.

3.6 CONCRETE PLACING

- A. General: Concrete placing shall conform to the requirements of ACI 301, 304, 305R, 306R, and 318. All concrete placing equipment and methods shall be satisfactory to the Engineer. All concrete shall be placed in the dry. Concrete shall not be placed under water without a written procedure approved by the Engineer. The applicable requirements of this section shall apply to placing of mix type AA. All exposed edges of concrete shall be chamfered as specified. Concrete mix type AA to be used in the Work shall be furnished in accordance with the Section 03100.
- B. Placing:
1. The retempering of concrete by the addition of water, cement or aggregate is not permitted. However, slump adjustment, when required, may be made in accordance with ASTM C 94, Paragraph 11.7. Once discharge of concrete has started for final placement, no further adjustment of water content is permitted.
 2. At the time of placing, the plastic concrete temperature shall meet the requirements of ACI 301.
 3. Placing of concrete may be done by means of buckets, belt conveyor, chutes, drop pipes or pumping, and shall be done in a manner that will prevent the segregation or loss of materials.
 4. There shall be no vertical free fall greater than 5 feet for any concrete, and the drop shall be reduced if segregation occurs.
 5. Lateral movement of concrete by means of vibrators shall not be permitted except for local consolidation of the mass or melting down of small mounds where deposited. The placement shall be carried on at such a rate that all concrete surfaces not yet to grade shall not have reached their initial set before additional concrete is placed thereon.
 6. When concrete lining placing operations for reinforced concrete lining are stopped for the day, interrupted because of breakdown, or delayed by other causes, the edge of the fresh concrete lining shall be bulkheaded to a surface normal to the lining along transverse or longitudinal lines. Before placing operations are resumed, the surface of the hardened concrete

shall be cleaned as specified for a construction joint in paragraph 3.5.C, above.

C. Cold Weather Requirements:

1. All concrete materials and all reinforcement and forms with which the concrete is to come in contact shall be free from frost, snow, and ice. Contact surfaces shall not be less than 40 °F. Cold weather concreting shall comply with the requirements of ACI 301 and ACI 306R.
2. Salt or other chemicals shall not be used for the prevention of freezing.
3. Construction procedures and loadings during cold weather construction shall not produce stresses or loadings that exceed the requirements of ACI 318 for the actual strength of concrete being loaded.

D. Hot Weather Requirements:

1. Hot weather requirements for concreting shall conform to ACI 301, sections 7.6 and 8.4 and ACI 305R. All concrete shall be delivered to the forms at all times at the coolest temperature that is practicable under existing conditions, but consistent with the temperature requirements specified. Concrete shall not be placed when hot weather conditions would prevent proper placement and consolidation.
2. Obtaining the acceptable temperature at the time of placement may require adding ice and/or chilled water to the mix. The coarse aggregate may be sprayed with water of the same quality required for mixing when ambient temperatures exceed 80 °F. Such measures shall be taken at the batch plant to furnish concrete at acceptable temperatures. The moisture content of the aggregates shall be taken into account when determining the amount of mixing water required for the concrete mix.

- E. Consolidation of Concrete:
1. Concrete shall be thoroughly worked around reinforcement and embedded fixtures and into the corners of the forms. ACI 309 shall be used as a guide to develop suitable consolidation techniques.
 2. Concrete shall be placed with the aid of mechanical vibrating equipment, supplemented by hand spading, rodding, or tamping. In no case shall vibrators be used to transport concrete inside the forms, Vibrating equipment shall be of the internal type and shall at all times be adequate in number of units and power of each unit to properly consolidate all concrete. Form or surface vibrators shall not be used.
 3. To obtain a good bond between the new and old section of the wall or slab at the vertical construction joint, the concrete shall be thoroughly vibrated immediately adjacent to the existing wall or slab.
 4. Concrete consolidation shall be judged satisfactory when the large aggregate is well embedded, the batch has generally leveled off, there is visible blending of the batch perimeter with concrete previously placed, a thin film of glistening mortar lies on the surface, air bubbles rising to the surface have practically been eliminated, and cement paste shows at the junction of the concrete and the form. In placing concrete, coarse aggregate that protrudes from the surface of the layer shall be depressed into the mass during the initial consolidating or vibrating operations.

3.7 ROUTINE TESTS OF CONCRETE

- A. Routine testing of concrete materials and of concrete will conform to ACI 301.
- B. Concrete material for preparing test specimens will be taken at the point of discharge for placement of the concrete after final adjustment of slump.

3.8 CURING AND PROTECTION

- A. The provisions of this Section shall apply for structural concrete. Curing and protection of freshly deposited concrete shall conform to the requirements described herein. For other conditions not covered

herein, requirements shall conform to ACI 301, chapter 12. These requirements include the control of moisture loss from concrete and control of concrete temperature.

