



Bartow County Water Department
50 Nelson Street : P.O. Box 850
Cartersville, GA 30120-0850
Phone: (770) 387-5170 Fax: (770) 387-5173
E-Mail Address: bcwd@bartowga.org

BARTOW COUNTY WATER & SEWER SYSTEM **STANDARD SPECIFICATIONS FOR WATER & SEWER CONSTRUCTION**

SECTION 01015 – BASIC REQUIREMENTS

- 1.1 Scope: This Section describes certain administrative and procedural requirements applicable to the Work.
- 1.2 Project Progress Meetings: Project Progress Meetings shall be held monthly prior to the submittal of an Application-for-Payment to enable Engineer's review of the status of the Work. The Contractor's Superintendent shall attend the site meeting and assist the Engineer's observation and measurement. The date and time of the meeting shall be as scheduled by the Contractor and approved by the Engineer. The holding of Project Progress Meetings shall not relieve the Contractor from cooperating should the Owner or regulatory/funding agencies desire additional meetings or visits.
- 1.3 Construction Schedules: Submit proposed Construction Schedule revision to the Engineer at least two (2) days prior to each monthly Project Progress Meeting. Submit an updated Construction Schedule monthly with each Application-for-Payment.
- 1.4 Field Engineering or Surveying:
 - A. Provide and submit payment for field engineering or surveying services as required for construction stake-out of the Work. Establish and certify as-constructed elevations, lines, levels and locations of the Work.
 - B. Replace any Owner-provided reference points that are destroyed by the Contractor's construction operations. Replacement shall be performed by a Registered Land Surveyor, approved by the Owner, and will be conducted at no cost to the Owner.
- 1.5 Reference Standards:
 - A. Comply with specified Reference Standards as minimum quality for the Work except when more stringent tolerances, codes or specified requirements indicate higher standards or more precise workmanship. Conform to Reference Standards by date of issue current as of the date for receiving Bids.
 - B. Should any specified Reference Standard conflict with Contract Documents, request clarification from Engineer before proceeding.
- 1.6 Job Site Safety and Security: Provide all construction aids and equipment required for job safety, for protection of the public, to facilitate execution of the Work and to facilitate access by the Owner, Engineer and regulatory personnel. Provide fences, barriers, lights, signs, ladders, sheeting, shoring, railings, hoists, and other such facilities and equipment. Maintain all facilities and equipment in "like-new" condition. Provide watchmen and other precautionary measures as appropriate.
- 1.7 Quality Assurance/Control of Installation: Monitor and maintain quality control over suppliers, manufacturers, products, services, site conditions and workmanship to produce Work of specified quality. Comply fully with equipment manufacturers' instructions for storage, assembly, installation and start-up.
- 1.8 Transportation and Handling:
 - A. Arrange deliveries of materials and products in accordance with construction schedules and in ample time to facilitate inspection prior to installation.

- B. Coordinate deliveries to avoid conflict with the Work; with the work of other Contractors or Owner; with limitations of storage space; and/or Owner's use of premises.
 - C. Deliver materials and products in undamaged condition in original containers or packaging with identifying labels intact and legible.
 - D. Provide equipment and personnel necessary and handle materials and products by methods to prevent soiling or damage. Provide additional protection during handling and storage as necessary to prevent scraping, marring or otherwise damaging. Handle products by methods to prevent bending or over-stressing. Lift heavy components only at designated lifting points.
- 1.9 Owner Occupancy: The Owner reserves the right to occupy and utilize partially completed parts of the Work prior to Substantial Completion, provided that such occupancy does not interfere with Substantial Completion of the Work. Such partial occupancy shall not constitute acceptance of the Work or any part of the Work.
- 1.10 Salvaged Materials and Equipment: All materials and equipment not reused in the Work, and which in the opinion of the Owner are of salvage quality, and any items specified to be removed, shall remain the property of the Owner and shall be neatly stored on site as directed by the Owner.
- 1.11 Record Drawings: Keep *accurate* up-to-date as-built drawings as the Work progresses. These drawings shall reflect *all* deviations from the original Contract Document. Upon completion of the Work, the Contractor shall deliver all "as-built" drawings with corrections and notations to the Engineer for approval prior to final payment.

SECTION 01030 – SPECIAL PROJECT PROCEDURES

- 1.1 Scope: This Section describes special procedures and conditions applicable to the Work.
- 1.2 Materials and Equipment Supplied by the OWNER:
- A. **ONLY the following equipment and materials will be furnished by the OWNER:**
 - 1. Reasonable quantities of water for filling, testing, disinfection and pipeline flushing.
 - 2. Bacteriological sampling and testing.
 - B. **All other materials and supplies shall be furnished by the CONTRACTOR.**
- 1.3 Lands and Premises:
- A. The Work is primarily conducted on public rights-of-way. Owner shall provide certain easements if indicated on the Drawings.
 - B. Owner may designate a reasonable portion of public land(s), ONLY if such lands are available, for Contractor's exclusive use for temporary construction facilities; access and egress; and material storage. Contractor shall confine its apparatus and storage to such designated areas.
 - C. Contractor shall inspect all easements and rights-of-way prior to start of Work to ensure that Owner has obtained all land and rights-of-way necessary for completion of the Work. Comply with all stipulations contained within easements acquired by the Owner. Easements and rights-of-way documents shall be made available by the Owner for inspection. The Contractor shall not be entitled to damages for the failure of the Owner to obtain rights-of-way.
 - D. Restrict all operations to Owner's property and easements, or public rights-of-way, designated for the Work unless specific, written authorization has been obtained from property owner(s) for use of private lands and a copy of said authorization has been submitted to the Engineer and approved by the Owner.
- 1.4 Permits and Regulations:

- A. The Owner will file applications with Georgia Department of Transportation (D.O.T.) and obtain D.O.T. Utility Encroachment Permits. Contactor shall provide advance notice to the Georgia D.O.T. Utilities Engineer prior to excavating bore pits; jacking; boring or tunneling pipe; excavating within rights-of-way; making tie-ins or cross connections; or storing any material on rights-of-way. Owner shall obtain and pay for extra insurance and Bonds (if any) required by the D.O.T. Utility Encroachment Permits. Delays, if any, in obtaining Owner-furnished permits will *not* be cause for extra compensation; however, such delays shall be cause for an extension of the Contract Time for a period equivalent to the delay. Contractor shall obtain all blasting permits, if required. Contractor's Work shall conform to all requirements of the permits.
- B. Owner will obtain approvals and permits for construction of water and sewer utilities that may be required from Georgia Environmental Protection Division (E.P.D.)
- C. Contractor shall comply with all applicable local, state and Federal regulatory rules, regulations and permit requirements.
- D. Contractor shall comply with all of the requirements of Public Law 91-956 enacted by Congress, December 29, 1970, cited as the "Occupational Safety and Health Act of 1970" and all amendments thereto, commonly referred to as O.S.H.A., and it shall be the responsibility of the Contractor to fully enforce and comply with all of the provisions of the Act. Comply with O.S.H.A. requirements for maintaining a competent person at the job site at all times who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees; and who is knowledgeable about O.S.H.A. standards; and has authorization to take prompt corrective measures to abate hazards. A competent person at excavation, trenching or shoring sites must also be one having training in, and be knowledgeable about, soils analysis and the use of protective systems and shall have completed trench safety training in a course approved by the O.S.H.A. Training Institute.

1.5 Coordination: Coordinate all Work with that of other Contractors; public and private utility companies; and Owner's forces.

1.6 Protection of Existing Facilities:

- A. The Work will require Contractor operations on, or in the vicinity of, existing public or private utility systems. Take extreme care to avoid contamination or unnecessary interruption of service to the public. Should contamination or unplanned interruption occur, devote full efforts, in coordination with Owner's personnel, to correct the problem without delay. Provide at least 24-hour advance notice to the utility system operator for any planned interruptions of service. Contractor shall have a responsible representative on call at all times and shall maintain a crew with necessary tools and equipment available on call after normal working hours, on weekends, during inclement weather and other times when Work is not in progress, to perform any necessary emergency repair work which may occur as a result of the Work under this Contract. Negligence on the part of the Contractor, in the opinion of the Owner, to satisfy such situations shall be just cause for the Owner to take whatever action necessary to remedy the situation and to deduct the cost from monies due the Contractor.
- B. Locate and protect existing underground and overhead utility pipes, poles, lines, services, structures, etc. from damage or interruption to service by the conduct of construction operations. Furnish and have available at all times an electronic pipe detector in working order and use said detector to survey the proposed path of excavation. The approximate position of known utilities is detailed on the Contract Drawings for the Contractor's information. The utilities shown on the Contract Drawings were located by an above-ground investigation and may not be accurate or complete. Location and protection of all underground and overhead utilities and structures in the construction area is the responsibility of the Contractor.
- C. Perform operations with special care in the vicinity of existing facilities and utilities. Protect above-ground or below-ground utilities which are to remain. If any damage is done to these facilities, repair immediately at no cost to the Owner. Pay all fines, penalties and costs resulting from damage to existing utilities and other facilities.

1.7 Site Conditions:

- A. Maintain access to existing facilities and private property at all times.

- B. Protect carefully all existing benchmarks, monuments and other such reference points. Replacement, if required, shall be performed by a Registered Land Surveyor at no cost to the Owner.
 - C. Comply with all erosion and sediment control measures specified elsewhere or required by law.
 - D. Conduct all Work required on public rights-of-way in strict conformance with rules and regulations of governing bodies having jurisdiction over the Work.
 - E. Provide traffic protection by means of suitable signs, barricades and lights.
 - F. If articles of historic or archaeological value, including coins, fossils and articles of antiquity are uncovered by the Work, or otherwise brought to the attention of the Contractor during the course of the Contract, the Engineer and Owner shall be notified immediately and all construction activities in the vicinity shall be stopped. All articles of historical or archaeological value shall remain the property of the Owner.
 - G. Do not conduct blasting operations for rock removal for pipe that is within six (6) feet of edge of any public roadway pavement.
 - H. Maintain a 10-foot minimum horizontal clearance between new water mains and existing metal (steel) gas mains. At crossings, maintain a 5-foot minimum vertical clearance between water mains and gas mains.
- 1.8 Construction Aids: Provide construction aids and equipment required for Work site safety including barriers; lights; signs; ladders; sheeting; shoring; railings; hoists; and other such facilities and equipment. Maintain all facilities and equipment in first-class “like-new” condition.
- 1.9 Salvaged Materials and Equipment: All materials and equipment not reused in the Work which is of salvage quality including pipes, fittings and all equipment specified to be removed shall remain the property of the Owner and shall be neatly stored as directed by the Owner.
- 1.10 Transportation and Handling:
- A. Coordinate deliveries of Owner-supplied materials to avoid conflict with the Work.
 - B. Provide equipment and personnel necessary and handle materials and products by methods to prevent soiling or damage. Provide additional protection during handing and storage as necessary to prevent scraping, marring or otherwise damaging. Handle products by methods to prevent bending or over-stressing. Lift heavy components only at designated lifting points.

SECTION 01050 – GRADES, LINES AND LEVELS

- 1.1 General:
- A. Provide and pay for field engineering services required for the Project, including construction stake-out.
 - B. Any reference points provided by the Owner that are destroyed by the Contractor’s operations shall be replaced by the Contractor. Replacement shall be by a Registered Surveyor approved by the Owner and shall be at no cost to the Owner.
- 1.2 Alignment and Grades:
- A. All pipelines and sewers shall be installed to the alignment and grade shown on the Drawings unless otherwise directed by the Engineer. A uniform grade shall be maintained as shown on the Drawings. Random changes in grade which create high or low points will not be acceptable.
 - B. All Work shall be subject to checking by the Owner or his representative. The Contractor shall cooperate in such checking by providing access to stored materials, the construction area and project records.

SECTION 01150 – MEASUREMENT AND PAYMENT

- 1.1 Scope: This Section describes the procedures for preparing and processing Applications-for-Payment. The provisions apply to all Work unless specific instructions are provided within additional Sections of the Specifications.
- 1.2 Submittal Procedures:
- A. Submit Applications-for-Payment on forms approved in advance by the Engineer. Submit to the Engineer's office only; applications cannot be accepted by field personnel.
 - B. Applications-for-Payment will be accepted on a monthly, or less frequent, cycle.
 - C. With each Application-for-Payment, submit copies of applicable invoices showing date of purchase, description and cost for all products and materials incorporated in the Work during the previous month and for all Materials-in-Storage being claimed.
 - D. Submit an updated Project Progress Schedule, as specified elsewhere, with each Application-for-Payment. Failure to submit may cause delays in payment.
- 1.3 Measurement of Work and Basis for Payment:
- A. Measure all Work, including Materials-in-Storage, in the presence of the Engineer's Representative, *prior* to each submittal of an Application-for-Payment. *The date of measurement shall be the date of the Application.* Provide Engineer a minimum of two (2) working days notice when scheduling required measurements. Failure to measure work an/or materials in storage in presence of Engineer's Representative will cause delays in processing of the Application-for-Payment.
 - B. The basis of payment will be the unit prices and/or lump sum amounts included in the Bid Form. Nothing in this Section shall be construed as providing for additional payment beyond the contractual bid items. All incidental Work necessary for a complete and operable project is included in the bid prices. Full payment will be made for completed and tested bid items only.
 - C. Specific bid items shall be measured as follows:
 - 1. Lump-sum items shall be measured for completion against the Schedule of Values provided by the Contractor. Everything necessary for complete and operable Work shall be included in the lump sum or per-each item.
 - 2. Water Mains and Service Tubing shall be measured along the centerline of pipes from center of fittings to center of fittings and from center of fittings to end of branch. No deduction will be made for fittings and valves. All clearing (unless clearing is a separate bid item); excavation (including rock unless rock is a separate bid item); trenching; dewatering; shoring; utility relocations; bedding; blocking; backfilling; compaction; flushing; disinfection; testing and clean-up; and temporary grassing shall be included in the unit price. No payment will be paid for water mains until hydrostatic testing has been completed and approved. Also, the unit price bid includes restoration or replacement of existing features such as culverts, mailboxes, signs, underground sprinkler systems, fences, sod, shrubs, landscaping, etc., unless there are separately bid items on the Proposal Form.
 - 3. Connection to Existing Facilities shall be counted and paid only when included as a separate bid item on the Proposal Form. The lump sum bid per connection for "pressure tap" shall include furnishing and installing a ductile iron split-tee for tapping and coring. (Valves at pressure tap connections will be paid under Valve bid items.) A "cut-in connection" shall include furnishing and installing required ductile iron solid sleeves, a cut-in tee and ductile iron (D.I.) connection pipe as required. All valves, including tapping valves, at connections will be paid separately under valve bid items. All D.I. fittings will be paid separately under bit items for fittings. The connection bid items include excavation; cutting or coring; dewatering; shoring; bedding; reaction blocking; testing; backfilling; cleanup; restoration of pavement and landscaping; and all incidentals and fittings necessary for a completed connection.
 - 4. D.I. Fittings shall be counted and paid at the minimum specification weights published in AWWA C110 for ductile iron, mechanical joint fittings, pressure rating 350 pounds per square inch (p.s.i.), *weight of*

body casting only. AWWA C110 weights will be paid regardless of actual weights of fittings installed. Accessories, reaction blocking and bedding shall be included in the unit prices bid for D.I. fittings. No payment will be paid for fittings until hydrostatic testing has been completed and approved.

