TECHNICAL SPECIFICATIONS

SECTION 01010 - SUMMARY OF WORK

PART 1 - GENERAL

101.01 GENERAL

A. The WORK to be performed under this Contract shall consist of furnishing all tools, equipment, materials, supplies, and manufactured articles and for furnishing all transportation and services, including fuel, power, and water for the performance of all labor, WORK, or other operations required for the fulfillment of the Contract in strict accordance with the Contract Documents.

101.02 WORK COVERED BY CONTRACT DOCUMENTS

A. The WORK of this Contract includes the includes:

1. Removal of interior mortar lining of fifteen locations on the Jordan Aqueduct Reach 1, a 78-inch weld steel, mortar lined and coated pipe, which were identified to have wall loss from a 2020 condition assessment as indicated in Appendix C. JVWCD's consultant will verify wall loss in these locations using nondestructive methods. If wall loss is occurring on the interior of the pipe, an interior patch will be placed and the interior mortar coating will be repaired. If wall loss is measured and not found on the interior of the pipe, the exterior of the pipe will be exposed, corrosion treated, an exterior patch will be placed and the interior and exterior linings will be repaired by the Contractor.

2. Excavation of three joints (46-47, 47-48, and 48-49) on the Jordan Aqueduct Reach 1 where interior butt straps were installed in 2020. The top of pipe at this location is approximately 9' deep according to record drawings. Pipe joints will be completely exposed 3' on each side of the joints. An inspection will be performed by JVWCD's Consultant. If repairs are required, they will be processed through a change order..

3. Excavation of a segment of the Jordan Aqueduct Reach 4 to investigate a current drop if the aqueduct's cathodic protection current. Indication GPS: 40.447574014667, -111.91382654783 (approximately 210' south of the Point of the Mountain Flow Control Structure). The top of pipe at this location is approximately 7' deep according to record drawings. Expose JA-4 down to the 4 and 8 o'clock positions 8' on both sides of the GPS point.

4. Backfill in accordance with JVWCD specifications and restore the surface to preconstruction conditions.

101.03 CONTRACT METHOD

SECTION 01010 - SUMMARY OF WORK

A. The WORK, hereunder, will be constructed based on lump sum prices.

B. The CONTRACTOR shall include the General Conditions and Supplementary General Conditions of the Contract as a part of all of its subcontract agreements.

101.04 **WORK BY OTHERS**

A. INTERFERENCE WITH WORK ON UTILITIES:

The CONTRACTOR shall cooperate fully with all utility forces of the OWNER or forces of other public or private agencies engaged in the relocation, altering, or otherwise rearranging of any facilities which interfere with the progress of the WORK, and shall schedule the WORK so as to minimize interference with said relocation, altering, or other rearranging of facilities.

101.05 **WORK SEQUENCE**

A. WORK under the Contract shall be scheduled and performed in such a manner as to result in the least possible disruption of water service.

B. The CONTRACTOR shall have all of his materials necessary to make a connection present at the site of WORK prior to interrupting water service, if any interruption becomes necessary.

C. The CONTRACTOR shall give notice to the OWNER of intent to start WORK at least 45 days prior to mobilization. The OWNER will responsible for dewatering of the Jordan Aqueduct. The CONTRACTOR will be responsible for mitigation of any nuisance water.

D. WORK shall be performed from December 1, 2025 through April 12, 2026.

E. ENGINEER will require 10 working days to perform their interior inspection once the interior grout has been removed. Upon completion of the inspection, CONTRACTOR will be directed which exterior locations, if any, require excavation.

101.06 **CONTRACTOR USE OF PROJECT SITE**

A. The CONTRACTOR’s use of the project site shall be limited to its construction operations, including on-site storage of materials, on-site fabrication facilities, and field offices.

B. The CONTRACTOR shall limit construction operations to areas within the public right-of-way of the OWNER's easements described in the drawings and shall maintain public access to driveways.

101.07 **OWNER USE OF THE PROJECT SITE**

A. When the CONTRACTOR's WORK involved rehabilitation of or extension to the existing facilities, the OWNER may utilize all or part of the existing site and existing facilities during the entire period of construction for the conduct of the OWNER's normal operations. The CONTRACTOR shall cooperate with the OWNER/ENGINEER to minimize interference with the CONTRACTOR's operations and to facilitate the OWNER's operations. In any event, the OWNER shall be allowed access to the project site during the period of construction.

101.08 **PROJECT MEETINGS**

A. PRECONSTRUCTION CONFERENCE:

Prior to the commencement of WORK at the site, a preconstruction conference will be held at a mutually agreed time and place which shall be attended by the CONTRACTOR, its superintendent, and its subcontractors as appropriate. Other attendees will include OWNER Representative, ENGINEER and designated project representative, representatives of other utilities affected by the WORK, others as requested by CONTRACTOR, OWNER, or ENGINEER.

B. The purpose of the conference is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. This agenda will include the following:

1. CONTRACTOR'S tentative schedules.

2. Transmittal, review, and distribution of CONTRACTOR's submittals.

3. Processing applications for payment.

4. Maintaining record documents.

5. Critical Work sequencing.

6. Field decisions and Change Orders.

7. Use of project site, office and storage areas, security, housekeeping, and OWNER's needs.

8. Major equipment deliveries and priorities.

9. CONTRACTOR's assignments for safety and first aid.

C. The ENGINEER will conduct the preconstruction conference and will arrange for keeping the minutes and distributing the minutes to all persons in attendance.

D. PROGRESS MEETINGS:

The CONTRACTOR shall schedule and hold regular on-site progress meetings at least weekly and at other times as requested by ENGINEER or as required by progress of the WORK. The CONTRACTOR, ENGINEER, and OWNER shall be represented at each meeting. CONTRACTOR may at its discretion request attendance by representatives of its suppliers, manufacturers, and subcontractors.

E. The CONTRACTOR shall conduct the meetings and provide for keeping and distribution of the minutes. The purpose of the meetings will be to review the progress of the WORK, maintain coordination of efforts, discuss changes in scheduling, and resolve other problems which may develop.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

- END OF SECTION -

SECTION 01025 - MEASUREMENT AND PAYMENT

PART 1 - GENERAL

101.01 **SCOPE**

A. Payment for various items of the Bid Sheets, as further specified herein, shall include all compensation to be received by the CONTRACTOR for furnishing all tools, equipment, supplies, and manufactured articles, and for all labor, operations, and incidentals appurtenant to the item of WORK being described, as necessary to complete the various items of the WORK all in accordance with the requirements of the Contract Documents, including all appurtenances thereto, and including all costs of compliance with the regulations of public agencies having jurisdiction, including Safety and Health Requirements of the Occupational Safety and Health Administration of the U.S. Department of Labor (OSHA). No separate payment will be made for any item that is not specifically set forth in the Bid Schedule, and all costs therefore shall be included in the prices named in the Bid Schedule for the various appurtenant items of WORK.

101.02 **APPLICATION FOR PAYMENT**

A. Application for Progress Payment shall be submitted in accordance with Article 14 of the General Conditions of this Contract.

101.03 **LUMP SUM ITEMS**

A. No separate measurement of quantities will be made for those items of WORK performed on a lump sum basis, but the item will be constructed, complete, as required to complete the WORK shown on the Drawings and as described in the Specifications.

B. Bid prices for lump sum items represent the total cost to the OWNER. Such price shall constitute full compensation for furnishing and placing of materials required to complete the item, and for all labor, equipment, tools and incidentals needed to complete the WORK in conformity with the plans and specifications.

SECTION 01025 - MEASUREMENT AND PAYMENT

101.04 **UNIT PRICE ITEMS**

A. Determination of the actual quantities and classifications of Unit Price WORK performed by CONTRACTOR will be made by the ENGINEER in accordance with individual sections of specifications. Payment will be for actual quantities and at the price stated in the Bid. Estimated quantities in the Bid are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

- END OF SECTION -

SECTION 01300 - CONTRACTOR SUBMITTALS

PART 1 - GENERAL

101.01 REQUIREMENT

A. Wherever submittals are required hereunder, all such submittals by the CONTRACTOR shall be submitted to the ENGINEER.

B. Within 14 days after the award of Construction Contract, the CONTRACTOR shall submit the following items to the ENGINEER for review:

1. A preliminary construction schedule indicating the starting and completion dates of the various stages of the WORK.

2. One electronic copy of the manufacturer's technical submittal information for the following items:

   a. Steel plate details.

   b. Mortar and paint and coating systems.

3. A list of all permits and licenses the CONTRACTOR shall obtain indicating the agency required to grant the permit and the expected date of submittal for the permit and required date for receipt of the permit.

4. CONTRACTOR shall verify all submitted items meet the project specifications prior to submission of submittals to the ENGINEER for review.

101.02 CONTRACTOR'S SCHEDULES

A. TIME OF SUBMITTALS:

At the preconstruction conference, the CONTRACTOR shall submit for acceptance by the ENGINEER, a preliminary construction schedule for the WORK, showing its general plan for orderly completion of the WORK, showing its general plan for orderly completion of the WORK and showing in detail its planned mobilization of plant and equipment, sequence of early operations, and timing of procurement of materials and equipment. The construction schedule produced and submitted shall indicate a project completion date on or before the contract completion date. The ENGINEER within 14 days after receipt of the preliminary construction schedule, shall meet with a representative of the CONTRACTOR to review the preliminary plan and construction schedule. After review by ENGINEER, revise and resubmit as required.

B. CONSTRUCTION SCHEDULE REVISIONS:

Submit revised schedules with each Application of Payment, reflecting changes since previous submittal.

101.03 **PROPOSED SUBSTITUTES OR EQUAL ITEMS**

A. For convenience in designation in the Contract Documents, any material, product, or equipment to be incorporated in the WORK may be designated under a brand or trade name or the name of a manufacturer and its catalog information. The use of any substitute material, product, or equipment which is equal in quality and utility and possesses the required characteristics for the purpose intended will be permitted, subject to the following requirements:

1. The burden of proof as to the quality and utility of any such substitute material, product, or equipment shall be upon the CONTRACTOR.