- B. Concrete sections having a total overall least dimension greater than 36 inches, shall be cured for 7 days; during the first two days, the concrete shall be water cured, and during the remaining time, water curing may be used or the concrete surfaces shall be coated with an approved curing compound.
- C. Temperature of concrete shall be maintained in accordance with Section 12.3 of ACI 301.
- D. Water curing requires the presence of a visibly wet concrete surface together with the presence of some free water continually throughout the curing period as stipulated in chapters 12 and 14 of ACI 301.
- E. Water curing may be accomplished by water sprays, ponding, or wet burlap or fabric, covering a wet surface with waterproof paper, plastic film or canvas, and periodically adding water to provide water curing is also acceptable. Covers shall be lapped, weighted, or sealed at the edges, and maintained in good condition to prevent any drying of the surface.
- F. Water for curing shall be clear and free from any elements that might cause staining or discoloration of the concrete.
- G. If a curing compound is used instead of water curing, the compound shall be applied immediately after removal of forms unless surface cleanup and repair of surface defects are to be done at once. In this case, the surface shall be kept moist to prevent drying out during this work, and the curing compound shall be applied upon its completion. If there is any appreciable drying or loss of moisture from the concrete surface that is to be coated, the surface shall be sprayed with water and brought to a uniformly damp appearance just prior to applying the curing compound. The storage, handling, and application of curing materials shall conform to the manufacturer's recommendations. Two coats of curing compound shall be applied to concrete surfaces with each application spread to minimize drips and runs.
- H. Wood forms shall be prevented from drying out whenever the ambient air temperature exceeds 50 °F.
- I. Combustion heaters used in enclosures shall not be used during the

first 24 hours, unless precautions are taken to prevent exposure of the concrete to exhaust gases that contain carbon dioxide.

- J. Records shall be kept of the air temperature, the temperature within any heated or protective enclosure, and of the concrete temperature during the seven-day curing period. Records shall satisfy the intent of chapter 8 of ACI 306R.

3.9 WATERSTOP INSTALLATION

- A. Waterstop shall be placed in joints where shown on the Drawings. Installation of the waterstop and field splices, where required, shall be in accordance with the manufacturer's recommended procedures.
- B. Rough or uneven concrete surfaces against which the waterstop will be attached shall receive a bead of the manufacturer's recommended hydrophilic paste prior to installation of the waterstop.
- C. Splices and joints in the waterstop shall incorporate the manufacturer's recommended hydrophilic paste and attachment pins or screws.
- D. Waterstop shall be free of grease, oil, dirt, or any other foreign material that might prevent bond.
- E. All material shall be stored in as cool a place as practicable and, in no case, shall the waterstop be stored in the open or exposed to the direct rays of the sun. All material shall be stored so as to permit free circulation of air about it.
- F. Suitable precautions shall be taken to protect the waterstop during the progress of the work.

3.10 FINISHING

- A. Unformed Surfaces:
 - 1. General:
 - a. The ambient temperature of spaces adjacent to surfaces being finished shall be not less than 40 °F.
 - b. All unformed surfaces that are not to be covered by additional concrete or backfill shall have a screeded finish followed by a float finish, unless a trowel finish is

specified, and shall be true to the elevation shown on the Drawings. A screeded finish is also used as the first stage of float and trowel finishes. Finishing operations shall consist of sufficient leveling and screeding to produce even uniform surfaces.

- c. Surfaces to receive additional concrete or backfill shall be brought to the elevation shown on the Drawings and left true and regular.
 - d. Exterior surfaces shall be sloped for drainage unless otherwise shown on the drawing or as directed.
 - e. Joints shall be carefully made with a jointing or edging tool.
 - f. The finished surfaces shall be protected from stains or abrasions.
2. Float Finish:
- a. Surfaces shall be screeded and darried or bullfloated to bring the surface to the required finish level with no coarse aggregate visible. No water, cement, or mortar shall be added to the surface during the finishing operation.
 - b. The concrete, while still green but sufficiently hardened to bear a man's weight without deep imprint, shall be floated to a true and even plane.
 - c. Floating may be performed by use of suitable hand floats or power-driven equipment. Hand floats shall be made of magnesium or aluminum. Floating is also used as the second stage of a trowel finish.
 - d. Tolerance for a floated finish shall be true plane within 5/16 inch in 10 feet as determined by a 10-foot straightedge placed anywhere on the slab in any direction unless specified otherwise.
3. Protection:
- a. The finished surfaces shall be protected from stains or

abrasions.

- b. Surfaces and edges shall be protected from damage.

B. Formed Surfaces:

1. General:

- a. Formed surfaces, unless other type of finish is specified, shall be left with the texture imparted by the forms except that defective surfaces shall be repaired as described in the following.
- b. After removal of forms, all ridges or lips shall be removed and undesirable local bulging on the surfaces to be permanently exposed shall be remedied. Epoxy bonding agent shall be in accordance with ACI 503.2. Latex bonding agent meeting the requirements of ASTM C 1059 may be used instead of epoxy resin if concrete to be patched was placed less than 24 hours previously. Repair of surfaces damaged during excavation or as a result of excavation shall conform to the requirements of this section.

- 2. Repair of Formed Surfaces: After removal of forms, areas of honeycomb or voids shall be reamed or chipped and filled with dry pack mortar. Defective and unsound areas larger than 45 square inches and deeper than 2 inches shall be removed by saw cuts in a rectangular pattern and repaired with concrete replacement as required in subparagraph C., below. The prepared area shall be brush-coated with an approved epoxy resin or with a neat cement grout after dampening and then filled with mortar or concrete.

