

TECHNICAL SPECIFICATIONS

April 17, 2023

PINTLER DISTRICT RANGER STATION WATER DISTRIBUTION SYSTEM

**USDA Forest Service Region One
Beaverhead - Deerlodge National Forest
Pintler Ranger District
Granite County, Montana**

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DIVISION 1

GENERAL REQUIREMENTS

SECTION 01110

SUMMARY OF WORK

PART 1- GENERAL

1.1 DESCRIPTION

- A. In general, the Work under this Contract includes, but is not necessarily limited to, the following major items of work as shown on the plans and as specified. The following descriptions are provided as an outline of major work items and shall not be construed as an inclusive or complete listing of all items of Work under this Contract.
 - 1. Replacement of the water distribution system serving the Pintler District Ranger Station Administrative Site. The project includes new water mains, and all associated valves, fittings, hydrants, service lines into buildings and a water meter/pressure reducing valve vault.

1.2 WORDING OF SPECIFICATIONS

- A. Throughout these specifications the abbreviation CO shall mean "Contracting Officer"
- B. Other reference standards are specified in Section 01420. The Contractor shall become thoroughly familiar with all reference specifications.

1.3 GENERAL SITE CONDITIONS

- A. In-depth water table surveys have not been performed. The Contractor shall perform adequate dewatering to keep the excavation free from water and dispose of the water without damage to property.

1.4 USE OF PREMISES

- A. General: Contractor shall have full access to grounds for construction operations during construction period, and limited access to facilities. Contractor's use of premises is limited by the Government's right to perform work or to retain other contractors on portions of Project site. Building access shall be coordinated with CO.
- B. Contractor shall conduct his operations to ensure the least inconvenience to the public and employees. Work is limited to the hours of 7am-8pm.
- C. Notify Contracting Officer at least 72 hours prior to start of work. Provide 24-hours' notice prior to any work occurring within buildings onsite.
- D. Confine storage of equipment and materials to areas as approved by the CO.
- E. Contractor shall provide adequate signing and barricades and take necessary safety measures to protect the public during all construction operations. Contractor shall minimize disturbance of work area.

- F. Preservation of Natural Features: Confines all operations to work limits of the project. Prevent damage to natural surroundings. Restore damaged areas, at no additional expense to the Government.
 - 1. Provide temporary barriers to protect existing trees and plants and root zones.
 - 2. Do not remove, injure, or destroy trees or other plants without prior approval. Consult with CO and remove agreed-on roots and branches that interfere with construction.
 - 3. Do not fasten ropes, cables, or guys to existing trees.
 - 4. Carefully supervise excavating, grading, filling, and other construction operations near trees to prevent damage.
- G. Existing Utilities: Notify CO and utility companies of proposed locations and times for excavation.
 - 1. Contractor shall be responsible for locating and preventing damage to known utilities. Call the Utilities Underground Location Center at 1-800-424-5555, at least 2 business days in advance of excavation for the marking of underground utilities. If damage occurs, repair utility at no additional expense to the Government.
 - 2. Interruption of Existing Utility Service: Notify CO, 48 hours in advance of any interruption of existing utilities.
 - 3. Water service interruption shall be minimized and approved by the Contracting Officer in the construction schedule.

1.5 CONSTRUCTION SEQUENCE

- A. Contractor shall provide construction sequencing in the schedule that reduces service interruption to the work center.
- B. The Contractor may use water and power utilities available onsite.

1.6 FIELD VERIFICATION

- A. Field verify all new and existing dimensions affecting the work of this contract before ordering materials.

END SECTION

SECTION 01275

MEASUREMENT AND PAYMENT

PART 1- GENERAL

1.1 MEASUREMENT AND PAYMENT

- A. Measurement and payment for contract work will be made only for and under those pay items included in the SCHEDULE OF ITEMS. All other work and materials will be considered as included in the payment for items shown.

1.2 QUANTITY MEASUREMENT

- A. The Contractor shall make all measurements for computation of quantities for all work items except those specified for payment by Actual Quantity (AQ) or Lump Sum Quantity (LSQ).
- B. The contractor shall compute the quantities for periodic progress payments; the Contracting Officer shall compute the quantities for the final payment based on measurements taken by the Contractor.
- C. All Contractor measurements are subject to verification.
- D. The Contractor shall submit all field notes, calculation sheets, and other data used to determine quantities.
- E. The Contractor shall certify in writing as to the accuracy of the measurements and computations submitted.

1.3 METHODS OF MEASURE AND UNITS OF MEASUREMENT

- A. One of the following methods for measurement for determining final payment is DESIGNATED on the SCHEDULE OF ITEMS for each pay item;
 - 1. Actual Quantities (AQ): Estimated quantities which are determined from actual measurements of completed work.
 - 2. Linear Feet (LF): Linear feet measured horizontally.
 - 3. Lump Sum Quantity (LSQ) – These quantities denote one complete unit of work as required by or described in the contract including necessary materials, equipment, and labor to complete the job. They will not be measured.
 - 4. Each: One complete unit, which may consist of one or more parts.

1.4 PAY ITEMS

- A. Pay Item No. 1 - MOBILIZATION
 - 1. Description: This item is intended to compensate the Contractor for operations including, but not limited to, those necessary for the movement of personnel, equipment, supplies, and incidentals to the project site; for payment of premiums for bonds and insurance for the project; and for any other work and operations

which must be performed or costs that must be incurred incident to the initiation of meaningful work at the site and for which payment is not otherwise provided for under the contract.

2. Work Required: Work required under this section includes but is not limited to the following.
 - a. The movement of personnel, equipment, supplies and incidentals to the project site;
 - b. The establishment of all facilities necessary for the work on the project;
 - c. The costs of obtaining the required permits, bonds, and insurance; and
 - d. All other work and operations which must be performed, or costs incurred prior to beginning work on the various items of the project.
3. Unit of Measurement: Lump Sum
4. Measurement: Measurement for MOBILIZATION will be made as a percentage completed of the lump sum. The total amount of premiums paid by the Contractor to obtain performance and payment bonds will be paid at one time together with the first progress payment otherwise due. When 5 percent of the total original contract amount is earned from other schedule items, 50 percent of the amount bid for mobilization will be paid, exclusive of any amount already paid the Contractor for performance and payment bond premiums. When 10 percent of the total original contract amount is earned from other schedule items, the balance of the amount bid for mobilization will be paid.
5. Payment: Payment for MOBILIZATION will be made at the contract unit price bid as a lump sum.

B. Pay Item No. 2 – CONSTRUCTION SURVEY AND STAKING

1. Description: This item includes providing construction survey and staking necessary for construction of the project as shown in the Contract Documents.
2. Work Required: Work required under this section includes but is not limited to the following.
 - a. Provide personnel, equipment and supplies required for construction layout and reference staking necessary for the proper control and satisfactory completion of all structures, pipelines and other appurtenances required for the completion of the work and acceptance of the project;
 - b. All incidental materials, tools, equipment, and labor for the completion of this item.
3. Unit of Measurement: Lump Sum
4. Measurement: Measurement for CONSTRUCTION SURVEY AND STAKING will be made as a percentage completed of the lump sum. 50% of the lump sum will be credited to the first progress payment, with the second 50% being credited to subsequent progress payments in proportion to total construction completed as a percentage of the contract unit price.
5. Payment: Payment for CONSTRUCTION SURVEY AND STAKING will be made at the contract unit price bid as a lump sum.

C. Pay Item No. 3 – POLYVINYL CHLORIDE (PVC) WATER MAIN

1. Description: PVC water main in sizes and classes indicated on the drawings and in the contract documents.
2. Work Required: Work required under this section shall include but not be limited to the following:
 - a. Excavation and backfill;

- b. Dewatering, sheeting, and shoring required for installation;
 - c. Furnishing and installing pipe with gaskets, lubricants, etc.;
 - d. Furnishing and installing appropriate detection wire;
 - e. Furnishing and installing bedding;
 - f. Testing, cleaning and disinfecting;
 - g. Thrust and anchor blocking;
 - h. All labor, tools, equipment, materials, royalties, and incidentals necessary to complete the work as specified.
- 3. Unit of Measurement: Per Lineal Foot.
 - 4. Measurement: PVC WATER MAIN will be measured per lineal foot along the centerline of the pipe through all valves, fittings, and appurtenances as indicated in the Bid Form.
 - 5. Payment: Payment will be made at the contract price bid per lineal foot of the various sizes and classes of PVC WATER MAIN indicated in the Bid Form and shall include the cost of trench excavation, pipe bedding and backfill.

D. Pay Items No. 4-9 – HDPE WATER LINE

- 1. Description: HDPE water line in sizes and classes indicated on the drawings and in the contract documents.
- 2. Work Required: Work required under this section shall include but not be limited to the following:
 - a. Excavation and backfill;
 - b. Dewatering, sheeting, and shoring required for installation;
 - c. Furnishing and installing pipe and fused joints;
 - d. Furnishing and installing appropriate detection wire;
 - e. Horizontal directional drilling, where required;
 - f. Conserve and replace gravel surfacing, where required;
 - g. Furnishing and installing bedding;
 - h. Testing, cleaning and disinfecting;
 - i. Thrust and anchor blocking;
 - j. All labor, tools, equipment, materials, royalties, and incidentals necessary to complete the work as specified.
- 3. Unit of Measurement: Per Lineal Foot.
- 4. Measurement: HDPE WATER LINE will be measured per lineal foot along the centerline of the pipe through all valves, fittings, and appurtenances as indicated in the Bid Form.
- 5. Payment: Payment will be made at the contract price bid per lineal foot of the various sizes and classes of HDPE WATER LINE indicated in the Bid Form and shall include the cost of trench excavation, pipe bedding and backfill.

E. Pay Items No. 10-11 – GATE VALVE WITH VALVE BOX

- 1. Description: Gate valves with valve boxes in sizes indicated on the drawings and in the contract documents.
- 2. Work Required: Work required under this section shall include but not be limited to the following:
 - a. Additional excavation, bedding, backfill and compaction;
 - b. Furnishing and installing the gate valve and box;
 - c. Additional couplings required;
 - d. Dewatering, sheeting, and shoring required for installation;
 - e. Thrust and anchor blocking;
 - f. Furnishing and installing polyethylene wrap;

- g. Disinfection and testing;
 - h. All labor, tools, equipment, materials, royalties, and incidentals necessary to complete the work as specified.
 - 3. Unit of Measurement: Per Each.
 - 4. Measurement: GATE VALVE WITH VALVE BOX will be measured per each for each size of gate valve specified. Auxiliary gate valves and boxes associated with fire hydrants will not be measured and paid for separately, but shall be included in the costs of installing six-inch fire hydrants.
 - 5. Payment: Payment will be made at the contract unit price bid for each size and type of GATE VALVE WITH VALVE BOX as specified in the Bid Form.
- F. Pay Items No. 12-14 – CURB VALVE WITH VALVE BOX
- 1. Description: Curb valves with valve boxes in sizes indicated on the drawings and in the contract documents.
 - 2. Work Required: Work required under this section shall include but not be limited to the following:
 - a. Trench excavation, bedding, backfill, and compaction;
 - b. Salvage to the Owner of existing valves and curb boxes on existing water services;
 - c. Dewatering, sheeting, and shoring;
 - d. Furnishing and installing curb valves and boxes;
 - e. Furnishing and installing fittings to connect new service lines to existing service lines;
 - f. All labor, tools, equipment, materials, royalties, and incidentals necessary to complete the work as specified.
 - 3. Unit of Measurement: Per Each.
 - 4. Measurement: Measurement for CURB VALVE WITH VALVE BOX will be measured per each for the various types and sizes listed in the Bid Form.
 - 5. Payment: Payment will be made at the contract unit price bid per each type and size of CURB VALVE WITH VALVE BOX as specified in the Bid Form.
- G. Pay Item No. 15 – 6" FIRE HYDRANT W/ AUXILIARY GATE VALVE
- 1. Description: This section shall include new six-inch fire hydrants with an auxiliary gate valve and box.
 - 2. Work Required: Work required under this section shall include but not be limited to the following:
 - a. Dewatering, sheeting, and shoring;
 - b. Excavation, bedding, backfill and compaction around the hydrant;
 - c. Furnishing and installing new six-inch fire hydrants, auxiliary gate valves, valve boxes and fittings;
 - d. Thrust and anchor blocking;
 - e. Connection to water main;
 - f. Furnishing and installing polyethylene wrap;
 - g. Furnishing and installing drain gravel;
 - h. All labor, tools, equipment, materials, royalties, and incidentals necessary to complete the work as specified.
 - 3. Unit of Measurement: Per Each.
 - 4. Measurement: 6" FIRE HYDRANT WITH AUXILIARY GATE VALVE will be measured per each and shall include all work and materials needed for installation. Pipe and fittings will be measured and paid for separately.

5. Payment: Payment will be made at the contract unit price bid per each for 6" FIRE HYDRANT WITH AUXILIARY GATE VALVE.
- H. Pay Item No. 16 – 1" FROST-FREE HYDRANT W/ BACKFLOW PREVENTER
1. Description: This section shall include new frost-free hydrants tied into the new mains.
 2. Work Required: Work required under this section shall include but not be limited to the following:
 - a. Dewatering, sheeting, and shoring;
 - b. Excavation, bedding, backfill and compaction around the hydrant;
 - c. Furnishing and installing new frost-free hydrants;
 - d. All labor, tools, equipment, materials, royalties, and incidentals necessary to complete the work as specified.
 3. Unit of Measurement: Per Each.
 4. Measurement: 1" FROST-FREE HYDRANT W/ BACKFLOW PREVENTER will be measured per each and shall include all work and materials needed for installation, including furnishing and installing all necessary couplings. Tees and fittings will be measured and paid for separately.
 5. Payment: Payment will be made at the contract unit price bid per each for 1" FROST-FREE HYDRANT W/ BACKFLOW PREVENTER.
- I. Pay Items No. 17-30 - FITTINGS
1. Description: This item shall include furnishing and installation of all appropriate tees, bends, reducers, caps, and blind flanges as per the Drawings and Contract Documents.
 2. Work Requirement: Work required under this section shall include but not be limited to the following:
 - a. Additional excavation, bedding, backfill and compaction, dewatering, sheeting, and shoring required for installation;
 - b. Furnishing and installing each fitting;
 - c. Thrust blocking;
 - d. Furnishing and installing polyethylene wrap;
 - e. Additional thrust blocking for vertical fittings;
 - f. All labor, tools, equipment, materials, royalties, and incidentals necessary to complete the work as specified.
 3. Unit of Measurement: Per Each.
 4. Measurement: TEES, ELBOWS, REDUCERS and BLIND FLANGES will be measured per each for each size of fitting.
 5. Payment: Payment will be made at the contract unit price bid per each size of TEES, ELBOWS, REDUCERS and BLIND FLANGES as specified in the Bid Form.
- J. Pay Item No. 31 – REMOVE EXISTING METER PITS
1. Description: Remove three existing meter pits and meters and salvage to Owner, as indicated on the plans.
 2. Work Required: Work required under this section shall include, but not be limited to the following:
 - a. Trench excavation, backfill and compaction;
 - b. Dewatering, sheeting, and shoring;
 - c. Removing the existing meter pit;
 - d. Plugging the existing pipe;

- e. All labor, tools, equipment, materials, royalties, and incidentals necessary to complete the work as specified.
 3. Unit of Measurement: Lump Sum.
 4. Measurement: REMOVE EXISTING METER PITS will be made per Lump Sum.
 5. Payment: Payment for REMOVE EXISTING METER PITS will be made at the contract unit price bid as a lump sum.
- K. Pay Item No. 32 – WATER METER AND PRESSURE REDUCING VALVE VAULT
1. Description: Furnish and install concrete vault, piping, pressure reducing valve and appurtenances in vault as specified on the drawings and in the contract documents. Install Owner furnished water meter.
 2. Work Required: Work required under this section shall include but not be limited to the following:
 - a. Additional trench excavation, bedding, backfill, and compaction;
 - b. Connection of piping to the vault and air valves;
 - c. Furnish and install necessary couplings, piping and reducers to make connections;
 - d. Furnish and install pressure reducing valve;
 - e. Furnish and install pipe supports;
 - f. Furnish and install concrete vault;
 - g. Furnish and install drain rock;
 - h. Install Owner provided water meter;
 - i. All labor, tools, equipment, materials, royalties, and incidentals necessary to complete work as specified.
 3. Unit of Measurement: Per Each.
 4. Measurement: WATER METER AND PRESSURE REDUCING VALVE VAULT will be measured per each.
 5. Payment: Payment will be made at the contract unit price bid per each WATER METER AND PRESSURE REDUCING VALVE VAULT as specified in the Bid Form.
- L. Pay Item No. 33 – INSTALL 2" WATER SERVICE LINE INTO GARAGE/SHOP
1. Description: This item includes installing a 2" service line into the existing Garage/Shop and connecting to the existing water plumbing. Demolition and rehabilitation inside the existing building may be necessary to facilitate installation.
 2. Work Required: Work required under this section includes but is not limited to the following.
 - a. Furnishing and installing service line from new curb stop into building;
 - b. Furnishing and installing fittings required to connect to existing building water plumbing;
 - c. Removal of existing water meter and salvage to Owner;
 - d. Demolition and rehabilitation of existing concrete floor as necessary for installation;
 - e. All labor, tools, equipment, materials, royalties, and incidentals necessary to complete the work as specified.
 3. Unit of Measurement: Lump Sum.
 4. Measurement: Measurement for INSTALL 2" WATER SERVICE LINE INTO GARAGE/SHOP will be made per lump sum.

5. Payment: Payment for INSTALL 2" WATER SERVICE LINE INTO GARAGE/SHOP will be made at the contract unit price bid as a lump sum.
- M. Pay Item No. 34 – INSTALL 1-1/2" WATER SERVICE LINE INTO DISTRICT OFFICE
1. Description: This item includes installing a 1-1/2" service line into the existing District Office and connecting to the existing water plumbing. Demolition and rehabilitation inside the existing building may be necessary to facilitate installation.
 2. Work Required: Work required under this section includes but is not limited to the following.
 - a. Furnishing and installing service line from new curb stop into building;
 - b. Furnishing and installing fittings required to connect to existing building water plumbing;
 - c. Demolition and rehabilitation of existing interior wall, tile and concrete floor as necessary for installation;
 - d. All labor, tools, equipment, materials, royalties, and incidentals necessary to complete the work as specified.
 3. Unit of Measurement: Lump Sum.
 4. Measurement: Measurement for INSTALL 1-1/2" WATER SERVICE LINE INTO DISTRICT OFFICE will be made per lump sum.
 5. Payment: Payment for INSTALL 1-1/2" WATER SERVICE LINE INTO DISTRICT OFFICE will be made at the contract unit price bid as a lump sum.
- N. Pay Item No. 35 – INSTALL 1" WATER SERVICE LINE INTO WAREHOUSE/GARAGE
1. Description: This item includes installing a 1" service line into the existing Warehouse/Garage and connecting to the existing water plumbing. Demolition and rehabilitation inside the existing building may be necessary to facilitate installation.
 2. Work Required: Work required under this section includes but is not limited to the following.
 - a. Furnishing and installing service line from new curb stop into building;
 - b. Furnishing and installing fittings required to connect to existing building water plumbing;
 - c. Demolition and rehabilitation of existing concrete floor as necessary for installation;
 - d. All labor, tools, equipment, materials, royalties, and incidentals necessary to complete the work as specified.
 3. Unit of Measurement: Lump Sum.
 4. Measurement: Measurement for INSTALL 1" WATER SERVICE LINE INTO WAREHOUSE/GARAGE will be made per lump sum.
 5. Payment: Payment for INSTALL 1" WATER SERVICE LINE INTO WAREHOUSE/GARAGE will be made at the contract unit price bid as a lump sum.
- O. Pay Item No. 36 – CONNECT TO EXISTING 2" CURB STOP AT BUNKHOUSE
1. Description: This item includes relocating the existing 2" curb stop to within five feet of the building and then connecting the new 2" PE service line to the curb stop.
 2. Work Required: Work required under this section includes but is not limited to the following.