2. The ENGINEER will be the sole judge as to the quality and utility of any such substitute decision shall be final.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

- END OF SECTION -

SECTION 01400 - QUALITY CONTROL

PART 1 - GENERAL

101.01 SITE INVESTIGATION AND CONTROL

A. The Contractor shall verify all dimensions the field and shall check field conditions continuously during construction. The Contractor shall solely be responsible for any inaccuracies built into the work due to his failure to comply with this requirement.

B. The Contractor shall inspect related and appurtenant work and shall report in writing to the ENGINEER any conditions which will prevent proper completion of the work. Failure to report any such condition shall constitute acceptance of all site conditions, and any required removal, repair, or replacement caused by unsuitable conditions shall be performed by the Contractor at his sole cost and expense.

101.02 DESCRIPTION OF WORK

A. The work shall be conducted under the general observation of the ENGINEER and shall be subject to inspection by representatives of the OWNER to ensure strict compliance with the requirements of the Contract Documents. Such inspection may include mill, plant, shop of field inspection, as required. The ENGINEER shall be permitted access to all parts of the WORK, including plants where materials or equipment are manufactured or fabricated.

B. The presence of the ENGINEER or any inspector(s), however, shall not relieve the Contractor of the responsibility for the proper execution of the WORK in accordance with all requirements of the Contract Documents. Compliance is a duty of the Contractor and said duty shall not be avoided by any act or omission on the part of the ENGINEER or any inspector(s).

C. All materials and articles furnished by the Contractor shall be subject to rigid inspection, and no materials or articles shall be used in the WORK until they have been inspected and accepted by the ENGINEER or his authorized representative. No WORK shall be backfilled, buried, cast in concrete, hidden, or otherwise covered until it has been inspected by the ENGINEER or is authorized representative. Any WORK so covered in the absence of inspection shall be subject to uncovering. Where uninspected WORK cannot be uncovered, such as in concrete cast over reinforcing steel, all such WORK shall be subject to demolition, removal, and reconstruction under proper inspection, and no addition payment will be allowed, therefore.

SECTION 01400 - QUALITY CONTROL

101.03 **TIME OF INSPECTION AND TESTS**

A. Except as otherwise provided in these specifications, performance of the required tests will be by the OWNER, and all costs therefore will be borne by the OWNER at no cost to the Contractor; except, that the costs of any test which shows unsatisfactory results shall be borne by the Contractor. Whenever the Contractor is ready to backfill, bury, cast in concrete, hide, or otherwise cover any WORK under the contract, he shall notify the ENGINEER not less than 24 hours in advance to request inspection before beginning any such WORK of covering. Failure of the Contractor to notify the ENGINEER at least 24 hours in advance of any such inspection shall be reasonable cause for the ENGINEER to order a sufficient delay in the Contractor's schedule to allow time for such inspections and any remedial or corrective WORK required, and all costs of such delays, including its effect upon other portions of the WORK, shall be borne by the Contractor.

101.04 **RIGHT OF REJECTION**

A. The ENGINEER, acting for the OWNER shall have the right, at all times and places, to reject any articles or materials to be furnished hereunder which, in any respect, fail to meet the requirements of these specifications, regardless of whether the defects in such articles of materials are detected at the point of manufacture or after completion of the WORK at the site. If the ENGINEER or inspector, through an oversight or otherwise, as accepted materials or WORK which is defective or which is contrary to the specifications, such material, no matter in what stage or condition of manufacture, delivery, or erection, may be rejected by the ENGINEER for the OWNER.

B. The Contractor shall promptly remove rejected articles or materials from the site of the WORK after notification of rejection.

C. All costs of removal and replacement of rejected articles or materials as specified herein shall be borne by the Contractor.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

- END OF SECTION -

SECTION 01500 - CONSTRUCTION FACILITIES AND ENVIRONMENTAL CONTROLS

PART 1 - GENERAL

101.01 GENERAL

A. The Contractor shall provide and maintain adequate construction facilities and perform the necessary work to minimize the impact and inconvenience of the construction activities.

101.02 SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures in accordance with Part 1926 of the OSHA Standards for Construction.

101.03 BARRIERS AND ENCLOSURES

A. Provide as required to prevent public entry to construction areas, and to protect existing facilities and adjacent properties from damage from construction operations.

B. Provide barricades as required by governing authorities for public rights-of-way and for public access to existing building.

C. Provide barriers around trees and plants designated to remain. Protect against vehicular traffic, stored materials, dumping, chemically injurious materials, and puddling or continuous running water.

101.04 PROTECTION OF INSTALLED WORK

A. Provide temporary protection for installed products. Control traffic in immediate area to minimize damage. Repair or replace at OWNER's option any installed work damaged by traffic, the public, or Work operations.

B. Prohibit traffic on restored lawn and landscaped areas.

SECTION 01500 - CONSTRUCTION FACILITIES AND ENVIRONMENTAL CONTROLS

101.05 **DUST, WATER AND NOISE CONTROL**

A. Surface Water, Erosion and Sediment Control:

1. Surface water shall be controlled so that the construction area is not allowed to become wet from runoff from adjacent areas. Surface water shall be directed away from these areas but not directed toward adjacent property, buildings, or any improvement that may be damaged by water. Surface water shall not be allowed to enter sanitary sewers.

2. Maintain excavations free of water. Provide and operate pumping equipment.

3. Prevent erosion and sedimentation.

4. Provide temporary measures such as beams, dikes, and drains, to prevent water flow.

B. DUST CONTROL:

1. Dust control measures shall be implemented by application of water to all work areas, storage areas, haul and access roads, or other areas affected by construction.

2. All work shall be in compliance with the Federal, State, and local air pollution standards, and not cause a hazard or nuisance to personnel and the public in the vicinity of the work.

3. Provide and operate at least one mobile tank sprinkling unit or other positive means to prevent air-borne dust from dispersing into atmosphere.

4. Other methods of dust control for haul and access roads may include chemical treatment, light bituminous treatment or other method as approved by the ENGINEER.

5. Execute work by methods to minimize raising dust from construction operations.

C. NOISE CONTROL:

1. Execute construction between the hours as allowed unless otherwise approved by OWNER.

101.06 CONSTRUCTION CLEANING

A. All public and private areas used as haul roads shall be continuously maintained and cleaned of all construction caused debris such as mud, sand, gravel, soils, pavement fragments, sod, etc. Care shall be taken to prevent spillage on haul routes. Any such spillage shall be removed immediately, and the area cleaned.

B. Public roads shall be maintained in accordance with applicable ordinances and regulations.

C. Through all phases of construction, including suspension of work, and until final acceptance of the project, the Contractor shall keep the work site clean and shall remove daily all refuse, dirt, damaged materials, unusable materials, and all other trash or debris that he has created from his construction activities.

D. Materials and equipment shall be removed from the site as soon as they are no longer necessary; and upon completion of the work and before final inspection, the entire work site shall be cleared of equipment, unused materials, and rubbish so as to present a satisfactory clean and neat appearance. All cleanup costs shall be included in the Contractor's Bid.

101.07 PROJECT IDENTIFICATION

A. NOT USED

101.08 TRAFFIC REGULATION

A. Comply with all requirements of the applicable governmental organization responsible for regulating traffic including creating, submitting for review approval, and maintaining an appropriate traffic control plan.

B. Control vehicular parking to prevent interference with public traffic and parking, access by emergency vehicles, and OWNER's operations.

C. Monitor parking of construction personnel's vehicles. Maintain vehicular access to and through parking areas.

D. Prevent parking on or adjacent to access roads or in non-designated areas.

E. Provide trained and equipped flagmen to regulate traffic when construction operations or traffic encroach on public traffic lanes.

F. Use flares and lights during hours of low visibility to delineate traffic lanes and to guide traffic.

G. Consult with authorities, establish public thoroughfares to be used for haul routes and site access.

H. Confine construction traffic to haul routes and designated construction limits.

I. Provide traffic control at critical areas of haul routes to regulate traffic, to minimize interference with public traffic.

J. At approaches to site and on site, install at crossroads, detours, parking areas, and elsewhere as needed to direct construction and affected public traffic.

K. Relocate as work progresses, to maintain effective traffic control.

L. Maintain traffic flow to private driveway during entire contract period.

M. Post-mounted traffic control and informational signs, traffic cones and drums, flagman equipment: as approved by local jurisdictions.

N. Where local jurisdictions have no requirements, construct, and erect according to "Manual on Uniform Traffic Control Devices for streets and Highway" (MUTCD).

O. Remove equipment and devices when no longer required. Repair damage caused by installation. Remove post settings to a depth of three feet.

101.09 **FIELD OFFICE**

A. NOT USED

SECTION 01500 - CONSTRUCTION FACILITIES AND ENVIRONMENTAL CONTROLS

101.10 **REMOVAL**

A. Remove temporary materials, equipment, services, and construction prior to Substantial Completion inspection.

B. Clean and repair damage caused by installation or use of temporary facilities. Remove underground installations to a depth of two feet; grade site as indicated. Restore existing facilities used during construction to specified, or to original, condition.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

- END OF SECTION -

SECTION 01600 - MATERIAL AND EQUIPMENT

PART 1 - GENERAL

101.01 GENERAL

A. It is the responsibility of the Contractor to provide products as specified in the Contract Documents free from manufacturer defects or damage from shipping.

101.02 PRODUCTS

A. Products include all material, equipment, and systems.

B. Comply with specifications and referenced standards as minimum requirements.

C. Components required to be supplied in quantity within a specification section shall be the same and shall be interchangeable.

D. Do not use products removed from an existing structure, pipeline, etc., except as specifically required, or allowed, by Contract Documents.

101.03 TRANSPORTATION AND HANDLING

A. Transport products by methods to avoid product damage; deliver in undamaged condition.

B. Provide equipment and personnel to handle products by methods to prevent damage.

C. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.

101.04 STORAGE AND PROTECTION

A. Store products in accordance with manufacturer's instructions. Store sensitive products in weather-tight enclosures; maintain within temperature and humidity ranges required by manufacturer's instructions.

B. For exterior storage of fabricated products, place on sloped supports above ground. Cover products subject to deterioration with impervious sheet covering; provide ventilation to avoid condensation.