C. Material and Procedure for Repairs:

- 1. The cement used in the dry-pack mortar or replacement concrete shall be a blend of the cement utilized for production of project concrete and white Portland cement properly proportioned so that the final color of the mortar or concrete will match adjacent concrete. Trial batches shall be utilized to determine the proportions required to match colors.
- 2. Dry-pack mortar shall consist of 1 part cement to 2-1/2 parts

fine aggregate. The fine aggregate shall be that utilized for production of project concrete. The mortar shall be remixed without addition of water until it obtains the stiffest consistency that will permit placing.

3. Mortar shall be thoroughly compacted into the prepared void by tamping, rodding, ramming, etc., and struck off to adjacent concrete. Replacement concrete shall be produced utilizing project materials to meet requirements of the concrete it is replacing, and shall be proportioned by the Contractor and approved by the Engineer. It shall be drier than the usual mixtures and shall be thoroughly compacted into the prepared void by tamping, rodding, ramming, etc., and shall be struck off and finished to adjacent concrete. Forms shall be utilized as required or as directed.
4. Metal tools shall not be used to finish permanent view surfaces. The repaired areas shall be cured for 7 days. The temperature of the in situ concrete, adjacent air and replacement mortar or concrete shall be above 40 °F during placement, finishing and curing. Packaged materials meeting the requirements of ASTM C 928 may be used in lieu of dry-pack mortar when approved.
5. Unless painting of surfaces is required, uniform color of the concrete shall be maintained by use of only one mixture without changes in materials or proportions for any structure or portion of structure that is exposed to view or on which a special finish is required.
6. The form panels used to produce the finish shall be orderly in arrangement, with joints between panels planned in approved relation to openings, building corners, and other architectural features. Forms shall not be reused if there is any evidence of surface wear or defects that would impair the quality of the surface.

- END OF SECTION -

SECTION 03300
REINFORCING STEEL

PLACING CONCRETE AND

ATTACHMENT 1		
THORNTON RECHARGE FACILITIES – TRIAL SITE PROJECT		
CONCRETE PLACEMENT CARD		
Placement No.		Lift No.
Cubic Yds Theoretical	Cubic Yds Actual	Date
Concrete Mix		Strength
Identification of Placement		
Drawings		
Ready for Placement	Signatures and Dates	
Forms		
Reinforcing		
Piping		
Electrical		
Mechanical		
Misc.		
Engineering		
Quality Control		
Water Stop		
Embeds		
Subsurface Preparation		
Working Conditions		
Time Started	Time Completed	
Remarks		
Released for Placement	_____	
	Resident Engineer	
Released for Placement	_____	
	Quality Control Engineer	

SECTION 03300
REINFORCING STEEL

PLACING CONCRETE AND

QUANTITIES	ACCOUNT NO.
Excavation	
Backfill	
Forms	
Keyways	
Reinforcing	
Miscellaneous Metalwork	
Expansion Joints	
Water Stops	
Concrete Theoretical	
Concrete Actual	
Remarks	

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This Section includes furnishing all materials, fabrication, and installation of structural steel, miscellaneous metalwork, and embedded metalwork.

1.2 DESIGN CRITERIA:

- A. Structural Connections and Framing: AISC Specification for Structural Steel Buildings.

1.3 SUBMITTALS:

- A. Submit the following in accordance with Section 01330.
- B. Submit drawings detailing fabrication and erection of each metal fabrication indicated. Reproductions of drawings will not be accepted for this purpose.
- C. Include plans, elevations, sections and details of metal fabrications and their connections. Show anchorage and accessory items.
- D. Indicate welded connections using standard AWS welding symbols. Clearly indicate net weld lengths, sizes and welding sequences.
- E. Provide manufacturer's design and calculations for gratings, including load tables.
- F. Provide manufacturer's data sheets, handling and installation instructions for concrete anchors.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. Unless otherwise indicated, materials shall meet the requirements in Table 05100-1 and the following paragraphs:

SECTION 05100**STRUCTURAL STEEL,
MISCELLANEOUS METALWORK, AND EMBEDMENTS**

Table 05100-1 Structural Steel, Miscellaneous Metalwork, and Embedments

ITEM	SPECIFICATION
Structural Steel Shapes and Plates: Steel Plate for Lifting Lugs Wide Flange Shapes Other Rolled Shapes and Plates	ASTM A 242 ASTM A 992, Grade 50 ASTM A 36
Structural Steel Tubing (HSS): Round Shapes ($t \leq 0.625$ inch) Round Shapes ($t > 0.625$ inch) Square or Rectangular Shapes	ASTM A 500, Grade B ASTM A 53, Grade B ASTM A 500, Grade B
Steel Pipe	ASTM A 501 or A 53, Type E or S, Grade B
Stainless Steel: Bars and Shapes Steel Plate, Sheet and Strip Bolts and Threaded Rods Expansion Bolts Nuts	ASTM A 276, AISI Type 316 ASTM A 240 or A 666, AISI Type 316 ASTM A 193, AISI Type 316, B8M, B8MN, B8M2 or B8M3 ASTM A 582, Type 303 ASTM A 194, AISI Type 316, 8M, 8MN, 8M2 or 8M3