5. Gravity Sewers will be measured from diameter, depth of cut, and type of pipe. The depth of cut will be measured as the vertical distance between the sewer invert and the existing ground profile as shown on the Drawings unless otherwise noted. Depths of cut up to and including six (6) feet will be paid at the 0-6' price; depths of cut above six (6) feet to and including eight (8) feet will be paid at the 6'-8' price and so on. The length of sewers will be paid for as the required length which is actually installed, measured as the horizontal distance from center of manhole to center of manhole. No extra payment will be made for sewers laid deeper than called for on the Contract Drawings unless the change has been approved by the Engineer prior to installation of the pipe. D.I. pipe will be paid for the required length and diameter of pipe that is installed at the unit prices bid.
6. Manholes will be counted in place and the depth measured as the vertical distance between the manhole invert and the top of the cover frame as shown on the manhole detail on the Drawings. No extra payment will be made for manholes installed higher than called for on the Drawings unless the change has been approved by the Engineer prior to installation. Unit prices bid shall include connections to gravity sewers, inverts, installation of gaskets, steps, pipe collars, testing, etc.
7. Sewer Service Laterals will be measured along the centerline of pipes from center of connection to end, or to connection. No deduction will be made for fittings. All excavation (including rock), trenching, blocking, backfilling, compaction, utility relocation, fittings, plugs, connections to building sewers, miscellaneous or incidental work, testing, and restoration shall be included in the unit prices bid.
8. Sewer Service Wyes or Tees will be counted and paid for at the unit price bid. The unit price shall include all related work and miscellaneous materials including temporary plugs for the ends of stub-outs or laterals, all vertical risers, and concrete encasements required and furnishing of accurate as-built location drawings and stakeout of as-built locations.
9. Sewer Service Clean-Outs will be counted and paid for at the unit price bid. The unit price bid shall include all related work and miscellaneous material required to install clean-outs including wyes, caps, plugs for the ends of stub-outs, vertical risers, fittings and adapters for house connections where required.
10. Force Main will be measured along the centerline of the pipe from center of fittings to center of fittings, and from center of fittings to end of branch. No deduction will be made for fittings and valves. All excavation (including rock), trenching, blocking, backfilling, compaction, utility relocation, testing and restoration shall be included in the unit prices bid. No additional payment will be made for such activity.
11. Steel Casing Pipe by Boring or Jacking shall be measured and paid on a unit price basis for actual length of casing required and installed. The bid price includes mobilization, stake-out, bore pit excavations, shoring, stabilization, dewatering, bedding, backfilling, restoration of pavement and landscaping, and all incidentals required for a completed installation. No extra payment will be made for incomplete and unacceptable borings; for realignments; or for lengths of casing increased for the convenience of Contractor. The carrier pipe, locking gaskets, casing spacers, end seals, blocking, bedding, testing, and all other items related for furnishing and installing the carrier will be paid separately at unit prices bid for DIP carrier pipe.
12. Pipe Installed by Directional Drilling will be measured and paid on a unit price basis for actual length of pipe required and installed. The bid price includes mobilization, stake-out, bore pit excavations, shoring, stabilization, dewatering, backfilling, carrier pipe and special joints and fittings, poly-wrap or coating of pipe, testing, restoration of pavement and landscaping, and all incidentals required for a completed installation. No extra payment will be made for incomplete or unacceptable installations; for alignments; or for lengths of pipe increased for the convenience of Contractor.
13. Free Bore for Water Mains will be paid only where free bore is shown on the Drawings or otherwise directed by the Engineer. Length of free bore will be measured as the same linear distance as the pavement that otherwise would be open cut. No additional payment will be made for pavement

replacement. The water main will be paid separately under the water main bid item. The Free Bore bid item is not applicable to 2" and small pipes and tubing.

14. Payment Replacement for asphalt and concrete roadways; driveways; and parking lots shall be measured along the centerline of the installed pipe and paid in lineal feet (L.F.). Width of pavement will not be considered a factor in measurement or payment. All damaged pavement must be replaced. No additional payment will be made for replacing pavement damaged by Contractor's operations or for maintaining gravel or stone surfaces.
15. Erosion Control will be paid only if separate bid item(s) are included on the Proposed Form. Unless otherwise shown as individual bid items, Erosion Control includes temporary construction exit(s) as required, silt fencing as shown on the Drawings, check dams, sediment traps, and other structures required by the Drawings, Specifications, and the approved Erosion Control Plan. Erosion Control also includes temporary vegetative cover and maintenance of all erosion control measures until completion and acceptance of the Work. Additionally, Erosion Control includes removal of all silt fences and other control measures upon completion when permanent stabilization has been established. Payment for Erosion Control will be prorated over the Contract Time of the Contract Agreement.
16. Final Clean-Up and Permanent Grassing will be measured and paid only if there is a separate liner foot bid item on the Bid Form. If so, measurement will be along grassed surfaces along the centerline of the open-cut installed pipe. Width of disturbed area to be grassed will not be a factor in payment. A full stand of permanent and healthy grass must be established on all disturbed areas before payment of this item.
17. Crushed stone for special bedding or backfill, only if directed by the Engineer, shall be measured and paid by the ton (or on a cubic yard basis using a conversion factor of 2.0 tons per cubic yard). No payment will be made for crushed stone or granular material unless its use was directed by and quantities were verified by the Engineer's Representative. Pay requests must be supported by legible and dated weight tickets signed by the Engineer's Representative. No payment will be made for imported material used to cushion pipe in rock excavation; for roadway maintenance or pavement base; for backfill under pavements; for bore pits; or for satisfying special D.O.T. requirements.
18. Rock excavation shall be measured for payment only if it is a separate bid item on the Bid Form. Rock will be measured as the actual dimensions of rock excavated, except that no payment will be made for a depth greater than 6" inches below the invert of the pipe, fitting, valve, or structure, or for a trench width greater than O.D. of bell or coupling plus 15". Rock removal for service tubing and 2" casing will be measured as the actual dimensions of rock excavated, except that no payment will be made for a depth greater than 3" below the tubing or casing, or for a trench greater than 18" wide. Rock shall be measured for payment only when specifically approved by the Engineer prior to excavation. The cost of rock disposal and extra granular material to cushion pipe in areas of rock excavation shall be included in the unit price bid.
19. Sod shall be measured and paid only if a separate bid item on the Bid Form. Sod includes ground surface preparation; application of fertilizer and lime appropriate for soil type and season; and placement of sod to successfully match in kind the pre-construction condition. The actual area of sodded surface shall be measured for payment; however, width of disturbed area shall not exceed twelve (12) feet unless directed by the Engineer. All disturbed areas to receive sod must be cleaned-up and a full stand of permanent and healthy grass must be established before payment of this item.

1.4 Payment:

- A. Applications-for-Payment that have been prepared based upon measurements described in this Section of the Specifications shall be processed in accordance the General Conditions and the terms of the Construction Agreement.
- B. Applications-for-Payment that are not based on measurements as described in this Section of Specifications may be subject to delay while such measurements are made and/or discrepancies between measurements and the Applications-for-Payment are resolved.

SECTION 01330 – SUBMITTAL PROCEDURES

- 1.1 **Scope:** This Section, which covers additional requirements for submittals, is supplementary to the General Conditions and forms a part of all other Sections in which submittals are specified or required.
- 1.2 **Submittal Procedures:**
- A. Unless otherwise specified, submit at least five (5) copies (includes only one (1) for return to Contractor) of initial submittals within thirty (30) days after issuance of the Notice to Proceed. If re-submittals are required, the Contractor will be notified in writing of required corrections or of rejected submittals and shall submit new or corrected submittals with fifteen (15) days after such notification.
 - B. Submittals shall include copy of the invoice for any product or material ordered, purchased or delivered prior to the date of submittal.
- 1.3 **Contractor's Responsibility:**
- A. Each submittal *must* include the Contractor's statement that the submission has been ***reviewed and approved*** by the Contractor. This statement shall warrant the submittal conforms to the requirements of the Contract Documents except for any deviations, which shall be clearly noted.
 - B. Contractor's review and approval stamp must be on each sheet of each submittal. Provide a title block identifying the Project, the Contractor, the SubContractor, Manufacturer or Supplier, the date, scale of drawings and a drawing or sheet identification number.
 - C. On each submittal provide a 3 ½" x 2" clear space for the Engineer's approval or correction stamp.
- 1.4 **Samples:** If samples are required, submit at least sixty (60) days prior to start of operations involving material sampled. Label or tag each sample or set of samples identifying the manufacturer's name and address, brand name, catalog number, project title and intended use.
- 1.5 **Limitations of Engineer's Responsibility:** Engineer's review of Contractor's submittals will be only for conformance with the design concept of the Project and general compliance with the information given in the Contract Documents. The Contractor is fully responsible for confirming and correlating all quantities and dimensions; for selecting fabrication processes and techniques of construction; and for coordinating Work with that of all trades.

SECTION 01450 – QUALITY CONTROL

- 1.1 **General:** Quality Control will be responsibility of the Contractor. The Owner may, at his/her option, perform additional tests, measurements, etc. to provide Quality Assurance (QA). Discrepancies in results or QA tests that do not meet project specifications will be resolved by mutual duplicate tests. All unacceptable Work will be removed, replace and retested at Contractor's expense.
- 1.2 **Source of Supply:**
- A. Prior to shipment of any materials to the job site, submit to the Engineer for approval a list showing the source of supply of all materials.
 - B. The Owner shall have the right to sample, test and inspect materials at any time and place during their manufacture, preparation or use. If sources of supply which have previously been approved do not furnish materials or products of uniform quality, the Owner may order the Contractor to discontinue use of materials or products from that source. Any materials found to be unfit for use shall be removed from the site.
 - C. The Owner and/or Engineer shall have the right to witness testing performed at the factory of supplier's test facility. Unless otherwise specified, the Owner will pay the cost of factory test witnessing.
- 1.3 **Certified Test Reports:**

- A. Before delivery of materials for which certified test reports are required, submit notarized copies of the reports of all tests to the Engineer. The testing shall have been performed in an approved independent laboratory, within one (1) year of submittal of the reports for approval.
- B. As an option the Contractor may, in lieu of the specified test reports, furnish a Certificate of Compliance from the manufacturer stating that the manufacturer has performed all required tests; that products to be supplied meet all test requirements; that tests have been performed within one (1) year of submittal of the certificate; and that products tested were of the same type, quality, manufacturer and make as those proposed to be supplied.

SECTION 01450 – TESTING AND INSPECTION

- 1.1 Scope: This Section covers testing and inspection requirements for quality control supplementary to those of the General Conditions and other Sections of these Specifications.
- 1.2 Pre-construction Concrete Mix Verification:
 - A. Mix Design: If concrete (or shotcrete) mix design verification is required, Contractor shall employ and pay an independent testing laboratory acceptable to the Engineer to perform *job-specific* concrete mix design, preparation of concrete cylinders (or shotcrete panels) and laboratory verification thereof.
- 1.3 Construction Quality Control Testing and Inspection:
 - A. The Contractor shall select and employ a testing laboratory acceptable to the Engineer for performing specified field quality control sampling, testing, field inspections and laboratory testing at Contractor's expense.
 - B. Contractor shall schedule and coordinate all required quality control sampling and/or testing and shall notify Owner's laboratory sufficiently in advance of operations to allow scheduling of testing and assignment of laboratory and field personnel.
 - C. Contractor shall cooperate with all sampling and testing personnel and provide, at Contractor's expense, all equipment and labor required for access to the Work; field quality control sampling; preparation of samples; and transport of samples to the designated testing laboratory. Any costs incurred because of Contractor's failure to properly schedule and coordinate quality control testing shall be borne by the Contractor.
 - D. Owner may also employ a second, independent testing laboratory for duplicate or additional quality control testing at Owner's sole expense. If quality control testing indicates Contractor's failure to meet specifications, the cost of such tests and subsequent retests shall be borne by the Contractor. Contractor shall require any such laboratory engaged for any purpose in connection with the Work to promptly send two (2) signed copies of any and all job specific field inspection and/or laboratory testing reports to the Engineer.
- 1.4 Equipment or Product Testing: When an item of equipment is ready for testing, the Contractor shall schedule the testing; provide the specified notice; and conduct tests in the presence of the Engineer and the designated factory-certified representative.

SECTION 01500 – TEMPORARY UTILITIES, FACILITIES AND CONTROLS

- 1.1 Requirements Included: Provide and maintain temporary utilities, facilities and controls as necessary to provide utilities needed for construction and to provide control over environmental conditions at the construction site(s) and related areas under Contractor's control. Remove physical evidence of temporary facilities upon completion of Work.
- 1.2 Temporary Electricity: Provide temporary electric power service to the site(s) for the duration of construction activities as required for the Work.
- 1.3 Temporary Lighting: Provide temporary lighting for the site(s) as necessary for safety; for construction operations and for the Contractor's and Engineer's quality control inspections.

- 1.4 Temporary Telephone Service: Provide temporary telephone service to the site(s). **Superintendent shall have functional pager (beeper) and cell telephone activated at site at all times while construction activities are taking place.**
- 1.5 Temporary Trash and Garbage Disposal: Periodically remove and properly dispose of all trash, debris and garbage to keep the site(s) clean and sanitary at all times, including storage and parking area, along access roads and haul routes.
- 1.6 Temporary Water Service: Provide temporary water needed for construction activities on the site(s). Owner will provide reasonable volumes of water for filling, testing and flushing the pipelines to the extent that water is available.
- 1.7 Temporary Sanitary Facilities: Provide and maintain required toilet facilities and enclosures and maintain in clean and sanitary condition. (Owner's facilities will not be available.)
- 1.8 Noise Control: Comply with all local, state and Federal (O.S.H.A.) requirements regarding noise. Limit all operations, except during emergencies, to daylight periods when noise from operations will not disturb residential neighborhoods. *No Work shall be executed prior to 6 a.m., after 8 p.m. or on Sundays!*
- 1.9 Dust Control: Provide positive methods by applying water or other dust control materials to minimize dust emissions from construction operations and provide positive means to prevent air-borne dust from dispersing into the atmosphere at all times.
- 1.10 Storm Water and Erosion Control:
- A. Provide methods to control surface water to prevent damage to stored materials, installed Work, the site, adjoining properties and receiving materials.
 - B. Control all earthwork filling, grading and ditching to direct surface drainage away from excavations, pits, tunnels and other construction areas while directing drainage to proper runoff.
 - C. Dispose of pumped drainage water in a manner to prevent flooding, erosion or other damage to any portion of the site or to adjoining properties.
 - D. Plan and execute construction by methods which control surface drainage from cuts and fills, and from borrow and waste disposal areas, to prevent erosion and sedimentation.
 - E. Periodically inspect excavated or disturbed areas to detect any evidence of the start of erosion, apply corrective measures as required to control erosion. Provide maintenance and supplementary erosion and run-off control measures whenever it becomes apparent that additional problems exist.
 - F. Comply with approved Land Disturbance Permit and applicable construction site NPDES permit(s), if any.
- 1.11 Pollution Control: Provide methods, means and facilities required to prevent contamination of soil, water, or atmosphere by the discharge or spills of petroleum or noxious substances from construction operations or stored materials.
- A. Provide necessary equipment and personnel to perform emergency measures as required to contain any spillage and to remove contaminated solid or liquids.
 - B. Take special measures to contain harmful substances. Provide containment as required by law for all petroleum products or other liquid chemicals stored on construction site(s).

SECTION 01550 – TRAFFIC REGULATIONS

- 1.1 Requirements Included: Provide, operate and maintain equipment, services and personnel with traffic control and protective devices, as required, to expedite vehicular traffic flow and provide for the safety of personnel and the public.