C. Store loose granular materials on solid surfaces in a well-drained area; prevent mixing with foreign matter.

D. Arrange storage to provide access for inspection. Periodically inspect to assure products are undamaged and are maintained under required conditions.

101.05 **PRODUCT OPTIONS**

A. Products Specified by Reference Standards or by Description Only; Any product meeting those standards.

B. Products Specified by Naming One or More Manufacturers with a Provision of Substitutions: Submit a request for substitution for any manufacturer not specifically named.

C. Product Specified by Naming Several Manufacturers: Products of named manufacturers meeting specifications: no options, or substitutions allowed.

D. Products Specified by Naming Only One Manufacturer: No options, no substitutions allowed.

101.06 **PRODUCTS LISTS**

A. Within 10 days after date of Owner-Contractor Agreement, submit complete list of major products proposed for use, with name of manufacturer, trade name, and model number (if applicable) of each product.

101.07 **SUBSTITUTIONS**

A. Only within 15 days after date established in Notice to Proceed will ENGINEER consider requests from Contractor for substitutions. Subsequently, substitutions will be considered only when a product becomes unavailable due to no fault of Contractor.

B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.

C. Request constitutes a representation that Contractor:

1. Has investigated proposed product and determined that it meets or exceeds, in all respects, specified product.

2. Will provide the same warranty for substitution as for specified product.

3. Will coordinate installation and make other changes which may be required for WORK to complete in all respects.

4. Waives claims for additional costs which may subsequently become apparent.

D. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals without separate written request, or when acceptance will require substantial revision of Contract Documents.

E. ENGINEER will determine acceptability of proposed substitution and will notify Contractor of acceptance or rejection in writing within a reasonable time.

F. Only one request for substitution will be considered for each product. When substitution is not accepted, Contractor must provide specified product.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

- END OF SECTION -

SECTION 01700 - CONTRACT CLOSEOUT

PART 1 - GENERAL

101.01 CLOSEOUT PROCEDURES

A. Comply with procedures stated in General Conditions of the Contract for issuance of Certificate of Substantial Completion.

B. When Contractor considers WORK has been reached final completion, submit written certification that Contract Documents have been reviewed, WORK has been inspected, and that WORK is complete in accordance with Contract Documents and ready for ENGINEER's review.

C. In addition to submittals required by the conditions of the Contract, provide submittals required by governing authorities, and submit a final statement of accounting giving total adjusted Contract Sum, previous payments, and sum remaining due.

D. ENGINEER will issue a final Change Order reflecting approved adjustments to Contract Sum not previously made by Change Order.

101.02 FINAL CLEANING

A. Execute prior to final inspection.

B. Clean and flush drainage systems.

C. Clean site; sweep paved areas, rake clean other surfaces.

D. Remove waste and surplus materials, rubbish, and construction facilities from the Project and from the site.

101.03 PROJECT RECORD DOCUMENTS

A. Provide completed record drawings and other required closeout documents prior to requesting final payment.

B. Store record documents separate from those used for construction.

C. Keep documents current; do not permanently conceal any WORK until required information has been recorded.

D. At Contract closeout, submit documents with transmittal letter containing date, Project title, Contractor's name and address, list of documents, and signature of Contractor.

SECTION 01700 - CONTRACT CLOSEOUT

101.04 **OPERATION AND MAINTENANCE DATA**

A. Provide data for:

1. Mechanical equipment and controls.

2. Painting and coating systems.

B. Submit digital copy of the operation and maintenance manuals prior to requesting final payment for the project.

101.05 **MAINTENANCE AND GUARANTEE**

A. The Contractor shall comply with the maintenance and guarantee requirements contained in Article 13.01 of the General Conditions.

B. Replacement of earth fill or backfill, where it has settled below the required finish elevations, shall be considered as a part of such required repair work, and any repair or resurfacing constructed by the Contractor which becomes necessary by reason of such settlement shall likewise be considered as a part of such required repair work unless the Contractor shall have obtained a statement in writing from the affected private owner or public agency releasing the OWNER from further responsibility in connection with such repair or resurfacing.

C. The Contractor shall make all repairs and replacements promptly upon receipt of written order from the OWNER. If the Contractor fails to make such repairs or replacements promptly, the OWNER reserves the right to do the WORK and the Contractor and his surety shall be liable to the OWNER for the cost thereof.

D. Comply with General Conditions and ordinances of local jurisdictions having authority.

E. Make periodic inspections during guarantee period and correct defective work or correct defective work as directed by the OWNER or appropriate governing authority.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

- END OF SECTION -

SECTION 01720 - RECORD DRAWINGS

PART 1 - GENERAL

101.01 RECORD DRAWINGS

A. The CONTRACTOR shall keep and maintain, at the job site, one record set of drawings. On these, it shall mark all project conditions, locations, configurations, and any other changes or deviations which may vary from the details represented on the Contract Drawings, including buried or concealed construction and utility features which are revealed during the course of construction. Special attention shall be given to recording the horizontal and vertical location of all buried utilities that differ from the locations indicated, or which were not indicated on the Contract Drawings, said record drawings shall be supplemented by any detailed sketches as necessary or directed to indicate, fully, the WORK as actually constructed. These master record drawings of the CONTRACTOR's representation of as-built conditions, including all revisions made necessary by addenda, change orders, and the like shall be maintained up-to-date during the progress of the WORK.

B. In the case of those drawings which depict the detail requirement for equipment to be assembled and wired in the factory, such as motor control centers and the like, the record drawings shall be updated by indicating those portions which are superseded by change order drawings or final shop drawings, and by including appropriate reference information describing the change orders by number and the shop drawings by manufacturer, drawing, and revision numbers.

C. Record drawings shall be accessible to the ENGINEER at all times during the construction period and shall be delivered to the ENGINEER upon completion of the WORK.

D. Requests for partial payments will not be approved if the record drawings are not kept current, and not until the completed record drawings, showing all variations between the WORK as actually constructed and as originally shown on the Contract Drawings or other Contract Documents, have been inspected by the ENGINEER.

E. Final payment will not be approved until the CONTRACTOR-prepared record drawings have been delivered to the ENGINEER. Said up-to-date, record drawings may be in the form of a set of prints with carefully plotted information overlaid in pencil.

F. Upon substantial completion of the WORK and prior to final acceptance, the CONTRACTOR shall complete and deliver a complete set of record drawings to the ENGINEER for transmittal to the OWNER, conforming to the construction records of the CONTRACTOR. This set of drawings shall consist of corrected plans showing the reported location of the WORK. The information submitted by the CONTRACTOR and incorporated by the ENGINEER into the Record Drawings will be assumed to be reliable, and the ENGINEER will not be responsible for the accuracy of such information, nor for any error or omissions which may appear on the Record Drawings as a result.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

- END OF SECTION -

SECTION 09 90 10
PIPELINE COATINGS AND LININGS

PART 1 GENERAL

1.1 WORK RESULTS

A. This section covers the work necessary to apply external coating and internal lining on steel pipe, field coating of joints, and shop and field repair of coating damage, complete.

1.2 RELATED SECTIONS:

A. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

B. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.

1.3 SUBMITTAL REQUIREMENTS

A. Submit all proposed products for use in project to Engineer for review and approval.

B. Shop Drawings: Catalog cuts and other information for all products proposed. Provide copy of approved coating system submittals to the coating applicator.

1.4 QUALITY ASSURANCE

A. Coating Applicator's Experience and Certification:
1. Coating and lining application personnel, who have direct coating application and repair responsibility, shall have a minimum of 2 years practical experience in application of the indicated coating system.

1.5 ABBREVIATIONS

ANSI	American National Standards Institute
AWWA	American Water Works Association

1.6 REFERENCE STANDARDS

A. This specification recognizes AWWA as minimum industry standards and they are referenced for purpose of conformance, except where modified herein. The requirements of this specification section have been written to a higher design standard with the intent of achieving a long-term coating performance of 100 years.

AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe-4-inch and Larger- Shop Applied

1.7 SPECIAL WARRANTY REQUIREMENTS

A. The Contractor and coating applicator shall jointly and separately warrant to the Owner and guarantee the work under this section against defective workmanship and materials for a period of two (2) years commencing on the date of final acceptance of the work.

1.8 OBSERVATION OF WORK

A. The Contractor shall give the Owner Representative notice a minimum of 14 days prior to start of work for scheduling shop or field observation.

B. Provide Owner Representative with a minimum 3 days' notice for actual start of surface preparation and coating application work.

C. Provisions shall be made to allow Owner's representative full access to facilities and appropriate documentation regarding coating application.

D. Observation by the Owner's representative or the waiver of observation of any portion of the work shall not be construed to relieve the Contractor of his responsibility to perform the work in accordance with these Specifications.

E. Materials shall be subject to testing for conformance with this specification as the Owner's representative may elect, prior to or during incorporation into the work.

F. Perform work in the presence of Engineer or Owner Representative, unless prior approval to perform such work is granted. Approval to perform work is limited to the current day unless specifically noted to extend beyond the completion of the workday.

PART 2 PRODUCTS

2.1 GENERAL

A. Coatings and linings will be stored and handled per manufacturer's written directions.

B. Exterior and interior pipe and fitting surfaces shall be prepared and coated in accordance with referenced standards, written instructions of the coating or lining manufacturer, and these specifications, whichever is more stringent.

C. Coatings shall be the product of a single manufacturer. Product substitutions during the project will not be permitted without Engineer approval.

2.2 SHOP-APPLIED, BURIED PIPE COATINGS

A. Cement Mortar Coating or Cement Mortar Overcoat
   1. Apply cement mortar coating system on steel pipe, where specifically shown on the Drawings, in accordance with AWWA C205, except as modified herein.
   2. Cement mortar overcoat shall be applied over dielectric coating system on all steel pipe and fittings in accordance with AWWA C205, except as modified herein. Holdback:

a. Mortar overcoat shall be held back of dielectric coating a minimum of 3 inches for overlap of field applied joint coating onto dielectric coating system.
b. Mortar overcoat shall not extend into structures unless otherwise noted.