ITEM	SPECIFICATION
Steel Bolts, Nuts and Washers:	
Carbon Steel	ASTM A 307 or A 36
High-Strength	ASTM A 325, Type 1
Galvanized Steel Bolts and Nuts	ASTM A 307 or A 36, with ASTM A 153 zinc coating and ANSI B1.1
Machine Bolts	Federal Specification FF-B-575, Grade 5
Lag Bolts	ASME B18.21.1
Eyebolts	ASTM A 489
Threaded Rods	ASTM A 36
Flat Washers (Unhardened)	ASTM F 844; use A 153 zinc coating
Flat Washers (Hardened)	ASTM F 436
Lock Washers (Helical Spring Type, Carbon Steel)	Federal Specification FF-W-84A
Steel Sheet:	
Uncoated, Structural, Cold-Rolled	ASTM A 1008, Grade A, unless otherwise indicated or required by design loading
Uncoated, Nonstructural, Cold-Rolled	ASTM A 1008, Commercial Quality
Galvanized, Structural Quality	ASTM A 653, Grade A, unless otherwise required by design loading, with G-90 coating
Machine Screws, Cadmium Plated Steel	Federal Specification FF-S-92B
Aluminum Structural Shapes and Plates	ASTM B 209 and B 308, Alloy and Temper 6061-T6
Aluminum Bolts and Nuts	ASTM F 468 Alloy and Temper 2024-T4
Cast Iron	ASTM A 48, Class 35

B. Drilled Anchors:

- Where indicated on the Drawings, drilled anchors shall be SS AISI 304 threaded rods secured in concrete with Hilti HIT-RE

500 V3 epoxy adhesive as manufactured by Hilti, or equal.
Anchors shall have ICBO-approved testing.

- C. **Headed Anchor Studs:** Headed anchor studs for embedded metalwork anchors shall be Nelson Stud Anchors or equal, and of the sizes shown on the Drawings.
- D. **Anchor Bolt Sleeves:**
 - 1. Anchor bolt sleeves shall be high-density polyethylene plastic, single unit construction, with deformed sidewalls such that the concrete and grout lock in place.
 - 2. The top of the sleeve shall be self-threading to provide adjustment of the threaded anchor bolt projection.
 - 3. The sleeves shall be equal to the anchor bolt sleeves by the Wilson Anchor Bolt Sleeve Company.
- E. **Antiseizing Lubricant:** Lubricant shall contain substantial amounts of molybdenum disulfide, graphite, mica, talc, or copper and shall be Permatex Antiseizing Lubricant by Loc Tite Co.; or equal. Apply to threads of stainless steel bolts.
- F. **Welding Electrodes:**
 - 1. Welding electrodes for structural steel shall conform to AWS D1.1 Standards – AWS A5.1 or A 5.5 E70XX Series Electrodes.
 - 2. Welding electrodes for aluminum shall be ER4043 filler metal.
 - 3. Welding electrodes for stainless steel shall conform to AWS A 5.4. Use electrodes E308 for Type 304 stainless steel and E316 for Type 316 stainless steel.

PART 3 - EXECUTION

3.1 STORAGE OF MATERIALS:

- A. Store material, either plain or fabricated, above ground on platforms, skids, or other supports. Keep materials free from dirt, grease, and other foreign matter and protect from corrosion.

3.2 FABRICATION AND ERECTION:

- A. Fabricate miscellaneous metal items to straight lines and true curves. Drilling and punching shall not leave burrs or deformations.
- B. Continuously weld permanent connections along the entire area of contact.
- C. Exposed work shall have a smooth finish with welds ground smooth. Joints shall have a close fit with corner joints coped or mitered and shall be in true alignment. Unless specifically indicated on the Drawings, there shall be no bends, twists, or open joints in any finished member nor any projecting edges or corners at intersections.
- D. Conceal fastenings wherever possible. Built-up parts shall be free of warp. Exposed ends and edges of metal shall be slightly rounded.
- E. Clean the surfaces of metalwork to be in contact with concrete of rust, dirt, grease and other foreign substances before placing concrete.
- F. Set embedded metalwork accurately in position when concrete is placed and support rigidly to prevent displacement or undue vibration during or after the placement of concrete. Unless otherwise specified, where metalwork is to be installed in recesses in formed concrete, said recesses shall be made, metalwork installed, and recesses filled with non-shrink grout in conformance with Section 03300.

3.3 GALVANIZING:

- A. Zinc coating shall be in accordance with ASTM A 123.
- B. All metal fabrications shall be galvanized steel unless noted otherwise on the Drawings or Specifications.

3.4 WELDING:

- A. Perform welding on steel by the shielded metal arc welding (SMAW) process. Welding shall conform to the AWS Structural Welding Code-Steel, D1.1, except as modified in AISC Section J2.
- B. Perform welding on aluminum by the gas metal arc (MIG) or gas tungsten arc (TIG) process. Welding shall conform to the AWS Structural Welding Code-Aluminum, D1.2.