- a. Additional trench excavation, bedding, backfill, and compaction;
 - b. Dewatering, sheeting, and shoring;
 - c. Relocate existing curb stop;
 - d. Furnishing and installing fittings required to connect to existing service line;
 - e. All labor, tools, equipment, materials, royalties, and incidentals necessary to complete the work as specified.
 3. Unit of Measurement: Lump Sum.
 4. Measurement: Measurement for CONNECT TO EXISTING 2" CURB STOP AT BUNKHOUSE will be made per lump sum.
 5. Payment: Payment for CONNECT TO EXISTING 2" CURB STOP AT BUNKHOUSE will be made at the contract unit price bid as a lump sum.
- P. Pay Item No. 37 – CONNECT TO EXISTING HORSE WATERER
1. Description: This item includes connecting new 1" PE service line to the existing horse waterer.
 2. Work Required: Work required under this section includes but is not limited to the following.
 - a. Additional trench excavation, bedding, backfill, and compaction;
 - b. Dewatering, sheeting, and shoring;
 - c. Furnishing and installing fittings required to connect new service line to existing horse waterer;
 - d. All labor, tools, equipment, materials, royalties, and incidentals necessary to complete the work as specified.
 3. Unit of Measurement: Lump Sum.
 4. Measurement: Measurement for CONNECT TO EXISTING HORSE WATERER will be made per lump sum.
 5. Payment: Payment for CONNECT TO EXISTING HORSE WATERER will be made at the contract unit price bid as a lump sum.
- Q. Pay Item No. 38 – REMOVE EXISTING HYDRANTS:
1. Description: This item includes the removal and disposal of an existing fire hydrant and an existing blowoff hydrant as indicated on the plans.
 2. Work Required: Work required under this section shall include, but not be limited to the following:
 - a. Trench excavation, backfill and compaction;
 - b. Dewatering, sheeting, and shoring;
 - c. Removing and disposing of the fire hydrant and blowoff hydrant;
 - d. Plugging the existing pipe;
 - e. All labor, tools, equipment, materials, royalties, and incidentals necessary to complete the work as specified.
 3. Unit of Measurement: Lump Sum.
 4. Measurement: REMOVE EXISTING HYDRANTS will be made per lump sum.
 5. Payment: Payment for REMOVE EXISTING HYDRANTS will be made at the contract unit price bid as a lump sum.
- R. Pay Item No. 39 – TYPE C SURFACE RESTORATION
1. Description: This item includes the surface restoration for trench excavations in lawns and native grass areas.
 2. Work Required: Work required under this section includes but is not limited to the following.

- a. Restoring, sodding or reseeding, and fertilizing any disturbed areas;
 - b. All labor, tools, equipment, materials, royalties, and incidentals necessary to complete the work as specified.
- 3. Unit of Measurement: Lineal Foot.
 - 4. Measurement: Measurement for TYPE C SURFACE RESTORATION will be made per lineal foot measured along the centerline of the trench excavation.
 - 5. Payment: Payment for TYPE C SURFACE RESTORATION will be made at the contract unit price bid per lineal foot. The limits for payment extend 8 feet (2.4 m) either side of the trench excavation centerline. Areas disturbed outside of the payment limits must be restored at the Contractor's expense.

END SECTION

SECTION 01330

SUBMITTALS

PART 1- GENERAL

1.1 DESCRIPTION

- A. Work Included:
 - 1. Submittals are required under this contract for the purpose of establishing the final specifications for: (1) quality assurance; (2) design configuration; (3) performance standards; (4) color, texture, or finish; and/or (5) other features necessary for a complete description of the Work to be performed.
- B. Submittals shall be approved by the Contracting Officer. The Contractor shall not purchase, order, ship, install, or otherwise incur costs for a product or other work subject to submittal approval until after approval is granted by the Contracting Officer; the Government shall not be responsible for payment for any work, product, design, etc., not approved.
- C. Rejection of any submittals by the Contracting Officer constitutes notice that a resubmittal is required for the same purpose; rejections shall be explained.
- D. The intent of the submittals is to provide complete information about the subject item sufficient for the Government to make a decision on that item's compliance with the purpose of the item and the general specification for that item. Descriptions contained in the approved submittals shall constitute an extension of the general specification concerning that item; and subsequent performance by the Contractor shall conform to submittal information except as allowed as substitutions in other sections as indicated.

1.2 RELATED WORK

- A. Individual requirements for submittals may also be described in pertinent sections of the Technical Specifications.

1.3 QUALITY ASSURANCE

- A. "Or Equal":
 - 1. Where the phrase "or equal" or "equal as approved by the Contracting Officer," or "but are not limited to" occurs in the contract documents, do not assume that the materials, equipment, or methods will be approved as equal unless the item has been so specifically approved by the Contracting Officer.

PART 2 - PRODUCTS

2.1 REQUIRED SUBMITTALS

- A. It shall be the Contractor's responsibility to submit all items with such promptness as to cause no delay in the Work. Approvals must be obtained before starting any Work which involves them.

The following submittals are required following award of the contract for review and/or approval pursuant to contract provisions:

1. One copy of the Work Progress Schedule listing main types of Work and anticipated times for construction and completion.
- B. One copy of the list of subcontractors proposed for the principal parts of the Work.
- C. Copies of Certification and other documentation which establish the qualifications of proposed workers to perform the Work.

At a minimum the contractor shall provide project submittals as shown on the Submittal Log below. Submittal requirements are listed throughout these specifications and the Drawings.

Log No.	Incidental to Pay Item(s)	Description of Submittal	Type of Submittal	Requirement found in Specification No. /Drawings
1	1	Schedule	Schedule	01330
2	1	List of Subcontractors	Listing	01330
3	1	Qualifications of Proposed Workers	Listing	01330
4	1	Contractor Quality Control Plan	Plan	01450
5	1	Temporary Erosion and Sedimentation Control Plan	Plan	01330, 01500
6	1	Material Storage/Staging Plan	Plan and Description	Drawings
7	3-32	Water Pipe, Fittings, Hydrants, Valve Boxes, Pressure Reducing Valve, Concrete Vault and all Appurtenances (Including Tracer Wire)	Material Submittals	02615, 02660, 02665, Plans
8	3-32	Pipe Bedding Material	Material Certifications	02221
9	33-35	Concrete Mix Design	Mix Design Material Certifications	03310, Plans
10	33-35	Concrete compressive strength, slump, and air-entrainment testing	Test Results	03310
11	1	Closeout Documents	As-Built Drawings	01770

2.2 MANUFACTURER'S LITERATURE AND SHOP DRAWINGS

- A. One (1) electronic copy of applicable submittals shall be provided to the COR through email, ftp site, or other electronic method.

The information provided shall be adequate to determine compliance with the specifications. Literature which is not marked or otherwise designated to show the exact model, size, etc. which the Contractor proposes to use, will be returned by the Contracting Officer "without action." Circle or check applicable items on submittals. Do not use highlighter pens.

Submittals which are received from sources other than through the Contractor's office will be returned by the Contracting Officer "without notice."

Make submittals of Shop Drawings, Manufacturer's literature, tests, Schedules, samples, substitution requests, and other items in accordance with the provisions of this Section.

2.3 SAMPLES

- A. Submit two samples of each color, style, etc. One sample of selected color, etc. will be retained. All other samples and all hardware samples will be returned.

PART 3 - EXECUTION

3.1 IDENTIFICATION OF SUBMITTALS

- A. Consecutively number all submittals. Cross reference all submittals with the specific Section number of the specifications.

- 1. When material is resubmitted for any reason, transmit under a new letter of transmittal with a new submittal number.

- B. On submittals, cite the original submittal number for reference.

Accompany each submittal with letter of transmittal showing all information for identification and checking.

On at least the first page of each submittal, and elsewhere as required for positive identification, show the submittal number in which the item was included.

Where contents from manufacturers include data not pertinent to the submittal, clearly show which portions of the contents are being submitted for review.

Maintain an accurate submittal log for the duration of the Work, showing current status of all submittals at all times. The submittal log shall be made available to the Contracting Officer for review upon request.

3.2 GROUPING OF SUBMITTALS

- A. Make construction drawing submittals in a group containing all associated items to assure that information is available for checking each item when it is received.

- 1. Partial submittals may be rejected as not complying with the provisions of the contract.

- B. The Contractor may be liable for delays caused by rejected submittals.

3.3 TIMING OF SUBMITTALS

- A. Submit temporary erosion control plan at the Post Award Conference. No work shall be started on the project site until the erosion control plan is approved by the Contracting Officer.
- B. Make construction submittals for the first phases of Work within 15 days of the date of the Notice-To-Proceed.

In scheduling, allow at least twenty (20) working days for review by the Contracting Officer following receipt of the submittal.

3.4 REVIEW OF SUBMITTALS

- A. The Contracting Officer will review submittals with reasonable promptness, indicating in writing the appropriate approval category ("Approved," "Disapproved," "Approved Subject to Corrections Shown") upon them. One (1) copy of the drawings or vendor's data shall be returned to the Contractor and when corrections are required, the Contractor shall make such corrections. The drawing (or other vendor's data) shall then be resubmitted by the Contractor for approval until an unqualified approval is obtained. After unqualified approval is obtained, the Contractor shall furnish the Contracting Officer with three (3) copies of the approved submittals.

Review by the Contracting Officer does not relieve the Contractor from responsibility for errors which may exist in the submitted data.

Revisions:

- 1. Make revisions required by Contracting Officer.
- B. If the Contractor considers any required revision to be a change, the Contractor shall notify the Contracting Officer as provided for in the General Conditions.

END OF SECTION

SECTION 01410

REGULATORY REQUIREMENTS

PART 1- GENERAL

1.1 DESIGN STANDARDS AND CODES

- A. All work shall comply with the rules and regulations of federal, state, and local agencies having jurisdiction. The Contractor shall acquire all permits, licenses and approval needed to complete the project from applicable state and local officials.
- B. The construction methods shall meet the latest edition of all national, state and local codes. The following standards and codes are made part of the contract specifications. In case of conflict, the most stringent shall apply.

AAN	American Association of Nurserymen
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ADAABAAG	Americans with Disabilities Act-Architectural Barriers Act Accessibility Guidelines
AISC	American Institute of Steel Construction
AITC	American Institute of Timber Construction
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
AWPA	American Wood Preservers Association
AWPB	American Wood Preservers Bureau
FSORAG	USDA Forest Service Outdoor Recreation Accessibility Guidelines
FSTAG	USDA Forest Service Trail Accessibility Guidelines
IBC	International Building Code
ICBO	International Committee of Building Officials
IEC	International Electric Code
MUTCD	Manual on Uniform Traffic Control Devices (Department of Transportation)
NBS	National Bureau of Standards (Department of Commerce)
NEC	National Electric Code
OSHA	Occupational Safety and Health Administration (Department of Labor)
SSPC	Steel Structures Painting Council
UFAS	Uniform Federal Accessibility Standards
WWPA	Western Wood Products Association

1.2 REFERENCE SPECIFICATION

- A. At all times, keep the following documents on site and available for use by the Contractor, Subcontractors, if any, and Contracting Officer:
 - 1. American Concrete Institute Specifications for Structural Concrete (ACI 301-20).

1.3 VARIATIONS WITH REFERENCES

- A. Promptly notify the Contracting Officer of any observed conflict between drawings and referenced standard or specification.

- B. Assume responsibility for work known to be contrary to such requirements without notice.

END SECTION

SECTION 01420

REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specifications Sections, apply to this Section.

1.2 DEFINITIONS

- A. General: Basic contract definitions are included in the Conditions of the Contract.
- B. “Indicated”: The term “indicated” refers to graphic representations, notes, or schedules on the Drawings, or other paragraphs or Schedules in the Specifications, and similar requirements in the Contract Documents. Terms such as “shown,” “noted,” “scheduled,” and “specified” are used to help the reader locate the reference. Location is not limited.
- C. “Directed”: Terms such as “directed,” “requested,” “authorized,” “selected,” “approved,” “required,” and “permitted” mean directed by the CO, requested by the CO, and similar phrases.
- D. “Approved”: The term “approved,” when used in conjunction with the CO’s action on the Contractor’s submittals, applications, and requests, is limited to the CO’s duties and responsibilities as stated in the Conditions of the Contract.
- E. “Regulations”: The term “regulations” includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the work.
- F. “Furnish”: The term “furnish” means supply and deliver to the Project Site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. “Install”: The term “install” describes operations at the Project Site including the actual unloading, unpacking, assembly, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. “Provide”: The term “provide” means to furnish and install, complete and ready for the intended use.
- I. “Installer”: An installer is the Contractor or another entity engaged by the Contractor, either as an employee, subcontractor, or contractor of lower tier, to perform a particular construction activity, including installations, erection, application, or similar operations. Installers are required to be experienced in the operations they are engaged to perform.
 - 1. The term “experienced,” when used with the term “installer,” means having a minimum of 5 previous projects similar in size and scope to this Project, being familiar with the special requirements indicated, and having complied with requirements of authorities having jurisdiction.

- A. Trades: Using terms such as “carpentry” does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as “carpenter.” It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name.
- B. Assigning Specialists: Certain Sections of the Specifications require that specific construction activities shall be performed by specialists who are recognized experts in those operations. The specialist must be engaged for those activities, and their assignments are requirements over which the Contractor has no option. However, the ultimate responsibility for fulfilling contract requirements remains with the Contractor.
 - 1. This requirement shall not be interpreted to conflict with enforcing building codes and similar regulations governing the Work. It is also not intended to interfere with local trade-union jurisdictional settlements and similar conventions.
- C. “Project Site”: The space available to the Contractor for performing construction activities, either exclusively or in conjunction, with others performing other work as part of the Project. The extent of the Project Site is shown on the Drawings and may or may not be identical with the description of the land on which the Project is to be built.
- D. “Testing Agencies”: A testing agency is an independent entity engaged to perform specific inspections or tests, either at the Project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.
- E. “CO”: Contracting Officer.

1.3 SPECIFICATION FORMAT AND CONTENT EXPLANATION

- A. Specification Format: These Specifications are organized into Divisions and Sections based on Construction Specifications Institute (CSI) numbering system.
- B. Specification Content: This Specification uses certain conventions regarding the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations or circumstances. These conventions are explained as follows:
- C. Abbreviated Language: Language used in Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be interpreted as the sense requires. Singular words will be interpreted as plural and plural words interpreted as singular where applicable as the context of the Contract Documents indicates.
- D. Streamlined Language: The Specifications generally use the imperative mood and streamlined language. Requirements expressed in the imperative mood are to be performed by the Contractor. At certain locations in the Text, subjective language is used for clarity to describe responsibilities that must be fulfilled indirectly by the Contractor or by others so noted. The words “shall be” are implied where a colon (:) is used within a sentence or phrase.

1.4 INDUSTRY STANDARDS

- A. Applicability of Standards: Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publications Dates: Comply with the standards in effect as of the date of the Contract Documents.
- C. Conflicting Requirements: Where compliance with 2 or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer to the CO before proceeding for a decision on requirements that are different, but apparently equal; and where it is uncertain which requirement is the most stringent.
 - 1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum acceptable. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of the requirements. Refer uncertainties to the CO for a decision before proceeding.
- D. Copies of Standards: Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents. Where copies of standards are needed to perform a required construction activity, the Contractor shall obtain copies directly from the publication source.
- E. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where such acronyms or abbreviations are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standard-generating organization, authorities having jurisdiction, or other entity applicable to the context of the text provision. Refer to "Gale Research Co." "Encyclopedia of Associations," available in most libraries.

END OF SECTION

SECTION 01430

QUALITY ASSURANCE

PART 1- GENERAL

1.1 DESCRIPTION

- A. Establish and maintain an effective quality control program and perform sufficient inspections and tests of all items of work, including those of subcontractors, to ensure compliance with the Contract Documents.

1.2 GENERAL

- A. Provide for procedures to ensure that the latest Contract Documents, standards, codes, shop drawings and instructions are used for fabrication, construction and testing.
- B. Furnish appropriate facilities, instruments and testing devices required for performance of the quality control program.
- C. Contractor is responsible for inspections and tests required in Divisions 2 and 3, and the cost of same shall be included in the Contract Sum.
- D. Ensure that the work of related trades is properly coordinated.

1.3 QUALIFICATIONS

- A. Persons qualified by training and/or experience shall provide, install and/or perform all work. Qualifications and/or minimum years of experience are specified in the technical sections of these Specifications. At the Pre-Work Conference, provide documentation demonstrating that qualifications for each phase of work will be met.

1.4 PRE-INSTALLATION

- A. It is the Contractor's responsibility to be certain that all equipment and materials selected by the Contractor, subcontractors or material suppliers conform exactly to the requirements of the Contract Documents. Approval of a manufacturer's name by the CO does not relieve the Contractor of the responsibility for providing materials and equipment which comply with the Drawings and Specifications.
- B. Before the installation of every major unit of work that requires coordination with other work, ensure that the unit of work can be installed and function as intended and required in conjunction with other work which has preceded or will follow. If the installer reports unsatisfactory conditions for installation, do not proceed until these conditions have been corrected.

1.5 INSTALLATION

- A. Conform to testing and inspection requirements as specified. Coordinate enclosure of work with required inspections and tests, so as to avoid the necessity of uncovering work for that purpose.

- B. Unless otherwise noted or directed, install all work in accordance with Manufacturer's recommendations for best results. Do not omit any preparatory steps or installation procedures unless specifically modified or exempted by the Documents.
- C. Recheck measurements and dimensions of the Work, as an integral step of starting each installation.
- D. Any modification necessary for the proper installation and function of an approved substituted item shall be made by the Contractor at no additional cost to the Government. The Contractor shall bear the cost of any detailing or design required to accommodate the change.
- E. Protect newly installed work to ensure that it will remain without damage or deterioration during the remainder of the construction period. If damage or deterioration should occur, restore to new condition at no additional cost to the Government.

END SECTION

SECTION 01450

QUALITY CONTROL

PART 1- GENERAL

1.1 DESCRIPTION

- A. Contractor provided testing laboratory services.

1.2 RELATED WORK

- A. Section 01780, Closeout Submittals
- B. Individual Specification Sections: Inspections and tests required, and standards for testing.

1.3 REFERENCES

- A. ANSI/ASTM D-3740: Practice for Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
- B. ANSI/ASTM E-329: Standard Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction.

1.4 SELECTION AND PAYMENT

- A. Contractor will employ and pay for services of an independent testing laboratory to perform specified inspection and testing. Sampling and testing shall be provided to assure compliance with the requirements of the drawings and Specifications.
- B. Employment of testing laboratory shall in no way relieve the Contractor of obligation to perform work in accordance with requirements of contract documents.
- C. Under no circumstances shall a supplier of materials be allowed to act as an approved testing laboratory.
- D. No materials shall be placed or installed without prior acceptance by the Contracting Officer, based on test and inspection results.

1.5 QUALITY ASSURANCE

- A. Comply with requirements of ANSI/ASTM E-329 and ANSI/ASTM D3740.
- B. Laboratory shall maintain a full-time registered engineer on staff to review services.
- C. Laboratory authorized to operate in the State of Montana.
- D. Testing equipment shall be calibrated at reasonable intervals with devices of an accuracy traceable to either NBS Standards or accepted values of natural physical constants.

1.6 CONTRACTOR SUBMITTALS

- A. Prior to start work, submit testing laboratory name, address, and telephone number, and names of full-time registered engineer and responsible officer.
- B. Submit copy of report of laboratory facilities inspection made by Materials Reference Laboratory of National Bureau of Standards during most recent tour of inspection, with memorandum of remedies of any deficiencies reported by the inspection.