- 1.2 Related requirements: Comply with traffic control and safety requirements of local authorities and any Georgia D.O.T. permits applicable to the Work.
- 1.3 Traffic Signals and Signs:
- D. Provide and operate traffic control and directional signals required to direct and maintain an orderly, safe flow of traffic in all areas under Contractor's control or affected by Contractor's operations.
 - E. Any and all traffic control signs shall be clean, in a "like-new" condition, and easily seen and read. Old, faded, and/or dirty signs will not be allowed at the site(s).
- 1.4 Flagers: Provide qualified and suitably equipped flagers whenever and wherever construction operations encroach upon traffic lanes as required for regulation of traffic; and/or as requested by applicable D.O.T. permits; and/or as requested by the Engineer or Owner's representatives.
- 1.5 Flares and Lights:
- A. Provide flares and lights during periods of low visibility to clearly delineate traffic lanes, to guide traffic and to assist flagers in directing traffic.
 - B. Provide illumination of critical traffic and parking areas.
 - C. Provide adequate signs and flagging to alert traffic of construction operations underway, of restricted traffic lanes or utility cuts across traffic lanes.
- 1.6 Parking: Arrange for temporary parking areas to accommodate construction personnel.
- 1.7 Access to Property:
- A. Maintain local traffic access to all driveways and parking areas at all times except when approved temporary (up to 6 hours) blockage is necessary for construction activities.
 - B. Notify residential and business property owners at least 24 hours in advance of any proposed blockage of access, giving notice of approximate time and duration of such blockage of access.

SECTION 01710 – CLEANING AND RESTORATION

- 1.1 Siltation:
- A. Conduct the Work and restore disturbed areas in such a manner so as to minimize siltation of local streams.
 - B. Comply with all requirements of the Erosion and Sediment Control Plan and Section 02269. Provide as a minimum, the erosion control measures shown on the Drawings. If necessary provide additional erosion control measures, i.e., berms, hay bales, or silt fences as required to comply with all local, state and federal erosion control requirements.
- 1.2 Water Pollution:
- A. Take extreme care to avoid contamination of water supply systems or discharge of polluted water into streams. Take special care when making connections between existing facilities and new work, and where water and sewer lines cross.
 - B. Do not discard waste material of any type into surface streams.
- 1.3 Solid Waste:
- A. Dispose of all solid waste that is generated in the execution of the Work in a sanitary landfill in accordance with local and state regulations.

B. Do not burn or bury trash without the express written consent of the Owner and the property owner involved.

1.4 Air Pollution:

A. Any burning that is permitted by written consent of the Owner shall be done without creating any nuisance conditions and in compliance with local, State and Federal air quality control regulations.

B. Control dust by regular cleaning and watering of road surfaces in Work areas and by watering trenches and unpaved areas as necessary to avoid dust problems.

SECTION 01710 – CLEANING AND RESTORATION

PART 1 – GENERAL

1.1 Requirements Included: Cleaning during progress of the Work and restoration of all disturbed property upon completion.

1.2 Related Requirements:

C. Comply with cleaning and restoration requirements in each Section of the Specifications.

D. Comply with Temporary Controls specified elsewhere including requirements for control of noise, dust, storm water, debris and erosion.

E. Comply with grassing and landscaping requirements specified elsewhere.

1.3 Disposal Requirements: Conduct cleaning, restoration and disposal operations to comply with applicable codes, ordinances, regulations and anti-pollution laws.

PART 2 – PRODUCTS

2.1 Materials: Use only those materials and products which will not create hazards to health or damage to the environment.

PART 3 – EXECUTION

3.1 General Requirements: Comply with cleaning and restoration requirements in each Section of the Specifications.

3.2 During Construction:

C. Restore all areas that are disturbed areas equal to their original condition with the exception of trees or other physical features that are designated to be removed.

D. Establish a full stand of permanent grass on all undeveloped areas that have been disturbed such as woods and open fields to protect against erosion.

E. Reestablish lawns and previously grassed areas that are disturbed by construction with permanent grass equal to that which existed prior to construction. Restored grass must be mowable with residential type lawnmower.

F. Restore or replace all disturbed features of any type including landscaping, shrubs, structures, fences, signs, mailboxes, bridges, walkways, pavements, etc. equal to their condition prior to construction.

3.3 Special Procedures:

A. D.O.T. Right-of-Way: Completely restore all disturbed areas on D.O.T. rights-of-ways on a daily basis. Backfill all trenches, regrade ditches and proceed with handwork as needed to complete the restoration of each individual property owner. Re-grass immediately when in season. Provide adequate erosion control. Comply with requirements of the D.O.T. District Engineer and applicable D.O.T. permits.

- B. Private Driveways & Public Roads: Provide crushed stone, cover plates or temporary pavement as necessary to maintain in a safe and passable condition at all times until the permanent roadway surface is repaired.

3.4 Periodic Cleaning:

- A. Execute periodic (at least weekly) cleaning as necessary to keep the Work, the site and adjacent properties free from accumulations of waste materials, rubbish and windblown debris resulting from construction operations.
- B. Provide adequate on-site containers for the collection of waste materials, debris and rubbish.
- C. Remove waste materials, debris and rubbish from the site periodically and transport to legal disposal areas away from the site for proper disposal.
- D. Periodically broom-clean paved surfaces and rake-clean other surfaces. Keep debris cleaned off roadways, from gutters and storm drainage systems, etc. and adjacent properties.

3.5 Final Cleaning and Restoration:

- A. Execute final, complete cleaning and restoration of construction area(s) for the Work upon completion of each area or segment of the Work prior to final inspection.
- B. Prior to final completion and acceptance of the Work, conduct an inspection of all construction areas with the Owner and Engineer to verify that the entire Work is cleaned and restored to its original or specified final condition and acceptable to the Owner.

SECTION 02110 – SITE CLEARING FOR UTILITIES

PART 1 – GENERAL

- 1.1 Section Includes: Clearing and grubbing of areas to be graded or areas required for construction of utilities, pipelines and related structures. The Work also includes erosion and sediment control including the removal and proper disposal of all material resulting from clearing and grubbing operations.
- 1.2 Site Conditions:
 - A. Comply with applicable Land Disturbance Permit and all state and local erosion and sediment control laws and regulations.
 - B. Comply with all state and local laws and regulations relative to disposal or burning of waste materials.
- 1.3 Definition of Terms:
 - A. Construction Area: Those areas where excavation or other construction activities are intended to take place, as indicated on the Drawings, including adjacent public rights-of-way and easements on private properties.
 - B. Clearing Area: The area within the construction area to be cleared and grubbed as necessary for execution of the Work unless specific instructions to the contrary are provided in the Contract Documents or by the Engineer. Clearing area shall include building sites, utility trenches and other areas to be graded, landscaped or paved.
 - C. Clearing: The act of removal and disposal of all obstructions which interfere with the construction including minor structures; loose pavement or curb pieces; broken slabs; loose surface rock; trees; brush; rubbish; fences; debris; and all other such items except items to be protected and preserved.
 - D. Grubbing: The removal from the ground and disposal of all roots and stumps which are larger than ¾” in diameter.
 - E. Debris: Any and all waste material which is generated by the clearing or grubbing operations, including minor structures, construction debris, broken pavement, curbs, etc.

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION

3.1 Preparation:

- A. Construct wooden barricades of 2” x 4” lumber, 3’ high, around individual, or groups of, trees and shrubs designated on the Drawings to be preserved. Locate barricades at the dripline of trees.
- B. Provide silt fences and other erosion and sediment control measures required.

3.2 Clearing:

- A. Clear only the minimum areas necessary for trenching operations, structures, access route and bore pits. Clear excavation, grading, filling, and building areas except such trees and vegetation indicated or directed to remain. Protect and preserve all trees, structures and physical features outside the minimum clearing area from any damage including damage from any burning operations that may be permitted whether or not designated on the Drawings.
- B. For pipeline trenches, clear 7.5 feet on both sides of the proposed pipeline centerline, unless otherwise designated on the Drawings.
- C. For trees to remain, protect tree root systems from damage by construction operations, materials, compaction or erosion. Repair damaged trees by trimming and painting with approved tree-wound paint.

3.3 Grubbing: Unless otherwise directed, grub cleared areas including:

- 1) Fill areas where subgrades for roads or pavement are to be placed: Grub to a minimum depth of 12” below the finished subgrade.
- 2) Areas of excavation for structures: Grub to the depth of excavation.
- 3) Areas outside of subgrades where fill is to be placed: Grub to the existing grade.
- 4) Areas to be graded and/or landscaped without fill: Grub to a minimum 6” below the final grade.

3.4 Burning of Waste Material: Perform burning only if permissible by applicable laws and regulations and only if a permit has been obtained by the Contractor. Burn in a manner that will avoid all risk of damage to adjoining property.

3.5 Clean-Up: Remove and properly dispose of all debris from the clearing, grubbing and burning operations. Remove loose paving, broken concrete and curbs, surface rock, debris, etc.

SECTION 02221 – TRENCHING, BACKFILLING AND COMPACTION

PART 1 – GENERAL

1.1 Section Includes: Trenching and excavation of all materials encountered including rock and unsuitable materials; disposal of excess and unsuitable materials; sheeting and shoring; pumping and dewatering; bedding; backfilling; and compaction for installation of pipe, piped utilities, underground conduits and appurtenances thereto, which are 5’ outside building lines.

1.2 Quality Assurance:

- A. Owner will select and employ a testing laboratory for performing all specified field and laboratory quality control testing and inspection at Owner’s expense. If Owner’s quality control testing indicates Contractor’s failure to meet specifications, the cost of such tests and subsequent retests shall be borne by the Contractor.

- B. Contractor shall schedule required quality control testing, cooperate with all testing personnel and provide equipment and labor required for all sampling, preparation of samples, field testing and transport of samples to the testing laboratory.
- C. Two (2) signed copies of all field and laboratory testing reports shall be sent to the Owner and Engineer immediately upon completion.

1.3 Reference Standards:

- A. ASTM C33-97 Concrete Aggregates.
- B. ASTM C136-96a Sieve Analysis of Fine and Course Aggregates.
- C. ASTM D698-91, Laboratory Compaction Characteristics of Soil Using Standard Effort (Standard Proctor).
- D. ASTM D1556-90, Density of Soil in Place by the Sand-Cone Method.
- E. ASTM D2487-93, Test Method Classification of Soils for Engineering Purposes.
- F. ASTM D4318-95a, Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
- G. NEPA 495, Code for the Manufacture, Transportation, Storage and Use of Explosives.

1.4 Site Conditions:

- A. All Work under this Section shall conform fully to applicable O.S.H.A. rules and regulations.
- B. Maintain access to the existing facilities and private property at all times.
- C. Perform operations with special care in the vicinity of existing facilities. Protect above-ground or below-ground utilities which are to remain. If any damage is done to these facilities, repair immediately.
- D. Conduct all Work required on public rights-of-way in strict conformance with rules and regulations of governing bodies having jurisdiction over the rights-of-way.
- E. Provide traffic protection by means of suitable signs, barricades, lights and flaggers.
- F. Protect existing underground and overhead utility pipes, poles, lines, services, structures, etc. from damage or interruption of service by the conduct of construction operations. Furnish and have available at all times an electronic pipe detector in working order and use to survey the proposed path of trenching prior to excavation. The approximate position of known utilities is shown on the Contract Drawings for the Contractor's information. The utilities shown on the Contract Drawings were located during an above-ground investigation and may not be accurate or complete. Location and protection of all underground and overhead utilities and structures in the construction area is the responsibility of the Contractor.

PART 2 – PRODUCTS

- 2.1 General: All bedding and backfill material shall be subject to approval of the Engineer. For approval of imported backfill or bedding material, give at least five (5) working days advance notice of intent to import material and designate the proposed borrow area. Allow the Owner's testing laboratory to sample as necessary from the borrow area for the purpose of making acceptance tests to prove the quality of the material.
- 2.2 Native Material Suitable for Backfill: Excavated on-site soils which do not contain "Unsuitable Material" as defined herein. Excessively wet or dry soils may not be used until moisture is adjusted to optimum level to permit proper compaction.
- 2.3 Granular Bedding Material: An approved granular soil, sand, chert, crushed stone, or mixture of these, all of which meets the requirements of ASTM C33 for coarse aggregate, Grading Size No. 57, free of organic matter, debris and Unsuitable Material.

- 2.4 Stone for Stabilization or Backfill: Sound, durable gravel or “crusher run” rock, all of which passes a 1 ½” sieve, free of organic matter, debris and Unsuitable Material.
- 2.5 Unsuitable Material: Any Group PT, OH, OL, CH, or MH soil per ASTM D 2487, silt, topsoil, roots, vegetable matter, trash, debris, asphalt, frozen or excessively wet soil, stone or gravel larger than 3” in maximum dimension.
- 2.6 Rock Definition for Trenching: Any material which cannot be excavated with a backhoe having a bucket curling force rated at not less than 33,010 pounds (Caterpillar 225B or equivalent).

PART 3 – EXECUTION

3.1 Preparation: Prior to excavation activities:

- A. Install erosion and sediment control measures as required.
- B. Perform demolition, clearing and grubbing as required.
- C. Strip and properly stockpile all sod and topsoil suitable for reuse in restoration. Protect until use.
- D. Remove pavement only as necessary for excavating the trench and installing the pipelines and appurtenances. Cut all asphalt pavement in straight, uniform lines by means of a jackhammer or suitable pavement cutter. Cut all concrete pavements to a depth of at least 2” along the cut line with a rotary saw, after which the pavement may be broken with a jackhammer or suitable pavement cutter.
- E. Determine location of existing utilities (underground and overhead utility lines, poles, pipes, services, structures, etc.) and mark them in advance of trenching operations. Furnish and have available at all times an electronic pipe detector in working order, and use said detector to survey the proposed path of excavation. Excavate and exposed underground utilities in test pits to verify the locations, depths and materials of construction. Notify Engineer of potential conflicts and presence of cathodically protected facilities. No extra compensation will be given for manual excavation required to locate, protect or restore underground utilities.

3.2 Trench Excavation:

- A. Excavate all subsurface material within the trenching limits specified regardless of the material encountered including rock. Excavated materials satisfying the requirements of this Section of Native Material may be used for backfill. Remove surplus excavated material and Unsuitable Material from the job site.
- B. Do not excavate in areas of excessive groundwater. Provide dewatering, by methods of Contractor’s choice, as required to achieve dry ditches.
- C. Excavate the banks of trenches vertical from bottom of trench to one (1) foot above the top of pipe or conduit.
- D. Keep the trench width within the limits specified below; however, O.S.H.A. safety requirements shall supersede the requirements stated herein whenever applicable and shall be followed:
 - 1. Maximum trench width at top of pipe: Pipe outside diameter (O.D.) plus 24”. If the maximum trench width is exceeded, the required bedding must be upgraded to the next higher class, at Contractor’s expense, for that part of trench that exceeds the maximum allowable width.
 - 2. Minimum width of trench: O.D. of bell or coupling plus 15”. (This minimum applies to all trenches including those in rock excavation.)
- E. Place excavated material (spoil) sufficiently back from the edge of trench to prevent caving of the trench wall and to permit safe access along the trench. Provide at least three (3) feet clearance from toe of spoil bank on at least one side of trench for access. Do not endanger the workers or public and do not obstruct roadways or sidewalks.