- C. Perform welding on stainless steel by the gas tungsten arc (TIG) process. All welds shall be full penetration and smooth unless otherwise indicated on the Drawings. Provide inert gas on the inside of pipe during welding to reduce oxidation.
 - D. Provide a minimum of two passes for metal in excess of 5/16-inch thickness.
 - E. Produce weld uniform in width and size throughout its length with each layer of weldment smooth; free of slag, cracks, pinholes, and undercuttings; and completely fused to the adjacent weld beads and base metal. Avoid irregular surface, nonuniform bead pattern, and high crown. Form fillet welds of the indicated size of uniform height and fully penetrating. Accomplish repair, chipping, and grinding of welds in manner that will not gouge, groove, or reduce the base metal thickness.
- 3.5 INSTALLING BOLTS:
- A. Bolts shall be of the length that will extend entirely through but not more than 1/4 inch beyond the nuts. Draw boltheads and nuts tight against the work. Tap boltheads with a hammer while the nut is being tightened.
- 3.6 INSTALLING ANCHOR BOLTS:
- A. Preset bolts and anchors by the use of templates. For mechanical equipment, do not use concrete anchors set in holes drilled in the concrete after the concrete is placed.
 - B. For static items, use preset anchor bolts where shown on the Drawings or drilled anchors with ICBO report data.
 - C. After anchor bolts have been embedded, protect projecting threads by applying grease and having the nuts installed until the time of installation of the equipment or metalwork.
 - D. Minimum depth of embedment of drilled mechanical anchors shall be as recommended by the manufacturer, but no less than that shown on the Drawings and no less than six and one-half bolt diameters.
 - E. Minimum depth of embedment of adhesive anchors shall be as recommended by the manufacturer, but no less than that shown on the Drawings and no less than 12 bolt diameters.

3.7 ANCHORING SYSTEMS FOR CONCRETE:

- A. Begin installation only after concrete or masonry receiving anchors has attained design strength.
- B. Do not install an anchor closer than six times its diameter to either an edge of concrete, or to another anchor, unless shown otherwise.
- C. Install anchors in accordance with manufacturer's instructions. Hole diameters are critical to installation, use only drills recommended by anchor manufacturer.
- D. Follow specific manufacturer's safe handling practices when handling and installing anchors.

3.8 CONTROL OF FLAME CUTTING:

- A. Do not use a gas-cutting torch in the field for correcting fabrication errors on any member in structural framing. Use a gas-cutting torch only on minor members when the member is not under stress.

3.9 REPAIR OF GALVANIZED SURFACES:

- A. Repair damaged galvanizing at galvanized surfaces with surface primer containing zinc dust in accordance with ASTM A780. Provide a dry film thickness not less than 6 mils.

3.10 CORROSION PROTECTION OF ALUMINUM SURFACES:

- A. Coat aluminum surfaces to be embedded or which will be in contact with concrete or grout with bituminous paint having a minimum volume solids of 68 percent coal-tar pitch based.
- B. Prepare surfaces to be coated with solvent or steam cleaning per SSPC SP-1; do not use alkali cleaning. Then dust blast.
- C. Prime coat: surfaces to be coated by application of a synthetic resin or epoxy primer to metal surface before application of bituminous coating.
- D. Finish Coat: Two coats of bituminous coating, 12 mils each.
- E. Products and Manufacturers: Super Service Black by Carboline, St. Louis, MO; Tnemec 46-465 by Tnemec, North Kansas City, MO; Intertuf 100 by International Paint, Inc., Houston TX; or equal.

- F. Allow the coating to dry before the aluminum is placed in contact with the concrete.
- G. Where aluminum surfaces come in contact with dissimilar metals, except stainless steel, keep the dissimilar metallic surfaces from direct contact by use of neoprene gaskets or washers.

- END OF SECTION -

PART 1 - GENERAL

1.5 DESCRIPTION

- C. This section includes the design, furnishing all materials of construction, fabrication, delivery and installation of slide gates as shown on the Drawings and described herein.

1.6 SUBMITTALS

- A. Submit shop drawings for the slide gates.
- B. Submit manufacturer's catalog data and detailed dimensional drawings showing slide gate parts and material of construction, specification (such as AISI, ASTM, SAE, or CDA), and grade or type. Show coatings. Identify each slide gate by tag number to which the catalog data and detail sheets pertain. Provide information on actuator to confirm it meets the specifications.
- C. Submit calculations to show that gates and accessories meet the specifications.
- D. Submit manufacturer's installation and operational instructions.

PART 2 – MATERIALS

2.1 GATE SCHEDULE

- A. Gates shall be Series 6600 Model 101C by Fresno Valves and Castings, Inc. or equal unless noted in Section B.
 - 1. Seating Head: 23 ft.
 - 2. Unseating Head: 0 ft.
 - 3. Actuator: Manual Operation.
 - 4. Frame: Self Contained.
- B. The north gate on the 4-way splitter box which is the outlet pipe from the Section 8 pond and the west gate on the 4-way splitter box shall

be Series 6400 Model 20-10C by Fresno Valves and Castings, Inc. or equal.

1. Seating Head: 20 ft.
2. Unseating Head: 10 ft.
3. Actuator: Manual Operation.
4. Frame: Self Contained.

2.2 MANUFACTURERS

- A. Slide gates shall be of the self-contained upward-opening type designed to mount on the face of concrete walls.
- B. Slide Gate Design
 1. Slide gates and appurtenances shall comply with AWWA C561, except as modified herein.
 2. Provide slide gates complete with gates, guides, frames, baseplates, seats, stems, stem guides, seals, electric motor actuators, and anchor bolts.
 3. Design slide gates for minimum seating and unseating heads listed in Section 2.1. Measure the seating and unseating heads from the top surface of the water to the centerline of the disc.
 4. Under the design seating and unseating heads, the leakage shall not exceed 0.1 gpm per foot of wetted seating perimeter.
 5. Slide gates shall have rising stems.

2.3 FRAMES FOR SELF-CONTAINED SLIDE GATES

- A. Design frames to be suitable for bolting to concrete walls. Furnish flush inverts for wall-mounted gates as required.