1.7 LABORATORY RESPONSIBILITIES

- A. Test samples of mixes submitted by Contractor.
- B. Provide qualified personnel at site after due notice; cooperate with the Contracting Officer and Contractor in performance of services.
- C. Perform specified inspection, sampling, and testing of products.
- D. Ascertain compliance of materials and mixes with requirements of contract documents.
- E. Promptly notify the Contracting Officer and Contractor of observed irregularities or non conformance of work or products.
- F. Perform additional inspections and tests required by the Contracting Officer.

1.8 LABORATORY REPORTS

- A. After each inspection and test, promptly submit two (2) copies of the laboratory report to the Contracting Officer. Include: Date issued, project title and number, name of inspector, date and time of sampling or inspection, identification of product and specifications section, location in the project, type of inspection or test, date of test, results of test, and conformance with contract documents. When requested by the Contracting Officer, provide interpretation of test results.

1.9 LIMITS ON TESTING LABORATORY AUTHORITY

- A. Laboratory may not release, revoke, alter, or enlarge on requirements of contract documents.
- B. Laboratory may not approve or accept any portion of the work.
- C. Laboratory may not assume any duties of the Contractor.
- D. Laboratory has no authority to stop work.

1.10 CONTRACTOR RESPONSIBILITIES

- A. Deliver to laboratory at designated location adequate samples of materials proposed to be used which require testing, together with proposed mix designs.
- B. Cooperate with laboratory personnel and provide access to work.

- C. Provide incidental labor and facilities for access to work to be tested, to obtain and handle samples at the site or source of products to be tested, to facilitate tests and inspections, and for storage and curing of test samples.

END SECTION

SECTION 01500

TEMPORARY FACILITIES AND CONTROLS

PART 1- GENERAL

1.1 DESCRIPTION

- A. Work under this Section includes temporary facilities to facilitate the Work and construction controls to protect workers and the public from injury, harm or discomfort.

1.2 RELATED WORK

- A. Section 01330, Submittals

1.3 RULES AND REGULATIONS

- A. All construction methods and procedures shall be in compliance with the State of Montana, Department of Labor, Division of Labor Standards and Safety.
- B. The Contractor shall familiarize himself/herself with current OSHA rules and observe these regulations at all times during the term of this Contract.

1.4 SAFETY AND NOISE CONTROLS

- A. Provide all labor, material, and equipment necessary for protection of public, personnel, vehicles and the environment from injury or damage.
- B. Erect all necessary barricades and guards. Post appropriate warning signs. Use a water truck as necessary to control dust.
- C. Comply with all applicable regulations and restrictions in regard to noise levels and noise-generating activities.

1.5 CLEANUP AND DISPOSAL

- A. Remove all temporary facilities and construction controls at the completion of the Work.
- B. Leave work area clean and free of all debris associated with this Section of Work.

END SECTION

SECTION 01660

PRODUCT STORAGE AND HANDLING REQUIREMENTS

PART 1 GENERAL

1.1 DESCRIPTION

- A. This work includes the protection of products scheduled for use in the work by means including, but not necessarily limited to, those described in this Section.

1.2 QUALITY ASSURANCE

- A. Include within the Contractor's quality assurance program such procedures as are required to assure full protection of work and materials.

1.3 MANUFACTURERS' RECOMMENDATIONS

- A. Except as otherwise approved by the Contracting Officer, determine and comply with manufacturers' recommendations on product handling, storage, and protection.

1.4 PACKAGING

- A. Deliver products to the job site in their manufacturer's original containers, with labels intact and legible.
- B. Maintain packaged materials with seals unbroken and labels intact until time of use.
- C. Promptly remove damaged material and unsuitable items from the job site, and promptly replace with material meeting the specified requirements, at no additional cost to the Government.
- D. The Contracting Officer may reject as non-complying such material and products that do not bear identification satisfactory to the Contracting Officer as to manufacturer, grade, quality, and other pertinent information. All packaging must include evidence that materials comply with the Buy American Regulations.

1.5 PROTECTION

- A. Protect finished surfaces, including columns, beams and fascias of openings used as passageways, through which equipment and materials are handled.
- B. Provide protection for finished surfacing in traffic areas prior to allowing equipment or materials to be moved over such surfaces.
- C. Maintain finished surfaces clean, unmarred, and suitably protected until accepted by the Contracting Officer.

1.6 REPAIRS AND REPLACEMENTS

- A. In event of damage, promptly make replacements and repairs to the approval of the Contracting Officer and at no additional cost to the Government.

- B. Additional time required to secure placements and to make repairs will not be considered by the Contracting Officer to justify an extension in the Contract Time of Completion.

END OF SECTION

SECTION 01712

FIELD ENGINEERING

PART 1- GENERAL

1.1 DESCRIPTION

- A. All field engineering services required to complete the work shall be provided by the Contractor unless otherwise noted.

1.2 RELATED WORK

- A. Section 01770, Close Out Submittals

1.3 QUALITY ASSURANCE

- A. Cost of field engineering shall be considered incidental to the item being constructed.
- B. Survey work shall be completed by, or under the direct supervision of, a person experienced in construction surveying.
- C. Provide layout and grade staking according to professional engineering and surveying procedures for the type of work being performed.
- D. Provide structural design of shores, forms and similar items used by the Contractor as part of his/her means and methods of construction.
- E. During the course of construction, the Contractor shall make available a person to help the Contracting Officer with field checking of grades and control as may be necessary to assure proper construction.

1.4 REFERENCE POINTS

- A. Locate and protect monuments, benchmarks, and initial control point, or reference thereto, prior to commencing work. Establish additional reference points as needed during construction.
- B. Report to the Contracting Officer when reference points or initial control points are lost or destroyed during construction. Replace points immediately.

1.5 REQUIREMENTS

- A. Establish lines and levels to properly layout and construct the work to the dimensions and elevations shown on the Plans. Re-establish and restake survey bearings, traverse lines, stationing and points of intersection as required to construct the work to the horizontal and vertical alignments as detailed.
- B. Take measurements as far in advance of required installation as possible and verify measurements given on Drawings. Promptly report variations, discrepancies or non-closing dimensions with the Contracting Officer for further direction.

- C. Maintain construction lines and grade staking to assure accurate and proper control of the work and to verify final grades and construction lines.
- D. Periodically, verify layouts and elevations by methods as required. No extra will be paid to the Contractor for removal and replacement of work which is found to be incorrectly installed.

1.6 FIELD ADJUSTMENTS

- A. The Government reserves the right to field adjust layouts and grades for the purpose of avoiding obstructions and/or conforming to existing site features.
- B. The Contractor shall make adjustments as directed by the Contracting Officer at no additional cost to the Government.

1.7 SURVEY RECORDS

- A. Maintain a complete, accurate log of all control and construction survey work as it progresses.

END SECTION

SECTION 01740

CLEANING AND WASTE MANAGEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. All clean-up work including all materials, labor and equipment necessary for cleaning and debris removal.

1.2 DISPOSAL REQUIREMENTS

- A. Conduct cleaning and disposal operations to comply with local codes, ordinances and regulations.
- B. Dispose of all debris and materials at a site approved by the USFS, Contracting Officer, and Local Authority.
- C. The Contractor shall be responsible for all costs and fees associated with disposal of waste materials and debris.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Use only those cleaning materials which will not create hazards to health or property and which will not damage surfaces.
- B. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

PART 3 - EXECUTION

3.1 DURING CONSTRUCTION

- A. Execute periodic cleaning to keep the work site and adjacent properties free from accumulations of waste materials and trash.
- B. Provide on-site containers for the collection of waste materials and trash.

3.2 DUST CONTROL

- A. Clean interior spaces prior to the start of finish painting and continue cleaning as needed until painting is finished.
- B. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly-coated surfaces.

3.3 FINAL CLEANING

- A. At the completion of the project, or prior thereto if so directed by the Contracting Officer, the Contractor shall be responsible for complete cleaning of those portions of the project and site which his work effects.
- B. Sweep and clean concrete slabs thoroughly and remove all marks, stains, fingerprints, dust, dirt, paint drippings and other construction residue from all surfaces. Clean and touch up all painted work. Clean site and remove excess debris, branches, rocks, and trash.
- C. Prior to final inspection by Contracting Officer, Contractor shall conduct his own inspection of exposed interior and exterior surfaces, and all work areas, to verify that the entire work is clean and ready for inspection and use by the Government.

3.4 RESTORATION OF DAMAGED PROPERTY

- A. To the extent that any roads, vegetation, structures, utilities or other items are damaged or displaced by the Contractor's operations, these shall be restored to their original or better condition prior to Final Inspection. This shall include both on-site and off-site items. Any damage which is severe enough to disrupt community travel or utilities shall be repaired by the Contractor immediately, when requested by the Contracting Officer.

END OF SECTION

SECTION 01770

CLOSEOUT PROCEDURES

PART 1- GENERAL

1.1 DESCRIPTION

- A. This Section describes an orderly and efficient transfer of the completed work to the USFS.

1.2 QUALITY ASSURANCE

- A. Prior to requesting inspection by the Contracting Officer, use adequate means to assure that the work is substantially completed in accordance with the specified requirements and is ready for the requested inspection.

1.3 PROCEDURES

- A. Substantial Completion:
 - 1. Substantial completion is defined as that point at which the work is basically complete and ready for use. All specified products shall have been installed and are functionally operational. Remaining work shall be extremely minor or require seasonal opportunity to complete or subject to delayed completion items and shall not impair the functionality of the site.
- B. The Contractor shall notify the Contracting Officer, in writing as required by the General Conditions, as to the date when in its opinion all or a designated portion of the work will be substantially completed and ready for inspection.
- C. Within a reasonable time after receipt of such notice, the Contracting Officer will inspect to determine status of completion.
- D. Should the Contracting Officer determine that the Work is not substantially complete:
 - 1. The Contracting Officer promptly will so notify the Contractor in writing, giving the reasons therefore.
 - 2. The Contractor shall remedy the deficiencies and notify the Contracting Officer when ready for reinspection.
 - 3. The Contracting Officer will reinspect the Work.
 - 4. The Contractor shall be liable for expenses incurred by the USFS for reason of such Substantial Completion Reinspection.
- E. When the Contracting Officer concurs that the Work is substantially complete:
 - 1. The Contracting Officer will prepare a Punch List of items to be completed or corrected, as verified by the CO.
 - 2. The Contracting Officer will submit the Punch List to the Contractor for their written acceptance of the responsibilities assigned to them in the Punch List.
 - 3. Once the Contractor executes the Punch List, the Contracting Officer must be notified in writing.

- F. Immediately following approval of Substantial Completion, the Contractor shall submit the following documents.
1. Final Pay Request with final adjustment of accounts stating all adjustments to the contract sum.
 2. Previous change orders.
 3. Deductions or uncorrected work.
 4. Other adjustments.
 - i. Contractor's Certificate and Release
 - ii. Operation and Maintenance Manuals.
 - iii. As-Built Drawings and Submittals.
- G. Final Inspection: Final Inspection shall be defined as that period at which all work in the Contract is 100% complete and no minor details remain to be performed.
1. Final inspection shall not be made until all work under the contract is completed. The Contractor shall notify the Contracting Officer in writing, at least 4 days prior to the date requested on which the work will be ready for final inspection.
 2. Following notification, the Contracting Officer will make an inspection of the Contractor's work and record any deficiencies on the Final Punch List. The Contractor shall immediately correct these deficiencies at her/his own expense and notify the Contracting Officer in writing when all items have been corrected. The Contracting Officer will re-inspect the work to assure correction of all deficiencies before release of amounts retained for minor, seasonal or delayed items. The Contractor shall be liable for all costs of reinspection when the Substantial Completion Punch List deficiencies have not been corrected at the time of the Final Inspection and reinspection is required.
 3. Any reasonable delay by the CO in making final inspection shall not relieve the Contractor of responsibility for the work nor shall the Government be held responsible for damages or claims for compensation on account of continuing overhead, maintenance, etc., occasioned by such a delay.
- H. Final Pay Request will be processed for payment upon final inspection and Contracting Officer's certification that work under the contract is 100% complete.

PART 2 - PRODUCTS

2.1 WARRANTY

- A. The Contractor warrants the products delivered under the contract to be free from defects in design, material or workmanship, and against damage caused prior to final inspection. Unless otherwise specified, this warranty extends for a period of one (1) year from the date of final acceptance.

The Contractor shall promptly repair or replace all defective or damaged items delivered under the Contract. The Contractor may elect to have any replaced item returned to his plant at his expense.

END OF SECTION

DIVISION 2

SITE CONSTRUCTION

SECTION 02221

TRENCH EXCAVATION AND BACKFILL FOR PIPELINES & APPURTENANT STRUCTURES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This work is the excavation, trenching, and backfilling for pipelines and appurtenances. It includes all clearing, grubbing, site preparation, removal, and disposal of debris from the excavation, handling and storing materials for fill and backfill, all bracing, shoring and trench protection, construction dewatering, all backfill, subgrade preparation, final grading, site dressing, and cleanup.

1.2 REFERENCES

- A. The current publications listed below form a part of this specification.

AASHTO T99	Moisture-Density Relations of Soils Using 5-lb (2.5kg) Rammer and 12-inch (305mm) Drop
ASTM D698	Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft ³)(600 kn-m/m ³)
AASHTO T191 (ASTM D1556)	Density of Soil In-Place by the Sand-Cone Method
AASHTO T310 (ASTM D6938)	In-Place density and water content of the soil and soil aggregate by Nuclear Method (Shallow Depth)
AASHTO T11 (ASTM C117)	Materials Finer Than 0.075mm (No. 200) Sieve in Mineral Aggregates by Washing
AASHTO T27 (ASTM C136)	Sieve Analysis of Fine and Coarse Aggregate
AASHTO T89	Determining the Liquid Limit of Soils
AASHTO T90	Determining the Plastic Limit and Plasticity Index of Soils
ASTM D4318	Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4253	Maximum Index Density and Unit Weight of Soils Using a Vibratory Tube

1.3 TESTING

A. Field Density Testing

1. Meet the quality control and quality assurance testing requirements in Sections 01430 and 01450, Contractor Quality Control and Owner Quality Assurance.
2. In-place field density tests for quality assurance are at Owner expense meeting AASHTO T191 (ASTM D1556), Sand Cone Method; or by AASHTO T310 (ASTM D6938) Nuclear Densometer Methods. Quality assurance field density testing frequency is at the Engineer's discretion.
3. Retesting failing areas is at the expense of the Contractor. Where Engineer provides testing on behalf of the Owner, the Contractor will be assessed the cost of all retests conducted by the Engineer, with that cost deducted from the progress payments.
4. At the direction of the Engineer, provide the necessary equipment and labor to excavate and replace materials for test holes up to 5 feet deep into the compacted backfill to allow testing below the surface of any layers covered without inspection and approval by the Engineer.

B. Laboratory Maximum Density and Optimum Moisture

1. Quality assurance tests will be made by the Engineer for each on-site natural soil or each source of off-site material, including borrow material, to determine the laboratory maximum density values and optimum compaction moisture content according to AASHTO T-99 or ASTM D698.

C. Material Submittals

1. Submit to the Engineer material quality test results, including Type 1 Bedding gradation and plasticity index, and Type 2 Bedding gradation.
2. Submit to the Engineer laboratory moisture-density relationship testing results of on-site and off-site borrow soils.
3. If applicable, submit a blasting plan to the Engineer.

PART 2 - PRODUCTS

2.1 PIPE BEDDING MATERIALS

A. Type 1 Pipe Bedding

1. Type 1 Pipe Bedding includes the material placed from 4 inches (10 cm) below the bottom of the pipe to 6 inches (15 cm) over the pipe.
2. Provide Type 1 Bedding consisting of crushed stone or gravel, which is free of cementitious substances or thin, flat particles in an amount that would cause the material to cake, pack, or otherwise form and unyielding support for the pipe.
3. Provide imported granular material with a gradation as follows and a maximum plasticity index of 6, determined by AASHTO T89 and T90 or by ASTM D4318.

Percent by Weight Passing	
Sieve Size	% Passing
1" (25 mm)	100
3/4" (19.0 mm)	90 - 100
3/8" (9.5 mm)	20 - 55
No. 4 (4.75 mm)	5 - 10
No. 8 (2.36 mm)	0 - 5

4. Crush material so that the percentage of fractured particles in the finished product is as constant and uniform as practical. Crush to produce material where at least 50 percent of the material retained on the No. 4 sieve has at least one fractured face.
5. To prevent migration of material from around the pipe, do not use sand, sandy gravel, or material composed mainly of sand for bedding material in the pipe zone where groundwater is or will be present or where existing material contains voids which would allow migration. Where trench excavation encounters wet or unstable material, Type 1 Pipe Bedding must be well graded, free-draining, and non-plastic.
6. Refer to the Special Provisions and details in the Drawings for other requirements.

B. Type 2 Pipe Bedding

1. Type 2 Pipe Bedding is used as directed by the Engineer to replace unsuitable material encountered in the trench bottom.
2. Place Type 2 Pipe Bedding from the bottom of the Type 1 Bedding material to the depth required to adequately support the pipe.
3. Type 2 Bedding consists of granular material meeting the following gradation and having a maximum plasticity index of 6 and a maximum liquid limit of 25 percent.

Percent by Weight Passing	
Sieve Size	Type B-Modified
3" (75 mm)	100
No. 4 (4.75 mm)	0 - 25
No. 8 (2.36 mm)	0 - 10

C. Separation Geotextile

1. The plans may require, or the Engineer may direct, the use of non-woven geotextile fabric intended to provide materials separation. The fabric will wrap all or part of the Type 1 Pipe Bedding and Select Type 1 Pipe Bedding to prevent materials migrating into the trench bottom and trench walls as shown on the plans or as

directed by the Engineer. The fabric shall be AASHTO M288 Class 1, 2, or 3 as specified or determined by the Engineer.

2.2 TRENCH BACKFILL MATERIALS

- A. Materials from Trench Excavation
 - 1. Backfill material obtained from trench excavations must be free of cinders, ash, refuse, organic or frozen material, boulders, or other deleterious materials. Backfill materials and placement are further described in the Execution Section of this specification.
- B. Imported Backfill Material
 - 1. Imported backfill material is from borrow source(s) outside the project limits and is used when, in the opinion of the Engineer, an adequate volume of suitable backfill material is not available within the project limits. Imported Backfill Materials must comply with the requirements of Section 2.2.A, MATERIALS FROM TRENCH EXCAVATION.

2.3 FLOWABLE FILL

- A. If used, Flowable Fill is to meet the requirements of Section 2225, Flowable Fill.

2.4 DETECTABLE BURIED WARNING TAPE

- A. Detectable buried warning tape is to have a minimum 6 inch (15cm) width and 5 mil (0.12mm) thickness and a solid aluminum core running the full length and width of the tape enclosed in a color coded inert plastic jacket, impervious to alkalis, chemical reagents and solvents in the soil. The tape is to meet APWA/ULCC Color Code requirements and is to have a maximum 36-inch(90cm) imprint.

PART 3 - EXECUTION

3.1 PROTECTION OF EXISTING PROPERTIES

- A. General
 - 1. Take precautions to protect all adjoining private and public property and facilities, including underground and overhead utilities, curbs, sidewalks, driveways, structures, and fences. Restore or replace all disturbed or damaged facilities to its original condition at the Contractor's expense.
 - 2. Contact utility owners using the Montana One Call System for utility locates before starting work. Protect the utilities exposed during the work and prevent damaging underground utilities adjacent to excavations. Immediately notify the utility owner of any construction damage. Repairs of damage to marked utilities are at the expense of the Contractor.
 - 3. Re-locate existing water mains, sanitary sewers, and storm drains shown on the plans that conflict with new pipelines or structures, as indicated in the contract

documents. No separate payment will be made for this work unless shown as a payment item. If the Owner authorizes the relocation of mains or sewers, which are not indicated in the bid documents, and the Engineer determines the work was not included in the original contract, payment will be made under the applicable sections of the General Conditions.

4. Cut and replace existing service lines interfering with trenching operations only with the Engineer's permission and at the Contractor's expense.
5. Show all repaired and/or adjusted water and sewer lines on the As-Built Plans.
6. Protect existing water and sewer mains and water and sewer services from freezing at all times during construction.