- F. Unless prior approval is obtained from the Owner, limit the length of open trench to that which can be completed in one (1) working day. ***Do not leave trenches open overnight.*** If there are extenuating circumstances *approved by the Owner*, excavations may remain open overnight if fully protected by safe and effective barricades and lights.
- G. Where necessary, and as required by O.S.H.A. regulations, provide and install sufficient and suitably sized movable trench boxes, shields, sheeting, shoring and/or bracing which shall remain in place until the backfill has proceed to a point where it can be removed safely. When damage is liable to result from withdrawing sheeting, it shall remain in place. Movable shields, sheeting, shoring, bracing, etc. are considered as an integral part of the Work and no extra payment will be allowed.
- H. Remove rock encountered in trench excavation for the specified minimum width of the trench and to a depth of 6” below the invert of the pipe.
- I. Obtain all required permits for handling explosives and performing blasting. Conduct blasting operations in strict accordance with all existing ordinances and regulations and only with the prior approval of the Owner. Carefully protect all exposed structures from the effects of blast and cover all blasts with heavy timbers, mats or other suitable protection. Blasting shall be done only by licensed personnel. Use very light charges to prevent damage to adjacent structures. Promptly repair any damage. Store all blasting supplies in accordance with local ordinances. In no case shall caps or other explosives be kept at the place where dynamite or other explosives are stored.
- J. As trenching approaches exiting underground utilities, perform excavation with extreme care. Perform necessary removals, relocations or relaying of pipes, utility lines and appurtenances which will obstruct the Work. Provide temporary support, adequate protection and maintenance of all underground and surface utilities, drains, structures or other obstructions encountered.
- K. Promptly correct damage to existing utilities or structures caused by construction activities. Promptly restore disrupted utility service and provide a condition at least equal to the original condition before the damage occurred. Should the Contractor fail to promptly restore service or correct damage, the Owner or utility companies may correct the damage and back-charge the Contractor for cost incurred for the required corrective Work.
- L. Where existing storm drains or culverts are damaged or destroyed by removal to facilitate trenching and pipe laying, replace the damaged or destroyed drains or culverts with new reinforced concrete pipe meeting the requirements of ASTM Designation C 76-97, Class II. Drain pipe shall be equal to that removed except sizes smaller than 12” which shall be replaced with 12” pipe.
- M. If trench subgrade is found to contain unsuitable or potentially corrosive material such as ashes, cinders, refuse, petroleum contaminated soil or organic matter, undercut and remove at least 6” below the trench bottom. Replace with Granular Bedding Material.

3.3 Bedding:

- A. Bedding shall conform to the individual requirements for the pipe or conduit material being used. Unless otherwise specified or shown on the Drawings, bedding shall be Class B for PVC sanitary sewers; Class C for PVC water pipe and Ductile Iron sanitary sewers; and Class D for DI water pipe or RCP/CMP culverts.
- B. Grade the trench bottom to provide a firm, uniform and continuous bearing all along the entire length of the barrel of the pipe. *Excavate bell holes no larger than necessary to allow joint assembly and to ensure that the pipe barrel will lie flat on the trench bottom.* Pipe bells or couplings shall not support any load. When excavation is carried below or beyond that required, fill the over-excavated space with specified bedding material.
- C. In areas of rock excavation and where needed in other areas, provide compacted Granular Bedding Material cushion across the full width of the excavation to a minimum of 6” depth under the pipe, fittings and valves.
- D. Whenever the sub-grade is unstable or too soft to provide a satisfactory foundation for any pipe, dewater and undercut the trench as necessary and stabilize with Stone. Compact and bring the trench bottom to proper grade to create a firm, unyielding stabilized subgrade for bedding material and/or pipe.

3.4 Backfill:

- A. General - Backfill and compact all trenches and excavations immediately after the pipe and appurtenance have been installed. Unless otherwise specified or shown on the Drawings, use excavated Native Material Suitable for Backfill for backfilling. If sufficient suitable Native Material Suitable for Backfill is not available on site, furnish sufficient and suitable borrow material for backfill.
- B. Initial Backfill: Place select backfill around haunches of the pipe and appurtenance by hand placement and compaction from the trench bottom up to at least 6" above the pipe (12" for pipe with Class B bedding). Use no stone larger than ¾" maximum dimension in the initial backfill. For Class B and Class C Bedding, provide Granular Bedding Material and initial backfill to the dimensions shown on the Bedding Drawing. Compact firmly and evenly, but without use of mechanical compactors.
- C. Remaining Backfill: Place backfill from top of Initial Backfill to the trench surface as described herein. Do not place rocks larger than 12" in maximum dimension in the upper layer of backfill unless otherwise approved by the Engineer.
 1. Trenches in areas to be paved and in areas beneath proposed structures: Backfill above the Initial Backfill with Stone for Stabilization or Backfill. Place the stone backfill in layers to achieve 6" compacted layers at 95% Standard Proctor Density. Use mechanical tamping to achieve the required compaction. In paved roadways, also install and compact the specified pavement base material to the required thickness as shown on the Pavement Replacement Drawing. Install a temporary traffic surface at grade consisting of 2" depth of crushed stone or pug mix. Leave backfilled trench open to traffic and maintain the surface at a uniform grade by refilling with stone and re-compacting as necessary to remedy any settlement. Continue such maintenance, including dust control, until surface paving is authorized by the Engineer.
 2. Trenches in ditch lines or other areas subject to erosion: Unless otherwise specified, backfill trenches with Native Material Suitable for Backfill and mechanically compact in 6" layers to achieve 95% Standard Proctor Density. Refill and re-compact eroded or settled trenches as often as necessary to restore and maintain the surface at the required finished grade.
 3. Trenches in areas to be grassed or landscaped: Unless otherwise specified, backfill trenches with Native Material Suitable for Backfill and compact by methods of Contractor's choice to achieve at least 85% Standard Proctor Density. However, if the trench is on D.O.T. or Railroad rights-of-way, compact to the density specified in the applicable permit. Refill and re-compact settled trenches as often as necessary to restore and maintain the trench surface at the required finished grade.

3.5 Field Quality Control:

- A. Perform routine quality control compaction testing at a frequency sufficient to ensure adequate compaction throughout the trenching and backfilling.
- B. In areas to be paved, perform compaction testing of the underlying backfill prior to placing pavement base material.
- C. Notify the testing laboratory and the Engineer 24 hours prior to need for testing. When any tests indicate the density or moisture content does not meet requirements specified herein, as determined by the Engineer, rework until the required density has been obtained.

SECTION 02224 – BORING AND JACKING PIPE (HIGHWAY, RAILROAD AND CREEK CROSSINGS)

PART 1 – GENERAL

- 1.1 Section Includes: Furnishing and installing open-cut, bored-and-jacked, casings under highway crossings, railroad crossings, creek crossings, and any other locations where cased pipelines are required, including installation of carrier pipe within the casings, and installation of pipelines by horizontal directional drilling (HDD) at creek crossings, at locations shown on the Drawings.

1.2 Related Work:

A. SECTION 02221 – TRENCHING, BACKFILLING AND COMPACTION

1.3 Reference Standards: All Work under this Section shall conform to the following:

A. Department of Transportation (D.O.T.) Permit for Utility Encroachment and General Provisions as issued to the Owner.

B. Department of Transportation (D.O.T.), UTILITY ACCOMODATION POLICY AND STANDARDS.

C. Department of Transportation (D.O.T.), MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES.

D. Field Welding of Steel Water Pipe (AWWA C206-97).

E. Polyethylene Encasement for Ductile-Iron Pipe Systems (AWWA C105-99).

1.4 Submittals: Submit under provisions of SECTION 01330:

A. Casing pipe manufacturer's certification stating the pipe class and wall thickness and that all specified tests have been made and the results thereof comply with the requirements of this Specification.

B. Manufacturer's material specifications and installation instructions for carrier pipe spacers, end closures, support assemblies, polyethylene encasement material, and other specified products.

1.5 Site Conditions:

A. All Work under this Section shall conform fully to applicable O.S.H.A. rules and regulations.

B. Conduct all Work on State D.O.T. right-of-way in strict conformance with the State Department of Transportation rules and regulations, with the applicable Utility Encroachment Permit and under the supervision of the D.O.T. Resident Engineer.

C. Conduct all Work on Railroad right-of-way in strict conformance with the Railroad Company's rules and regulations; the applicable permit; and under the supervision of the Railroad inspector.

D. Maintain access to the existing facilities and private property at all times.

E. Protect carefully all benchmarks, monuments and other reference points. Replacement, if required, shall be performed by a Registered Land Surveyor at no cost to the Owner.

F. Perform operations with special care in the vicinity of existing facilities. Protect above-ground or below-ground utilities which are to remain. If any damage is done to the facilities, repair immediately.

G. Limit operations to Owner's property and easements. Do not trespass on adjacent property without written permission from the owner of such property.

H. Comply with all erosion and sediment control measures specified elsewhere or required by law.

I. Conduct all Work required on public right-of-way in strict conformance with rules and regulations of governing bodies having jurisdiction over the Work.

J. Provide traffic protection by means of suitable signs, barricades and lights.

K. Protect existing underground and overhead utility pipes, poles, lines, service, structures, etc. from damage or interruption of service by the conduct of construction operations. Furnish and have available at all times an electronic pipe detector in working order and use to survey the proposed path of trenching prior to excavation. The approximate position of known utilities is shown on the Contract Drawings for the Contractor's information.

The utilities shown on the Contract Drawings were located during an above-ground investigation and may not be accurate or complete. Location and protection of all underground and overhead utilities and structures in the construction area is the responsibility of the Contractor.

- L. Do not interfere with Railroad or highway operation and do not weaken the roadbed or structure.

PART 2 – PRODUCTS

- 2.1 Casing Pipe: New and unused, welded steel, smooth wall, uncoated pipe conforming to ASTM A139, Grade B, except that the hydrostatic test is not required.
 - A. Unless otherwise specified on the Drawings, casing wall thickness shall be ¼” for 12” NPS and smaller, 0.375” for 14” NPS through 24” NPS, and ½” for 26” NPS and larger.
 - B. Casings for railroad crossings shall be Standard Weight (STD) for sizes up to 24” NPS and Extra Strong (XH) Weight for 24” NPS and larger.
 - C. Diameter shall be NPS size as indicated on the Drawings.
 - D. Pipe shall be furnished with beveled ends for field-butt welding.
 - E. Pipe with pitted or corroded surfaces will not be acceptable and shall be removed from the job site.
- 2.2 Carrier Pipe for Casing Installation: Ductile iron pipe with push-on joints, conforming to other Sections of these Specifications, as applicable, except that carrier pipe 24” diameter or less shall have Field Lok Gaskets by U.S. Pipe or Fast Grip Gaskets by American Cast Iron Pipe Company.
- 2.3 Carrier Pipe for HDD Installation: Ductile iron pipe with restrained joints, conforming to other Sections of these Specifications, as applicable, except that pipe up to 24” diameter TR-Flex restrained joints by U.S. Pipe or Flex-Ring restrained joints by American Cast Iron Pipe Company.
- 2.4 Casing Spacers: Type 304 stainless steel spacers with PVC liners and abrasion resistant, low-friction polymer runners. Center restrained type, as manufactured by Cascade Waterworks Manufacturing Company, PowerSeal Type 304, or Advance Products & Systems, Incorporated (Two (2) spacers per pipe joint).
- 2.5 Casing End Seals: Flexible Rubber End Seals by Maloney, Incorporated, or an equal approved by Engineer, and all stainless steel hardware.

PART 3 – EXECUTION

- 3.1 Access:
 - A. Provide access to site as approved by the State D.O.T., local government or Railroad Company.
 - B. Direct access to the Work, either ingress or egress, is prohibited from the main traveled way of a limited access highway or its on-off ramps except upon specific approval by the State D.O.T.
- 3.2 Preparation:
 - A. Perform demolition, clearing and grubbing as required.
 - B. Install erosion and sediment control measures as required.
 - C. Remove pavement only as necessary for open cut, or for excavating bore pit, and installing the casing and pipeline appurtenances. Cut all asphalt pavement in straight, uniform lines by means of a jack hammer or suitable pavement cutter. Cut concrete pavements to a depth of at least 2” along the cut line with a rotary saw, after which the pavement may be broken with a jack hammer or suitable pavement cutter.

- D. Contact all local utility owners and with their assistance, locate underground structures, pipes and utility lines, and mark them in advance. Excavate and expose underground utilities in test pits to verify locations and depths.
 - E. Promptly correct damage to utilities or structures, to provide a condition at least equal to the original condition before the damage occurred. Should the Contractor fail to promptly correct the damage, the Owner may correct the damage and back-charge the Contractor for costs incurred for the correction.
- 3.3 Techniques of Construction: Unless otherwise specified, the construction techniques, for whichever Method of Installation is used, shall be the Contractor's choice. However, the Work must be performed using generally accepted, and safe, construction procedures using adequate equipment, by experienced workmen, and in conformance with applicable permit requirements and all Federal, state, and local laws.
- 3.4 Installation by Open-Cut Method: Use the open-cut method for crossing a roadway or stream only when specifically shown on the Drawings or directed by the Engineer when permission has been obtained from the governing authority or a specific highway or roadway crossing.
- A. Cut pavement and excavate trenches in accordance with SECTION 02221. Provide suitable sheeting and bracing where necessary. Keep the Work dewatered at all times.
 - B. The bottom of the trench shall be evenly graded to a depth of approximately 6" below the bottom of the casing in order to accommodate bedding materials. Bedding material shall be compacted crushed stone.
 - C. Accurately lay the casing pipe on the prepared bed to the alignment and grade indicated, and securely block in place to prevent movement during the succeeding phase of the backfilling operation.
 - D. Backfill over the casing shall conform to requirements of SECTION 02221 for casings and pipelines under pavement or shall be placed in accordance with the requirements of D.O.T. permits, whichever are more stringent.
 - E. Pavement replacement shall conform to the requirements herein, but shall not be less than applicable D.O.T. requirement unless specific written approval is received.
 - F. Make all arrangements for diversion of traffic and control of traffic during the making of the crossing, all in accordance with the requirements described herein.
 - G. In the even that open-cut road crossings cannot be completed in one (1) day, cover the section of the trench not yet backfilled with steel plates of such size and thickness as to safely withstand heavy traffic over the trench and remain in place under such heavy traffic.
 - H. Casing for highway crossings made by the open-cut method shall be as described herein. Carrier pipe shall be installed inside the casing and ends of casing sealed as described herein.
- 3.5 Installation by Boring-and-Jacking Method: Use the boring-and-jacking method where a crossing is designated on the Drawings, unless Open-Cut or Horizontal Directional Drilling (HDD) is specified or directed by the Engineer. The boring-and-jacking method of installation of casing for the carrier pipe shall be a "dry" operation without use of hydraulic jetting to soften, loosen or sluice away the material to be excavated.
- A. Excavate suitable bore pits or trenches in accordance with Specification SECTION 02221. Provide suitable sheeting and bracing where necessary. Keep the Work dewatered at all times. Provide suitable traffic signs, barricades, and lights for protection of all open excavations and to conform to permit conditions.
 - B. Excavate and remove whatever material is encountered in the bore pit and boring excavation, including rock, and extend excavation no farther than two (2) feet ahead of the casing pipe.
 - C. Limit minimum diameter of the boring excavation to the outside diameter of the casing pipe as closely as practical.
 - D. Remove excavated material from the boring as the excavation progresses. Accumulation of excavated material within the casing pipe will not be permitted.

- E. Should appreciable loss of ground occur as a result of boring-and-jacking operations, immediately fill the voids with soil cement using 1-part cement to 5-parts granular soil ratio. If available material is not suitable for this purpose, provide granular soil fill. Mix and place the soil cement as rapidly as possible after loss of ground.
- F. If blasting operations are required, apply for and obtain all required permits for handling explosives and performing blasting operations. The use of explosives on a State or Interstate highway right-of-way is prohibited unless approved in writing by Owner and authorized by a separate D.O.T. blasting permit obtained by the Contractor.