2.4 GUIDES

- A. The guides shall extend in one continuous piece from the gate invert to form posts for handwheel operator stand. The extended guides or posts shall require no additional reinforcing to support the operator. Construct the guides of formed plate into a rigid, continuous structural shape.

- B. Provide a flush invert at the bottom of the frame as required. Provide a rubber insert to function as a seating surface for the gate disc.
- C. Provide rubber J-bulb or UHMW polyurethane seals or seats along the sides of the gates.
- D. For self-contained gates, provide replaceable polyethylene bearing strips in extruded retainer slots along the guides. Provide strips along both sides of the guide channels containing the disc. Mount strips in dovetail grooves in the guides. Alternatively, mount the replaceable polyethylene bearing strips on the disc.
- E. Provide rubber or UHMWPE J-bulb seals along the top of the gate for submerged applications.

2.5 DISC

- A. Fabricate the disc using stainless steel flat plate with stainless steel structural or formed members welded to the plate. Provide disc components with a minimum material thickness of 1/4 inch.
- B. The disc shall be a one-piece plate, reinforced with ribs so that the disc will not deflect more than 1/720 of the gate span when the upstream side of the gate is subjected to the specified seating head and the downstream side of the gate contains no liquid.
- C. Design the disc to limit deflection to a maximum of 1/8 inch when the disc is subjected to the maximum specified unseating head.
- D. Attach reinforcing ribs to disc by welding; do not use bolting. Reinforcing ribs shall extend into the guides such that they overlap the seating surface of the guide.
- E. Design the disc so that all surfaces are free of metal-to-metal contact with the frames.

2.6 STEMS AND STEM GUIDES

- A. Lifting stems shall be one piece. The stem shall withstand an actuator effort of 80 pounds without buckling, assuming the critical buckling load as determined by using the Euler Column Formula with $C = 2.0$. Support the stems with stem guides such that the L/R ratio for the unsupported part of the stem does not exceed 200.
- B. The stem connection to the disc shall be either the clevis type, with structural members welded to the slide and containing a bolt to act as

a pivot pin, or a threaded and bolted or keyed thrust nut supported in a welded nut pocket. The pocket shall be capable of withstanding a load of 80 pounds on the actuator.

- C. Provide tandem stems and actuators when the gate width is more than twice the gate height.
- D. Provide a graduated clear plastic stem cover to show the gate position in increments of 1/4 inch. Provide vent holes to prevent condensation.

PART 3 - EXECUTION

3.1 Welding:

- A. Welder qualification shall comply with AWS D1.6 Welding rod and electrodes shall comply with AWS A5.4. In addition to structural welds, seal weld interfaces between mating parts to prevent moisture intrusion.

3.2 Gate Installation

- A. The Owner-furnished gate frame, gate, operator and accessories shall be installed by the Contractor in accordance with the gate manufacturer's installation procedures, as approved by the Engineer.

3.3 Dry Field Test

- A. The gate shall be operated through six (6) complete cycles to ensure that it meets the requirements in all aspects and is suitable for performing the work intended.
- B. Adjustments necessary to achieve the above shall be made where required. All gate and stem guide support bolts shall be field inspected to verify they have been installed to the correct torque.
- C. Smooth travel of the gate; operation of the position indicator; vibration free hoist operation; and no binding of, or side thrust on, the operating stem shall be provided and demonstrated in the field test.

3.4 Cleaning and Final Adjustments

- A. After final testing is completed, the entire gate assembly and operator shall be thoroughly cleaned. Particular attention shall be paid to bearing, sliding and sealing surfaces.

- END OF SECTION -

SECTION 11500
MISCELLANEOUS EQUIPMENT

FLUMES AND

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section includes furnishing and installing flumes, staff gages and other miscellaneous equipment required to complete the work shown on the Drawings and as specified herein.

1.2 SUBMITTALS

- A. Submit shop drawings for the flume insert.
- B. Submit manufacturer's catalog data for the CMP, PVC pipe, instrument box, staff gauge, and miscellaneous hardware.
- C. Submit detail on planned connection between instrument box and 24-inch CMP standpipe.
- D. Submit detail on planned connection between intake pipe and 24-inch CMP standpipe.

PART 2 – PRODUCTS

2.1 FLUMES:

- A. Flumes shall be a galvanized Parshall Flume as manufactured by DBE Manufacturing & Supply in Greeley, <https://dbesupply.com>. Substitutions may be approved with appropriate documentation.

2.2 STAFF GAGES:

- A. Staff gages shall be Stevens Style C w/ 0.01' increments and marked every foot. Gage shall be a minimum of 8-10 feet tall.

2.2 STILLING WELLS:

- A. The equipment boxes for the stilling wells shall be 3' by 3' by 1' NEMA 4 waterproof galvanized box with hinged top. The City of Thornton will furnish and install their own telemetry/SCADA equipment after construction. The size of the equipment box shall be coordinated with the City of Thornton.

PART 3 - EXECUTION

SECTION 11500
MISCELLANEOUS EQUIPMENT

FLUMES AND

3.4 GENERAL

- A. Equipment shall be installed in accordance with the manufacturer's recommendations and as shown on the Drawings.