B. Privately Owned Utilities

1. If any existing private utility interferes with the work in either alignment or grade and has to be moved, the work will be performed by the appropriate Utility Owner unless otherwise specified in the contract documents. Such private utilities may include gas mains, underground electrical and telephone cables, telephone poles, light poles, etc.
2. If, however, such private utility relocation is performed by the Contractor, and the relocation is not a separate payment item, payment will be made under the Section 02221 conditions covering such changes.
3. Such payment will be made only if the work is determined by the Engineer to be a change from the original contract work scope.

C. Existing Structures

1. Prevent damage to existing buildings or structures in the work area. Repair all construction related damage to the satisfaction of the Owner.

D. Existing Overhead Utilities

1. Use extreme caution to avoid conflict, contact, or damage to overhead utilities during the work.

E. Exploratory Excavation

1. The location of existing buried public utilities may need to be verified by exploratory excavation before construction.
2. Where authorized by the Engineer, the Contractor will be reimbursed for exploratory excavation work at the unit price bid per hour for a backhoe/excavator with an operator and a laborer to assist. Use a backhoe/excavator having at least 60 horsepower (45kw), as rated by the manufacturer.
3. The unit price per hour includes the backhoe/excavator, operator, and one laborer based upon the actual time, to the nearest one-half hour, that the equipment and personnel are used in actual excavating and backfilling operations, including standby time between excavation and backfilling, which allows the Engineer to make the necessary survey of the underground utilities.
4. Exercise care to prevent damaging all utilities and repair any utility damage caused by exploratory excavation.

F. Pavement Removal and Stripping

1. Where trench excavation or appurtenant structure excavation requires removing curb and gutter, concrete sidewalks, asphalt concrete pavement, or Portland cement concrete pavement, cut the concrete or pavement in a straight line parallel to the excavation's edge using a spade-bitted air hammer, concrete saw or other suitable

- equipment to produce a straight, square and clean break. Re-cut edges broken during construction, before concrete or paving operations.
2. For trenches passing through the existing pavement, cut the pavement along a neat vertical line at least 12 inches (30cm) from the trench edge. Where the neat line cut is less than 3 feet (0.9m) from the edge of the existing pavement, remove and replace the entire pavement section between the trench and edge of the pavement.
 3. Dispose of the asphalt concrete and/or Portland cement concrete debris off-site according to applicable state and local regulations.
- G. When excavating across existing gravel streets or other developed surfaces, remove the surfacing material full depth and stockpile for inclusion in the trench backfill or legally dispose of the surfacing material.
- H. When excavating across cultivated or sodded areas, remove full topsoil depth or a maximum 12-inch (30cm) depth, whichever is less, and stockpile for possible project use.
- I. Re-sod or reseed, as specified in the contract documents, all established lawn areas cut by trenching or damaged during the construction, according to Section 2910, to the Engineer's satisfaction.

3.2 MAINTENANCE OF FLOWS

- A. Maintain the flow of sewers, drains, and watercourses encountered during construction. Restore culverts, ditches, fences, crosswalks, and structures disturbed by construction to their original condition upon completion of the work.

3.3 TRENCH EXCAVATION

- A. General
1. Meet current OSHA Safety and Health Standards for all excavation, trenching, shoring, and related work.
 2. Excavate at the specified locations for pipeline installations and appurtenant structures.
 3. Crossings under sidewalks or curbs may be made by tunneling if approved by the Engineer. If a portion of a sidewalk or curb is removed, use a concrete saw to make joints, compact the backfill as specified, and replace the removed Section with a new concrete sidewalk or curb.
 4. During excavation, stockpile backfill materials away from the trench banks to assure trench wall stability. Stockpile excavated materials on only one side of the trench without obstructing existing fire hydrants, valves, manholes, and other appurtenances. Assure surface drainage of adjoining areas is unobstructed.
 5. Remove and dispose of all excess or unsuitable excavated materials.
 6. Prevent surface water from flowing into excavations. Promptly remove all water accumulating in trench excavations. Do not permit water to accumulate in any open trench. Remove and re-lay all pipe out of alignment or grade caused by trench flooding.
 7. Grade the trench bottoms to the specified lines and grades. Assure bedding material provides uniform bearing and support for each pipe section along its entire length. Excavate for bell and joints after the trench bedding is graded, limiting the

excavation to the required length, depth, and width for making the particular type of joint used. Backfill over- excavations with Type 2 Bedding Material.

8. No classification of trench excavated material materials will be made. Excavation and trenching work includes the removal and subsequent handling of all earth, loose or cemented gravel, loose or solid rock, and other materials excavated or otherwise removed in the performance of the contract work, regardless of the type, character, composition, or condition thereof. All materials excavated or otherwise removed, including asphalt, curb, gutter, sidewalk, soils, etc., will become the property of the Contractor, who will be responsible for environmentally sound disposal of said material in accordance with state and federal regulations.
9. The use of trench digging machinery is permitted, except in places where its operation is likely to cause damage to existing structures or features, in which case hand methods are to be employed.

B. Trench Dimensions

1. Excavate to the trench dimensions specified below.
2. Width
 - a. Excavate to provide room to install and join the pipe as specified. The minimum trench width is 3'-6" (1.1m), for outside pipe diameters of 18 inches (0.5m) or less. The minimum trench width is 2'-0" (0.6m) plus the outside pipe diameter, for pipe sizes exceeding 18 inches (0.5m). Maximum trench width may be specified in the contract documents.
 - b. If the trench is excavated wider than the specified minimum, provide Type 1 Pipe Bedding for the additional width to yield a consistent backfill for the entire width of the trench or take such other measures as the Engineer may direct to protect the pipe against the crushing forces of trench backfill at the Contractor's expense.
3. Depth
 - a. Excavate the trench as required for the invert grade or pipe bury as specified in the contract documents, plus 4 inches (10cm) for the Type 1 Pipe Bedding. If bedrock, boulders, or large stones are encountered at the bottom of the trench, excavate at least 6 inches (15cm) below the bottom of the pipe for backfilling with Type 1 Pipe Bedding.

C. Soft or Unsuitable Trench Subgrade

1. When soft or unstable material is encountered at the trench subgrade, which will not uniformly support the pipe, excavate the material to the depth directed by the Engineer and backfill to trench subgrade elevation with Type 2 Pipe Bedding.

D. Blasting

1. Obtain Engineer approval to blast for excavation. If approved, the Engineer will establish the time limits blasting will be permitted.
2. Use the utmost care to protect life and property during blasting. Use only a licensed blaster with experience in the type of blasting required for the work.
3. Safely and securely store all blasting materials meeting local laws and ordinances, and clearly mark all storage places "Dangerous Explosives." Do not leave any explosives where they could endanger persons or property.
4. Blasting Rock in Trenches
 - a. When blasting rock in trenches, cover the blasting area with earth backfill or approved blasting mats. Before blasting, station workers and provide danger signals to warn people and stop vehicles.

- b. Assume responsibility for all damage to property and injury to persons resulting from blasting or accidental explosions during the work.
 - c. Furnish the following information to the Owner and Engineer at least 48 hours before the commencement of blasting operations: Name of the Contractor's powder man, powder man's experience, type of shot, type of explosives and detonator being used, proof of insurance covering liability for such operation, traffic control plans and planned procedures for protecting the public.
 - 5. Assure the blasting plan meets federal, state, and local ordinances. Obtain all required permits before blasting starts.
- E. Pavement Damage Cause by Equipment
 - 1. Equip all track-mounted equipment operated on pavement surfacing with pads to prevent pavement damage.
 - 2. Remove and replace all pavement damaged during construction by the Contractor's equipment, or the use thereof, to at least a depth of 1 inch (25 mm). Patches will not be allowed less than 1 inch (25 mm) in thickness.
 - 3. Replace all asphalt pavement damaged during construction outside of restoration pay limits in conjunction with asphalt restoration and as otherwise required by the Engineer. Place asphalt to produce a final surface uniform in texture and consistent with the line and grade of adjacent pavement or as directed by Engineer. No compensation will be allowed for removal and replacement of damaged pavement outside of the pay limits for asphalt restoration.
- F. Shoring, Bracing, and Sheeting
 - 1. Provide all shoring, bracing, and tight sheeting required to prevent caving and protect workers, meeting current Occupational Safety and Health Act Requirements, and to protect adjacent property and structures. The cost of this work is included in the price of trench excavation.
- G. Excavation for Appurtenances
 - 1. Make excavations for manholes, hydrants, structures, and other appurtenances of the size and depth to permit compacting of backfill on all sides to the specified density. The requirements for removing water and other applicable portions of these specifications apply to excavation for appurtenances.

3.4 DEWATERING

- A. General
 - 1. Furnish all necessary labor, equipment, and incidentals necessary to dewater the project site during construction.
 - 2. Keep all excavation dry and free from water during construction and the placement of materials. Do not place pipe, bedding, or backfill materials below the groundwater elevation established by dewatering operations. Do not allow groundwater or stormwater to enter or flow through the underground piping during installation.
 - 3. The cost of dewatering operations will be incidental to the cost of pipeline and appurtenance installation, and no additional payment will be made for dewatering. Consider shifts in the groundwater level caused by changing seasons or local

conditions in estimating the cost of dewatering operations, as no additional payments will be made for fluctuating groundwater levels.

4. Protect all structures that could be potentially impacted by dewatering operations. Repair any damage to structures caused as a result of dewatering at Contractor's expense.

B. Discharge

1. Do not discharge or dispose of water from dewatering operations in such a manner as to flood existing landscaped areas, graveled areas, or structures unless approved by Engineer. Written permission from the appropriate landowner shall also be required for discharge or disposal on private property.
2. It is the Contractor's responsibility to comply with requirements and regulations of federal, state, and local agencies that govern areas affected by dewatering of the construction site and application for and maintenance of any required permits.

3.5 EXCAVATION STABILITY AND SAFETY

- A. The stability of construction excavations and associated worker safety, including slope geometry and shoring/bracing considerations, are the Contractor's responsibility. Meet current OSHA regulations. This may require the design of temporary slopes and/or shoring by a licensed professional engineer.

3.6 TRENCH FILLING AND BACKFILLING

A. General

1. Backfill all trenches as specified immediately after grade, alignment, and pipe jointing has been inspected and approved by the Engineer. Conduct any pipe testing as specified in the respective water distribution, sewerage/drainage sections. Correct all defects discovered by tests prior to backfilling.
2. Storage of all imported backfill materials, including protecting said materials from adverse conditions that would disqualify them from use under these specifications, is the responsibility of the Contractor.

B. Pipe Bedding Placement

1. Type 1 Bedding.
 - a. Place Type 1 Pipe Bedding material 4 inches (10 cm) under, around the pipe, and to a point 6 inches (15 cm) above the top of the pipe in 6 inch (15 cm) lifts, using hand or other compaction methods without damaging or disturbing the pipe including mains and service lines and all appurtenances.
 - b. Place bedding material in equal lifts on both sides of the pipe for the full trench width. Thoroughly compact each lift of pipe bedding by tamping, vibration, slicing with a shovel, rodding, or by a combination of these methods. Take special care to assure complete compaction under the haunches of the pipe.
2. Type 2 Pipe Bedding.
 - a. Use Type 2 Pipe Bedding described in PRODUCTS SECTION as specified or as directed by the Engineer to replace unsuitable material

- encountered in the trench bottom, placing it from the bottom of the Type 1 Bedding material to the depth required to adequately support the pipe.
3. Separation Geotextile
 - a. Place Separation Geotextile where shown on the plans or where directed by the Engineer.
- C. Trench Backfill
1. After the pipe bedding materials are placed and compacted as specified, backfill the trench.
 - a. Use backfill material free of cinders, ash, refuse, organic or frozen material, boulders, or other deleterious material.
 - b. From the top of the Type 1 Bedding to 6 inches (15 cm) below the ground surface, or the subgrade elevation, material containing stone up to 8 inches (20 cm) in the greatest dimension may be used.
 - c. Cost of screening, drying, or moistening excavated backfill to comply with specifications will be considered incidental to the Contractor's bid price per linear foot of pipe and service lines and unit prices for appurtenances, and no additional payment will be made for such work.
 2. Trench backfill from the top of the pipe bedding to ground surface or to the street subgrade is separated into three classifications.
 - a. Type A Trench Backfill is compacted backfill typically used in streets or paved areas.
 - b. Type B Trench Backfill is typically used for unpaved alleys, cultivated areas, borrow pits, unimproved streets or other un-surfaced areas, and other areas where compaction is less critical.
 - c. Type C Trench Backfill is typically used in open and unimproved areas outside of the public right-of-way.
 3. Meet the backfill and compaction requirements for all of the backfill types described in the contract documents.
 4. Watering
 - a. Apply uncontaminated water, when required, at the locations and in the amounts required to compact the backfill material to the specified requirements. Maintain an adequate water supply during the work. Assure the equipment used for watering is of the capacity and design to provide uniform water application.
 - b. Apply water during the work to control dust and to maintain all embankment and base courses in a damp condition in accordance with these contract documents.
 - c. Water required for compacting trench backfill may be obtained from the municipal system if approved by the Owner or from other sources.
 5. Remove, replace, and re-compact backfill in trenches where settlement has occurred as directed by the Engineer at the Contractor's expense.
 6. Trench backfill types are designated as follows:
 - a. Type A Trench Backfill. Place trench backfill in maximum 8 inch (20 cm) compacted lifts within 3 percent of optimum moisture content and compact to at least 95 percent of maximum dry density determined by AASHTO T99 or by ASTM D698. For materials that do not exhibit a typical well-defined moisture-density curve, compact backfill to 70 percent relative density as determined by ASTM D4253 and D4254.
 - b. Type B Trench Backfill. Place trench backfill in maximum 8 inch (20 cm) compacted lifts within 3 percent of optimum moisture content, and

compact to at least 90 percent of maximum dry density determined by AASHTO T99 or by ASTM D698. For materials that do not exhibit a typical well-defined moisture-density curve, compact backfill to 50 percent relative density as determined by ASTM D4253 and D4254.

- c. Type C Trench Backfill. Place and compact Type C Trench Backfill in maximum 12-inch (30 cm) lifts at densities equal to or greater than the densities of adjoining undisturbed soil. Mound earth over the trench top, if so directed by the Engineer. In cultivated areas, place stripped topsoil uniformly over the backfilled trench to the original depth. Do not compact the topsoil, but grade to provide a smooth surface conforming to the adjoining ground surfaces.
- d. Flowable Fill. Place flowable fill as trench backfill as shown in the contract documents or as directed by the Engineer. Flowable fill may also be used as a construction expedient, substituting for any type of trench backfill, subject to approval by the Engineer, and at the expense of the Contractor.

D. Replacement of Unsuitable Backfill Material

- 1. Remove and dispose of excavated soils that are saturated, contain deleterious materials, or have characteristics that, in the opinion of the Engineer, render the soils unsuitable as backfill and/or which cannot be readily conditioned or dried to be made suitable.
- 2. Replace unsuitable soils with material obtained from trench excavations within the project limits at the expense of the Contractor.
- 3. If suitable replacement material is not available within project limits, notify the Engineer. The Engineer will quantify the extent of any unsuitable soils to be removed and replaced with material from an approved source, to be paid for as Imported Backfill Material, and provide written notification of the approved quantities to the Contractor. Payment for Imported Backfill Material will not be approved if the Contractor fails to notify the Engineer and/or proceeds with removal and disposal of unsuitable material prior to receiving written notice from the Engineer.
- 4. Provide imported backfill material with a gradation as follows and a maximum plasticity index of 10, determined by AASHTO T89 and T90 or by ASTM D4318. Imported backfill may not contain rock measuring greater than 6 inches (15 cm) in the greatest dimension.

Percent by Weight Passing	
Sieve Size	% Passing
1" (25 mm)	70 - 100
No. 4 (4.75 mm)	40 - 80
No. 10 (2.00 mm)	25 - 60
No. 200 (0.075 mm)	2 - 35

- 5. Place and compact all imported material according to the applicable backfill specification requirements.

- E. Backfill of Appurtenances
 - 1. Place and compact backfill for appurtenances to finished grade around manholes, inlets, valve boxes, and other underground items without disturbing appurtenance alignments.
 - 2. Meet the backfill material, placement, and compaction requirements specified for the adjoining trench.
- F. Detectable Buried Warning Tape
 - 1. Provide warning tape, as described in this Section. Bury tape a maximum of 18 inches (45 cm) below finish surface grade.

3.7 SURVEY MARKERS AND MONUMENTS

- A. Protect all survey markers and monuments. Protection includes marking with flagged high lath and supervising work near markers and monuments. Do not disturb monuments without prior approval from the Engineer.
- B. Replace all Contractors disturbed or destroyed survey markers or monuments not approved during construction, using a licensed land surveyor. See Section 01050 for details on survey marker protection/disturbance.

3.8 CLEANUP

- A. As work progresses, remove debris and complete to finish grade each portion of the work. Once the work is complete, clear debris and finish the entire site to smooth, uniform slopes presenting a neat and workmanlike appearance. Remove and dispose of all rocks brought to the surface during excavation or backfilling.
- B. Dispose of vegetation; coarse debris resulting from pavement or sidewalk removal; stones, junk, debris, and other materials encountered in excavation work; and other similar waste materials away from the site of the work at the Contractor's expense.

3.9 TIME AND DISTANCE OF OPEN TRENCHES

- A. Perform the work so that trenches will remain open the minimum time required to accomplish the work.
- B. Do not begin trench excavating until appropriate compaction equipment is at the excavation site.
- C. The maximum permissible distance between backfilling/compaction operations and the end of newly installed pipe is 100 feet (30 m) in existing streets (and/or alleys) and 200 feet (60 m) in all other areas.
- D. The maximum distance between the newly installed pipe and the excavator is to be 100 feet (30m) in existing streets (and/or alleys) and 200 feet (60m) in all other areas.

- E. For each workgroup consisting of a trench excavator, a pipe laying crew, and a backfilling/compaction crew, the maximum allowable open ditch at any time is 200 feet (60 m) in existing streets (and/or alleys) and 400 feet (120 m) in all other areas.
- F. The maximum distance behind the end of the new pipe is 1,500 feet (460m) for gravel surfacing replacement, base placement, or pavement replacement.
- G. At the completion of each working day, fill all trenches and/or provide safety netting, Jersey barrier, and other barricades required for public safety.

3.10 DRAINAGE CROSSINGS

- A. Where trenches are constructed in or across roadway ditches or other watercourses, protect the backfill from surface erosion by adequate means. Where the grade of the ditch exceeds 1 percent, prevent erosion by a suitable method approved by the Engineer. Backfill trenches in such a manner that water will not accumulate in unfilled or partially filled trenches.
- B. Remove all material deposited in roadway ditches or other water courses crossed by the trench immediately after backfilling is completed and restore the Section, grades, and contours of such ditches or watercourses to their original conditions, in order that the surface drainage is obstructed no longer than necessary.

END OF SECTION

SECTION 02449

HORIZONTAL DIRECTION DRILLING

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Provide all plant, materials, equipment and incidentals necessary for the construction of new high density polyethylene water mains by horizontal direction drilling as shown on the Drawings and as specified herein. Horizontal Direction Drilling (HDD) is meant as a method of trenchless pipe installation using a steerable drilling operation which directly installs a pipe along a linear alignment (not necessarily horizontal) without an open hole or open face.
- B. Furnish all survey including layout, inspection and record-keeping incidental to the drilling and pipe installation.
- C. Drilling shall be conducted below all paved surfaces. Location control, recovery, installation, bypassing obstructions and drilling must all be conducted without access to the roadway.