3.6 Alignment and Grade Casing Pipe:

- A. Install casing pipes at the location, alignment and grade shown on the Drawings. Variations in the installed position of the casing from the line and grade shown on the Drawings will be permitted only if approved by the Engineer. However, the Contractor shall be responsible for any costs of related realignment of pipelines which may result from misaligned casings.
- B. If site conditions are suitable, leave casing pipe exposed at both ends until inspected and approved by the Engineer and the D.O.T. or Railroad inspector. Otherwise, provide temporary backfill, then re-excavate and expose both ends for inspection when requested to do so.
- C. Provide a dimensioned, as-built drawing showing all pertinent details of casing location including horizontal and vertical location of both ends.
- D. Fill any abandoned casings with sand and plug ends with masonry or concrete at least 12" depth or by welded steel plate.

3.7 Welding of Casing Pipe: Steel casing pipe shall be field-butt welded by experienced welders generally according to AWWA C206, Section 5: Welding-Procedure Details. Field joints shall be continuous, circumferential welded to result in a joint meeting the minimum strength requirements of base metals and which is completely watertight.

3.8 Installation of Carrier Pipe Inside Casings:

- A. Notify the Engineer at least two (2) days prior to installation of the carrier pipe and obtain Engineer's approval prior to proceeding with sealing and backfilling. Install carrier pipe only in the presence of the Engineer's Representative.
- B. Provide a minimum of two (2) stainless steel spacers per section of pipe. Mount spacers and install pipe in strict accordance with manufacturer's written instructions.
- C. If spacers are not used, casing pipe shall be pumped completely full with sand after installation of carrier pipe.
- D. After inspection by the Engineer's Representative, seal casing ends against entrance of foreign material by means of flexible rubber and seals.
- E. Filling, testing, and disinfection of carrier pipe shall be as specified in SECTION 02713 of these Specifications, except that testing of that section of the pipeline with the limits given for a particular crossing shall be performed separately from the testing of other sections of the pipeline.

3.9 Installation by Horizontal Directional Drilling (HDD): Use the HDD method for crossing a roadway or stream only when specifically shown on the Drawings or directed by the Engineer.

- A. Conduct pre-drilling planning to design a specific trajectory that will meet the requirements of the crossing. Submit a drilling plan and designate the equipment and techniques to be used, the proposed method of mud disposal, and evidence that the proposed plan, techniques and equipment are acceptable to the ductile iron pipe manufacturer for installation of ductile iron pipe.
- B. Perform drilling from locations that will provide ample working area around the drilling machine with sufficient laydown area for the length of pipe to be pre-assembled and installed.

- C. Conduct directional drilling in three (3) stages which including the drilling of the pilot hole, reaming of the pilot hole and back-pulling of the ductile iron pipe through the reamed hole.
 - D. Drill the pilot hole such that the angle of entry of the drill bit and wash pipe will be between 8° and 20°.
 - E. Provide a tracking device which shall be capable of providing the path and the depth of the drill bit in order to maintain alignment and depth of cover as shown on the drawings and/or required by the approved drilling plan.
 - F. Pilot hole integrity shall be maintained by pumping a bentonite and water slurry into the hole. Slurry discharged from the exit hole may be collected and reused provided that cutting must be filtered from the slurry.
 - G. Ream bore diameter of a diameter that will not allow the ductile iron pipe joints to exceed the maximum allowable deflection. Maximum allowable deflection shall be 5° unless otherwise specified.
 - H. Provide double of polyethylene encasement for the ductile iron pipe in accordance with pipe manufacturer's written instructions and AWWA C105.
 - I. Pull ductile iron pipe only from spigot end. Do not exceed pulling force specified by the ductile iron pipe manufacturer.
 - J. Filling, testing and disinfection of the installed ductile iron pipe shall be as specified in SECTION 02713 of these Specifications, except that testing of that section of the pipeline within the limits given for a particular crossing shall be performed separately from the testing of other sections of the pipeline.
- 3.10 Backfilling: Permanently backfill bore pits, drilling pits, slurry pits and trenches immediately after approval of the crossing pipe installation by the Engineer. Backfilling and compaction shall be as specified in SECTION 02221 of these Specifications and shall conform to applicable D.O.T. or railroad permit requirements.
- 3.11 Restoration and Clean-up: Remove all material not used and all rubbish of every description from the job site. Restore all private and public facilities and structures that have been disturbed to essentially as good a condition as existed prior to the Work.

SECTION 02269 – EROSION & SEDIMENT CONTROL

PART 1 – GENERAL

- 1.1 Section Includes: Providing adequate protection against erosion and sediment transport off the site(s) during the execution of the Work including, but not limited to, those features specifically shown on the Drawings and/or required by the approved Erosion and Sediment Control Plan.
- 1.2 Reference Standards:
- A. "Manual for Erosion and Sediment Control in Georgia" Fourth Edition, Revised 2000, prepared by the Georgia Soil and Water Conservation Commission.
 - B. "Standard Specifications for Construction of Transportation Systems, 2001 Edition", Georgia Department of Transportation. Sections of which are referenced herein as the "DOT Specifications".
- 1.3 Site Conditions:
- A. Protect all adjacent public and private property from siltation and other damage due to construction activities.
 - B. Confirm that applicable Land Disturbance Permit has been obtained by Owner for the Work. Comply with approved Erosion and Sediment Control Plan, if applicable, and with all local and state regulations relating to erosion and sediment control.
 - C. Maintain all temporary controls in place until permanent grassing or landscaping has been completed.

- D. Provide supplementary erosion and run-off control measures whenever it becomes apparent that additional problems exist.

PART 2 – PRODUCTS

- 2.1 Hay or Straw Bales: Wire-bound or string-tied.
- 2.2 Silt Fence: Type A (36” width) unless otherwise shown on the Drawings or on the approved Erosion and Sediment Control Plan. Woven or non-woven fabric as listed on Georgia D.O.T. Qualified Products List #36.
- 2.3 Stakes: For Type A and Type B Silt Fence: 1.5” x 1.5” x 48” hardwood, or 2” x 4” x 48” soft wood, or 1.3 lb./ft. steel posts. Maximum 6-foot spacing.
- 2.4 Seed: Select plants appropriate to the season and site conditions from Appendix A of “On-site Erosion Control.” Temporary grass shall be a quick growing species such as millet, rye grass, Italian rye grass or cereal grasses suitable to the area providing a temporary cover which will not later compete with grasses sown for permanent cover. Seed shall meet the requirements of the Georgia Seed Law Rules and Regulations.
- 2.5 Lime: Agricultural grade ground or pulverized limestone.
- 2.6 Fertilizer: Standard commercial grade, either 4-12-12, 6-12-12 or 5-10-15.
- 2.7 Corrugated Metal Pipe: 16-gauge, Type I or Type II culvert pipe conforming to AASHTO M36.
- 2.8 Stone for Construction Exit/Entrance Pad: National Stone Association R-2 (1.5” to 3.5” stone), or DOT Specifications. Section 800, Size No. 3 (1” to 2.5”).
- 2.9 Riprap: Conforming to DOT Specification Section 805.2.01, Stone for Plain Riprap, Type 3 (or Type 1 if noted on Drawings).

PART 3 – EXECUTION

- 3.1 Inspection: Prior to clearing the site, inspect site and determine all preliminary erosion control measures that will be required to prevent erosion and sedimentation problems and comply with any applicable Erosion Control Plans approved by local and/or state authorities.
- 3.2 Preparation: Provide all necessary materials at the site prior to clearing and/or grading.
- 3.3 Installation:
- A. Where applicable, provide temporary stone exit/entrance pad located at points of vehicular ingress and egress to the site and maintain in service until pavement is placed. Minimum pad thickness shall be 6”; minimum width shall be 20 feet; minimum length shall be 50 feet. Maintain in a condition that will prevent tracking or flow of mud onto public roads.
 - B. Promptly clean-up any mud and debris tracked on to public roadways. Clean by scraping, power brushing and hosing down with water.
 - C. Provide erosion and sediment control barriers as shown on the Drawings, as required by the approved Erosion Control Plan, or as needed for the proposed construction methods and procedures to detain sediment on site.
 - D. If impoundments or sediment traps are required, construct these prior to clearing operations except the minimum clearing necessary for construction of sediment impoundments.
 - E. Install all permanent site drainage facilities as early as practical in the construction process. Where practical without creating erosion problems, divert run-off into permanent drainage facilities.
 - F. Provide temporary sediment barriers around drainage structures and all grading areas and excavations where sub-grades are being prepared.

- G. Provide diversion berms or dikes at top of all slopes and abrupt changes in slope. Diversion dikes or berms are to be minimum 2 feet in width and 18" in height. Machine-compact and provide temporary seeding immediately after construction.
 - H. Provide temporary drains where necessary to convey water down slopes. Drains may consist of pipes, filter cloth, rubble, concrete, asphalt or plastic sheets. Inspect for damage after each rainfall event and repair as required.
 - I. Provide riprap or other protection at all drainage discharge points to prevent scour at these points. Provide 4" filter material under riprap.
 - J. As soon as practical following grading of areas to be paved, apply an initial base course of stone of at least 4" thickness and maintain by periodic top dressing until final base course and pavement are installed.
 - K. Provide temporary seeding immediately on all disturbed areas which will not receive final grading or landscaping within fourteen (14) days.
 - L. Where no specific controls are called for on the Drawings for drainage leaving the site, provide check dams to create ponding for sediment deposition and collection of debris. Maximum height shall be four (4) feet and the impounded area shall be kept clean as much as practical.
- 3.4 **Maintenance:** Inspect for damage after each rainfall event. Clear all debris and accumulated sediment from behind barriers, check dams, etc. so that the functional capacity of these items is not significantly reduced throughout the construction period.
- 3.5 **Clean-Up:** Following completion of permanent site drainage, landscaping and establishment of full stand of permanent grassing, remove all temporary erosion control facilities and dispose of all accumulated waste in a manner approved by the Engineer. Landscape any resulting disturbed areas to conform to and blend with the remainder of the site landscaping.

SECTION 02270 – TEMPORARY SEEDING

PART 1 – GENERAL

- 1.1 **Work Included:** The Work covered by this Section consists of the establishment of a temporary vegetative cover on disturbed areas by seeding with appropriate rapidly growing annual plants. Temporary seeding shall be provided for all exposed soil surfaces that are not to be fine graded or landscaped within thirty (30) days after grading.
- 1.2 **References:** "On-site Erosion Control," prepared by State Soil and Water Conservation Committee of Georgia, November, 1979.

PART 2 – PRODUCTS

- 2.1 **Seed:** Select plants appropriate to the season and site conditions from Appendix A of "On-site Erosion Control." Temporary grass shall be a quick growing species such as millet, rye grasses, Italian rye grass, or cereal grasses suitable to the area providing a temporary cover which will not later compete with grasses sown for permanent cover. Seed shall meet the requirements of the Georgia Seed Law and Rules of Regulations.
- 2.2 **Lime:** Agricultural grade ground or pulverized limestone.
- 2.3 **Fertilizer:** Standard commercial grade, either 4-12-12, 6-12-12, or 5-10-15.

PART 3 – EXECUTION

- 3.1 **Seed-bed Preparation:**
- A. **Liming:** Where soils are know to be highly acid (pH 5.5 and lower), apply lime at the rate of two (2) tons per acre.

- B. Fertilizer: Apply at 450 lbs/acre or 10 lbs/1,000 square feet or equivalent. Lime and fertilizer shall be incorporated into the top 2 to 4 inches of the soil.
- C. Surface Roughening: Loosen surface by discing, raking or harrowing approximately 3 inches of surface. If the area has been recently loosed or disturbed, no further roughening is required. Remove all large clods, boulders, and debris which will interfere with the Work.
- 3.2 Seeding: Apply seed evenly with a cyclone seeder, drill, cultipacker seeder or hydroseeder. Small grains shall be planted no more than 1" deep. Grasses and legumes shall be planted no more than ¼" deep. Distribution by hand will not be permitted.
- 3.3 Rolling: Roll all seeded areas before applying mulch. On steep slopes cover seeds by dragging spiked chains or other satisfactory method.
- 3.4 Mulching: Mulch all seedlings. Mulch shall be straw or hay spread at the rate of approximately two (2) tons/acre; wood cellulose fiber applied at the rate of approximately 1,500 lbs/acre; or other material approved by the Owner's Representative. Bituminous treated mulch shall be used on all slopes steeper than 2:1. Anchor mulch immediately after application using 5 gallons/1,000 square feet of emulsified asphalt on flat area and 8 gallons/1,000 square feet on slopes steeper than 2:1 or 8 feet in height.
- 3.5 Watering: Provide watering as required to establish and maintain vegetative cover.
- 3.6 Reseeding: Reseed as required to establish and maintain vegetative cover to prevent sheet and rill erosion until permanent grassing or landscaping activities have been initiated.

SECTION 02271 – RIPRAP

PART 1 – GENERAL

- 1.1 Section Includes: Furnishing, installation and maintenance of stone riprap as shown on the Drawings and described herein.
- 1.2 Quality Assurance: Submit letter from stone supplier certifying conformance to these and referenced Specifications.
- 1.3 Reference Standards: "Standard Specifications for Construction of Transportation Systems, 2001 Edition" Georgia Department of Transportation,. Sections of which are referenced herein as the "DOT Specifications".

PART 2 – PRODUCTS

- 2.1 Riprap: DOT Specification Section 805.1, Stone Plain Riprap, Type 3 (or Type 1 if noted on Drawings).
- 2.2 Filter Stone: Georgia D.O.T. Standard Specification Section 815.01, Graded Aggregate or Section 800, Coarse Aggregate Size No. 467.
- 2.3 Filter Fabric: Georgia D.O.T. Standard Specification Section 881.06, for woven fabrics.

PART 3 – EXECUTION

- 3.1 Areas to be Riprapped: Place riprap as indicated on the Drawings to the dimensions and thicknesses shown and conforming to DOT Specifications Section 603.03.
- 3.2 Preparation: Clear and grade the area to receive riprap, filter stone (or filter fabric) and carefully shape the receiving surface to result in the finished cross sections and grades shown on the Drawings.
- 3.3 Placing Filter Material: Dump filter stone and handle into place to form a compacted layer, minimum 4" thickness. If fabric is used, lay fabric sheets with long dimension up the slope, minimizing horizontal laps. Overlap sheets a minimum of 12". Anchor the sheets with 15" pins in center of lap at 3-foot spacing.

- 3.4 Placing Stone Riprap: Dump riprap stone and handle into place to form a compact layer to the design thickness, but not less than 12" minimum thickness. Finished surface shall be uniform in conformance with the specified cross-section.
- 3.5 Placing Grouted Riprap: If specified, fill spaces between stone with approved 1:3 grout, sweep to a uniform and smooth surface with still bristle broom, and cure for at least five (5) days.