3. Shop Applied Coating System:
   a. Cement: Conform to ASTM C150, Type II.
   b. Aggregate shall be silica sand or other aggregate that is not subject to leaching. Conform to ASTM C33.
   c. Cement mortar mixture shall consist of 1-part cement to not more than 2 parts aggregate.
   d. Water for cement mortar: Clean and free from organic matter, strong alkalis, vegetable matter, and other impurities. Use no more than 4-1/2 gallons of water per sack of cement.
   e. Bonding admixture: For potable water projects, NSF-61 certification of admixture is required.
   f. Cement mortar coating: Nominal 1-inch thick coating with permitted tolerance of ±1/4-inch.
4. Joint Coating:
   a. Joints of cement mortar overcoat dielectrically coated pipe do not require field application of cement mortar overcoat when properly coated with heat shrink sleeve joint coating system.

2.3 SHOP-APPLIED INTERIOR LININGS

A. Cement Mortar Lining:
1. Cement: Conform to ASTM C150, Type II.
2. Shop applied cement mortar lining shall be uniform in thickness over the full length of the pipe joint.
3. Aggregate shall be silica sand or other aggregate that is not subject to leaching. Conform to ASTM C33.
4. Water for cement mortar: Clean and free from organic matter, strong alkalis, vegetable matter, and other impurities.
5. Bonding admixture: For potable water projects, NSF-61 certification of admixture is required.

2.4 FIELD APPLIED COATING SYSTEMS

A. Cement Mortar Coating or Overcoat:
1. Joints of cement mortar coated or cement mortar overcoated steel pipe shall be mortar coated as specified herein after application of the specified joint coating materials, where applicable.
2. Polyethylene foam-lined fabric with steel strapping of sufficient strength to hold the fresh mortar, resist rodding of the mortar and allow excess water to escape.
   a. 100 percent closed-cell
   b. Chemically inert, insoluble in water, resistant to acids, alkalis, and solvents.
   c. Manufacturer and Product: Dow Chemical Company; Ethafoam 222.
3. Fabric Backing:
   a. Cut and sewn into strips wide enough to overlap shop-coated areas by 4 inches on either side.

b. Strips shall have slots for steel strapping on outer edges.

4. Joint Coating:

a. Joints of cement mortar overcoat dielectrically coated pipe do not require field application of cement mortar overcoat when properly coated with heat shrink sleeve or wax tape joint coating system.

2.5 FIELD APPLIED INTERIOR JOINT LINING

A. Mortar Lining:

1. After the backfill has been completed to final grade, the interior joint recess shall be filled with grout. The grout shall be tightly packed into the joint recess and trowelled flush with the interior surface. Excess shall be removed.
2. At no point shall there be an indentation or projection of the mortar exceeding 1/16-inch.
3. With pipe smaller than 24-inches in diameter, before the spigot is inserted into the bell, the bell shall be daubed with grout. The joint shall be completed and excess mortar on the inside of the joint shall be swabbed out.

2.6 REPAIR OF COATINGS AND LININGS

A. General

1. Coating or lining repair materials shall be compatible with the shop-applied coating or lining system and shall be approved by the coating or lining manufacturer.
2. Coating repair materials shall be as required for the coating system and repair classification as defined this section.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

A. General

1. Inspect and provide substrate surfaces prepared in accordance with these Specifications and the printed directions and recommendations of coating manufacturer whose product is to be applied.
2. Visible oil, grease, dirt, and contamination shall be removed in accordance with SSPC-SP1, solvent cleaning.
3. Surface imperfections such as metal slivers, burrs, weld splatter, gouges, or delaminati006Aons in the metal shall be removed by filing or grinding.
4. Protect prepared pipe from humidity, moisture, and rain. All flash rust, imperfections, or contamination on cleaned pipe surface shall be removed.

B. Steel Surface Preparation

1. Surface preparation of steel pipe shall be in accordance with SSPC surface preparation standards utilizing the degree of cleanliness specified for the coating system to be applied or as specified herein, whichever is more stringent.
2. Grit and/or shot abrasive mixture and gradation shall be as required to achieve the degree of cleanliness and coating adhesion specified.
3. Work shall be performed in a manner that does not permit the cleaned metal surface to rust back or flash rust.

4. Rust back or flash rust shall be fully removed with the steel surface cleanliness equal to the metal surface cleanliness prior to rust back or flash rusting. Determination of the equivalent surface cleanliness shall be at the Engineer's sole discretion.

3.2 SHOP -APPLIED COATING APPLICATION

A. Cement Mortar Coatings
1. Steel pipe shall have a cement mortar coating applied in accordance with AWWA C205, except as modified herein.
2. Tape wrap coated steel pipe shall have a cement mortar overcoat applied over the tape wrap or epoxy coating in accordance with AWWA C205, except as modified herein.
3. Cement Mortar Coating:
   a. Reinforcement:
      1) For pipe and specials smaller than 48 inches in diameter, reinforce coating with spirally-wound No. 12 gage steel wire spaced at 1-inch centers or with No. 14 gage steel wire at 1/2-inch centers positioned approximately in center of mortar coating.
      2) For pipe and specials 48 inches in diameter and larger, reinforce coating with 2 layers of spirally-wound No. 12 gage wire spaced at 1-inch centers or with No. 14 gage steel wire spaced at 1/2-inch centers positioned at the third points of mortar coating.
      3) Lap ends of reinforcement strips 4 inches and tie or loop free ends to assure continuity of reinforcement.
      4) All steel wire reinforcement placed in the mortar coating shall be electrically isolated from the pipe. Electrical isolation will be tested using high voltage spark test by the manufacturer prior to shipment to the project site. Provide certification that electrical isolation of reinforcement wire from steel pipe.
   b. Special Fittings:
      1) Coating for steel plate specials may be reinforced with 2-inch by 4-inch No. 12 gage welded wire mesh in lieu of reinforcing specified above.
      2) One layer of mesh shall be positioned approximately in center of coating for specials smaller than 48 inches in diameter; 2 layers of mesh shall be positioned at the third points of coating for specials 48 inches in diameter and larger.
   c. Coating Defects:
      1) Coating defects shall be repaired as specified in AWWA C205, except as specified this section.
4. Cement Mortar Overcoat:
   a. Cement mortar overcoat tape wrapped coated steel pipe as specified in AWWA C205, except mortar coating shall be applied over exterior pipe coating.
   b. Mortar coating shall be held back 3 inches, minimum, behind dielectric coating system cut back at joints.

c. Cement mortar overcoat holdback shall be increased with extruded polyethylene coating as required to for coating shrinkage and as required to maintain the minimum overlap specified for joint coating application.

d. Coating Defects:
   1) Cracking in the mortar "armor" coat less than 1/8-inch in width will be acceptable.
   2) Disbondment of the cement coating over a dielectric coating system should be anticipated and will not be grounds for repair or rejection of the pipe.
   3) Losses of cement mortar coating due to impact, movement, or shipping damage shall be repaired in accordance with C205.

e. Joint Coating:
   1) Joints of cement mortar overcoat dielectrically coated pipe do not require field application of cement mortar overcoat when properly coated with heat shrink sleeve joint coating system.

3.3 SHOP-APPLIED LINING APPLICATION

A. Shop-applied Cement Mortar Lining:

1. Place mortar lining used in steel piping and steel plate specials in pipe to thickness below.

Pipe Diameter, Inches	**Lining Thickness, Inches**	**Tolerances, Inches**
4 through 10	3/8	-1/16, +1/8
11 through 24	5/16	-1/16, +1/8
24 through 36	3/8	-1/16, +1/8
Greater than 36	1/2	-1/16, +3/16

2. Centrifugally line straight sections of pipe. Lining of special pieces or fittings shall be by mechanical, pneumatic, or hand placement. Provide cement mortar lining of uniform thickness. Finish to a smooth dense surface.
   a. Steel plate specials larger than 16 inches in diameter shall have lining reinforced with 2-inch by 4-inch No. 12-gage welded steel wire mesh.
   b. Brace and support pipe during lining application to minimize pipe distortion or vibration. Bracing and supports shall not damage the pipe, coating, or lining.
   c. Tightly close ends of pipe and fittings with plastic sheet caps. Plastic end caps shall be of sufficient thickness and strength to resist shipping, handling, and storage stresses.
   d. Damage to the cement mortar lining, including disbondment, cracking, or blistering, caused by improper curing, shipping, handling, or installation shall be repaired in accordance with AWWA specifications and to the satisfaction of the Engineer.
3. Other requirements of mortar lining materials and processes: As specified in AWWA C205.

3.4 FIELD COATING JOINTS

A. General:
   1. If joint bonds are required on project:
      a. Joint bonds shall be installed before application of joint coating as specified in Section 13 11 40, Corrosion Monitoring System.
      b. Joint bonds shall be low profile bonds and all gaps and crevices around the bonds shall be filled with filler mastic.
      c. Filler mastic shall be placed under copper strap bonds and extended ½ inch minimum beyond edges of bond to allow for sealing with heat shrink sleeve.
      d. Contractor to electrically test completed joint coating for holidays with high voltage spark tester at Engineer's direction or if damage to the joint coating occurs.

B. Cement Mortar Overcoat Coating:
   1. Joints of cement mortar coated pipe shall be cement mortar coated in accordance with AWWA C205.
   2. Polyethylene Foam Joint Diapers:
      a. Cut into strips wide enough to match uncoated field joint area.
      b. Slit to thickness of 1/4 inch that will expose a hollow or open cell surface on one side.
      c. Foam liner shall be attached to fabric backing with open or hollow cells facing towards pipe.
      d. Foam strip shall cover full interior circumference of grout band with sufficient length to permit 8-inch overlap of foam at or near top of joint.
      e. Splices to provide continuity of material will be permitted.
      f. Protect polyethylene foam material from direct sunlight.
   3. Field repair cement mortar coating in accordance with AWWA C205.