1.2 RELATED WORK

- A. Earthwork is included in Section 02221

1.3 SUBMITTALS

- A. Submit letters, shop drawings and product data showing materials of construction, installation equipment and details of installation for the HDD operation including:
 - 1. Qualifications of the micro-tunneling Contractor
 - a. Name, business, address and telephone number of the Contractor.
 - b. Experience in successfully constructing direction drilling operations.
 - c. List of similar projects performed over the last two years including the name of contact person and telephone number.
 - d. Certification of workman training.
 - e. Name(s) of all supervisory personnel to be directly involved with the project.
 - f. The Contractor shall sign and date the information provided and certify that to the extent of his knowledge, the information is true and accurate, and that the supervisory personnel for the HDD operations will be directly involved with this project.
 - 2. Construction Procedures
 - a. Written descriptions of the construction method and equipment to be used, and access pit sizes and locations required for equipment and material access.
 - b. Grouting techniques to be used for overexcavation if any, including equipment, pumping procedures, grout types, and mixtures.
 - c. Description of line and grade control.
 - d. Proposed procedures, materials and equipment for lubricating the exterior of the pipe during pulling.

- e. Details of spoil removal system, including equipment type, number and disposal location.
- f. Proposed methods, materials and equipment for removing and clearing obstructions so that the HDD can advance forward.
- g. Procedures for locating and controlling the direction of the drilling operation.

1.4 QUALIFICATIONS

A. HDD Contractor

- 1. The HDD contractor shall be trained and certified to operate the Horizontal Direction Drilling equipment with at least 5 years experience in directional drilling obtained over the last five years. Perform HDD operations under the constant direction of a drilling supervisor who shall remain on site and be in responsible charge throughout the drilling operation. The supervisor shall have micro-tunneled or supervised directional drilling of a minimum of 5,000 linear feet of pipe.

1.5 PROJECT/SITE REQUIREMENTS

- A. The Contractor is encouraged to perform his own subsurface investigation.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Carrier pipe shall be High Density Polyethylene Pipe (HDPE) DR 11.
- B. Cement grout shall consist of a mixture of 1 part cement to 6 parts sand. The amount of cement may be increased or decreased as necessary and as permitted by the Engineer to provide good flowing characteristics.
- C. Lubricant shall be bentonite or polymer-based slurry.

2.2 EQUIPMENT

- A. The drill rig and associated equipment shall be in good condition and capable of completing the project without significant delays.
- B. The drill bit and reamers shall have a closed face and shall be capable of supporting the excavated area (face) during excavation and shutdown. The bit shall be full directional in both the horizontal and vertical directions from the drill rig so that the alignment can be maintained during the entire drilling operation.
- C. The drill bit shall be capable of drilling through all materials encountered including sand, gravel, glacial till and outwash, organics and marine clay.

PART 3 - EXECUTION

3.1 ACCESS PITS/PREPARATION

- A. Excavation, trenching, dewatering, sheeting, shoring and bracing shall comply with all applicable specifications.
- B. Locate and protect existing utilities as required. Coordinate utility protection with the respective utility companies.

3.2 HDD OPERATIONS

- A. Though the installation process may be licensed or proprietary in nature, the Contractor shall not change any material, thickness, design, values or procedural matters stated in the submittals, without the prior knowledge and approval of the Engineer. The Contractor shall submit, in writing, full details about component materials, their properties and installation procedures and abide by them fully during the entire course of the work.
- B. Ream the pilot hole to a diameter which is sufficiently sized to reduce forces applied to the pipe during pull back. Intermediate temporary pipes may be used as required to install final pipe.
- C. If pulling equipment is not capable of monitoring pulling forces imposed upon the pipe, a weak link shall be between the pipe and the molehead/reamer in order not to exceed the safe pulling strength as prescribed by the pipe manufacturer.
- D. Install a swivel between the molehead/reamer and pipe connection to minimize torsional stresses imposed on the pipe.
- E. Pressure grout the annular space around the final pipe if the final ream produces a theoretical annular space of more than 0.2 cu ft per linear foot of pipe.
- F. Directly install the 2-in by 6-in dual containment pipe below the highway embankment by making either a single or multiple passes with a directional drill to the lines and grades indicated.
- G. Install the pipe from a pit which allows the pipe installation along the proposed grade directly.
- H. Provide remote sensing at the drill rig to maintain alignment of the drilling operation and provided a profile and plan locations of the as-installed pipe.
- I. Pull pipe into place without damaging the pipe joints or pipe sections. Replace any pipe damaged during installation at no additional cost to the Owner.
- J. Maintain proper lubrication during sleeve pipe installation to reduce the exterior friction and possibility of the pipe seizing in place.
- K. Submit a written record of each drive for daily review by the Engineer.

3.3 MONITORING

- A. Surface Settlement Monitoring
 - 1. Make a visual inspection of the roadway to look for signs of settlement on a hourly basis during the time of active drilling.
 - 2. Monitor ground settlement directly above and 10-ft before and after any utility or pipeline intersection.
- B. Reporting
 - 1. Report any loss of ground, roadway cracking, depression or settlement or other unusual activities immediately.
- C. HDD operations shall limit vibrations transmitted to surrounding structures so as not to cause damage.
- D. Disposal of Wastes and Groundwater
 - 1. The Contractor shall dispose of all waste soils, slurries and other wastes in accordance with applicable regulations. No waste shall be left on-site following completion of the work.
 - 2. The Contractor shall dispose of all groundwater generated by dewatering operations and any surface water entering access pits in accordance with these specifications and State of Montana Regulations.

3.4 GROUND SURFACE MOVEMENTS AND TOLERANCES

- A. Ground Surface Movement. Settlement or heave of the ground surface along the HDD alignment shall not exceed 0.5-in.
- B. Tolerances.
 - 1. No more than 1-foot horizontal and 1-foot vertical deviation from design location shall be permitted in the position of the carrier pipe.
 - 2. When the initial bore deviates from the design line or grade by amounts greater than that specified, return the pipe to design line or grade plus or minus the specified tolerance at a rate of not more than 1-in per 25 feet.
 - 3. If either pipe is off design line or grade by an amount that requires redesign of the pipeline or associated structures, the Contractor shall do so at no additional cost to the Owner.

END OF SECTION

SECTION 02615

INTERIOR PIPING, VALVES, AND ACCESSORIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section is the installation of all above ground or exposed (interior) piping, valves, and accessories as shown on the Drawings or identified in the Contract Documents. Interior piping must be furnished and installed complete with all fittings, jointing materials, hangers and supports, anchors, and other necessary appurtenances.

1.2 REFERENCES

AWWA C104 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110 Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. For Water
AWWA C111 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115 Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C151 Ductile-Iron Pipe
AWWA C153 Ductile-Iron Pipe Compact Fittings, 3 In. Through 64 In. for Water Service
ASTM D1785 Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120

1.3 SHOP DRAWINGS AND SUBMITTALS

- A. The piping layouts shown are schematic and not necessarily to scale. Prepare and submit complete layout drawings, details, and specifications covering all interior piping systems, valves, and accessories as indicated on the Drawings and specified herein.

1.4 CONTRACTOR QUALIFICATIONS

- A. Pipe jointing and installation must be conducted by experienced workmen in conformance with the pipe manufacturer's installation requirements.

PART 2 - MATERIALS

2.1 GENERAL

- A. All valves and accessories shall be class 125. The flanged ends of all valves and fittings shall be compatible with the pipe sizes and materials to which they are to be attached (ANSI 125 lb).
- B. Length Tolerance - Actual lengths of valves, fittings, etc. shall be within 1/16 inch (plus or minus) of the specified or theoretical length. Modifications of the piping and valve layouts drawn and specified necessitated by use of dimensionally different valves than specified shall be made only with the written approval of the Engineer and at no additional cost to the Owner.

2.2 PIPE MATERIALS

A. Ductile Iron Pipe

1. Furnish Class 52 cement-mortar lined ductile iron pipe (DIP), per AWWA C104, C110, C111, C151, and C153 for all interior pipe and fittings above 1½ inches in diameter, unless other material is specifically called for. Assure each pipe length is marked with nominal size, and class rating, and manufacturer's name and code, at a minimum.
2. Pipe Jointing
 - a. Join pipe, pipe fittings, and valves using flanged joints, unless other joining is specifically called out on the drawings. Assure all flanges conform to the requirements of AWWA C115. All bolts, nuts, and washers are to be Cor-Ten steel or stainless steel.
 - b. Assure couplings are designated for use at the rated pressures of the pipe with which they are utilized. Restrain couplings by use of two or more threaded joining rods between the nearest flanges. Provide lugs where required to span the coupling(s).
 - c. For all 1-inch diameter or less taps into DIP, provide pipe with factory made taps. Provide service saddles for taps of a larger diameter.
3. Assure the pipe interior is cement mortar lined meeting AWWA C104 requirements. Assure the outside pipe surface for aboveground or interior applications is factory coated with a high-solids epoxy primer and field coated with a high-solids epoxy finish

B. STEEL PIPE

1. Standard Weight Pipe: ASTM A53 or A106, standard weight (Schedule 40) Type S, Grade B or Fed Spec WW-P-404 (galvanized)
2. Fittings: ANSI B16.3 or Fed Spec WW-P- 521, Type II (galvanized) for galvanized pipe or Type I (black) for ungalvanized pipe
3. Unions: Fed Spec WW-U-531, Class 2; Type B (galvanized) for galvanized pipe or Type A (black) for ungalvanized pipe
4. Welding: ANSI B16.9
5. Thread Tape: Teflon; John Crane "Thread Tape", Garlock "Plasti- Thread", or Hoke "EZ Seal"
6. Thread Sealant: Thiokol, Urethane, or Teflon

C. PLASTIC

1. Drain Pipe: ASTM D-1785, Schedule 40 PVC unless otherwise noted

2. Fittings: ASTM D-2464 (threaded), Schedule 40 PVC; ASTM D-2467 (solvent-weld), Schedule 40 PVC

2.3 VALVES

A. Gate Valves

1. Four (4-inch) and larger gate valves shall be iron body, resilient seat with non-rising stems having design, construction and pressure rating conforming to AWWA C509. Gate valves shall be supplied with one operating wheel with an arrow indicating "OPEN".

B. Threaded Gate Valves

1. Gate valves $\frac{3}{4}$ " through 3" shall be Class 125, Type 1, bronze with solid wedge, threaded ends, heavy bronze body and have malleable-iron hand wheel. Gate valves shall have screw over bonnet for extra strength at higher operating pressures and a large port opening for maximum flow rate. Valves must conform to the specifications of MSS-SP-80 for low lead requirements.

C. Ball Valves

1. Unless otherwise indicated or specified, all 2" shutoff valves shall be ball valves. Two inch and smaller ball valves for water service shall be of bronze or brass construction with two-piece end entry body, bronze or brass ball, teflon or Viton stem seal, reinforced teflon seats and thrust washer, a removable operating lever, and threaded ends. Each ball valve in gauge isolation service shall be furnished with a round handle. Valves shall be rated not less than 500 psi nonshock cold WOG and shall be driptight in both directions. Valves shall be Conbraco Industries "Apollo 70-100 Series", Powell "Fig 4210T", or Stockham "S-216".

D. Pressure Reducing Valve

1. The valve shall be a 2-inch Cla-Val Model 90-01. Valve shall be globe style, full port, flanged class 150, ductile iron main valve, with Buna-N diaphragm, fusion bonded epoxy coating interior/exterior, and stainless steel trim and fasteners. Valve shall have a stainless steel pilot system with braided flex tubing, opening speed control, valve position indicator. Valve shall be equipped with check valve feature. Pressure reducing pilot spring range 30-300 psi, factory set at 75 psi.
2. The valve shall be pilot operated which will reduce a high inlet pressure to a low outlet pressure. The valve shall maintain a constant downstream pressure regardless of fluctuations in supply pressure or flow rate.

2.4 COUPLINGS

- A. Provide extended range couplings with rings constructed of ductile iron conforming to ASTM A536 and gaskets suitable for use with potable water.
- B. Install couplings as shown on the plans.

2.5 PRESSURE GAUGES

- A. Furnish 4 ½ inch (115 mm), oil-filled pressure gauges with grade B accuracy, rated for use with water. Assure gages are hermetically sealed with case constructed of stainless steel, aluminum, polypropylene, or phenolic plastic and have a white background, black enameled pointer with a 270 degree arc, and a clear acrylic window.
- B. Provide pressure gages with a gauge range of 0 to 150 pounds per square inch (0 to 1,379 kPa) unless otherwise indicated on the Drawings.
- C. Provide gages with ½ inch fittings prepared in pipe for acceptance of gage. Provide ½ inch (13 mm), brass or bronze shut-off cocks conforming to ASTM B16 or B62 or a ball valve on the connection between pipe and gage. If ball valve is used, provide sufficient stem extension for ease of full operation of handle.
- D. Provide gages with solid front with side or rear blowout relief.
- E. Furnish pressure gages as manufactured by Ashcroft, Crosby, Marsh, or an approved equivalent.

2.6 MISCELLANEOUS

- A. Pressure Reducing Valve and Meter Vault
 - 1. The pressure reducing valve and meter vault shall be a 72" diameter precast reinforced manhole, with integral floor.
 - 2. Furnish manholes meeting ASTM C478; "Precast Reinforced Concrete Manhole Sections", specifically including mandatory rejection requirements.
 - 3. Furnish non-corrosive steps, 12-inches (30 cm) in width, of 1/2-inch (13 mm) steel rod encased with polypropylene. Assure steps withstand 400 pound (180 kg) vertical loads and 1,000 pound (450 kg) pull-out resistance.
 - 4. Furnish precast concrete bases or field poured on undisturbed earth. Use M-3000 (f'c = 3,000 psi) concrete. The maximum allowable w/c for this concrete is 0.50.
- B. Floor Drains
 - 1. Furnish slotted floor drain covers with a satin bronze top of the sizes shown on the Drawings.
 - 2. Furnish Schedule 40 PVC pipe, solvent-welded for drain pipes. Assure a PVC trap is included with each floor drain.

C. Adjustable Pipe Supports

1. Where specified in the Drawings, provide adjustable steel pipe supports complete with saddle, stanchion, neoprene pad, and base plate sized as per manufacturer's recommendations.
2. Furnish pipe supports as manufactured by Anvil, Empire, PHD Manufacturing or approved equivalent.

D. Sampling Taps

1. Furnish smooth-nosed sampling taps without interior or exterior threads, for bacteriological analysis where indicated.
2. Sampling taps may not be of the petcock type or mixing type and may not have a screen, aerator, or other such appurtenance.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install all pipes to standards set forth in the technical specifications, industry standards, and in strict accordance with manufacturer's recommendations.

3.2 PIPING

A. Handling

1. Handle pipe, fittings, and accessories in a manner that will ensure installation in sound, undamaged condition. Assure equipment, tools, and methods used in handling and installing pipe and fittings do not damage the pipe and fittings. Any hooks inserted in ends of pipe must have broad, well padded contact surfaces.
2. Replace pipe and fittings with cement lining that has been damaged. Small and readily accessible damaged areas may be repaired.
3. Repair all pipe coating(s) that have been damaged before installing the pipe.

B. Cutting Pipe

1. Cut pipe in a neat manner, without damaging the pipe or the lining. Assure cuts are smooth, straight, and at right angles to the pipe axis. After cutting, dress the end of the pipe with a file to remove all roughness and sharp corners.
2. Cut cast iron pipe with mechanical pipe cutters except where the use of mechanical cutters would be difficult or impractical.
3. Field cut holes for saddles with mechanical cutters. Oxyacetylene cutting will not be permitted.

4. Repair chipped, spalled, or otherwise damaged linings.
- C. Cleaning
1. Thoroughly clean the interior of all pipe and fittings of foreign matter before installing and keep clean until the work has been accepted.
 2. Before jointing, wipe clean all joint contact surfaces and kept clean until jointing is completed.
 3. Take precautions to prevent foreign material from entering the pipe during installation. Do not place debris, tools, clothing, or other materials in or allow to enter the pipe.
- D. Pipe Jointing
1. Threaded Pipe
 - a. Assure threaded pipe threads conform to ANSI B2.1, NPT and are full and cleanly cut with sharp dies. Ream ends of pipe, after threading and before assembly, to remove all burrs.
 - b. Make up threaded joints with thread tape applied to all make threads or a suitable joint sealant. For all lines subject to vacuum, joint sealant will be required, and thread tape will not be allowed.
 - c. Not more than three threads at each pipe connection may remain exposed after installation.
 2. Solvent Welded
 - a. Cut the ends of PVC pipe square and smooth and wipe clean.
 - b. Apply solvent cement to the outside of the pipe and the inside of the fitting socket with a small paint brush. Immediately push the coated surfaces snugly together and rotate the pipe approximately one-half turn to insure uniform distribution of the cement. Remove excess cement by wiping.
 3. Push-On Joints
 - a. Follow the pipe manufacturer's instructions and recommendations for proper jointing operations.
 - b. Suitably bevel each spigot end to facilitate assembly.
 - c. Lubricate all joint surfaces with heavy vegetable soap solution immediately before the joint is completed. Assure lubricants are suitable for use in potable water. Store lubricants in closed containers and keep clean.

4. Flanged Joints

- a. Assure that the pipe extends completely through screwed on flanges and that the flange faces are flat and perpendicular to the pipe centerline. Assure that the pipe end and flange faces are finish machined in a single operation.
- b. When bolting flanged joints, take care to avoid restraint on the opposite end of the pipe or fitting which would prevent uniform gasket compression or which would cause unnecessary stress in the flanges. One flange must be free to move in any direction while the flange bolts are being tightened. Gradually tighten bolts at a uniform rate, so gasket compression is uniform.
- c. Take special care when connecting to equipment to insure that no stresses are transmitted to the flanges by the connected piping. Permanently support all such piping, so accurate matching of bolt holes and uniform contact over the entire surface of abutting piping flanges are obtained before installation of any bolts in those flanges. In addition, assure connection piping is free to move parallel to its longitudinal centerline while the bolts are tightened.
- d. Movable flanges ("Kwik-Flanges") may be used in lieu of welded or threaded flanges in areas where their use will not interfere with pipe support or valve, fitting, or appurtenance mounting, provided they are of comparable pressure rating and are installed in complete accordance with the manufacturer's specifications.

5. Mechanical Joints

- a. Mechanical joints are shown on the Drawings or specified at various locations on pipe and fittings to aid in assembly and/or allow flexibility. Changes in the locations of such joint or the use of mechanical couplings in lieu of mechanical joint fittings will be allowed if functionally equivalent only with the approval of the Engineer. Such changes or substitutions must be fully indicated on the submittals.
- b. Carefully assemble mechanical joints in accordance with the manufacturer's recommendations. If effective sealing is not obtained, disassemble, thoroughly clean, and reassemble the joint. Overtightening bolts to compensate for poor installation practice will not be permitted.
- c. Anchor all exposed piping with mechanical joints or couplings with tie rods.
- d. Carefully align the holes in mechanical joints with tie rods to permit installation of the tie rods. In flange and mechanical joint pieces, holes in the mechanical joint bells and the flanges shall straddle the top (or side for vertical piping) centerline. Assure the top (or side) centerline on each flange and mechanical joint piece is marked at the foundry.

6. Flanged Coupling Adapters
 - a. Install flanged coupling adapters in accordance with the coupling manufacturer's recommendations.
 - b. After the pipe is in place and bolted tight, determine the proper locations of holes for the anchor studs and field drill the pipe. Assure hole diameter are not more than 1/8 inch larger than the diameter of the stud projection.
7. Mechanical Couplings
 - a. Carefully install mechanical couplings in accordance with the manufacturer's recommendations.
 - b. Clean and smooth pipe ends before installation.
 - c. Leave a space of at least ¼ inch and not more than 1 inch between the pipe ends.

3.3 VALVES, EQUIPMENT, AND ACCESSORIES

A. Installation

1. Install all valves, equipment, and accessories in accordance with the manufacturer's requirements. Reference shall be made to jointing and alignment specifications.

B. Testing

1. Pressure test all valves in a similar manner to and in conjunction with the testing prescribed for piping systems.
2. Additionally, individually test each valve for full and unhindered operation after installation.