SECTION 02300 - EARTHWORK

PART 1 – GENERAL

- 1.1 Section Includes: Site grading and filling, including excavation and filling for structures and access roads; removal and disposal of rock and unsuitable materials (if any); pumping and dewatering; sheeting and shoring; borrow, delivery and placement of off-site borrow material; placing and compaction of controlled fill; and finish grading of the site. Utility trenching is specified elsewhere.
- 1.2 Related Sections:
- A. SECTION 02269 – EROSION AND SEDIMENT CONTROL
 - B. SECTION 02480 – HYDROSEEDING AND LANDSCAPING
- 1.3 Quality Assurance:
- A. Comply with provisions of SECTION 01450.
 - B. Imported fill material, if required, shall be subject to approval of the Engineer. For approval of imported fill materials, notify the Engineer at least five (5) working days in advance of intention to import material and designate the proposed borrow area. Allow the testing laboratory to sample as necessary from the borrow area for the purpose of making acceptance tests of the material.
 - C. Fill material which settles shall be removed and replaced with suitable material at no cost to the Owner. Construction, paving, landscaping and other improvements damaged by settlement shall be removed and replaced or reworked with suitable material at no cost to the Owner.
 - D. All excavations shall be inspected and approved by the Engineer prior to backfilling.
- 1.4 Reference Standards:
- A. ASTM D422-63 (2002) Test Method for Particle-Size Analysis of Soils.
 - B. ASTM D698-00, Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixture Using 5.5 lb (2.49 kg) Rammer and 12" (305-mm) Drop (Standard Proctor).
 - C. ASTM D1556-00, Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
 - D. ASTM D2167-94, Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
 - E. ASTM D2487-00, Test Method for Classification of Soils for Engineering Purposes.
 - F. ASTM 4318-00, Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
 - G. NEPA 495, Code for the Manufacture, Transportation, Storage and Use of Explosives.
- 1.5 Site Conditions:
- A. Check existing grades on the site prior to starting. Beginning of any grading shall constitute acceptance of the existing site conditions.

- B. Allowable borrow or waste areas, unless designated on the Drawings, shall be approved by the Owner prior to start of construction.

PART 2 – PRODUCTS

- 2.1 General: All structural fill must be capable of safely supporting 3,000 psf when compacted as specified.
- 2.2 Material for Controlled Fill: Granular inorganic soil or crushed stone with maximum dry density of 90 lb/cf or more, plasticity index less than 30. Material shall be free of unsuitable material. Maximum particle size shall be 3”.
- 2.3 Crushed Stone or GAB: Sound durable particles of crushed run limestone rock, all of which passes a 1 ½” sieve, free of organic matter, debris or unsuitable material. Shall conform to Georgia DOT Specification Section 815.01 for graded aggregate.
- 2.4 Unsuitable Material: Any Class IVA, IVB or V soil per ASTM D2321; any topsoil, roots, vegetable matter, trash, debris, asphalt, frozen or excessively wet soil; or any stone or gravel larger than 3” in maximum dimension or contaminated soil. Unsuitable material also includes soils not maintained within 2% of optimum moisture content.
- 2.5 Rock Definition: Rock is defined as any material that cannot be excavated with a single-tooth ripper drawn by a crawler tractor having a draw bar pull rated at not less than 56,000 pounds (Caterpillar D8K or equivalent) or excavated by a front-end loader with a minimum bucket breakout force of 25,600 pounds (Caterpillar 977 or equivalent). Rocks and boulders having a volume of 8 cubic yards or less shall not be classified as “rock”.
- 2.6 Topsoil: Natural, friable soil which produces heavy growth vegetation and is representative of the soil in the vicinity. Organic matter 1.5% minimum; pH between 5.0 and 7.0.

PART 3 – EXECUTION

- 3.1 Inspection: Verify that all preceding Work affecting Work of this Section has been satisfactorily completed.
- 3.2 Preparation:
- A. Notify all utility companies and locate, stake and flag all existing underground utilities prior to start of any excavation activities.
 - B. Provide and preserve sufficient reference points to ensure that Work conforms to the Contract Documents.
 - C. Provide dewatering as required. Do not undertake earthwork until suitable dewatering has been provided. Keep excavations free of water and protect subgrades from softening, undermining, washout, or other damage by rain or water accumulations.
 - D. Provide drainage control around areas to be graded to minimize erosion and siltation of adjacent surface waters. Comply with Land Disturbance Permit requirements, if applicable, and install erosion and sediment control measures *prior* to start of grading operations.
 - E. Erect barricades, sheeting, shoring and bracing as necessary for protection of persons, improvements, excavations, existing facilities and physical features that are to remain undisturbed.
 - F. Strip topsoil to a depth of at least six (6) inches from all areas within ten (10) feet of the limits of excavation or embankment. Stockpile the topsoil in such locations as approved by the Engineer and preserve for surfacing fill or excavated areas, or other disposal as approved by the Engineer.
 - G. Proof-roll all stripped areas which area to be subgrades beneath slabs, structures, buildings or pavements. Make at least three (3) coverages with a loaded dump truck or loaded earth-moving scraper in the presence of the Engineer. Remove all soft or yielding areas, loose soil or debris. Replace with suitable compacted fill.
- 3.3 General Excavation:

- A. Excavate whatever material is encountered, including rock, debris, remnants of existing structures and unsuitable material to the lines and grades shown on the Drawings. Remove existing fill material found under proposed foundations and slabs.
- B. All excavation shall be considered UNCLASSIFIED. Whether or not rock or unsuitable material is indicated by the Drawings, the Contractor is responsible for investigation to determine the extent of rock or unsuitable material. The presence of rock or unsuitable material shall not entitle the Contractor to additional compensation.
- C. Do not bring explosives on site or use in the Work without prior written notice to the Owner. Conduct blasting operations in strict accordance with all existing ordinances and regulations. Comply with NEPA 495 requirements. Protect all exposed structures from the effects of blast. Cover all blasts with heavy timbers, mats or other suitable protection. The blasting shall be done only by experienced specialists who are licensed for blasting work. Use very light charges to prevent damages to adjacent structures. Promptly repair or replace any facilities damaged by blasting operations at no cost to the Owner. Secure and store all blasting supplies in accordance with Federal, state and local law. In no case shall caps or other explosives be kept at the place where dynamite or other explosives are stored.
- D. Dispose of all unsuitable material at off-site, or on-site, locations specifically shown on the Drawings, or otherwise approved by the Owner. All rock excavated from the site shall be removed and disposed of off site unless the Engineer or Owner issues written instruction for on-site disposal.
- E. If conditions are encountered which might in any way endanger the Work, cease excavation and immediately notify the Engineer. Protect the site from erosion damage and perform no further earthwork operations until directed.

3.4 Structural Excavation:

- A. Excavations for building and structural foundations shall comply with all requirements listed in Section 3.3 of General Excavations.
- B. Structural excavation shall be sufficient to allow inspection of foundation walls and to permit the various trades to install their work. Trenches for formed foundation walls or piers shall be a minimum of two (2) feet wider than the wall or pier thickness.
- C. Excavation for footings shall be to the exact footing dimensions. If, for any reason, the excavation is carried below the exact lines of the footings or slabs, fill in the excess excavated volume with concrete under walls and footing, and with compacted crushed stone under slabs. Concrete for this purpose shall be of the same quality and mix as that for footings.
- D. When rock is encountered in the subgrade, excavate it to a minimum depth of 6" below the contemplated surface of the subgrade for the full width of the subgrade.
- E. Cut off bottoms of footing trenches level and remove all loose soil. Carefully examine all rock bottoms for footings and remove all loose or broken rock to solid bearing. Level or shelve rock surfaces to a slope not exceeding 1" per foot.
- F. Make no footing or slab excavation to full depth indicated when freezing temperatures may be expected unless footings or slabs can be poured immediately after this has been completed and inspected. Protect all foundation concrete from freezing in accordance with Specification SECTION 03300-Cast-In-Place Concrete.

3.5 Controlled Fill:

- A. Borrow Approval: Obtain Engineer's approval of borrow site and borrow material prior to start of filling operations.
- B. Preparation: Plow and scarify the upper 8" of existing ground and re-compact to 95% maximum density (Standard Proctor). Plow, step (bench) or break up sloped ground surfaces steeper than one vertical to four horizontal (1:4) on which fill is to be placed in such manner that the fill material will bond with the existing surface.

C. Placement:

1. Using approved Material for Controlled Fill, place material in 6" to 8" un-compacted (loose measure) layers. Uniformly and evenly spread each layer and blade mix during spreading to achieve uniformity of materials throughout the layer. Thoroughly compact each layer by use of heavy, tracked vehicles, sheepsfoot rollers, or other suitable equipment. Use heavy power tampering equipment around structures.
2. Maintain moisture content of fill as required to attain the degree of compaction specified. Fill soil should be placed with a moisture content within 4% of the optimum moisture content. Where necessary, dry out or moisten soil to produce optimum moisture content necessary for optimum compaction. Remove and stockpile soil that is too wet for optimum compaction. These soils may be reused after drying and upon approval by the Engineer.
3. Rock may be used in Controlled Fill only when specifically approved by the Engineer. If approved, fill that is within two (2) feet of the finished subgrade and in areas to be trenched for utilities may contain rock not over one (1) foot in its greatest dimension. Construct each layer so that all rock voids are filled with earth, rock spall, or rock fines. Place and manipulate the rock in uniform layers. Do not dump rock over the edges of the layer being constructed. Instead, deposit rock on the layer and move ahead so as to advance the layer with a mixture of rock, rock spall, rock fines and earth. The two (2) feet of the embankment immediately below the finished subgrade shall be composed of materials which can be placed in layers not exceeding 6" in thickness. Do not place rock greater than 3" in its greatest dimension with the upper 12" of the finished subgrade or within three (3) feet of any wall or surface of any structure.
4. Do not backfill around structures until after the forms are removed and the structure has been approved for backfilling. Place backfill in layers as specified herein. Compact with care to avoid damage to structures.
5. If paved areas (or areas to be paved) abut structures, backfill these areas with crushed stone.
6. When No. 57 or larger stone is used to backfill under slabs and around structures, compact using vibratory rollers/compactors and provide a cap of at least 6" of GAB over the No. 57 stone to provide a working surface.

D. Compaction:

1. Compact areas beneath proposed buildings and structures to not less than 98% of maximum dry density as determined by ASTM D698.
2. Compact areas beneath roadway, roadway shoulders, and parking lots, paved or unpaved, to no less than 95% of the maximum dry density as determined by ASTM D698.
3. Compact areas to be landscaped to not less than 90% of the maximum dry density as determined by ASTM D698.

3.6 Finish Site Grading:

- A. Perform finish grading to provide the elevations and grades shown on the Drawings. Blend finish grades into conformity with natural ground surfaces. Leave all graded surfaces smooth and free to drain. Provide berm ditches at the tops of all cuts.
- B. Generally, permanent cut slopes shall not be steeper than 2.5H:1V and fill slopes no steeper than 3H:1V.
- C. Trim and finish all open slopes to conform to the slope lines shown on the Drawings. Leave the finished surfaces in smooth, uniform planes.

- D. Spread topsoil which has been obtained from stripping the site upon the slopes of fills and other areas to be grassed. Spread excess materials as directed by the Engineer or remove from the site. If sufficient topsoil to provide 2" cover is not available on-site, obtain topsoil from off-site.
- E. Bring finish grading work in all areas to neat and smooth finish to the grades shown on the Drawings and specified herein to a tolerance of ± 0.05 foot for areas to be paved and ± 0.1 foot for all other areas.

3.7 Field Quality Control:

- A. Perform sufficient quality control compaction test as required by the approved schedule for Controlled Fill to ensure adequate compacted throughout the site. The test frequency for density tests shall be at least one (1) test per 1,500 square feet for each two (2) feet of fill thickness.
- B. For structural fill, provide for testing and approval of each lift before any additional lifts are placed.
- C. Notify the testing laboratory and the Engineer 24 hours prior to need for testing. Allow time to perform the tests upon completion of each layer of fill in designated areas. Provide equipment to cut out smooth surfaced spot locations on which to perform the test. When the tests indicate that density or moisture content does not meet requirements specified herein, rework the particular layer or portion thereof by rolling or scarifying, wetting, or drying and re-compacting until achieving the required density.
- D. Prior to acceptance of filled areas for any structure, slab, or area to be paved, proof rolling in the presence of the Engineer is required. Make at least three (3) coverages with a loaded dump truck or loaded earth-moving scraper. Remove all soft or yielding areas, loose soil or debris. Replace with suitable compacted fill or crushed stone as directed by the Engineer.

SECTION 02444 – CHAIN LINK FENCES AND GATES

PART 1 – GENERAL

- 1.1 Section Includes: Furnishing and installing chain link fencing, gates and related appurtenances for permanent perimeter security fencing for the site as shown on the Drawings.
- 1.2 Reference Standards:
 - A. Chain Link Fence Manufactures Institute, PRODUCT MANUAL, 1997.
 - B. Installation of Chain Link Fence, ANSI/ASTM F567-00.
 - C. "Standard Specifications for Construction of Transportation Systems, 2001 Edition" Georgia Department of Transportation. Referred to herein as the "DOT Specifications".
- 1.3 Submittals: Submit under provisions of SECTION 01330.
 - A. Product Data: Material descriptions, construction details, dimensions of individual components and profiles, and finishes for the following:
 - 1. Fence and gate posts, rails and fittings.
 - 2. Chain-link fabric, reinforcements and attachments.
 - 3. Gates and hardware.
 - B. Shop Drawings: Show locations of fence, each gate, posts, rails, and tension wires and details of extended posts, extension arms, gate swing, or other operation, hardware and accessories. Indicate materials, dimensions, sizes, weights and finishes of components. Include plans, elevations, sections, gate swing and other required installation and operational clearances, and details of post-anchorage and attachment and bracing.

1.4 Quality Assurance:

- A. Installer Qualifications: An experienced installer with a record of installing chain-link fences and gates similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Source Limitations for Chain-Link Fences and Gates: Obtain each color, grade, finish, type and variety of component for chain-link fences and gates from a single source with resources to provide chain-link fences and gates of consistent quality in appearance and physical properties.

1.5 Project Conditions:

- A. Field Measurements: Before commencing installation, verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.
- B. Obtain Engineer's approval of layout before beginning fence installation.

1.6 Delivery, Storage and Handling: Deliver materials to the job site with manufacturer's tags and labels intact.

PART 2 – PRODUCTS

2.1 General: Fence components must be galvanically compatible. All steel components shall be hot dip galvanized. All products shall conform to Chain Link Manufacturers Institute's "Standard Guide for Metallic-Coated Chain Link Fence", Latest Edition, unless otherwise specified herein.

2.2 Chain Link Fabric: Type II – Class I, as per ASTM A817-03. No 9 gauge (0.148"), galvanized after weaving by hot-dipped process with not less than 1.2 oz. or zinc per sq. ft. Once piece fabric, 72" in height, 2" mesh size, knuckled at one selvage and twisted and bared at the other selvage.

2.3 Gates: Swing or slide, as indicated on the Drawings. Swing gates shall conform to ASTM F900-03; Slide gates shall conform to ASTM F1184-03.

A. Framing Members: Minimum 1.66" O.D. steel pipe for gates six (6) feet or less, 1.90" O.D. for wider gates, welded or with corner fittings and 3/8" galvanized steel truss rods. Vertical interior bracing at 8-foot intervals.

B. Gate Fabric: Same as fence fabric.

C. Hinges: Heavy-duty galvanized steel, non-lift-off, adequate for weight of gate. Gates shall be easily operated by one (1) person.

D. Provide heavy duty chain and padlock with four (4) keys for each gate.

E. Fork type latch with plunger operable from either side of gate, with hasp as integral part of latch.

F. Mechanical keeper for each gate leaf to secure free end of gate when in full, open position.

G. Center Gate Stop: Set in concrete base to receive plunger bar.

2.4 Posts: Type I round hot dipped galvanized conforming to ASTM F1083-04 standard weight (Schedule 40) or Type II steel pipe ASTM F-669-92, Group IC, 50,000 p.s.i. minimum yield strength, external and internal zinc coating.