3.5 FIELD APPLIED INTERIOR JOINT LINING

A. Mortar Lining:
   1. After backfilling pipe, interior joint recess shall be filled with grout.
   2. The grout shall be tightly packed into the joint recess and troweled flush with the interior surface. Excess material shall be removed from pipe.
   3. At no point shall there be an indentation or projection of the mortar exceeding 1/16-inch.
   4. On pipe smaller than 24-inches in diameter, bell shall be daubed with grout before the spigot is inserted into the bell. The joint shall be completed and excess mortar on the inside of the joint shall be swabbed.

3.6 REPAIR OF COATING AND LININGS

A. Cement Mortar Coating
   1. Cement mortar coating that is cracked or disbonded shall be repaired in accordance with AWWA C205, except for mortar overcoat on tape wrapped steel.
   2. Disbonded mortar coating shall be removed and patched.

3. Mortar coating with disbondment greater than 25 percent of the pipe surface shall be rejected and recoated.
4. Cracks in mortar coating shall be repaired in accordance with AWWA C205.

3.7 QUALITY CONTROL TESTING AND INSPECTION

A. General
1. Applicator shall inspect and test the coating system in accordance with referenced standards and these specifications, whichever is more stringent.
2. Quality control testing as specified in AWWA standards are minimum industry standards and it is the intent of this specification to provide a higher level of quality control for the objective of achieving maximum coating performance. If any conflict between this specification and referenced standards occurs, the more stringent requirement shall apply and any interpretation of this requirement or results shall be with the objective of achieving maximum coating performance.
3. The frequency of the testing shall be determined by the applicator, but shall not be less than the requirements of this specification.

3.8 HANDLING, TRANSPORTATION, AND STORAGE

A. Pipe shall be handled in such a manner as to protect the existing pipe and coating from damage.

END OF SECTION

SECTION 31 10 00
SITE PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section includes all those measures required during the Contractor's initial move onto the site to protect existing fences, structures and associated improvements, streets, and utilities downslope of construction areas from damage due to boulders, trees or other objects dislodged during the construction process: clearing, grubbing and stripping; and regrading of areas to receive embankment fill.

B. The Contractor is required to protect and preserve all things designated to remain. Where Contractor's operation causes damage or injury to trees and plants designated to remain, an arborist or other qualified professional shall be employed by the Contractor, at no additional cost to the Owner, to repair the damage or provide adequate replacement to the Owner's satisfaction where damage is beyond repair.

1.2 SITE INSPECTION

A. Prior to moving onto the Project site, the Contractor shall inspect the site conditions and review maps of the existing plant site and off-site pipeline routes and facilities delineating the Owner's property and right-of-way lines.

B. Contractor shall submit photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site preparation.

C. The Contractor shall identify and accurately locate utilities and other subsurface structural, electrical, and mechanical conditions. Existing conditions shall be incorporated into the record drawings for the project.

1.3 DEFINITIONS

A. The following definitions apply to the Work of this Section:
1. Clearing is defined as cutting trees, removing fences and posts, removing curbs and other improvements to prepare the site for grubbing and stripping.
2. Grubbing is defined as the below grade part of clearing to remove roots, small piping, irrigation systems, etc., to prepare the site for stripping.
3. Stripping is defined as removing a surface layer of soil and organic material, sod, topsoil, and other unsuitable material as defined in Section 31 23 00 – Earthwork, to a depth that earthwork can proceed.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Provide erosion-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Locate and clearly flag trees and vegetation to remain or to be relocated.

D. Protect existing site improvements to remain from damage during construction.
   1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TREE PROTECTION

A. Erect and maintain a temporary fence around drip line of individual trees or around perimeter drip line of groups of trees to remain. Remove fence when construction is complete.
   1. Do not store construction materials, debris, or excavated material within drip line of remaining trees.
   2. Do not permit vehicles, equipment, or foot traffic within drip line of remaining trees.

B. Do not excavate within drip line of trees, unless otherwise indicated.

C. Where excavation for new construction is required within drip line of trees, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.
   1. Cover exposed roots with burlap and water regularly.
   2. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.
   3. Coat cut faces of roots more than 1-1/2 inches in diameter with an emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
   4. Cover exposed roots with wet burlap to prevent roots from drying out. Backfill with soil as soon as possible.

D. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Engineer.
   1. Employ a qualified arborist, licensed in jurisdiction where project is located, to submit details of proposed repairs and to repair damage to trees and shrubs.
   2. Replace trees that cannot be repaired and restored to full-growth status, as determined by the qualified arborist.

3.3 UTILITIES

A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.

1. Owner will arrange to shut off indicated utilities when requested by Contractor.
2. Arrange to shut off indicated utilities with utility companies.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
1. Notify Engineer not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Engineer's written permission.

C. Excavate for and remove underground utilities indicated to be removed.

3.4 PRIMARY PLANT SITE ACCESS

A. Develop any necessary access to the site, including barrier facilities to be installed at the beginning of construction in order to prohibit entry of unauthorized persons.

B. Utility Interference: Where existing utilities interfere with the Work of this Section, notify the Engineer and work around the interferences until a directive is issued.

3.5 CLEARING, GRUBBING, AND STRIPPING

A. All construction areas shall be cleared of grass and weeds to at least a depth of six inches and cleared of structures, concrete or masonry debris, trees, logs, upturned stumps, loose boulders, and any other objectionable material of any kind which would interfere with the performance or completion of the Work, create a hazard to safety, or impair the Work's subsequent usefulness or obstruct its operation. Loose boulders within 10 feet of the top of cut lines shall be incorporated in landscaping or removed from the site. Trees and other natural vegetation outside the actual lines of construction shall be protected from damage during construction, as directed by the Engineer.

B. Within the limits of clearing, the areas below the natural ground surface shall be grubbed to a depth necessary to remove all stumps, roots, buried logs, and all other objectionable material. Debris or waste shall be totally removed if they are found on the site. All objectionable material from the clearing and grubbing process shall be removed from the site and wasted in approved safe locations in compliance with state and federal regulations.

C. The area to be affected by construction that have not been pre-excavated to the subgrade elevation shall be removed and placed in the designated stockpile areas, and/or incorporated into landscaped areas or other nonstructural embankments.

D. For all areas that have not been previously disturbed, including staging areas and temporary construction easements, topsoil-salvaging operation shall immediately follow clearing operations. The area shall be stripped of topsoil to a depth of 8 inches. Unsuitable materials, specified in Section 31 23 00, shall not be considered topsoil. The Contractor shall strip to the depth indicated regardless of the material encountered. All stripped topsoil shall be stockpiled within stripped areas in stockpiles not to exceed 15 feet in height. Vegetation shall be ground or chipped to a mulching consistency and mixed with the stripped soil. Stockpiles shall be placed away from high construction traffic areas and shall be fenced and signed to prevent accidental use as fill prior to topsoil replacement.

E. Upon completion of Work within the construction areas stripped of topsoil, the stored topsoil shall be respread over the disturbed areas. Topsoil shall be spread in about a 6-inch layer. Respread topsoil shall match the existing terrain as much as possible. Interfaces between restored disturbed areas and undisturbed areas shall be chain dragged to eliminate obvious edges. All tracks and equipment marks shall be chain dragged or hand raked away. Replaced topsoil shall be thoroughly watered for dust control upon completion of the respreading operations. Once topsoil replacement has been completed, no vehicles or other motorized equipment shall be allowed to travel on the finished surface.

F. Unless otherwise indicated, native trees larger than three inches in diameter at the base shall not be removed without the Engineer's approval. The removal of any trees, shrubs, fences, or other improvements outside of rights-of-way, if not necessary for the Contractor's choice of means and methods, shall be arranged with the property owner and be removed and replaced at no increased cost to the Owner.

G. Except in areas to be excavated, holes and other holes resulting from Work of this section shall be backfilled with suitable material in accordance with Section 31 23 00 – Earthwork.

3.6 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
   1. Unless existing full-depth joints coincides with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.

3.7 DISPOSAL

A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION

SECTION 31 23 00
EARTHWORK

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall perform all earthwork indicated and required for construction of the Work, complete and in place, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

29 CFR 1926	OSHA Safety and Health Regulations for Construction
ASTM C150	Portland Cement
ASTM D 422	Method for Particle-Size Analysis of Soils
ASTM D 1556	Test Method for Density of Soil in Place by the Sand-Cone Method
ASTM D 1557	Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3) (2,700 kN-m/m^3)
ASTM D 1633	Test Method for Compressive Strength of Molded Soil-Cement Cylinders
ASTM D 2419	Test Method for Sand Equivalent Value of Soils and Fine Aggregate
ASTM D 2487	Classification of Soils for Engineering Purposes
ASTM D 2901	Test Method for Cement Content of Freshly Mixed Soil Cement
ASTM D 2922	Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods
ASTM D 4253	Test Methods for Maximum Index Density of Soils using a Vibratory Table
ASTM D4254	Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
ASTM D 4318	Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

ASTM D4832	Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders
ASTM D 5971	Practice for Sampling Freshly Mixed Controlled Low Strength Material (CLSM)
ASTM D 6023	Test Method for Unit Weight, Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low Strength Material (CLSM)
ASTM D 6024	Test Method for Ball Drop on Controlled Low Strength Material (CLSM) to Determine Suitability for Load Application
ASTM D 6103	Test Method for Flow Consistency of Controlled Low Strength Material (CLSM)

1.3 CONTRACTOR SUBMITTALS

A. The Contractor's attention is directed to the provisions of Subpart P, 29 CFR 1926 of the OSHA Safety and Health Standards for Construction, which relate to protection of employees in excavations. The Contractor shall submit, for information to the Engineer, the project excavation plan and the name of the Contractor's competent person, prior to commencing any excavation.

B. Submit samples of all materials proposed to be used in the work in accordance with the requirements in Section 01 33 20 – Submittal Procedures. Sample sizes shall be as determined by the testing laboratory.

C. Submit dewatering and water removal plan prior to performing any dewatering or water removal.

PART 2 - PRODUCTS

2.1 SUITABLE FILL AND BACKFILL MATERIAL REQUIREMENTS

A. General: Fill, backfill, and embankment materials shall be suitable material.

B. Suitable Materials: Suitable material is defined as selected or processed clean, well graded earth material, sands and gravels free of excessive fines, less than 20 percent rock and boulders larger than 4 inches, grass, roots, brush, vegetation, or other deleterious materials.