C. Finishing

1. Furnish valves, equipment, and accessories of metallic construction with the manufacturer's standard shop finish. Upon installation, paint with the same type and color of paint as the piping on which they are installed.
2. Take care to insure compatibility of the field-applied coatings with the manufacturer's shop coat. Use tie or binder coats, as required.
3. Paint operating handwheels, nuts, and tee-handles red or black, per the Owner's preference.

END OF SECTION

SECTION 02660

WATER DISTRIBUTION SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Furnish all water main pipe and fittings meeting the Contract documents or specified as follows.
- B. Furnish and install valves and fire hydrants for water mains, together with related appurtenances.
- C. Construct water services, including water service piping, tapping mains, corporation stops, curb stops and related items.

1.2 CERTIFICATION BY MANUFACTURER:

- A. Furnish a manufacturer's certification covering all pipe and fittings furnished, certifying that the pipe and fittings meet applicable specifications.

1.3 REFERENCES

ANSI B16.1	Tapping Sleeves
ASTM B88-62	Copper Pipe
ASTM PE3406-3408	Polyethylene Pressure Pipe
AWWA B300	Hypochlorite for Disinfecting
AWWA B301	Liquid Chlorine for Disinfecting
AWWA C104	Ductile Iron Cement-Mortar Lining
AWWA C110	Ductile Iron Fittings
AWWA C111	Ductile Iron Joints
AWWA C151	Ductile Iron Pipe
AWWA C153	Ductile Iron Compact Fittings
AWWA C301	Concrete Cylinder Pipe
AWWA C500	Gate Valves
AWWA C502	Fire Hydrants
AWWA C504	Butterfly Valves
AWWA C509	Gate Valves
AWWA C651	Disinfecting Water Mains
AWWA C900	PVC Water Main Pipe
ASTM F477	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
AWWA C116	Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Services
AWWA C600	Installation of Ductile-Iron Water Main and Their Appurtenances
ISO 8179	Ductile Iron Pipes – External Zinc-based Coating

PART 2 - PRODUCTS

2.1 GENERAL

- A. Furnish water main pipe and fittings as specified in the Contract Documents and meeting the material and testing requirements of this section. Furnish fittings and service line piping of the same material and design as the water main pipe unless specified otherwise. Pipe strength classifications are shown on plan drawings and/or are listed in the Contract Documents.
- B. References made to ASTM, ANSI, AWWA, USASI or AASHTO designations are the latest revision at the time of call for bids.
- C. Assure all water main pipe, service line pipe, fittings, and appurtenances do not contain more than a weighted average of 0.25% lead when used with respect to the wetted surfaces.
- D. Assure all water main pipe, fittings, valves, fire hydrants, and appurtenances conform to the latest standards issued by the AWWA and ANSI/NSF, where such standards exist.

2.2 PIPE MATERIALS

- A. General
 - 1. Furnish the pipe specified in the contract documents meeting the materials and testing requirements as outlined in this section.
 - 2. Assure all pipe is clearly marked showing type, class and/or thickness. Lettering must be legible and permanent under normal handling and storage conditions.
- B. Ductile Iron Pipe
 - 1. Furnish meeting AWWA C151, American National Standard for Ductile Iron Pipe for Water.
 - a. 3 inches to 12 inches Pressure Class 350
 - b. 14 inches to 20 inches Pressure Class 250
 - c. 24 inches Pressure Class 200
 - d. 30 inches to 64 inches Pressure Class 150
 - 2. Assure the pipe interior is cement mortar lined meeting AWWA C104 requirements. Assure the outside pipe surface for underground service is bituminous coal tar base coated 1 mil thick.
 - 3. Fittings
 - a. Furnish fittings meeting one of the following;
 - 1) Class 250 fittings meeting AWWA C110, latest edition, Gray-Iron and Ductile Iron Fittings For Water And Other Liquids
 - 2) Compact fittings meeting AWWA C153.
 - 4. Joints
 - a. Assure joints are mechanical or push-on joints meeting AWWA C111. Assure the fitting interior is cement mortar lined meeting AWWA C104. Assure the fitting exterior is bituminous tar coated 1 mil thick. Use compact fittings having a rated working pressure of 350 psi (2410 kPa) following manufacturer recommended laying lengths.

inch (50 mm) size are considered as water mains and are specified under the applicable sections.

- b. Furnish and install the service pipe from the main to the property line installing a curb stop and curb box at the property line.
- c. Copper Service Pipe
- d. Polyethylene Service Pipe
 - 1) Use pipe meeting AWWA Specification C901, "Polyethylene (PE) Pressure Pipe, Tubing and Fittings, 1/2 inch through 3 inch for Water" and ASTM PE3406-3408. PE pipe to be pressure tubing meeting Table 6 requirements of said specification. Use class 200 with a DR of 7 Polyethylene pipe.
 - 2) For all polyethylene service pipe, assure corporation stops, curb stops, couplings, and all other fittings have pressure connections designed specifically for polyethylene pipe as manufactured by Mueller (Insta-Tite Connection Series) or an approved equivalent.

2.3 TAPPING SLEEVES AND VALVES:

- A. Use tapping sleeves meeting either:
 - 1. Gray iron or ductile iron, split-sleeve, mechanical joint type with end and side gaskets,
 - 2. Split-body type with circular gasket forming a seal around the circumference of the outlet.
 - 3. Assure both types have a class 125, ANSI B16.1 outlet flange, are rated for a minimum 150 psi (1030 kPa) working pressure and contain a threaded test plug on the neck or body of the tapping sleeve. Assure gaskets are manufacturer's standard for use in potable water systems. Use stainless steel bolts and nuts. Assure mechanical joint type is fusion-bonded, 12-mil thickness, and epoxy coated. Limit the use of mechanical joint type to metal pipe. Assure tapping valves meet the applicable requirements for gate valves, as outlined in this section, with flanged inlets compatible with the flange of the tapping sleeve and mechanical joint outlet.
- B. Furnish sleeve (1) above as manufactured by Mueller, Rockwell, Dresser, or an approved equivalent. Provide thrust blocking behind tee flow-through sized per thrust block detail in the drawings. Furnish type (2) above as manufactured by Smith-Blair (Model 622), Ford (FTS), or an approved equivalent.

2.4 CORPORATION STOPS

- A. Furnish brass corporation stops with inlet end to meet tapping requirements and outlet with compression coupling for copper tubing or pressure coupling for polyethylene tubing.

2.5 SERVICE CLAMPS

- A. Provide service clamps, where required, that are flat, double strap, ductile iron bodied and that have a nylon coating and standard AWWA corporation stop threads. Assure service clamps meet all applicable parts of AWWA C800.

- B. Assure service clamps for PVC pipe provide full support around the pipe circumference with a bearing area of sufficient width along the pipe axis, 2 inch (50 mm) minimum, to insure the pipe will not be distorted when the saddle is tightened. Service clamps for PVC pipe, where required, shall be stainless steel full circumference bands with corporation stop threads.

2.6 CURB STOPS

- A. Furnish curb stops meeting AWWA C800 with bronze plug, tee head key with Minneapolis pattern, and screw box mount. Assure inlet and outlet connections are compression connections.
- B. Furnish compression connections as manufactured by Mueller (B-25155), or an approved equivalent.

2.7 CURB BOXES

- A. Provide extension type curb boxes having at least a 6.5 foot (1.98 m) extended length and a range between the extended length and retracted length that allows for the curb box to be installed absolutely flush with the sidewalk or finished grade.
- B. Furnish curb boxes as manufactured by Mueller (H-10300 Series or H-10380 Series) or an approved equivalent.

2.8 VALVES

- A. Gate Valves
 - 1. Unless designated otherwise, valves 12 inches (30 cm) in diameter or smaller will be gate valves. Furnish iron body gate valves or resilient seat gate valves with non-rising stems with design, construction, and pressure rating meeting AWWA C509 and the following requirements.
 - 2. Assure stem seals are double “O” ring seals capable of replacing the seal above the stem collar with the valve under pressure in full open position.
 - 3. Furnish gate valves for underground installation equipped with a 2-inch (31 mm) square operating nut for key operation. All valves to open counterclockwise. Valves to be equipped with push-on joints or mechanical joints for pipe connections.
 - 4. Furnish resilient seat gate valves as manufactured by Mueller or an approved equivalent.

2.9 VALVE BOXES

- A. Furnish cast iron valve boxes, 5-1/4-inch (13 cm) diameter, adjustable valve boxes with the required base for the valve size used. Assure valve boxes are screw type and of the specified length for the pipe bury. Assure the valve box cast iron cover has an arrow indicating the opening direction and stamped with the word “Water”.

2.10 FIRE HYDRANTS

- A. Furnish fire hydrants meeting AWWA C502; “Standard Specifications for Fire Hydrants for Ordinary Water Works Service”, and the Contract requirements. Hydrants to be Mueller or approved equivalent.
- B. Furnish hydrants with 5-1/4-inch (13 cm) valve openings, 6-inch (15 cm) mechanical joint, flanged or push-on inlet, one pumper connection and two, 2-1/2-inch (63 cm) hose connections. Assure hose nozzle threads meet ASA Specification B26 for National Standard Fire Hose Coupling Screw Threads, 7 1/2 threads per inch. Assure pumper nozzle size and threads match owners existing pattern. Furnish National Standard operating nut. Furnish hydrants opening counter clockwise and having an arrow on the hydrant top designating the opening direction.
- C. Furnish “Compression” type hydrants with safety flange and safety stem coupling above the ground line permitting repair without shutting off the water. Assure hydrants are of the dry top design with two or more “O” rings sealing the water from the operating mechanism. Assure the operating mechanism is automatically lubricated from a sealed, self-contained lubricating reservoir.
- D. Paint the hydrant portion above the ground line meeting the owner’s standards. Furnish hydrants for 6.5 foot (2 meters) bury.

2.11 SPECIAL FITTINGS

- A. Furnish special fittings meeting the Contract Documents. The Engineer will specify gasket materials for contaminated soil or special groundwater situations.

2.12 POLYETHYLENE ENCASEMENT

- A. Furnish polyethylene encasement or V-Bio® enhanced polyethylene encasement in accordance with AWWA C105, “Polyethylene Encasement for Ductile Iron Pipe Systems”.
- B. Optional for corrosion protection in corrosive soils - Polyethylene encasement for use with ductile iron pipe shall be V-Bio® enhanced polyethylene encasement as manufactured by Balcan Plastics Limited/First Film Extruding or Crayex Corporation .

2.13 WATER MAIN INSULATION

- A. Furnish extruded polystyrene rigid foam insulation conforming to ASTM C578, Type IV, with a minimum thermal resistance (R value) of 5.0 per 1 inch of thickness at 75° Fahrenheit mean temperature. Water absorption for the insulation shall not exceed 0.10 by volume as measured by ASTM C272.
- B. Materials shall be delivered in their original unopened units, stored off the ground, protected from direct sunlight with a light-colored opaque polyethylene film and ventilated to prevent excessive temperature. Damaged or deteriorated materials shall be removed from the premises.

- C. Furnish extruded polystyrene rigid foam insulation as manufactured by Owens-Corning (Foamular 250), or an approved equivalent.

2.14 YARD HYDRANTS

- A. Provide frost-proof sanitary yard hydrants designed for a minimum operating pressure of 100 pounds per square inch (689 kPa) and a minimum bury depth of 6.5 feet (2 m) meeting the standard of ASSE Standard 1057.
- B. Furnish sanitary yard hydrants complete with backflow protection compliant with Montana standards, brass hydrant ells and tees, locking flange for padlock, and integral drain that allows hydrant barrel to drain after use to prevent freeze damage.
- C. Provide a set of spare parts per each two sanitary yard hydrants installed, manufactured by the same manufacturer as the hydrants and specific to the hydrant model.
- D. Furnish sanitary yard hydrants as manufactured by Woodford (Model S3 with Repair Kits RK-Y1 and RK-SHL) or an approved equivalent.

PART 3 - EXECUTION

3.1 TRENCH EXCAVATION AND BACKFILL FOR WATER MAINS

- A. This work includes all excavation, backfilling, disposal of surplus and unsuitable material, and all other work incidental to trench construction, including excavation for valves, fittings, hydrants, thrust blocks or other pipeline structures and not classified as "Structural Excavation."
- B. Perform this work in accordance with Section 02221: TRENCH EXCAVATION AND BACKFILL FOR PIPELINES & APPURTENANT STRUCTURES.

3.2 PIPE INSTALLATION FOR WATER MAINS

- A. General
 - 1. Install pipe following the manufacturer's specifications and instructions. Provide all tools and equipment required to install each type of pipe used.
 - 2. The Contractor is responsible for all contractor furnished material. Replace all defective material or material damaged by handling after delivery by the manufacturer. This includes the furnishing of all materials and labor required to replace installed material discovered damaged or defective before final acceptance of the work, or during the guarantee period.
 - 3. Store all material safely and to prevent damage. Keep pipe interior and other accessories free from dirt and foreign matter at all times. If pipe is stored on site out of doors for more than 7 days, keep ends of pipe sealed against rodent intrusion and cover PVC pipe with protection from ultraviolet radiation from the sun.
 - 4. Deliver and distribute all Contractor furnished pipe at the site. Load and unload pipe, fittings, specials, valves, and accessories to prevent damage. Do not permit pipe handled on skidways to skid or roll against pipe already on the ground. Do not make metal-to-metal contact between pipes or between fittings when moving

or in storage, but rather use non-metal materials such as fire-hose. Do not drop pipe under any circumstance.

5. When distributing material at the work site, lay each piece adjacent to its installation point. Repair or replace all damaged pipe at Contractor's expense on the jobsite.

B. Dewatering of Trench

1. Remove all water in the trench during pipe laying and maintain a dry trench until the pipe ends are sealed. Do not permit the pipe to float. Do not allow any trench water to enter the pipe at any time.

C. Laying of Pipe

1. Inspect the pipe and pipe coating for damage or defects before installation. Lay pipe without damaging the pipe coating. Repair all pipe coating damage following the manufacturer's instructions before laying the pipe. When using belt slings to lower the pipe into the trench, remove the slings without damaging the pipe coating.
2. Lay pipe to the specified lines and grades with fittings and valves at the required locations. Plumb all valve stems.
3. Use implements, tools and facilities satisfactory to the Engineer for the safe and convenient prosecution of the work. Carefully lower all pipe, fittings and valves into the trench using a derrick, rope or other tools or equipment, without damaging pipe materials and protective coatings and linings. Do not drop or dump materials into the trench.
4. Take every precaution to prevent foreign material from entering the pipe as it is placed in the line. During laying operations, do not permit debris, tools, clothing or other materials to be placed in the pipe. At times when pipe laying is not in progress, close the open ends of the pipe using a watertight plug or other approved methods to prevent material entering the pipe.
5. Place pipe bedding in the bottom of the trench meeting Section 02221; TRENCH EXCAVATION AND BACKFILL FOR PIPELINES & APPURTENANT STRUCTURES. Voids may be left in the bedding material to remove pipe slings and for pipe bells to allow support along the full length of the pipe barrel.
6. Long radius curves, either horizontal or vertical, may be laid with ductile iron pipe using deflections at the joints when shown on the drawings. Deflection at the joints is not to exceed 50% of manufacturer's recommended maximum deflection. PVC pipe may be deflected over the length of the pipe or at fittings when shown on the drawings, based upon manufacturer's recommendations. The Contractor shall provide the Engineer all manufacturer's deflection requirements and warranty information that specifically states that deflection of pipe and fittings does not reduce or eliminate warranty coverage or pressure and safety ratings.
7. No additional payment will be made for laying pipe on planned curves, nor for field changes involving standard pipe lengths deflected at the joints or over the length of the pipe.
8. Do not exceed the applicable material and joint specifications of AWWA or the pipe manufacturer's recommendations at pipe joints for various types of pipe. When rubber gasketed pipe is laid on a curve, joint the pipe in a straight alignment and then deflect to the curved alignment. Excavate trenches to accommodate deflections and curves.
9. Construct reaction or thrust blocks at all tees, plugs, valves, reducers, caps and at bends deflecting 22-1/2 degrees or more. Construct thrust blocks at tapping sleeves

where the outlet diameter exceeds one-half the diameter of the main being tapped. Limit using metal rods or straps for thrust restraint to those specified on the plans, or where the use of concrete thrust blocks would be impractical. Do not use metal rods or straps without the Engineer's approval. Construct reaction blocks from concrete having a minimum compressive strength of 2,000 pounds per square inch (14,000 kPa) at 28 days. Place blocking between undisturbed ground and the fitting to be anchored. Place the blocking so that the pipe and fitting joints are accessible for repair.

10. Cut pipe for inserting valves, fittings or closure pieces in a neat and workmanlike manner without damaging the pipe or coating and leaving a smooth end at right angles to the pipe axis. Do not cut pipe using an oxyacetylene torch.
11. Provide vertical fittings with thrust blocks one and a half times the sizes set forth in the drawings and include 2 #5 rebar anchors bent around each fitting and set into the concrete.

D. Pipe Jointing

1. Rubber Gasket, "Push-On" Joints
 - a. Follow the manufacturer's recommendations for jointing of pipe and fittings with a rubber gasket, "push-on" type. Wipe the rubber gasket and gasket seat inside the bell clean with a cloth. Wipe the plain end of the adjoining pipe clean, lubricate and insert into the bell to make contact with the gasket. Force the plain end "home" using a crow bar, fork tool, or jack assembly.
2. Mechanical Joints
 - a. Thoroughly brush the bell and the outside of the spigot of the mechanical joint fitting with a wire brush to remove all loose rust or other foreign material just before assembly. Brush the cleaned surfaces with soapy water just before slipping the gasket over the spigot end and into the bell.
 - b. Center the spigot end of the pipe or fitting in the bell before jointing is begun. Once the gasket is in place, bring the gland up toward the pipe flange evenly, maintaining approximately the same distance between the gland and the face of the flange at all points around the socket. Partially tighten the bolts, alternately around the socket, maintaining approximately equal tension until the final tension is reached.
 - c. Use the following bolt torque range for the joints:

Bolt Size		Range of Torque	
Inch	(millimeters)	Ft.-Lb.	(joules)
5/8	(16)	40 - 60	(54-81)
3/4	(19)	60 - 90	(81-122)
1	(25)	70 - 100	(95-135)
1-1/4	(32)	90 - 120	(122-163)

- d. Apply the torque loads with torque measuring or indicating wrenches, or apply using regular socket wrenches, checked with torque wrenches.
 - e. If the joint is not sealed using the maximum torque indicated above, disassemble and re assemble the joint after thorough cleaning. Do not overstress bolts to provide the seal.
3. Connections to Existing Mains

- a. Make all connections to existing water mains in use unless otherwise specified. Furnish the special fittings, as shown on the plans, and all other material required. Make all necessary excavations to assure gradual transition between the new and existing water main, and perform all necessary backfilling.
- b. Where the connection of new work to old requires a service interruption and customer notification, the Engineer and the Contractor are to mutually agree upon a date for connections to permit adequate time to assemble labor and materials, and to notify all affected customers. All notifications are the Contractor's responsibility.

3.3 POLYETHYLENE ENCASEMENT

- A. Wrap all direct bury cast iron or ductile iron pipe and fittings including hydrants, valve boxes, curb boxes, and all other metal parts and surfaces, in polyethylene encasement.
- B. Polyethylene encasement installation shall be per the Ductile Iron Pipe Research Association (DIPRA) Polyethylene Encasement Installation Guide.