A. Line Posts: 2.375" O.D. steel pipe, 10-foot spacing maximum.

B. Corner Posts, Terminal Posts and Pull Posts: 2.88" O.D. steel pipe.

C. Gate Posts: 2.875" O.D. for gates 6-foot width or less; 4" O.D. steel pipe for gates between six (6) feet and 13 feet; and 6.625" O.D. for gates wider than 13 feet.

2.5 Accessories:

- A. Top Rail: 1.66" O.D. steel pipe, 6" steel couplings for each joint, with tie wires at 24" maximum intervals for securing to each gate, corner, pull and end post.
- B. Tension Wire: 6-gauge zinc coated steel, ASTM A824-01.
- C. Stretcher Bars: 3/16" x 3/4" hot-dipped galvanized steel, full height of fabric one for each End, Corner, Pull, and Gate Post, with pressed steel bands 15" on center.
- D. Post Tops: Manufacturer's standard ornamental top, set screw retained, with holes for top rail and extension arm; designed shall exclude moisture from post.
- E. Truss Rods: 3/8" diameter galvanized steel rods for each Gate Post, End Post, Pull Post, and both sides of Corner Posts.
- F. Accessories consisting of manufacturer's standard pipe, caps, bolts, wire ties, and clips, etc. all galvanized steel.
- G. Extension Arms: Cast steel to accommodate three (3) strands of barbed wire, single arm, sloped to 45° except at corner and gate posts. Each arm shall be capable of supporting at least 250 lbs.
- H. Barbed Wire: 12.5 gage twisted, 3 strands, with 14 gage, 4 point barbs spaced at 5"; zinc-coated steel conforming to ASTM A121-99(2004), Class 3.

PART 3 – EXECUTION

- 3.1 Inspection: Verify that clearing and final grading in fence area is complete and that there are no irregularities which would interfere with proper fence installation. Grading must be such that no more than 3" vertical space will exist under the fence.
- 3.2 Layout:
 - A. Measure and stake-out the layout of complete fence line and gates for inspection by Engineer and Owner's representative.
 - B. Locate and mark position of posts. Locate line posts at equal distance, spacing not exceeding 10-foot centers.
 - C. Locate corner posts at positions where fence changes direction more than 10°.
 - D. Obtain Engineer's approval of layout before starting installation of posts.
- 3.3 Installation: All erection shall be performed by competent and experienced fence mechanics.
 - A. Install framework fabric, accessories and gates in accordance with ANSI/ASTM F567-00, except that using mechanical devices to set line posts per ASTM F567 is not permitted.
 - B. Posts:
 - 1. Use Pull Posts at all abrupt changes in grade and at intervals of 300 feet.
 - 2. Encase line posts in 36" depth of concrete. Encase Corner, End, Pull, and Gate Posts in 42" depth of concrete.
 - 3. Provide concrete encasement, 12" minimum diameter, for line posts. Provide concrete encasement, four times post O.D., but not less than 18" diameter, for End, Corner, Pull, and Gate Posts.
 - 4. "Float" posts in concrete to provide at least 6" of concrete below bottom of posts.
 - 5. Set posts plumb to 1/4" in 10 feet. No exceptions.

6. Crown surface of concrete 2" above grade to slope away from post.
7. Allow all concrete to set firmly before proceeding with fabric and appurtenances.

C. Fence Fabric:

1. Place rail and bottom tension wire before stretching fabric.
2. Position bottom of fabric approximately 1" to 2" above ground level at each post. Stretch fabric tight between terminal posts using mechanical fence stretchers.
3. Cut fabric to form one continuous piece between terminal posts.
4. Attach fabric to terminal posts using tension bars and tension bands.
5. Attach fabric to line posts using wire ties or clips, spacing not to exceed 15" O.C.
6. Attach top edge of fabric to top rail using wire ties or clips, spacing not to exceed 24" O.C.
7. Attach bottom edge of fabric to bottom tension wire using wire ties or clips, spacing not to exceed 24" O.C.
8. Provide braces for Gate Posts and at each Corner, Pull, and End Post.
9. Provide three (3) strands of barbed wire above fence. Stretch strands to remove sag. Install on extension arms inclined at a 45° angle outward. Extension arms on corner posts and gates shall be vertical.

D. Gates: Install gates plumb and level to within ¼" in 10 feet. Install all ground-set items in concrete.

3.4 Adjust and Clean:

- A. Adjust brace rails and tension rods for tight, rigid installation.
- B. Tighten all hardware, fasteners and accessories.
- C. Adjust gate hardware to provide smooth operation.
- D. Remove excess and waste fence materials from project site.

SECTION 02480 – HYDROSEEDING AND LANDSCAPING

PART 1 – GENERAL

- 1.1 Section Includes: Preparing the ground surface; furnishing and applying lime; applying fertilizer and seed by HYDROSEEDING; mulching to establish a stand of mowable grass in all unpaved areas that have been disturbed; and replacement of all disturbed shrubs, trees and miscellaneous plants that are to remain.
- 1.2 Reference Standards: "Standard Specifications for Construction of Transportation Systems, 2001 Edition," Georgia Department of Transportation. Referred to herein as the "DOT Specifications".
- 1.3 Submittals: Submit under provisions of SECTION 01330.
 - A. Submit list of grasses, seeding rates and seeding dates for Engineer's review and approval prior to seeding.

PART 2 – PRODUCTS

- 2.1 Fertilizer: Standard commercial grade, 6-12-12 (N-P-K).

- 2.2 Lime: Agricultural grade, ground or pulverized limestone.
- 2.3 Grass Seed and Sod: Select grasses or sod appropriate to the season and site conditions from Table 700.04D in the DOT Specifications. Seed and sod shall conform to Section 890. Grass seed to be used in previously grassed areas shall be equal type and grade to the previously existing grass. Include a mixture of temporary grasses when applying permanent grass.
- 2.4 Mulch: As specified in Section 893.2.02 and Section 718.2 of the DOT Specifications.
- 2.5 Erosion Control Mats: As specified in Sections 893.2.02 and 418.2 of the DOT Specifications.
- 2.6 Trees, Shrubbery and Miscellaneous Plants: To be as specified in Standard Specification Section 893.2.03. All trees, shrubbery and plants damaged by the Work shall be replaced with identical plants of the same general size and quality as previously existed.

PART 3 – EXECUTION

- 3.1 Areas to be Grassed: All areas which are disturbed by construction activities including trenches and ungraded cleared areas, except areas to be paved, shall be provided with a full stand of permanent grass. Seed with temporary grass cover only for all disturbed areas that for any reason cannot be permanently grassed within 14 days after disturbing.
- 3.2 Preparation:
- A. Remove all rocks and debris of any kind from the area to be grassed and rake surface smooth to conform to adjacent ground. Loosen surface by discing, raking or harrowing to result in a smooth surface, free of rocks and mowable by residential-type lawn mower.
 - B. Apply lime at a rate of 2 tons/acre (92 lbs. per 1,000 sq. ft.).
 - C. Apply fertilizer at the rate of 1,500 lbs./acre (34 lbs. per 1,000 sq. ft.). *Fertilizer may be applied by hydroseeding.*
 - D. Prepare seedbed by thoroughly mixing lime with soil into the top 4” of the surface by discing or tilling prior to seeding. Roll to provide a firm, smooth seedbed.
- 3.3 Seeding: Apply seed evenly on freshly prepared and rolled seedbed. (May be applied by hydroseeder.) Include both temporary and permanent grasses in all seeding of permanent grasses. Include wood fiber mulch used as a metering agent applied at a rate of approximately 500 lbs./acre with the seed and fertilizer in the form of a slurry.
- 3.4 Rolling: Roll all seeded areas before applying mulch.
- 3.5 Mulching: Mulch the entire seeded area as specified in Section 700.3.05 of the DOT Specifications. Apply straw or hay mulch to evenly cover the ground to a depth of at least $\frac{3}{4}$ ". Apply mulch within 24 hours after seeding. Anchor mulch in place using a disk harrow, a commercial tackifier or 1" mesh netting.
- 3.6 Watering: Provide watering as required to establish and maintain a full stand of healthy grass and landscaping.
- 3.7 Reseeding: Reseed as required to establish and maintain permanent vegetative cover to prevent sheet and rill erosion. Repair erosion damage as required and reseed as necessary to obtain a full stand of healthy grass.
- 3.8 Planting of Shrubbery, Trees and Miscellaneous Plants:
- A. Plant shrubbery in accordance with written recommendations of nursery supplying the plants including mulching, fertilizing and watering instructions.
 - B. Provide an approved written guarantee from nursery for all transplanted shrubbery and trees for one (1) year after final acceptance. Guarantee shall provide that failed plants be replaced. Guarantee shall provide for mulching, fertilizing and watering of replaced plants and shall extend the guarantee for one (1) year from date of replacement.

3.9 Maintenance:

- A. Establish a full stand of permanent grass and healthy shrubs, trees and plants before final acceptance of the Work by the Owner.
- B. Control erosion at all times. Where damage occurs, repair landscaping Work as quickly as practical after a problem is identified.
- C. After grass has been established, mow as often as needed to maintain height between 4” and 6” until final acceptance.

SECTION 02575 – PAVEMENT, CURB AND SIDEWALK REPLACEMENT

PART 1 – GENERAL

- 1.1 Work Included: The Work included in this Section consists of repair and replacement of pavements including concrete, asphalt, surface treatment; and crushed stone or gravel roadways; sidewalks; curbs and gutters; stabilized shoulders; and driveways.
- 1.2 Quality Assurance: Coring and testing of pavement may be performed by the Owner at Owner’s expense, except that the Contractor will pay for all costs of tests that reveal unacceptable workmanship or materials.
- 1.3 References: All Work and materials shall conform to “Standard Specifications, Construction of Road and Bridges,” Georgia Department of Transportation, 1989 Edition.
- 1.4 Submittals: Prior to any pavement repair work, submit a schedule of work and materials to the Owner for approval. This submittal shall include:
 - A. Name and address of paving contractor.
 - B. Source(s) of materials to be used for the various types of pavement repair.
 - C. Detailed specifications for all materials to be used, application rates, etc.
 - D. Certification from the paving subcontractor that the materials and methods will comply with these Specifications.

PART 2 – PRODUCTS

- 2.1 Crushed Stone Base: Shall be sound, durable, “crusher-run” rock, all of which passes a 2” sieve, free of organic material and debris.
- 2.2 Portland Cement Concrete: Shall be ready-mixed concrete having a compressive strength of 4,000 psi at 28 days and shall meet the requirements of Section 430 of Georgia D.O.T. Standard Specifications, Class 1.
- 2.3 Bituminous Prime: Shall conform to Georgia D.O.T. Standard Specifications Section 821.01.
- 2.4 Asphaltic Concrete: Shall be Hot Mix Asphaltic Concrete Type F conforming to Section 400 of Georgia D.O.T. Standard Specifications, from a source approved, in advance, by the Engineer.

PART 3 – EXECUTION

- 3.1 General: Restore all pavement, base, sidewalks, curbs and gutters, shoulders, and driveways equal to or better than the original, but not less thickness than specified herein or shown on the Drawings.
- 3.2 Lines and Grades: Establish and maintain lines and grades shown on the Drawings by means of line and grade stakes.
- 3.3 Backfill: Carefully backfill any excavated area on which pavement, sidewalks, or curbs and gutters are to be placed as specified in Section 02220 of these Specifications.

- 3.4 Pavement, Sidewalk, Curb and Gutter Cuts: Before placing any base, pavement, sidewalk or curb and gutter, saw-cut the existing pavement in a neat straight line along the trench line back from the top edges of the ditch line a distance of at least 9" on each side of the ditch to allow solid bearing edges for base and pavement.
- 3.5 Base: Upon completion and consolidation of backfill, and immediately before pavement is placed, excavate the area to be paved as required and provide a base for either D.O.T. Pavement Replacement or County Road and Driveway Pavement Replacement as shown on the Drawings. Base thickness shall be 6" minimum compacted thickness unless otherwise shown on the Drawings.
- 3.6 Bituminous Paving:
- A. Transport bituminous concrete paving mixes from an approved mixing plant to the Work site in tight vehicles with metal bottoms previously cleaned of all foreign materials. All such vehicles shall be suitably insulated to avoid heat losses. Each load shall be covered or otherwise protected to prevent cooling and loss of ingredients.
 - B. Prime base course and place surface course in accordance with Section 400 of the Georgia D.O.T. Standard Specifications. Surface course in-place, compacted thickness shall be 1 ½" minimum unless otherwise shown on the Drawings.
 - C. Prime base course and place surface course in accordance with Section 400 of the Georgia D.O.T. Standard Specifications. Surface course in-place, compacted thickness shall be 1 ½" minimum unless otherwise shown on the Drawings.
 - D. Unless otherwise indicated or approved, place all bituminous concrete and complete initial rolling during daylight hours. Mixture shall be at a temperature of between 225°F and 325°F when placed.
 - E. During application, take care to prevent the splattering of adjacent curbs, gutter, concrete paving, and structures. Hand spreading may be employed where machine is impractical.
 - F. All bituminous concrete paving finish grades shall be approximately 6" below adjacent concrete sidewalks, and/or curbs, except as specifically shown on Drawings. Finished surfaces shall be true to grades shown and straight within ½" in 10 feet when checked with a straightedge. No "bird baths" will be allowed.
 - G. Provide sufficient rollers to obtain the required pavement density. Continue rolling until no further compression can be obtained and all other roller marks are eliminated.
 - H. Do not permit rollers to stand on pavement which has not been fully compacted and which has not cooled to atmospheric temperature. To prevent adhesion of surface mixture to roller, keep wheel thoroughly moistened with water; however, an excessive use of water will not be permitted.
 - I. Maintain slow enough movement of roller at all times to avoid displacement of mixture. If any displacement occurs, correct at once by use of rakes and addition of fresh mixture.
 - J. Take precautions to prevent dropping or oil, gasoline, or grease on pavement.
 - K. Along edges of pavement along curbs, headers, aprons, manholes, valves boxes and similar places not accessible to roller, thoroughly compact asphalt with lightly oiled hand-operated vibrating rollers or mechanical tampers
 - L. After final rolling, do not permit vehicular traffic on asphalt pavement until it has cooled and hardened, and in no case sooner than six (6) hours.
- 3.7 Surface Treatment: Shall conform to triple surface treatment as defined in the Georgia D.O.T. Standard Specifications.
- A. The Contractor (or Subcontractor) shall select the aggregates and bituminous material to be used subject to approval of the Engineer.
 - B. Aggregates and bituminous material shall conform to, and be applied in conformance with Table No. 1, Section 424.05 of the Georgia D.O.T. Standard Specifications.