C. Fill and backfill materials within 6 inches of any structure or pipe shall be smaller than 1 inch in any dimension.

1. Suitable materials may be obtained from onsite excavations, may be processed onsite materials, or may be imported. If imported materials are required by this Section or to meet the quantity requirements of the Project, provide the imported materials at no additional expense to the Owner, unless a unit price item is included for imported materials in the bidding schedule. Onsite materials shall be stockpiled and segregated prior to use.

2. The following types of suitable materials are defined:

Type A (Granular Backfill): Crushed rock or gravel, and sand well graded and readily compacted, non-plastic, meeting the following gradation requirements:

Sieve Size	Percentage Passing
1-inch	100
No. 40	15 - 60
No. 200	0 - 15

Type B (Crushed Rock): Manufactured angular, crushed rock, non-plastic, meeting the following gradation requirements:

Sieve Size	Percentage Passing
3/8-inch	100
No. 4	30 - 50
No. 200	0 - 5

Type C (Sand Backfill): Sand non-plastic, meeting the following gradation requirements:

Sieve Size	Percentage Passing
3/4-inch	100
No. 4	80 - 100
No. 10	30-50
No. 40	10-30
No. 200	7 - 15

Squeegee is not acceptable as sand backfill.

Type D (Select Backfill): Suitable material that can be readily compacted and meets the requirements of AASHTO M 145 classification A-1-a, non-plastic, well graded with a maximum particle size of 2 inches.

Sieve Size	Percentage Passing
2-inch	100
No. 10	30-50
No. 40	15-30
No. 200	0 - 15

Type E (Pea Gravel Backfill): Crushed rock or gravel with 100 percent passing a 1/2-inch sieve and not more than 10 percent passing a No. 4 sieve.

Type F (Drainrock): Crushed rock or gravel conforming to one of the following gradation requirements, as shown on the Drawings or approved by the Engineer:

	Percentage Passing		
Sieve Size	3-inch Max.	2-inch Max.	3/4-inch Max.
3-inch	100		
2-inch	90 - 100	100	
1-1/2 inch	70 - 100	95 - 100	
3/4 inch	0 - 50	50 - 100	100

1/2-inch			95 - 100
3/8-inch	0 - 10	0 - 55	70 - 100
No. 4	0 - 25	0 - 70	
No. 8	0 - 5	0 - 15	
No. 200	0 - 3	0 - 3	0 - 3

Type G (Type II Aggregate Base): Well-graded, clean, hard, tough, durable, and sound mineral aggregates consisting of crushed stone, or crushed gravel, free of organic matter and contamination from chemical or petroleum products meeting State specification requirements. At the option of the Contractor, the grading for either the 1½ -inch maximum size or ¾-inch maximum size shall be used except as otherwise noted in the drawings. The material shall meet the following table and gradation requirements:

Aggregate Properties			
	Aggregate Class		
	A	**B**	
Dry Rodded Unit Weight	Not less than 75 lb/ft^3		AASHTO T 19
Liquid Limit/Plastic Index	Non-plastic	PI ≤ 6	AASHTO T 89 AASHTO 90
Aggregate Wear	Not to exceed 50 percent		AASHTO T 96
Gradation	Table 2		AASHTO T 11 AASHTO T 27
CBR with a 10 lb surcharge measured at 0.20 inch penetration	70% Minimum	N/A	AASHTO T 193
Two Fractured Faces	50% Min	N/A	AASHTO T 335

a. 1-1/2-inch Max.:

Sieve Size	Percentage Passing
1-1/2-inch	100
1-inch	90 - 100
3/4-inch	70 – 85
1/2-inch	65 – 80
3/8-inch	55 – 75
No. 4	40 – 65
No. 16	25 – 40
No. 200	7 – 11

b. 3/4-inch Max.:

Sieve Size	Percentage Passing
3/4-inch	100
3/8-inch	78 – 92
No. 4	55 – 67
No. 16	28 – 38
No. 200	7 – 11

Type H (Graded Drainrock): Graded drainrock shall be crushed rock or gravel, durable and free from slaking or decomposition under the action of alternate wetting and drying. The material shall be uniformly graded and shall meet the following gradation requirements:

Sieve Size	Percentage Passing
1-inch	100
3/4 inch	90 - 100
3/8-inch	40 - 100
No. 4	25 - 40
No. 8	18 - 33
No. 30	5 - 15
No. 50	0 - 7
No. 200	0 - 3

Type I: (Levee Material): Clayey sand to sandy clay obtained from off-site borrow sources or from onsite excavations, processed to the extent required to produce a material with a maximum size of 4 inches, well-graded from coarse to fine, and free from roots, sticks, organic matter, concrete, asphalt and other deleterious material. Levee material shall meet the following gradation requirements:

Sieve Size	Percentage Passing
4-inch	100
No. 4	50 - 70
No. 200	30 - 50

Type J (Cement-Treated Backfill): Material which consists of Type F material, or any mixture of Types B, C, G, and H materials which has been cement-treated so that the cement content of the material is not less than 5 percent by weight when tested in accordance with ASTM D 2901. The ultimate compressive strength at 28 days shall be not less than 400 psi when tested in accordance with ASTM D 1633.

Type K (Topsoil): Stockpiled topsoil material which has been obtained at the site by removing soil to a depth as defined in Section 02100 - Site Preparation. Removal of the topsoil shall be done after the area has been stripped of vegetation and debris.

Type M (Aggregate Subbase): Crushed rock aggregate subbase material non-plastic that can be compacted readily by watering and rolling to form a stable base. The sand equivalent value shall not be less than 18 and shall meet one of the following gradation requirements, as shown on the Drawings or approved by the Engineer:

	Percentage Passing	
Sieve Size	3-inch Max.	2-inch Max.
3-inch	100 -	
2-inch	90 - 100	100
1-1/2 inch	-	95 - 100
1-inch	70 - 90	-
No. 4	30 - 65	30 - 65
No. 16	15 - 40	15 - 40
No. 200	2 - 12	2 - 12

Type N (trench plug): Low permeable fill material, a nondispersable clay material having a minimum plasticity index of 10.

Type O (Controlled Low Strength Material (CLSM)): CLSM shall consist of a mixture of portland cement, aggregate, fly ash, water, and approved admixtures conforming to the following requirements:

3. Portland Cement: ASTM C150, Type V.
4. Aggregate: Clean imported sand and gravel or selected material from the excavation, imported material, or a combination thereof as approved by the Engineer. Maximum aggregate size shall be 1 to 3 inches. The soluble sulfate content of aggregate in the mixture shall not exceed 0.3 percent by dry weight.
5. Water: Potable quality.
6. Fly Ash: Class C, ASTM C 618 or approved alternate.
7. The minus 200 sieve fraction shall be nonplastic, as defined by ASTM D 4318. By this standard, a soil is considered nonplastic if either the liquid or plastic limit cannot be determined, or if the plastic limit is equal to or greater than the liquid limit.
8. Proportion the CLSM to be a flowable, nonsegregating, self-consolidating low shrink slurry. The Contractor shall determine the materials and proportions used to meet the requirements of these Specifications.
9. The unconfined compressive strength at 7 days shall be a minimum of 100 psi and a maximum of 300 psi. Contractor shall form a minimum of six test cylinders with proposed materials to confirm design strength and mix design. Four of the cylinders shall be broken at 7 days in conformance with applicable concrete cylinder specifications and results provided to Engineer. The remaining two cylinders shall be broken by Contractor at discretion of Engineer. Initial mix design and cylinder breaks shall be completed at least 21 days prior to use of the material on the jobsite. Final mix approval and use of the material shall not occur prior to confirmation of strength by the cylinder breaks.
10. The temperature of the CLSM discharged into the trench shall be below 90 degrees F.
11. CLSM backfill under concrete structures shall be protected during curing as specified Section 03300 - Cast-in-Place Concrete.
12. CLSM shall be tested in accordance with ASTM D 4832, ASTM D 5971, ASTM D 6023, and ASTM D6103

Type P: (Suitable Trench Backfill): Suitable material that can be readily compacted, with less than 35 percent passing the No. 200 sieve and a plasticity index of 10 or less. Where allowed for backfill (including the trench zone), Type P material shall have a maximum particle size of 6-inches.

2.2 UNSUITABLE MATERIAL

A. Unsuitable materials include but are not limited to the materials listed below.
   1. Soils which, when classified under ASTM D 2487 - Classification of Soils for Engineering Purposes, fall in the classifications of Pt, OH, CH, MH, or OL.
   2. Soils which cannot be compacted sufficiently to achieve the density indicated for the intended use.
   3. Materials that contain hazardous or designated waste materials including petroleum hydrocarbons, pesticides, heavy metals, slag, and any material which may be classified as hazardous or toxic according to applicable regulations.

4. Soils that contain greater concentrations of chloride or sulfate ions, or have a soil resistivity or pH less than the existing onsite soils.
5. Topsoil, except as allowed below.

B. All unsuitable excavated material shall be disposed off site.

2.3 USE OF FILL, BACKFILL, AND EMBANKMENT MATERIAL TYPES

A. Use the types of materials as designated herein for all required fill, backfill, and embankment construction hereunder.

B. Where these Specifications conflict with the requirements of any local agency having jurisdiction or with the requirements of a pipe material manufacturer, notify the Engineer immediately. In case of conflict between types of pipe embedment backfills, use the agency-specified backfill material if that material provides a greater degree of support to the pipe, as determined by the Engineer. In case of conflict between types of trench or final backfill types, use the agency-specified backfill material if that material provides the greater in-place density after compaction.