3.4 TESTING, CLEANING & DISINFECTING WATER MAINS, VALVES & FITTINGS:

- A. Hydrostatic and Leakage Testing
 1. Perform hydrostatic and leakage testing in accordance with AWWA C600. Once the pipe is laid and backfilled, test for at least 2 hours, all newly laid pipe, or any valved section, at the highest point along the test section. Test to a hydrostatic pressure 2.0 times the normal operating pressure at the test point, but in no case less than a minimum gage pressure of 125 pounds per square inch (931 kPa) or greater than the pressure rating of the pipe being tested. Do not test more than 1,000 linear feet (305 m) of pipeline at one time, unless otherwise approved by the Engineer.
 2. Slowly fill the pipe with water, purging all air, and apply the test pressure using a pump hooked up so that the pressure and leakage can be measured. To purge the pipe of air during the test, it is necessary to tap the pipe at its highest points if permanent air vents, water services, hydrants, etc. are not located at the high points. Use corporation stops for this purpose. Furnish the pump connections, gauges, stops, and all necessary apparatus for testing.
 3. Disassemble and reassemble all joints showing leakage after thorough cleaning. Remove and replace all cracked or defective pipes or fittings discovered in during the pressure test with sound material and repeat the test.
 4. Conduct the leakage test concurrently with the pressure test for 2 hours. Leakage is defined as the quantity of water supplied into the pipe, or any valved section thereof, necessary to maintain pressure within 5 PSI of the pressure test after the pipe has been filled with water and purged of air.
 5. The pipe installation will be rejected if the leakage exceeds that determined by the following formula:

$$L = \frac{SD(P)^{1/2}}{148,000}$$
 6. In which L equals the allowable leakage in gallons per hour; S is the length of pipe tested, in feet; D is the nominal diameter of the pipe, in inches; and P is the average test pressure during the leakage test, in pounds per square inch gauge.

7. Should any test of pipe laid disclose leakage exceeding that specified above, locate and repair the defective joints until the leakage is within the specified allowance.
8. Conduct the pressure and leakage tests with the Engineer present.
9. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gallon per hour per inch of nominal valve size is allowed. Repair all visible leaks regardless of the amount of leakage.
10. Pressure test tapping sleeves after installation and before tapping.

B. Cleaning Water Mains

1. Before chlorination, flush the mains thoroughly after the pressure and leakage test are completed. Contractor is responsible for all permits, as may be required, associated with cleaning water mains and the entire disinfection process.
2. It is understood that such flushing removes only the lighter solids and cannot be relied upon to remove heavy material allowed to get into the main during laying. Use a minimum flushing velocity in the main of 2.5 feet per second (0.7 meters/second). If no hydrant is installed at the end of the main, provide a tap of the size to produce a velocity in the main of at least 2.5 feet per second (0.7 meters/second). Table 2 shows the rates of flow required to produce a velocity of 2.5 feet per second (0.7 meters/second) in various size pipes.

TABLE 1
REQUIRED FLOW AND OPENINGS TO FLUSH PIPELINES¹
 (40 psi (276 kPa) Residual Pressure in Water Main)

Pipe Diameter Inches (cm)	Flow Required to Produce 2.5 fps (approx.) Velocity in Main gpm (epm)	Size of Tap Inch (mm)			Hydrant Outlet	
		1 (25) Number of Taps on Pipe ²	1-1/2 (38)	2(51)	Number	Size Inches (mm)
4 (10)	100 (380)	1			1	2-1/2 (63)
6 (15)	200 (760)		1		1	2-1/2 (63)
8 (20)	400 (1510)		2	1	1	2-1/2 (63)
10 (25)	600 (2270)		3	2	1	2-1/2 (63)
12 (30)	900 (3400)			2	2	2-1/2 (63)
16 (41)	1600 (6060)			4	2	2-1/2 (63)

¹With a 40 psi (267 kPa) pressure in the main with the hydrant flowing to atmosphere, a 2-1/2-inch (63mm) hydrant outlet will discharge approximately 1000 gpm (3786 epm) and a 4-1/2-inch (114mm) hydrant nozzle will discharge approximately 2500 gpm (9463 epm).

²Number of taps on pipe based on discharge through 5 feet (1.5 meters) of galvanized iron (GI) pipe with one 90° elbow.

3. Exercise extreme care and conduct a thorough inspection during the water main laying to prevent and detect small stones, pieces of concrete, particles of material, or other foreign material that may have entered the mains. To remove this material, flush and inspect all hydrants on the lines to assure that the entire valve operating mechanism of each hydrant is in good condition.
4. In 24-inch (61 cm) or larger diameter mains, in addition to flushing, broom-sweep the main, removing all sweepings before chlorinating the main.

C. Disinfecting Water Mains

1. General

- a. Disinfect the water mains subject to the Engineer's approval in accordance with AWWA C651, "Disinfecting Water Mains", and these specifications, before placing the main in service. Keep the interior of all pipe, fittings and appurtenances free from dirt, heavy and foreign particles.

2. Forms of Chlorine

- a. The forms of chlorine that may be used, subject to the approval of the Engineer, are:
 - 1) Liquid chlorine containing 100% available chlorine under pressure in steel containers. Meet AWWA B301 requirements and use only in combination with appropriate gas-flow chlorinators and ejectors.
 - 2) Sodium hypochlorite in liquid form containing approximately 5 to 15% available chlorine. Meet AWWA B300 requirements.

3. Methods of Chlorination

- a. Two (2) methods of chlorination may be used. The continuous feed method gives a 24 hour chlorine residual of not less than 25 parts per million (25 mg/L), and the slug method provides a 3 hour exposure of not less than 50 parts per million (50 mg/L) free chlorine.
 - 1) Continuous Feed Method
 - a) Before chlorinating, fill the main with water to eliminate air pockets and flush as specified above.
 - b) Use water from the existing distribution system or other approved source of supply to flow at a constant, measured rate into the newly laid water main. At a point not more than 10 feet (3 m) downstream from the beginning of the new main, assure water entering the new main receives a dose of chlorine fed at a constant rate such that the water will have at least 50 parts per million (50 mg/L) free chlorine. To assure that this concentration is provided, measure the chlorine concentration at regular intervals.
 - c) Appendix B provides information on the amounts of chlorine compound required for various pipe sizes.
 - d) During chlorine application, position valves so that the chlorine solution in the main being treated does not flow into water mains in active service. Do not stop chlorine application until the entire main is filled with chlorinated water. Retain the chlorinated water in the main for at least 24 hours, operating all valves and hydrants in the section treated to disinfect the appurtenances. At the end of the 24-hour period, the treated water in all portions of the main must have a minimum free chlorine residual of 25 parts per million (25 mg/L).
 - e) The preferred equipment for applying liquid chlorine is a solution feed vacuum operated chlorinator to mix the chlorine gas in solution water, in combination with a booster pump for injecting the chlorine gas solution water into the main to be disinfected. It is recommended that

direct feed chlorinators not be used. Hypochlorite solutions may be applied to the water main with a chemical feed pump designed for feeding chlorine solutions.

- f) If approved, an optional continuous feed method utilizing calcium hypochlorite granules may be used. Place the granules in the pipe sections as specified under the Tablet Method.
- 2) Slug Method
 - a) Before chlorinating, preliminary flush the main as specified herein.
 - b) Use water from the existing distribution system or other approved source of supply to flow at a constant measured rate into the newly laid water main.
 - c) Not more than 10 feet (3 meters) downstream from the beginning of the new main, add chlorine to the water entering the new main at a constant rate that the water will have a minimum 100 mg/L free chlorine. Measure this concentration at regular intervals. Apply the chlorine continuously and for the time required to develop a solid column or "slug" of chlorinated water that will, as it moves through the main, expose all interior surfaces to a 100 mg/L for at least 3 hours.
 - d) Measure the free chlorine residual in the slug as it moves through the main. If at any time it drops below 50 mg/L stop the flow and relocate the chlorination equipment at the head of the slug, and as flow is resumed, add chlorine to restore the free chlorine in the slug to not less than 100 mg/L.
 - e) As the chlorinated water flows past fittings and valves, operate related valves and hydrants to disinfect appurtenances and pipe branches.
- 4. Final Flushing
 - a. After the retention period, flush the chlorinated water from the main until chlorine measurements show that the concentration in the water leaving the main is no higher than that in the system, or is acceptable for domestic use.

D. Bacteriological Tests

- 1. After final flushing and before the water main is placed in service, test a sample, or samples, collected from the main(s) for turbidity and bacteriological quality. Collect at least one sample from the new main and one from each branch. Collect the samples and have the tests performed at an approved laboratory.
- 2. Redisinfection
 - a. If the initial disinfection fails to produce approved bacteriological or turbidity samples, re-flush and resample the main. If check samples show bacterial contamination, re-chlorinate the main until approved results are obtained.
- 3. Swabbing
 - a. Where connections are made to existing piping and the connections are not disinfected along with the newly installed main, swab or spray the

interior of all pipe and fittings used in making the connections with a 1% hypochlorite solution before installation.

3.5 WATER AND SEWER MAIN SEPARATION

- A. Maintain horizontal and vertical separation between water mains and sewer mains in accordance with Standard Drawing No. 02660-2.

3.6 VALVES

- A. Set and joint gate valves and butterfly valves to the pipe as specified for pipe laying and jointing. Set valves with operating nut vertical. Center and plumb valve boxes over the operating nut to prevent shock or stress being transmitted to the valve.
- B. Valve Boxes
 - 1. Install gate valve boxes such that the tops are 3 inches (76 mm) below the finished grade in aggregate surfaced areas and at finished grade in asphalt surfaced areas. In unsurfaced areas, leave the top of gate valve boxes 6 inches (152 mm) above the existing grade and slope backfill to the top at a 4:1 slope.
- C. Valve Thrust Blocks
 - 1. For clarity thrust blocks have not been shown on drawings but install each valve with thrust blocking and anchor rods per the details in the drawings.

3.7 FIRE HYDRANTS

- A. Set all hydrants plumb with the pumper nozzle facing the street. Set the hydrant with the ground line at the location indicated by the hydrant manufacturer. Assure 1 to 2 inches (25 to 50 mm) of clearance between the existing ground or sidewalk and the bolt bottom on the hydrant bottom flange. Verify depth and riser length to establish clearance within 1-inch (25 mm) tolerance.
- B. Provide drainage at the hydrant base by placing clean gravel under and around it. Place gravel at least 12 inches (30 cm) on all sides from the base of the hydrant to at least 6 inches (15 cm) above the drain opening. Brace the hydrant against unexcavated earth at the trench end with concrete backing as detailed on the drawings. Furnish hydrants with the specified gate valves. The gate valve shall be located three feet from the hydrant unless otherwise staked in the field by the Engineer. Install hydrants in accordance with the detail provided in the drawings, or as located in the field by the Engineer.

3.8 SERVICE LINE INSTALLATION

- A. Provide all work and materials for the complete service line installation, including trench excavation and backfill; making the water main tap; furnishing and installing the corporation stop, curb stop and box, service clamp where necessary, and service line with fittings to make the connections to the stops. Bend the service line adjacent to the water main into a figure "S" in a horizontal or vertical plane to avoid a rigid connection. Assure all services have a minimum 6-1/2 feet (2 meters) of cover.

3.9 TAPPING

- A. Tap the newly installed water mains unless specified otherwise.
- B. Provide water service clamps for all corporation stops. Set the saddle and corporation stop on the pipe prior to tapping and make the tap through the corporation stop using a standard tapping machine only. Assure taps for water service saddles are full-size taps. Undersized taps will not be allowed. Perform tapping using an approved tapping machine using clean, sharp drill taps for DIP. Use shell cutters for tapping PVC pipe.

3.10 WATER MAIN INSULATION

- A. Install insulation on the new water main when crossing under, over, or within 6 feet of culverts that are open to the air, or in cases where less than 6 feet of cover is provided. Install the insulation the full width of the trench excavation.
- B. Place a 6 mil thick polyethylene sheeting over the insulation, lapping any joints a minimum of 12 inches (30 cm).
- C. Place a 6 inch (15 cm) sand cushion above and below the insulation.

3.11 YARD HYDRANTS

- A. Set all sanitary yard hydrants plumb with the outlet orientated as directed by Owner. Assure hydrants have a finished height above the final grade as shown in the drawings, if a detail is provided, or as specified by Engineer.
- B. Install all sanitary yard hydrants in accordance with manufacturer recommendations.

END OF SECTION

SECTION 02665

HDPE PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Furnish and install high density polyethylene (HDPE) pipe and fittings including manholes, service lines, and other appurtenant structures as specified in the Contract and this section. Pipe strength classifications are specified on the plans, listed in the Contract Documents, or specified herein.

1.2 REFERENCES

ASTM F714	Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
ASTM D3035	Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
ASTM D3350	Polyethylene Plastic Pipe and Fittings Material
AWWA C901	Polyethylene (PE) Pressure Pipe and Tubing, ½ In. Through 3 In.
AWWA C906	Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 63 In.

1.3 CONTRACTOR QUALIFICATIONS

- A. HDPE pipe thermal fusion welding and installation must be done by a firm or individual(s) having demonstrated satisfactory certification and performance history in the installation of HDPE pipe. If subcontracted, the firm or individual(s) will be responsible to the Contractor for all phases of HDPE pipe installation.
- B. Submit the following information within 5 calendar days of the Bid Opening.
 - 1. Copies of current factory certification(s) for the Contractor, or proposed Subcontractor, for the installation and thermal fusion welding of HDPE pipe in accordance with Code of Federal Regulations (CFR) Title 49 and Part 192.285.
 - 2. A list of similar work completed by the Contractor, or proposed Subcontractor, within the last 2 years that totals the installation of at least 1 mile (1.6 km) of 4-inch (100 mm) diameter or greater HDPE pipe using thermal fusion welded joints.
- C. Failure by a prospective Bidder to submit the required information within the allotted time will be deemed a material irregularity, which may result in the bid being determined non-responsive and rejected.
- D. The information provided will be evaluated by the Owner and Engineer to determine if the experience and qualifications submitted are adequate to perform the work. The Owner and Engineer's interpretation of Contractor or Subcontractor's ability to perform the work will be final.
- E. The information may be submitted to the Engineer up to 10 days before the bid opening for prequalification.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Furnish all HDPE piping as specified in the Contract Documents and meeting the materials and testing requirements of this Section. Furnish all fittings of the same material and design as the specified piping. Furnish the pipe sizes and strength classifications shown in the Contract documents.
- B. References to ASTM, or AASHTO designation, means the latest revision at the time of call for bids.
- C. Assure all pipe is clearly marked with type, class and/or thickness as applicable. Assure lettering is legible and permanent under normal handling and storage conditions.
- D. Furnish a manufacturer's certification for all pipe and fittings, certifying that the pipe and fittings meet the contract requirements.

2.2 HIGH DENSITY POLYETHYLENE PIPE (HDPE)

- A. Furnish HDPE pipe meeting AWWA C901 or C906 and ASTM D3350, with a material code of PE 3408, a cell classification of 345464C and a DR of 11, or with a material code of PE 4710, a cell classification of 445574C, and a PC of 160 DR of 13.5
- B. Assure HDPE pipe is manufactured with an ultraviolet (UV) stabilizer.
- C. Furnish pipe with iron pipe size (IPS) outside diameters. Assure dimensions and workmanship meet ASTM F714 requirements for nominal diameters of 4 inches (100 mm) or greater and ASTM D3035 for nominal diameters smaller than 4 inches (100 mm).
- D. Assure all HDPE pipe used in potable water applications is NSF approved.

2.3 FITTINGS

- A. Use tee or wye fittings for connecting service lines of the same material, construction, and joint design as the main pipe.
- B. Furnish special fittings meeting the Contract Documents.

2.4 PIPE JOINTING

- A. Thermally fuse HDPE pipe and fittings by one of the following types of thermal fusion per the manufacturer's recommended procedures: butt fusion, saddle fusion, or socket fusion.
- B. Thoroughly clean all pipe segments prior to fusing to assure no HDPE pieces remain in the pipe (these pieces may clog air valves).
- C. HDPE pipe and fittings may be joined together through the use of electrofusion fittings with the Engineer's approval.

- D. Join HDPE pipe and fittings to other materials with flange adapters with back-up rings, mechanical couplings designed for connecting HDPE pipe and fittings to another material, or mechanical joint adapters. Consult the manufacturer of the joining device for proper installation procedures.

PART 3 - EXECUTION

3.1 PIPELINE INSTALLATION

- A. Excavation and Backfill
 - 1. Excavate and backfill pipelines meeting the applicable portions of SECTION 02221: TRENCH EXCAVATION AND BACKFILL FOR PIPELINES AND APPURTENANT STRUCTURES.
- B. Responsibility for Materials
 - 1. The Contractor is responsible for all material furnished. Replace all material found defective in manufacture or damaged in handling after delivery. This includes furnishing all material and labor required for the replacement of installed material discovered defective before final acceptance of the work or during the guarantee period.
 - 2. The Contractor is responsible for the safe storage of material intended for the work until it has been incorporated in the completed project.
- C. Handling of Pipe
 - 1. Deliver and distribute all pipe to the site. Load and unload pipe, fittings and accessories by lifting with hoists or skidding to avoid shock or damage. Do not drop any materials. Do not roll or skid pipe handled on skidways against pipe already on the ground.
 - 2. In distributing the material at the site of the work, unload each piece opposite or near the place where it is to be laid in the trench. Keep the interior of all pipe and other accessories free from dirt and foreign matter at all times.
 - 3. Repair or replace all damaged pipe at Contractor's expense on the jobsite.
- D. Laying Pipe
 - 1. Lay and maintain all pipe to the specified lines and grades with fittings at the specified locations.
 - 2. Use tools and equipment, satisfactory to the Engineer, for the safe and convenient prosecution of the work. Carefully lower all pipe and fittings into the trench to prevent damage to the pipe materials and protective coatings and linings. Do not drop or dump any materials into the trench.
 - 3. Take every precaution to prevent foreign material from entering the pipe while it is being installed. At times when pipe laying is not in progress, close the open ends of the pipe using a plug or other means approved by the Engineer. Clean and remove all sand, gravel, concrete and cement grout that has entered the lines during construction.
 - 4. Place pipe bedding in the bottom of the trench meeting Section 02221; TRENCH EXCAVATION AND BACKFILL FOR PIPELINES & APPURTENANT STRUCTURES. Voids may be left in the bedding material to remove pipe slings to allow support along the full length of the pipe barrel.
 - 5. Join sections of HDPE into continuous lengths above ground. Assure the equipment used to join pipe sections shall be capable of meeting all conditions

recommended by the pipe manufacturer, including but not limited to, temperature requirements of a minimum of 400 degrees Fahrenheit (204° C), alignments, and an interfacial fusion minimum pressure of 75 pounds per square inch (517 kPa).

6. Cut pipe for inserting fittings in a neat and workmanlike manner without damaging the pipe or coating and leaving a smooth end at right angles to the pipe axis. Do not cut pipe using an oxyacetylene torch.

E. Tolerances

1. Install the pipe within ½ inch (13 mm) of the specified alignment and within ¼ inch (6 mm) of the specified grade.

3.2 Thermal Fusing HDPE

A. Butt Fusion

1. Clean pipe ends thoroughly with cotton cloth. Assure no HDPE cuttings remain in the pipe. Face the pipe ends to establish clean, parallel mating surfaces. Continue facing until a minimal distance exists between the fixed and movable jaws of the machine and the facer is locked firmly and squarely between the jaws. Provide a perfectly square face, perpendicular to the pipe centerline on each pipe end and with no detectable gap.
2. Align and round the pipe profiles with each other to minimize mismatch (high-low) of the pipe walls. Clamping jaws must not be loosened during fusion. Clamp the pipe as close to the joint area as possible to ensure proper pipe alignment.
3. Use heating tool with internal thermometer, assuring heater faces are clean, oil-free, and coated with a nonstick coating as recommended by the manufacturer. Periodically verify the proper surface temperature using a pyrometer or surface temperature measuring device. Melt the pipe interfaces until the proper bead size is formed per manufacturer's recommended temperature and bead size, without applying pressure.
4. Join the pipe ends rapidly, but carefully, with sufficient pressure to mix the pipe materials and form a homogenous joint. Follow manufacturer's recommendations for internal pressure or bead size of molten material.
5. Hold molten joint immobile under pressure as indicated until cooled adequately to develop strength. Use cooling times established by the pipe manufacturer. Do not apply water, wet cloths, or similar to shorten cool time.
6. Each fused joint must have a complete double roll-back bead and be inspected by Contractor personnel with qualifications approved under Section 02665.1.3.