- END OF SECTION -

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section includes the furnishing of all materials of construction, fabrication, delivery and installation of TWO (2) recharge pond stilling wells at locations shown in the Drawings and as described herein.

1.2 SUBMITTALS

- A. Submit manufacturer's catalog data for the CMP, PVC pipe, instrument box, nylon tubing, 2" steel pipe, staff gauge, and miscellaneous hardware.
- B. Submit detail on planned connection between instrument box and 24-inch CMP standpipe.
- C. Submit detail on planned connection between intake pipe and 24-inch CMP standpipe.

PART 2 – MATERIALS

2.1 PIPE

- A. Stilling well casing pipe shall be 24-inch diameter, CMP. The casing shall be furnished in 20-foot lengths.
- B. Solid intake pipe shall be flush-joint 2-inch diameter, schedule 40 PVC. The casing shall be furnished in 10-foot lengths.
- C. Screened intake pipe shall be flush-joint, 2-inch diameter, schedule 40 pre-fabricated PVC well screen. Slot size shall be 0.020 inches. The screen shall be supplied in 5-foot or 10-foot lengths.
- D. Provide 2-inch diameter end caps for the end of each screen pipe.

2.2 INSTRUMENT BOX

- A. The equipment boxes for the stilling wells shall be 3' by 3' by 1' NEMA 4 waterproof galvanized box with hinged top. A chain shall be provided to allow the lid to open to 110°. The City of Thornton will furnish and install their own telemetry/SCADA equipment after construction. The size of the equipment box shall be coordinated with the City of Thornton.

2.3 NYLON TUBING

- A. Nylon tubing shall be ½" high-pressure tubing rated for at least 500 pis.

2.4 STEEL MARKER POST

- A. The steel marker post shall be 2" diameter schedule 40 galvanized steel.

2.5 STAFF GAGES:

- A. Staff gages shall be Stevens Style C w/ 0.01' increments and marked every foot. Gage shall be a minimum of 6 feet tall.

2.6 MISCELLANEOUS HARDWARE

- A. Furnish a watertight union, or a substitute method, for attaching 2" PVC intake pipe to 24" PVC stilling well pipe.
- B. Furnish a U-bolt-type clamp, or a substitute method, for attaching 2" PVC intake to 2" steel marker post.

PART 3 - EXECUTION**3.1 GENERAL**

- A. Equipment shall be installed in accordance with the manufacture's recommendations and as shown on the Drawings.
 - 1. A marine plywood mounting shelf shall be mounted in the stilling well to support the water level transmitter. The shelf shall be securely fastened to the CMP pipe with adhesive and stainless-steel screws. The shelf shall contain a 9-inch diameter opening to allow access for floats and other instrumentation. Coordinate shelf placement and location of opening with the City of Thornton. The nylon tubing shall protrude through the shelf.
 - 2. The ½ nylon tubing, which will be used to blow-out the intake conduit, shall be attached to the CMP stilling well or otherwise secured. It shall terminate at the junction of the solid and perforated sections of the intake conduit.

- END OF SECTION -

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section includes the furnishing of all materials of construction, fabrication, delivery and installation of ONE (1) stilling well for the Section 8 Pond at the location shown in the Drawings and as described herein.

1.2 SUBMITTALS

- A. Submit manufacturer's catalog data for the CMP, PVC pipe, instrument box, nylon tubing, 2" steel pipe, staff gauge, and miscellaneous hardware.
- B. Submit detail on planned connection between instrument box and 24-inch PVC standpipe.
- C. Submit detail on planned connection between intake pipe and 24-inch CMP standpipe.

PART 2 – MATERIALS

2.7 PIPE

- A. Stilling well casing pipe shall be 24-inch diameter CMP. The casing shall be furnished in 10-foot or 20-foot lengths.
- B. Solid intake pipe shall be flush-joint 2-inch diameter, schedule 40 PVC. The casing shall be furnished in 10-foot lengths.
- C. Screened intake pipe shall be flush-joint, 2-inch diameter, schedule 40 pre-fabricated PVC well screen. Slot size shall be 0.020 inches. The screen shall be supplied in 5-foot or 10-foot lengths.
- D. Provide 2-inch diameter end caps for the end of each screen pipe.

2.8 INSTRUMENT BOX

- A. The equipment boxes for the stilling wells shall be 3' by 3' by 1' NEMA 4 waterproof galvanized box with hinged top. A chain shall be provided to allow the lid to open to 110°. The City of Thornton will furnish and install

their own telemetry/SCADA equipment after construction. The size of the equipment box shall be coordinated with the City of Thornton.

2.9 NYLON TUBING

- A. Nylon tubing shall be ½” high-pressure tubing rated for at least 500 psi.

2.10 STEEL MARKER POST

- A. The steel marker post shall be 2” diameter schedule 40 galvanized steel.

2.11 STAFF GAGES:

- A. Staff gages shall be Stevens Style C w/ 0.01' increments and marked every foot. Gage shall be a minimum of 9 feet tall.

2.12 MISCELLANEOUS HARDWARE

- A. Furnish a watertight union, or a substitute method, for attaching 2” PVC intake pipe to 24” CMP stilling well pipe.
- B. Furnish a U-bolt-type clamp, or a substitute method, for attaching 2” PVC intake to 2” steel marker post.