C. Fill and backfill types shall be used in accordance with the following provisions:
1. Embankment fills shall be constructed of Type P material, as defined herein, or any mixture of Type P and Type A through Type D materials.
2. Pipe zone backfill, as defined under "Pipe and Utility Trench Backfill" below, shall consist of the following materials for each pipe material listed below.
    a. Welded steel pipe larger than 36-inch diameter shall be backfilled to the springline with Type O (CLM) Material. Type C Material shall be used from the springline to the top of the pipe zone, unless noted otherwise.
    b. All other pipe materials shall be backfilled with Type C Material in the pipe zone.
    c. Trench plugs of Type N or Type O material shall be installed at locations shown on the drawings.
    d. Where pipelines are installed on grades exceeding 4 percent, and where backfill materials are graded such that there is less than 10 percent passing a No. 4 sieve, trench plugs of Type J or N material shall be provided at maximum intervals of 200 feet unless indicated otherwise.
    e. Type O material shall be used in the pipe zone where shown on plans, specified, or required by the Engineer for special crossings or other locations, or where otherwise approved.
    f. Type E material will not be allowed for backfill within the pipe zone.
3. Trench zone backfill for pipelines as defined under "Pipe and Utility Trench Backfill" shall be Type D backfill material.
4. Final backfill material for pipelines under paved areas, as defined under "Pipe and Utility Trench Backfill" shall be Type G backfill material. Final backfill under areas not paved shall be the same material as that used for trench backfill.
5. Aggregate base materials under pavements shall be Type G material constructed to the thicknesses indicated. Aggregate subbase shall be Type M material.
6. Backfill around structures shall be Type P material, or Types A through Type F materials, or any mixture thereof, except as shown.
7. Backfill materials beneath structures shall be as follows:

a. Drainrock materials under hydraulic structures or other water retaining structures with underdrain systems shall be Type F material.
b. Under concrete hydraulic structures or other water retaining structures without underdrain systems, Types F, G or H materials shall be used.
c. Under structures where groundwater must be removed to allow placement of concrete, Type F material shall be used. Before the Type F material is placed, filter type geotextile fabric shall be placed over the exposed foundation.
d. Under all other structures, Type F, G or H material shall be used.

8. Backfill used to replace pipeline trench overexcavation shall be a layer of Type F material with a 6-inch top filter layer of Type E material or filter fabric to prevent migration of fines for wet trench conditions or the same material as used for the pipe zone backfill if the trench conditions are not wet.

2.4 MATERIALS TESTING

A. All soils testing of samples submitted by the Contractor will be done by a testing laboratory of the Owner's choice and at the Owner's expense. At its discretion, the Engineer may request that the Contractor supply samples for testing of any material used in the work.

B. Particle size analysis of soils and aggregates will be performed using ASTM D 422 - Method for Particle-Size Analysis of Soils.

C. Determination of sand equivalent value will be performed using ASTM D 2419 - Test Method for Sand Equivalent Value of Soils and Fine Aggregate.

D. Unified Soil Classification System: References in this Section to soil classification types and standards shall have the meanings and definitions indicated in ASTM D 2487. The Contractor shall be bound by all applicable provisions of said ASTM D 2487 in the interpretation of soil classifications.

E. The testing for chloride, sulfate, resistivity, and pH will be done by a testing laboratory of the Owner's choice and at the Owner's expense.

PART 3 - EXECUTION

3.1 EXCAVATION – GENERAL

A. General: Except when specifically provided to the contrary, excavation shall include the removal of all materials of whatever nature encountered, including rock and all obstructions of any nature that would interfere with the proper execution and completion of the Work. The removal of said materials shall conform to the lines and grades indicated or ordered. Unless otherwise indicated, the entire construction site shall be stripped of all vegetation and debris, and such material shall be removed from the site prior to performing any excavation or placing any fill. Furnish, place, and maintain all supports and shoring that may be required for the sides of the excavations. Excavations shall be sloped or otherwise supported in a safe manner in accordance with safety requirements of the requirements of OSHA Safety and Health Standards for Construction (29CFR1926).

B. Maximum Length of Open Trench: The maximum length of open trench in urban and rural areas shall not exceed 500-feet at each pipe installation heading beyond the end of the installed pipeline, or the requirements of the agency with jurisdiction, whichever is lesser.

C. Construction Delays: In the case of any construction delay in excess of five calendar days, whether Contractor or Owner caused, the Contractor shall backfill the excavation, install temporary paving including temporary traffic markings, and restore traffic to pre-construction condition to minimize disruption to traffic and the community at no additional cost to the Owner.

D. Removal and Exclusion of Water: Remove and exclude water, including storm water, groundwater, irrigation water, and wastewater, from all excavations. Dewatering wells, well points, sump pumps, or other means shall be used to remove water and continuously maintain groundwater at a level at least 2 feet below the bottom of excavations before the excavation work begins at each location. Water shall be removed and excluded until backfilling is complete and all field soils testing has been completed.

3.2 STRUCTURE, ROADWAY, AND EMBANKMENT EXCAVATION

A. Excavation Beneath Structures and Embankments: Except where otherwise indicated for a particular structure or ordered by the Engineer, excavation shall be carried to the grade of the bottom of the footing or slab. Where indicated or ordered, areas beneath structures or fills shall be overexcavated. The subgrade areas beneath embankments shall be excavated to remove not less than the top 6 inches of native material and where such subgrade is sloped, the native material shall be benched. When such overexcavation is indicated, both overexcavation and subsequent backfill to the required grade shall be performed. When such overexcavation is not indicated but is ordered by the Engineer, such overexcavation and any resulting backfill will be paid for under a separate unit price bid item if such bid item has been established; otherwise payment will be made in accordance with a negotiated price. After the required excavation or overexcavation has been completed, the exposed surface shall be scarified to a depth of 6 inches, brought to optimum moisture content, and rolled with heavy compaction equipment to obtain 95 percent of maximum density.

B. Excavation Beneath Paved Areas: Excavation under areas to be paved shall extend to the bottom of the aggregate base or subbase, if such base is called for; otherwise it shall extend to the bottom of the paving thickness. After the required excavation has been completed, the top 12 inches of exposed surface shall be scarified, brought to optimum moisture content, and rolled with heavy compaction equipment to obtain 95 percent of maximum density. The finished subgrade shall be even, self-draining, and in conformance with the slope of the finished pavement. Areas that could accumulate standing water shall be regraded to provide a self-draining subgrade.

C. Notification of Engineer: Notify the Engineer at least 3 days in advance of completion of any structure excavation and allow the Engineer a review period of at least 1 day before the exposed foundation is scarified and compacted or is covered with backfill or with any construction materials.

3.3 PIPELINE AND UTILITY TRENCH EXCAVATION

A. General: Unless otherwise indicated or ordered, excavation for pipelines and utilities shall be open-cut trenches with widths as indicated.

B. Trench Bottom: Except when pipe bedding is required, the bottom of the trench shall be excavated uniformly to the grade of the bottom of the pipe zone. Excavations for pipe bells and welding shall be made as required.

C. Open Trench: The maximum amount of open trench permitted in any one location shall be 500 feet, or the length necessary to accommodate the amount of pipe installed in a single day, whichever is greater. All trenches shall be fully backfilled at the end of each day or, in lieu thereof, shall be protected in accordance with Section 01 71 50 – Protection of Existing Facilities. The Contractor shall provide temporary 6-foot chain link fencing panels for protection of all open excavations and trenches within public streets, residential areas, and all other locations with the exception of unimproved open areas where excavations and/or pipeline trenches that can be safely sloped in accordance with current OSHA standards to provide safe access without the use of shoring devices. Temporary fencing panels shall fully enclose open excavations and trenches, and shall remain in place during all non-working hours.

D. Trench Overexcavation: Where trenches are indicated to be overexcavated, excavation shall be to the depth indicated, and backfill shall be installed to the grade of the bottom of the pipe bedding.

E. Overexcavation: When ordered by the Engineer, whether indicated on the Drawings or not, trenches shall be overexcavated beyond the depth and/or width shown. Such overexcavation shall be to the dimensions ordered. The trench shall then be backfilled to the grade of the bottom of the pipe bedding. Overexcavation less than 6 inches below the limits on the Drawings shall be done at no increase in cost to the Owner. When the overexcavation ordered by the Engineer is 6 inches or greater below the limits shown, or wider, additional payment will be made. Said additional payment will be made under separate unit price bid items for overexcavation if such bid items have been established; otherwise payment will be made in accordance with a negotiated price.

F. Where pipelines are to be installed in embankments, fills, or structure backfills, the fill shall be constructed to a level at least one foot above the top of the pipe before the trench is excavated.

G. If a moveable trench shield is used during excavation operations, the trench width shall be wider than the shield so that the shield is free to be lifted and then moved horizontally without binding against the trench sidewalls. If the trench walls cave in or slough, the trench shall be excavated as an open excavation with sloped sidewalls or with trench shoring, as indicated and as required by the pipe structural design.

3.4 OVEREXCAVATION NOT ORDERED OR INDICATED

A. Any overexcavation carried below the grade ordered or indicated, shall be backfilled to the required grade with the indicated material and compaction. Such work shall be performed at no additional cost to the Owner.

3.5 EXCAVATION IN LAWN AREAS

A. Where excavation occurs in lawn areas, the sod shall be carefully removed, dampened, and stockpiled to preserve it for replacement. Excavated material may be placed on the lawn; provided, that a drop cloth or other suitable method is employed to protect the lawn from damage. The lawn shall not remain covered for more than 72 hours. Immediately after completion of backfilling and testing of the pipeline, the sod shall be replaced and lightly rolled in a manner so as to restore the lawn as near as possible to its original condition. Provide new sod if stockpiled sod has not been replaced within 72 hours.

3.6 EXCAVATION IN VICINITY OF TREES

A. Except where trees are indicated to be removed, trees shall be protected from injury during construction operations. No tree roots over 2 inches in diameter shall be cut without express permission of the Engineer. Trees shall be supported during excavation by any means previously reviewed by the Engineer.

3.7 BACKFILL – GENERAL

A. Backfill shall not be dropped directly upon any structure or pipe. Backfill shall not be placed around or upon any structure until the concrete has attained sufficient strength to withstand the loads imposed. Backfill around water retaining structures shall not be placed until the structures have been tested, and the structures shall be full of water while backfill is being placed. Structures shall not be constructed on CLSM backfill until the CLSM has obtained a 7-day minimum cure.

B. Except for drainrock materials being placed in overexcavated areas or trenches, backfill shall be placed after all water is removed from the excavation, and the trench sidewalls and bottom have been dried to a moisture content suitable for compaction.