3.3 JOINING HDPE TO OTHER PIPE MATERIALS

A. Flanged Connections for HDPE Pipe

1. Assure all flange connections made with HDPE pipe include the placement of metal backing as recommended by the HDPE manufacturer.
2. Butt fuse the flange adapter or stub end to the plastic pipe segment. Position the flange face of the adaptor as required so that the back-up ring on the plastic pipe segment can be attached to the metal flange.
3. Snug flanges to be joined prior to bolting. Adjust pipe spool position as required to assure snug fitting prior to bolting. Install and tighten flange bolts in alternating pattern, drawing the metal and plastic flange faces evenly and flat. Do not use the flanges to draw the two pipe sections together.

- B. Mechanical Compression Joints for HDPE Pipe
1. Provide mechanical joints only where specifically called for on the Drawings. Provide mechanical joints consisting of, at a minimum, a threaded compression nut or a follower and bolt arrangement, an elastomer seal ring, and a stiffener.
 2. Insert pipe stiffeners to provide support under the seal ring and gripping ring. Assure stiffener is long enough to prevent collapse of the pipe.
 3. Compress the seals by tightening the threaded compression nuts or follower and bolt arrangements. Assure seals are pressure-tight.
 4. Each joint must be inspected by Contractor personnel with qualifications approved under Section 02665.1.5.

3.4 TESTS

- A. Hydrostatic and Leakage Testing for Force Mains
1. Perform hydrostatic and leakage testing in accordance with AWWA C600 and Section 02660 WATER DISTRIBUTION, for all new mains. Once the pipe is laid and backfilled, test for at least 2 hours, all newly laid pipe, or any valved section, at the highest point along the test section. The maximum length of pipe to be tested at one time shall be 1,000 linear feet unless otherwise approved by the Engineer. Test to a hydrostatic pressure equal to 2.0 times the normal operating pressure at the test point, but in no case less than a minimum gage pressure of 125 pounds per square inch (862 kPa) or greater than a maximum gage pressure greater than the pressure rating of the pipe.
 2. Slowly fill the pipe with water, purging all air, and apply the test pressure using a pump hooked up so that the pressure and leakage can be measured. To purge the pipe of air during the test, it is necessary to tap the pipe at its highest points if permanent air vents are not located at the high points. Use corporation stops for this purpose. Furnish the pump connections, gauges, stops, and all necessary apparatus for testing.
 3. Disassemble and reassemble all joints showing leakage after thorough cleaning. Remove and replace all cracked or defective pipes or fittings discovered during the pressure test with sound material and repeat the test.
 4. Conduct the leakage test concurrent with the pressure test for 2 hours. Leakage is defined as the quantity of water supplied into the pipe, or any valved section thereof, necessary to maintain pressure within 5 pounds per square inch of the pressure test after the pipe has been filled with water and purged of air.
 5. The pipe installation will be rejected if the leakage exceeds that determined by the following formula:
$$L = SD(P)^{1/2} \div 148,000$$

In which L equals the allowable leakage in gallons per hour; S is the length of pipe being tested, in feet; D is the nominal diameter of the pipe being tested, in inches; and P is the average test pressure during the leakage test, in pounds per square inch gauge.
 6. Where the pipe being tested for leakage is thermally fused HDPE, the allowable leakage will be reduced to 25% of L, as calculated.
 7. Should any test of pipe laid disclose leakage exceeding that specified above, locate and repair the defective joints until the leakage is within the specified allowance.
 8. Conduct the pressure and leakage tests with the Engineer present.

- B. Cleaning, Disinfection, and Testing Water Mains
 - 1. Clean, disinfect, and test HDPE used in potable water mains in accordance with Paragraphs 3.1.B through 3.1.D, as modified, in Section 02660: WATER DISTRIBUTION.

3.5 WATER MAIN INSULATION

- A. When crossing under, over, or within six feet of culverts that are open to the air, or in cases where less than six feet of cover is provided, provide insulation on new water mains the full width of the trench excavation.
- B. Furnish 2-inch thick Styrofoam HI brand plastic foam insulation (Blue Board) with tongue and groove joints or an approved equivalent. Friction fit the joints and secure with an adhesive according to the manufacturer's recommendations.
- C. Place a 6-mil polyethylene sheeting over the insulation, lapping any joints a minimum of 12 inches.
- D. Place a 6-inch sand cushion above and below the insulation.

END OF SECTION

SECTION 02910

SEEDING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section includes ground surface preparation; furnishing and applying fertilizer; and furnishing and planting seed in areas described in the contract documents or directed by the Engineer.

1.2 SUBMITTALS

- A. Submit to the Engineer applicable seed mixture certifications, fertilizer descriptions and mulch certifications. Furnish duplicate signed copies of the vendors statement certifying that each seed lot has been tested by a recognized seed testing laboratory within 6 months of date of delivery. Assure the statement includes: Name and address of laboratory, date of test, lot number for each seed species and the test results including name, percentages of purity and of germination, percentage of weed content for each kind of seed furnished and, for seed mixes, the proportions of each kind of seed.

PART 2 - PRODUCTS

2.1 SEED

- A. Furnish seed and seed mixture, free of all prohibited noxious weed seed or any other weed seed prohibited by state or local ordinance.
- B. Seal and label all seed containers to comply with Montana Seed Law and Regulations or meeting U.S. Department of Agriculture and Regulations under the Federal Seed Act, if shipped in interstate commerce.
- C. Do not use wet, moldy, or otherwise damaged seed in the work.
- D. Furnish seed mixture of the species described in the contract documents. Furnish seed in standard containers labeled with the seed name, lot number, net weight, percentages of purity, germination, hard seed, and percentage of maximum weed seed content for each seed species.

2.2 TOPSOIL

- A. Use topsoil that is loose, friable, loamy soil, free of excess acid and alkali. Assure topsoil does not contain objectionable amounts of sod, hard lumps, gravel, sub-soil or other

undesirable material that would form a poor seedbed. Before striping topsoil, assure it has supported the growth of healthy crops, grass or other vegetable growth.

2.3 LIME

- A. Furnish ground limestone or other material deemed suitable by the Engineer containing a minimum 85% of total carbonate equivalent ground so that 90% will pass through a No. 100 mesh sieve. Coarser material may be acceptable, if the application rates are increased to provide at least the minimum quantities and depth specified using an approved Dolomitic lime or a high magnesium lime containing at least 10% magnesium oxide.

2.4 FERTILIZER

- A. Furnish standard commercial fertilizers supplied separately or in mixtures containing the specified percentages of total nitrogen, available phosphoric acid, and water soluble potash. Apply fertilizer at the specified rate and depth meeting the applicable State and Federal laws. Furnish fertilizer in standard containers clearly labeled with name, weight, and guaranteed analysis of contents. No cyanamide compounds of hydrated lime are permitted in mixed fertilizers.
- B. Fertilizers may be supplied in one of the following forms:
 - 1. A dry, free-flowing fertilizer suitable for application by a common fertilizer spreader;
 - 2. A finely-ground fertilizer soluble in water, suitable for application by power sprayers; or
 - 3. A granular or pellet form suitable for application by blower equipment.

2.5 SOILS FOR REPAIRS

- A. Use soil for filling and topsoiling repair areas of equal quality to the existing topsoil being repaired. Assure the soil is free of large stones, roots, stumps, or other materials that interfere with sowing, compacting, and establishing turf. Obtain approval from the Engineer before placing topsoil.

PART 3 - EXECUTION

3.1 TOPSOIL

- A. Place at least 6 inches (15 cm) of topsoil in all areas to be seeded. Import topsoil if sufficient topsoil is not available from excavated areas of the project.

B. ALLOWABLE SEEDING MONTHS

1. Perform seeding when the temperature and moisture are favorable to germination and plant growth. Seed preferably before June 1st and after October 1st of each year. Seeding dates must be approved by the Engineer.

3.2 SEEDBED PREPARATION AND SOWING

- A. Clear the areas to be seeded of all debris, vegetation, and other material determined by the Engineer to be detrimental to the preparation of a seedbed. Once the area is cleared, disc, harrow, rake, or work the area by other suitable methods, into a smooth, even seedbed. Assure the prepared seedbed surface is firm enough to prevent seed loss from high winds or normal rainfall. If rolling is required, perform rolling before seeding using a suitable roller, of a weight appropriate to the soil conditions.
- B. Sow seed in the areas described in the contract documents at the specified application rates.
- C. Sow seed using a force feed drill having a grass seed attachment, except of slopes steeper than three to one or on areas too small to be seeded with a force feed drill. In these areas, seed may be sown by power sprayers, blowers or other effective methods. Use equipment in good working order.
- D. Seed Kentucky Bluegrass at a depth of one-quarter inch or less and cultipack the seed.
- E. Do not sow seed in winds that prevent proper imbedment into the surface.

3.3 FERTILIZER

- A. Spread and work fertilizer into the soil during the final seedbed preparation. Apply fertilizer at the rate described in the contract documents.

3.4 CARE OF SEEDED AREAS

- A. Keep the seeded area moist until it has germinated and its continued growth is assured. Prevent erosion during watering. Water is incidental to the item "Seeding".
- B. Protect all seeded areas from traffic or pedestrian use with warning barricades or other Engineer approved methods.
- C. Maintain the seeded area, performing any required watering and mowing until the seed is firmly established. Prevent weeds and other undesirable vegetation from establishing in the seeded area. Mow weeds and rake and remove the clippings from the areas.
- D. Replace any seeded areas failing to germinate which have died or been damaged by construction activities. Replace such areas to meet the contract requirements. The contract warranty period applies to this item.

PART 4 - MEASUREMENT AND PAYMENT

4.1 GENERAL

- A. Seeding is measured by the square yard (square meter) and paid for at the unit price bid including topsoil salvage and/or importing, topsoil placement, seedbed preparation, and seeding, complete in place and accepted by the Engineer.
- B. Payment indicated to include complete compensation for all labor, equipment, materials and incidentals required for the completion of the work.

END OF SECTION

DIVISION 3

CONCRETE

SECTION 03310
STRUCTURAL CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section of the specifications covers the requirements for furnishing and installing cast-in-place concrete for slabs on grade, including formwork and reinforcement, in conjunction with notes as shown on Drawings.

1.2 RELATED WORK

- A. Section 01330, Submittals
- B. Section 01450, Quality Control

1.3 REFERENCE SPECIFICATION

- A. ACI 301-20 - Standard Specifications for Structural Concrete.
- B. International Building Code (IBC) - Chapter 19.
- C. American Society For Testing and Materials (ASTM).

1.4 FIELD REFERENCE

- A. The Contractor shall make available for on-site review one copy of ACI Field Reference Manual, SP-15 – Standard Specifications for Structural Concrete (ACI 301) with Selected ACI and ASTM.

1.5 QUALITY ASSURANCE

- A. Concrete shall be supplied by a commercial ready-mix firm.
- B. Mix design and trip tickets shall be submitted for all concrete delivered in conformance with Section 01330, Submittals.

1.6 TESTING

- A. Compressive Strength Tests:
 - 1. Obtain samples and conduct tests in accordance with ACI 301 Section 1.6.4.
 - 2. One (1) set of three (3) cylinders per set shall be cast for testing for the concrete slabs, unless the slabs are placed on separate days, in which case one set of three cylinders shall be cast for each slab.
 - 3. For each specified test: Cure one (1) cylinders for 28-day test age. Test one (1) cylinder at seven days, test one (1) cylinders at twenty-eight days, and hold one (1) cylinder in reserve as the CO directs. After fifty-six days, unless notified by the CO to the contrary, the reserve cylinder may be discarded without being tested for specimens meeting 28-day strength requirement.
 - 4. Acceptance. Strength is satisfactory when:

- i. The average of all tests equal or exceed the specified strength
 - ii. No individual test falls below the specified strength by more than 500 psi.
- B. Slump Test:
 - 1. Obtain samples and conduct slump tests in accordance with ASTM C143/C143M. Take concrete samples during concrete placement. Perform test at commencement of concrete placement and when test cylinders are made.
- C. Air-Entrainment Test:
 - 1. Obtain samples and conduct air-entrainment tests in accordance with ASTM C173/C173M. Test for air content at commencement of concrete placement and when test cylinders are made.

1.7 SUBMITTALS

- A. Submit concrete design mix for CO review and approval fourteen (14) days prior to placing concrete. Conform to requirements of ACI Section 4.1.2.

Submit results of compressive strength, slump, and air-entrainment testing to CO for review. Conform to requirements of ACI Section 1.5.2.
- B. Submit above per Section 013300, Submittals.

PART 2 - MATERIALS

2.1 FORM MATERIALS

- A. Conform to ACI 301 Section 2 - Formwork and Form Accessories.”
- B. Removal of Forms shall conform to ACI 301 Section 2.3.2 except strength indicated in ACI 301 Section 2.3.2.5 shall be $0.75 f'_c$.
- C. Forms: Steel, wood, or other suitable material of size and strength to resist movement during concrete placement. Use straight forms, free of defects. Use flexible spring steel forms or laminated boards to form curved edges.
- D. Form Coating: Release agent that will not adversely affect concrete or interfere with coating application.

2.2 BAR REINFORCEMENT

- A. Bar reinforcement shall conform ASTM A615/A615M, Grade 60 unless noted otherwise.
- B. Reinforcement shall be unfinished deformed billet-steel bars.

2.3 CONCRETE MIXTURES

- A. Conform to ACI 301 Section 4 - Concrete Mixtures.
- B. Provide concrete mixes conforming to the following requirements:

Member Type/Location	STRENGTH (psi)	TEST AGE (days)	MAX. AGGREGATE	MAX W/C RATIO	AIR CONTENT
Slabs Exposed to Freeze/Thaw Conditions	4,000	28	1"	0.45	6%
Interior Slabs without Exposure to Freeze/Thaw	4,000	28	1"	0.45	0-3%

C. Mix Design Notes

1. Water Cement (W/C) ratio: Water-cementitious material ratios shall be based on the total weight of cementitious materials. Ratios not shown in the table above are controlled by strength requirements.
2. Cementitious content: 5 ½ sack per cubic yard. The use of fly ash, other pozzolans, silica fume, or slag shall conform to ACI 301 Sec 4.2.2.8.B. Maximum amount of fly ash shall be 20% of total cementitious content unless reviewed and approved otherwise by the CO.
3. Air content: Conform to ACI 301 Section 4.2.2.4. Horizontal exterior surfaces in contact with the soil require entrained air. Use "Severe Exposure". Tolerance is $\pm 1\frac{1}{2}\%$. Air content shall be measured at point of placement.
4. Slump: Conform to ACI 301 Section 4.2.2.2. Slump shall be determined at point of placement.
5. Chloride Content: Conform to ACI 301 Section 4.4.1 and Table 4.1.1 for "Other Reinforced Concrete Construction."
6. Non-Chloride Accelerator: Non-chloride accelerating admixture may be used in concrete slabs placed at ambient temperatures below 50°F at the Contractor's option.

2.4 CONCRETE MATERIALS

- A. Portland Cement: Portland cement shall conform to ASTM C150, Type I or Type II. The cement shall be of the same brand and type and from the same plant of manufacture.
- B. Aggregate: Conform to ASTM C33. Maximum aggregate size of $\frac{3}{4}$ " unless approved otherwise by the CO. Aggregates shall be free from any substance that may be deleteriously reactive the alkalis in the cement and in a sufficient amount to cause excessive expansion of the concrete.
- C. Fly Ash: Pozzolanic mineral admixture conforming to ASTM C618, Class F. Maximum loss on ignition to be 1%. Use fly ash from one single source for the whole project. When fly ash is used, the maximum amount shall be 30% weight of the total cementitious materials, unless otherwise noted.
- D. Admixtures: Use of admixtures shall be the responsibility of the Contractor. When more than one admixture is used in the mix, furnish satisfactory evidence to the CO that the admixtures to be used are compatible in combination with the cement and aggregates. Provide only one brand of each type of admixture. Accelerating admixtures shall not be used. Unless approved by the CO admixtures shall be free of calcium chloride and

thiocynate (no more than 0.05% chloride ions). The following types of admixtures are approved:

1. Air-Entrainment Admixture: Master Builders “Micro-Air,” Grace “Davavair,” Sika “AEA-15,” or approved equal conforming to ASTM C260.
2. Water reducing Admixture (Low Range): Master Builders “Pozzolith 322-N,” Grace “WRDA with Hycol,” Sika “Plastocrete 161,” or approved equal conforming to ASTM C494, Type A.
3. Water reducing Admixture (High Range): Master Builders “Rheobuild 1000,” Grace “WRDA-19,” Sika “Sikament 86,” or approved equal conforming to ASTM C494, Type F.

2.5 ACCESSORIES

- A. Form Release Agent: Colorless material which will not stain concrete, absorb moisture or impair natural bonding or color characteristics of coating intended for use on concrete; Release #1, or Crystal Release as manufactured by Burke Concrete Accessories or approved equal.
- B. Polyurethane Joint Sealer shall conform to ASTM C 920.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Conform to requirements of ACI 301 Section 2 -Formwork and Form Accessories.

3.2 CONCRETE PLACEMENT

- A. Preparation
 1. Do not place concrete until the CO approves all required submittals.
 2. Remove snow, ice, frost, water, and other foreign materials from form surfaces, reinforcement, and embedded items against which concrete is to be placed.
 3. Place concrete on properly prepared and unfrozen subgrade and only in dewatered excavations and forms.
 4. Do not allow mud or foreign materials into the concrete during placement operations.
 5. When the ambient temperature necessitates the use of cold or hot weather concreting, make provisions in advance of concrete placement.
 6. Do not begin placing concrete when the sun, heat, wind, or limitations of facilities furnished by the Contractor prevent proper consolidation, finishing and curing.
 7. Do not begin placing concrete while rain, sleet, or snow is falling unless adequate protection is provided. Do not allow rainwater to increase mixing water or to damage the surface of the concrete.
- B. Installation of Embedded Items
 1. Position and secure in place expansion joint material, anchors, and other structural and non-structural embedded items before placing concrete.

Contractor shall coordinate placement of all embedded items shown on the Drawings.

- C. Reinforcing Steel
 - 1. Conform to the following cover requirements from ACI 301, Table 3.3.2.3, unless noted otherwise on the drawings. Concrete cast against earth – three inches. Concrete exposed to earth or weather – two inches.
 - 2. Field bending. Conform to ACI 301 Section 3.3.2.8 – Field Bending or Straightening. Bar sizes #3 through #5 may be field bent cold the first time. Other bars require preheating. Do not twist bars.
- D. Concrete Measuring, Mixing, and Delivery
 - 1. Conform to requirements of ACI 301 - Section 4.3.
- E. Handling, Placing, Constructing and Curing Concrete
 - 1. Conform to requirements of ACI 301 – Section 5.

3.3 FINISHES FOR UNFORMED SURFACES

- A. General: Finish slab surfaces as described below. Finish all joints and edges with proper tools as approved.
- B. Placement: Place concrete at a rate that allows spreading, straight edging, darbying or bullfloating before bleed water appears. Screed all slabs, topping fills to true levels and slopes. Work surfaces as required to produce specified finish. Do not finishing in areas where water accumulated; drain and re-screed. In no case use a sprinkling of cement and sand to absorb moisture.
- C. Tolerances: Measure slabs-on-grade to verify compliance with the tolerance requirements of ACI 117 Section 4.5.7, Classification: Bullfloated. Measure floor finish tolerances within 72 hours after slab finishing.
- D. Broom Finish: Confirm with CO the need for a broom finish. If broom finish is required immediately after concrete has received a floated finish; give the concrete a coarse transverse scored texture by drawing a stiff broom across the surface. Degree of texture shall be as approved by the CO.

3.4 CONCRETE CURING

- A. Conform to the requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury. In hot, dry, and windy conditions, apply an evaporation-control compound according to the manufacturer's instructions after screeding and/or bull floating, but before power floating and troweling.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for a period not less than seven days for the hydration of the cement and hardening of the concrete.

END SECTION