PART 3 - EXECUTION**3.2 GENERAL**

- A. Equipment shall be installed in accordance with the manufacture’s recommendations and as shown on the Drawings.
 - 1. A marine plywood mounting shelf shall be mounted in the stilling well to support the water level transmitter. The shelf shall be securely fastened to the CMP pipe with adhesive and stainless-steel screws. The shelf shall contain a 9-inch diameter opening to allow access for floats and other instrumentation. Coordinate shelf placement and location of opening with the City of Thornton. The nylon tubing shall protrude through the shelf.

2. The ½ nylon tubing, which will be used to blow-out the intake conduit, shall be attached to the CMP stilling well or otherwise secured. It shall terminate at the junction of the solid and perforated sections of the intake conduit.

- END OF SECTION -

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section includes the permitting and furnishing of all materials of construction, fabrication, delivery and installation of three (3) monitoring wells at locations shown in the Drawings and as described herein.

1.2 SUBMITTALS

- A. Contractor shall coordinate with the City of Thornton and pay for and obtain monitoring well permits for each of the wells from the Colorado State Engineer (well will exist for more than 18 months). Submit copies of permits obtained from the Colorado State Engineer for each of the wells.
- B. Submit manufacturer's catalog data for the PVC casing, PVC screen, sand pack, and protective enclosure.

PART 2 – MATERIALS

2.1 CASING AND SCREEN

- A. Well casing shall be flush-joint 2-inch diameter, schedule 40 PVC. The casing shall be furnished in 5 foot lengths.
- B. Well screen shall be flush-joint, 2-inch diameter, schedule 40 pre-fabricated PVC well screen. Slot size shall be 0.020 inches. The screen shall be supplied in 5 foot lengths.
- C. Well screen and casing shall be as manufactured by Johnson Screens, or equal.

2.2 SAND PACK

- A. Sand pack shall be #20-#40 silica sand.

- B. Sand pack shall be as supplied by Premier Silica, or approved equal
- 2.3 CEMENT
- A. Cement shall be 4,000 psi ready mix concrete.
 - B. Cement shall be as supplied by Quikrete, or approved equal.
- 2.4 CASING PROTECTOR
- A. The casing protector shall be fabricated from steel and measure 4 inches x 4 inches x 5 feet. It shall be lockable.
 - B. The casing protector shall be as distributed by Enviro Design Products, or approved equal.
- 2.5 EXPANSION PLUGS
- A. Furnish locking expansion plugs for each of the three wells.
 - B. The expansion plugs shall be as distributed by Enviro Design Products or approved equal.
- 2.6 END CAPS
- A. Provide 2-inch diameter, end caps for each of the three wells.
 - B. End caps shall be as manufactured by Johnson Screens, or approved equal.
- 2.7 BENTONITE CHIPS
- A. Furnish bentonite chips.
 - B. Chips shall be 3/8" as distributed by Baroid, or approved equal.

PART 3 - EXECUTION**3.1 REGULATIONS**

- A. All work will be performed by individuals licensed to construct monitoring wells in the State of Colorado.

- A. All work shall comply with the Rules and Regulations for Water Well Construction, Pump Installation, Cistern Installation and Monitoring and Observation Hole/Well Construction, 2 CCR 402-2.

3.2 DRILLING

- A. Drilling shall be done using hollow-stem augers, measuring 4-inch ID x 8-inch OD. Contractor may propose use of alternate size augers; however, the ID shall not be less than 4 inches.
- B. The drilling shall be to an estimated depth of 18 feet or to bedrock, whichever comes first. Where bedrock is encountered prior to reaching 18 feet, do not advance the hole into bedrock.

3.3 WELL CONSTRUCTION

- A. Install 10 feet of screen and end cap plus 10 feet of solid casing in the well where drilling has been to 18 feet. In this case, 2 feet of the solid casing will extend above ground surface.
- B. Where drilling is less than 18 feet, install 10 feet of screen and a sufficient length of solid casing so that there are 2 feet of solid casing extending above ground surface.
- C. Install sand pack in the annulus between the casing/screen and the inside diameter of the hollow stem augers while slowly extracting the augers. Install sand pack by such means as will prevent bridging and fully surround the casing/screen. Install sand pack to within 5 feet of ground surface.
- D. Install bentonite chips sufficient to create a one-foot-tall bentonite plug above the sand pack.
- E. Install a locking well cap.
- F. Install well protector such that the shoulder of the protector stands at approximately 2 feet above ground surface. Fill remaining annular space between casing and well protector to within 1 inch of the top of casing with sand pack.
- G. Install a concrete pad around the well protector. The concrete pad shall be square and extend 2 feet two feet laterally from the outside of the well boring. The pad shall be 4 inches thick. The pad shall be installed using temporary forms that shall be removed after 24 hours. The surface of the pad shall be sloped away from the well at the rate of about 0.5 inches vertical to 2 feet horizontal.

- H. Following a 12-hour period for setting of the cement the well shall be developed. Development shall be done by bailing the well, using a bailer measuring no less than 1-inch in diameter and no less than three feet long. Development shall consist of lowering the bailer to the bottom of the well, allowing the bailer to fill with water, and removing and emptying the bailer. Development will be complete when 40 full bailers of water have been removed from the well.

3.4 SITE RESTORATION

- A. Contractor may spread drill cuttings on the site.
- B. Following well completion, level and disperse cuttings, and restore site to near original condition.

- END OF SECTION -