C. If a moveable trench shield is used during excavation, pipe installation, and backfill operations, the shield shall be moved by lifting the shield free of the trench bottom or backfill and then moving the shield horizontally. Do not drag trench shields along the trench causing damage or displacement to the trench sidewalls, the pipe, or the bedding and backfill.

D. Immediately prior to placement of backfill materials, the bottoms and sidewalls of trenches and structure excavations shall have all loose sloughing, or caving soil and rock materials removed. All materials disturbed from their intact condition that are 4 inches or larger in least dimension or aggregates of soil material thicker than 4 inches shall be removed from the excavation walls and base prior to placing pipe or any backfill material. Trench sidewalls shall consist of excavated surfaces that are in a relatively undisturbed condition before placement of backfill materials.

3.8 PLACING AND SPREADING OF BACKFILL MATERIALS

A. Backfill materials shall be placed and spread evenly in layers. When compaction is achieved using mechanical equipment, the layers shall be evenly spread so that the depth of each uncompacted layer shall not exceed 8 inches of compacted thickness.

B. During spreading, each layer shall be thoroughly mixed as necessary to promote uniformity of material in each layer. Pipe zone backfill materials shall be manually spread around the pipe so that when compacted the pipe zone backfill will provide uniform bearing and side support.

C. Where the backfill material moisture content is below the optimum moisture content, water shall be added before or during spreading until the proper moisture content is achieved.

D. Where the backfill material moisture content is too high to permit the indicated degree of compaction the material shall be dried or mixed with drier material until the moisture content is satisfactory.

3.9 COMPACTION OF EARTH FILL, BACKFILL, AND EMBANKMENT MATERIALS

A. Each layer of Types A, B, C, G, H, I, and K backfill materials as defined herein, where the material is graded such that at least 10 percent passes a No. 4 sieve, shall be mechanically compacted to the indicated percentage of density. Equipment that is consistently capable of achieving the required degree of compaction shall be used and each layer shall be compacted over its entire area while the material is at the required moisture content.

B. Each layer of Type E and J backfill materials shall be compacted by means of at least 2 passes from a flat plate vibratory compactor. When such materials are used for pipe zone backfill, vibratory compaction shall be used at the top of the pipe zone or at vertical intervals of 24 inches, whichever is the least distance from the subgrade.

C. Fill on reservoir and structure roofs shall be deposited at least 30 days after the concrete roof slab has been placed. Equipment weighing more than 10,000 pounds when loaded shall not be used on a roof. A roller weighing not more than 8,000 pounds shall be used to compact fill on a roof.

D. Pipe zone backfill materials that are granular, shall be compacted by using vibratory compactors.

E. Equipment weighing more than 10,000 pounds shall not be used closer to structure walls than a horizontal distance equal to the depth of the fill at that time. Hand operated power compaction equipment shall be used where use of heavier equipment is impractical or restricted due to weight limitations.

F. Backfill around and over pipelines that is mechanically compacted shall be compacted using light, hand operated, vibratory compactors and rollers. After completion of at least 2 feet of compacted backfill over the top of pipeline, compaction equipment weighing no more than 8,000 pounds may be used to complete the trench backfill.

G. Compaction Requirements: The following compaction test requirements shall be in accordance with ASTM D 1557, method C. Compaction shall be obtained with the moisture content within plus or minus 2 percent of the optimum moisture content. Where agency or utility company requirements govern, the highest compaction standards shall apply.

Location or Use of Fill	Percentage of Maximum Density

Pipe embedment backfill for flexible pipe	90
Pipe bedding and overexcavated zones under bedding for flexible pipe, including trench plugs	90
Pipe embedment backfill for steel yard piping	---
Pipe embedment backfill for rigid pipe	90
Pipe zone backfill portion above embedment for rigid pipe	90
Pipe bedding and overexcavated zones under bedding for rigid pipe	90
Final backfill, beneath paved areas or structures	95
Final backfill, not beneath paved areas or structures	85
Trench zone backfill, beneath paved areas and structures, including trench plugs	95
Trench zone backfill, not beneath paved areas or structures, including trench plugs	90
Embankments and fills	90

Embankments and fills beneath paved areas or structures	95
Backfill beneath structures and hydraulic structures	95
Backfill and fill around structures on reservoir or structure roof	90
Topsoil (Type K material)	80
Aggregate base or subbase (Type G or M material)	95

H.

3.10 PLACEMENT OF CLSM

A. Following placement and anchoring of the pipe, remove all loose soil from trench walls and floor. Remove any unstable soil at the top of the trench, which might fall into the trench during placement of the CLSM.

B. Prior to placement of CLSM, the pipeline steel temperature shall be controlled as specified in Section 33 11 11 - Steel Pipe.

C. Deliver the CLSM to the trench in ready mix trucks and utilize pump or chutes to place the CLSM in the trench. Direct CLSM to one side of the pipe, taking care not to displace the pipe at any time. Continue placing CLSM on one side of the pipe until CLSM has gone under the pipe and up the other side to a depth of 1.5 feet above the pipe bottom. Use at least two hand-held vibrators to continuously liquefy and move CLSM into all voids. Adjust water in mixture to maintain fluid consistency but maintain strength requirements. Continue placing CLSM on both sides of the pipe continuously using two vibrators for every 30 feet of pipe run.

D. Maintain stability of pipe throughout CLSM placement. CLSM will likely require placement in lifts to prevent pipe flotation. No movement of the pipe caused by flotation will be allowed. If any movement occurs, the CLSM material shall be removed and the pipe placed back on line and grade. Any damage to the pipeline system caused by movement of the pipe shall be removed and/or repaired in full conformance with these Contract Documents at no additional cost to the Owner. Remove all sloughed material or other debris from top of previously placed CLSM.

3.11 PIPE AND UTILITY TRENCH BACKFILL

A. Pipe Zone

1. The pipe zone is defined as that portion of the vertical trench cross-section lying between a plane 6 inches below the bottom surface of the pipe and a plane at a point 12 inches above the top surface of the pipe. The bedding is defined as that portion of pipe zone backfill material between the bottom of the trench and the bottom of the pipe. The embedment is defined as that portion of the pipe zone material between the bedding and a plane at a point 6 inches above the top surface of the pipe.
2. After compacting the bedding, perform a final trim using a string line for establishing grade, such that each pipe section when first laid will be continually in contact with the bedding along the extreme bottom of the pipe. Excavation for pipe bells and welding shall be made as required.
3. The pipe zone shall be backfilled with the indicated backfill material. Exercise care to prevent damage to the pipeline coating, cathodic bonds, and the pipe itself during the installation and backfill operations.
4. If a moveable trench shield is used during backfill operations the shield shall be lifted to a location above each layer of backfill material prior to compaction of the layer. Do not displace the pipe or backfill while the shield is being moved.

B. Trench Zone: After the pipe zone backfills have been placed, backfilling of the trench zone may proceed. The trench zone is defined as that portion of the vertical trench cross-section lying between a plane 12 inches above the top surface of the pipe and a plane at a point 18 inches below the finished surface grade, or if the trench is under pavement, 18 inches below the roadway subgrade.

C. Final Backfill: Final backfill is all backfill in the trench cross-sectional area within 18 inches of finished grade, or if the trench is under pavement, all backfill within 18 inches of the roadway subgrade.

3.12 FILL AND EMBANKMENT CONSTRUCTION

A. The area where a fill or embankment is to be constructed shall be cleared of all vegetation, roots and foreign material. Following this, the surface shall be scarified to a depth of 6 inches, moisture conditioned, and rolled or otherwise mechanically compacted. Embankment and fill material shall be placed and spread evenly in approximately horizontal layers. Each layer shall be moistened or aerated, as necessary. Unless otherwise approved by the Engineer, the depth of each uncompacted layer shall not exceed 8 inches of compacted thickness. The embankment, fill, and the scarified layer of underlying ground shall be compacted to 95 percent of maximum density under structures and paved areas, and 90 percent of maximum density elsewhere.

B. When an embankment or fill is to be made and compacted against hillsides or fill slopes steeper than 5H:1V, the slopes of hillsides or fills shall be horizontally benched to key the embankment or fill to the underlying ground. A minimum of 12 inches normal to the slope of the hillside or fill shall be removed and recompacted as the embankment or fill is brought up in layers. Material thus cut shall be recompacted along with the new material at no additional cost to the Owner. Hillside or fill slopes 5H:1V or flatter shall be prepared in accordance with Paragraph A, above.

C. Where embankment or structure fills are constructed over pipelines, the first 4 feet of fill over the pipe shall be constructed using light placement and compaction equipment that does not damage the pipe.

D. The finish graded surface of the drainrock immediately beneath hydraulic structures shall be stabilized to provide a firm, smooth surface upon which to construct reinforced concrete floor slabs. Where needed to protect slopes and prevent movement of the drainrock, spray asphalt on the finished drainrock surface.

3.13 FIELD TESTING

A. General: All field soils testing will be done by a testing laboratory of the Owner's choice at the Owner's expense except as indicated below.

B. Where soil material is required to be compacted to a percentage of maximum density, the maximum density at optimum moisture content will be determined in accordance with Method C of ASTM D 1557. Field density in-place tests will be performed in accordance with ASTM D 1556 or by such other means acceptable to the Engineer.

C. In case the test of the fill or backfill show noncompliance with the required density, perform remedies as may be required to ensure compliance. Subsequent testing to show compliance shall be by a testing laboratory selected by the Owner, paid by the Contractor, at no additional cost to the Owner.

D. Provide test trenches and excavations including excavation, trench support, and groundwater removal for the Owner's field soils testing operations. The trenches and excavations shall be provided at the locations and to the depths required by the Owner. All Work for test trenches and excavations shall be provided at no additional cost to the Owner.

E. Frequency of Testing
   1. Backfill around structures and in embankments shall be tested every 300 square ft of each lift of placement.
   2. CLSM shall be tested each batch being placed or every 300 cubic yards that is placed.
   3. Pipe backfill shall have one test every 80 feet (2 joints) of backfill placed.

END OF SECTION