- C. Spread materials at a uniform rate; use hand work where necessary to ensure uniform, adequate cover.
 - D. Provide sufficient rolling to key the aggregate into the bituminous material.
 - E. Broom surface as necessary.
 - F. Do not permit traffic on any course until the bituminous material has cooled and set.
- 3.8 Portland Cement Concrete Pavement: Shall conform to requirements of Section 430 of Georgia D.O.T. Standard Specifications. Concrete shall meet minimum requirements for Class No. 1 concrete (3,500 psi, 28 days.)
- A. Place concrete in such a manner as to require as little rehandling as possible.
 - B. Provide reinforcement equal to the original pavement with sufficient ties to ensure an integral slab.
 - C. Vibrate concrete over its full width and depth.
 - D. Finish by float or finishing machine, continuously following placement.
- 3.9 Special Pavement Replacement: Where indicated on the Drawings, provide pavement replacement which conforms to these Specifications and special requirements indicated on the Drawing details.
- 3.10 Curbs and Gutters:
- A. Cut back to existing expansion joint or provide a saw-cut joint at the edges of old and new work.
 - B. Asphaltic concrete curb shall conform to requirements of Section 436 of Georgia D.O.T. Standard Specifications. Match existing curb.
 - C. Portland Cement Concrete curbs and gutters shall conform to Section 441 of Georgia D.O.T. Standard Specifications. Match existing curb. Construct ½” wide expansion joints with premolded joint filler across lengths or curb at all tangent points and at fifty (50) feet intervals and 1” wide expansion joints with premolded joint filler and ¾” joint sealing between curbs and concrete paving. Finish curb surfaces with dense uniform texture equal to burlap drag, and cross-score with ¼” deep cross joints at ten (10) foot intervals with edges smoothed at 1/8”
- 3.11 Sidewalks: Shall conform to requirements of Section 441 of Georgia D.O.T. Standard Specifications. Reinforce with #6 x #6 10/10 welded wire mesh. Minimum sidewalk thickness shall be 4”. Provide transverse contraction joints at six (6) foot intervals by cutting a groove in the fresh concrete 1” deep with a jointer having an approved radius and a cutting blade not over 1/8” thick. Construct ½” wide expansion joints with premolded joint filler across walks at a maximum of fifty (50) feet intervals. Finish to a broom or burlap drag gritty surface. Tool all joints and all edges to provide smooth border between sections. Match existing sidewalks.
- 3.12 Clean-Up: Before the Work shall be considered complete, remove all material not used and rubbish of every character from the job site. Any subsequent settlement of pavement or backfill, or erosion over or in the trenches, shall be replaced or repaired and the surface shall be brought to grade. Any and all items disturbed by the construction shall in every case be restored to their original conditions as closely as possible after completion of the construction.

SECTION 02620 – PIPE CULVERTS

PART 1 – GENERAL

- 1.5 Section Includes: Furnishing and installing storm drainage pipe, corrugated metal pipe (CMP) or reinforced concrete pipe (RCP), as indicated on the Drawings.
- 1.6 Related Work:

SECTION 02221 – TRENCHING, BACKFILLING AND COMPACTION

1.7 Reference Standards:

1. American Association of State Highway Transportation Officials (AASHTO) Standard Specifications for corrugated steel pipe, latest editions.
2. Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe (ASTM C76-04).
3. Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains (ASTM A760-01a).
4. Standard Practice for Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications (ASTM A798-01).

1.8 Submittals: Submit manufacturer's certification that pipe and accessories conform with these and referenced Specifications.

PART 2 – PRODUCTS

- 2.1 Corrugated Metal Pipe (CMP): In accordance with ASTM A760 or AASHTO M-36, Lock seam or welded joint with re-rolled ends. Pipe having a diameter of 48" or less shall be 14 gauge with 2 2/3" x 1/2" corrugation.
- 2.2 Coupling for CMP: 14 gauge hugger bands with O-ring gaskets and tie rods, or 24" connecting bands with rubber gasket meeting ASTM D1056-00 to provide watertight joint.
- 2.3 Coating for CMP and Accessories: Pipe and fittings shall have full bituminous coating conforming to AASHTO M-190 and ASTM A849-00.
- 2.4 Reinforced Concrete Pipe (RCP) Culvert: Pipe shall conform to ASTM C76, bell and spigot type, Class III, Wall B, 8-foot lengths. Joints shall be butyl mastic sealant conforming to Federal Specification SS-S-00210-A or "O"-ring gaskets conforming to ASTM C443-03. Pipe shall have circumferential steel reinforcement.

PART 3 – EXECUTION

3.1 Preparation:

- A. Provide construction stake-out and verify required inverts and alignment.
- B. Prepare trenches in accordance with Specification SECTION 02221 – Trenching, Backfilling and Compaction.

3.2 Bedding:

- A. Provide bedding appropriate for the pipe material being used and the site conditions encountered. Unless otherwise specified, bedding shall conform to Class D as shown on the Drawings.
- B. Maximum trench widths at the top of pipe = pipe outside diameter (O.D.) plus 24". If the maximum trench width is exceeded or rock is encountered, the bedding must be increased by one class at Contractor's expense. Minimum width of trench = O.D. of bell or coupling plus 12"

3.3 Installation of Culvert Pipe:

- A. Unload, store, lay, joint and backfill all pipe strictly in conformance with pipe manufacturer's instructions and recommendations.
- B. Carefully examine all pipe for defects before being lowered into the trench.

- C. Carefully grade the bottom of the trench. Lay pipe to the line and grade shown on the Drawings or as directed by the Engineer. The accuracy of the finish line and grade of the pipe shall be obtained in the preparation of the trench bottom. No pipe shall be laid on blocking of any kind.
 - D. Carefully assemble joints in strict conformance with manufacturer's instructions. Before backfilling, inspect each joint to ensure a secure watertight joint.
 - E. Backfill with suitable granular material and/or crushed stone meeting requirements of Specification SECTION 02221. Place sidefill material in layers not exceeding 6" in depth and compact to not less than 95% of the maximum dry density as determined by ASTM D698-00a. Maintain straight alignment and grade until placement and compaction of backfill has been completed.
 - F. During and after installation, repair any visible damage to the pipe coating using bituminous material equal to the original coating.
- 3.4 Clean-up and Restoration: Remove all material not used and rubbish of every character from the site. Replace or repair any subsequent settlement of pavement or backfill. Keep culverts and structures cleaned of mud, debris and silt caused by the construction until final acceptance of the Work.

SECTION 02713 – WATER DISTRIBUTION SYSTEMS

PART 1 – GENERAL

- 1.1 Work Included: The Work covered by this Section consists of furnishing and installing water distribution pipes, valves, fittings, and other appurtenances, including reaction blocking, testing and disinfection.
- 1.2 Related Work:
- A. SECTION 02221 – TRENCHING, BACKFILLING AND COMPACTION
 - B. SECTION 02269 – EROSION AND SEDIMENT CONTROL
 - C. SECTION 02480 – HYDROSEEDING AND LANDSCAPING
- 1.3 Reference Standards:
- A. All materials and installation shall conform to requirements of Georgia Rules for Safe Drinking Water Chapter 391-3-5, revised October 16, 1997 and Environmental Protection Division's *Minimum Standards for Public Water Systems*, latest edition.
 - B. Cement-Mortar Lining for Ductile-Iron Pipe and Gray-Iron Pipe and Fittings for Water (AWWA-C104-03).
 - C. Polyethylene Encasement for Ductile Iron Pipe Systems (AWWA C105-99).
 - D. Ductile-Iron and Gray-Iron Fittings, 3" through 48", for Water and Other Liquids (AWWA-C110-03).
 - E. Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings (AWWA-C111-00).
 - F. Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges (AWWA C115-99).
 - G. Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water and Other Liquids (AWWA-C151-02).
 - H. Ductile-Iron Compact Fittings, 3" through 64", for Water Service (AWWA C153-00).
 - I. Polyvinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series) (ASTM D2241-04a).
 - J. Rigid Polyvinyl (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds (ASTM D1784-03).

- K. Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4” through 12” for Water Distribution (AWWA C900-97).
- L. Metal-Seated Gate Valves for Water Supply Service (AWWA C500-02).
- M. Dry-Barrel Fire Hydrants (AWWA-C502-94).
- N. Rubber-Seated Butterfly Valves (AWWA-C504-00).
- O. Swing-Check Valves for Waterworks Service 2” through 24” NPS (AWWA-C508-01).
- P. Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service (AWWA-C515-01).
- Q. Double Check Valve Backflow Prevention Assembly (AWWA C510-97).
- R. Air Release, Air/Vacuum and Combination Air Valves for Water Works Service (AWWA C512-99).
- S. Protective Epoxy Interior Coatings for Valves and Hydrants (AWWA C550-01).
- T. Installation of Ductile-Iron Water Mains and Their Appurtenances (AWWA-C600-99).
- U. Underground Installation of PVC Pressure Pipe and Fittings for Water (AWWA C605-94).
- V. Disinfecting Water Mains (AWWA-C651-99).
- W. Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals (ASTM D3139-98).
- X. Elastomeric Seals (Gaskets) for Joining Plastic Pipe (ASTM F477-02e1).

1.4 Submittals: Submit under provisions of SECTION 01330.

- A. Submit complete descriptions, including manufacturer’s catalog data and operation and maintenance instructions, for all products for approval prior to shipment.
- B. Submit manufacturer’s certification for all pipe, valves, hydrants, and fittings shipped to the job stating that specified tests have been made and the results thereof comply with applicable specifications.

1.5 Delivery, Storage and Handling:

- A. Properly and safely unload, store and care for all material furnished by or to the Contractor until it has been incorporated into the Work and accepted.
- B. Unload pipe, fittings, valves and hydrants by lifting with hoists or skidding to avoid damage. Do not unload by rolling or dropping off trucks. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.
- C. Unload the material at the site of the Work, near the place where it will be placed in the trench. Place material so that it shall not interfere with traffic or create a safety hazard. Provide signs, lights and barricades as necessary to protect the public.
- D. Handle all material carefully to prevent breakage and to avoid damage to coatings and linings. Keep interior of all pipe, fittings, valves and hydrants free of all dirt or foreign matter at all times. Do not place materials in drainage ways or ditches.
- E. When materials cannot be placed along the site of the Work, store in protected area at no expense to the Owner. The Owner’s storage yards may be utilized if available.

- 1.6 Site Conditions: Reasonable quantities of water used for construction, testing, flushing or disinfection will be furnished by the Owner through connections to the Owner's water system made by the Contractor upon coordination with the Owner. Excessive usage may result in charges for water used.

PART 2 – PRODUCTS

- 2.1 Ductile Iron Pipe (DIP): Manufactured in USA in conformance with AWWA-C151 and cement mortar lined in accordance with AWWA-C104 standard thickness, with seal coat.
- A. Unless otherwise specified, pipe shall be Pressure Class 350 for 4" through 12" diameter pipe, Pressure Class 300 for 14" through 20" pipe and Pressure Class 250 for all larger diameters.
 - B. Unless otherwise specified, the pipe shall have push-on (P-O) compression type joints conforming to AWWA-C111.
 - C. Restrained joint (RJ) pipe, where specified or indicated on the Drawings, shall consist of push-on compression type joint with a locking gasket with stainless steel locking segments vulcanized into the gasket to grip the pipe to prevent joint separation. Restrained joints shall be Fast Grip Gasket by American Cast Iron Pipe Company or Field-Lok Gasket by U.S. Pipe Company, or equal approved by the Engineer. Retainer glands with set screws are not acceptable.
 - D. River Crossing Pipe, where specified, shall be flexible ball joint ductile iron pipe conforming to ANSI-A21.50 and ANSI A21.51, special class 56. Joints shall allow 15° deflection in any direction and allow minimum 100 ton safe end pull for 16" pipe. American Flex-Lok ball joint pipe, or approved equal.
- 2.2 Plastic Pipe (PVC): Polyvinyl Chloride (PVC) pipe conforming to all requirements of ASTM D2241. PVC plastic extrusion compound shall meet the requirements of ASTM D1784-03 for Class 12454-B (PVC 1120)
- A. Pipe and fittings shall be Standard Dimension Ratio 21 (SDR 21), unless otherwise specified on the Drawings. C900 pipe, if specified, shall be pressure Class 200, DR14, CI pipe equivalent OD, conforming to AWWA C900.
 - B. Pipe, couplings and fittings shall bear the National Sanitation Foundation Testing Laboratories, Incorporated (NSF) seal of approval for potable water use.
 - C. Pipe joints shall be integral push-on type complying with ASTM D3139-98, designed to provide for thermal expansion or contraction experience with a total temperature change of at least 75°F in each length of pipe. Gaskets shall be vulcanized natural or synthetic rubber conforming to AWWA C111 and ASTM F477.
- 2.3 Ductile Iron Fittings: Fittings for ductile iron pipe (DIP) and polyvinyl chloride (PVC) shall be ductile iron fittings. Fittings and accessories shall be manufactured in the USA. Fittings shall conform to AWWA C153 for diameters through 24" and AWWA C110 for diameters larger than 24". Fittings shall be pressure rated 350 p.s.i. for diameters through 24" and 250 p.s.i. for diameters larger than 24". Fittings will be paid at AWWA C110 weights (body weights only), regardless of actual weight of fitting used.
- A. Cement mortar lined in accordance with AWWA-C104, standard thickness, with seal coat. Interior walls shall be smooth and free of defects.
 - B. Mechanical joint (MJ) unless otherwise specified on the Drawings.
 - C. Fittings used on restrained joint (RJ) fittings with push-on compression type joints equal to those specified for restrained joint ductile iron pipe.
 - D. Rubber gasket joints shall conform to AWWA C111.
 - E. Gaskets for PVC pipe shall be plain rubber-transition type compatible with the type of pipe and fittings used.
- 2.4 Joint Restraint Devices:

- A. DIP with Push-on Joints: Wedge action restraint ring on the spigot end jointed by tie rods to a ductile iron follower gland behind the bell. Rated for 350 p.s.i. for 16" and small and 250 p.s.i. for 18" and larger. Series 1700 Megalug restraint harness as manufactured by EBAA Iron, Incorporated, or equal specifically approved by the Engineer.
 - B. DIP and Fittings with Mechanical Joints: Follower gland with individually actuated wedges. Rated for 350 p.s.i. for 16" and small and 250 p.s.i. for 18" and larger. Series 1100 Megalug restrain as manufactured by EBAA Iron, Incorporated, For Uni-Flange Series 1400, or equal specifically approved by the Engineer.
- 2.5 Butterfly Valves (BFV): All valves larger than 16" shall be butterfly valves conforming to AWWA C504.
- 2.6 Gate Valves, Metal –Seated: (Acceptable only for 8" and smaller mains.) Conform to AWWA C500 for double-disc type, iron body, bronze mounted valves for buried, vertical installation, except that valves shall be rated for 200 p.s.i. working pressure.
- A. Valve Ends: Mechanical joint unless shown otherwise on the Drawings.
 - B. Valve Discs: Double-disc type, parallel seat.
 - C. Stem and Seal: Bronze, non-rising stem (NRS), unless shown otherwise on the Drawings.
 - D. Epoxy Coating: Interior and exterior, shall conform to AWWA C550.
 - E. Operator: Manual operating nut, 2" square, unless shown otherwise on the Drawings; valve to open when turned to the left (counter-clockwise).
- 2.7 Gate Valves, Resilient Seat: Conform to AWWA C515 for reduced-wall, resilient seated, iron body, bronze mounted gate valves, except that all cast ferrous valve components shall be ductile iron.
- A. Valve Ends: Mechanical joint unless shown otherwise on the Drawings.
 - B. Valve Discs: Resilient rubber seat ring.
 - C. Stem and Seal: Bronze, non-rising stem (NRS), unless shown otherwise on the Drawings; O-ring seals.
 - D. Epoxy Coating: Interior and exterior, shall conform to AWWA C550.
 - E. Operator: Manual operating nut, 2" square, unless shown otherwise on the Drawings; valve to open when turned to the left (counter-clockwise).
- 2.8 Small Gate Valves: Gate valves smaller than 3" shall conform to the level of quality and manufacturing standards established for valves 3" and larger by the respective AWWA Standards. All small gate valves shall be rated for 200 p.s.i. working pressure.
- A. Valves for non-buried service shall be bronze body, rising stem, solid wedge disc, with handwheel, Crane 428, Jenkins 47, or equal specifically approved by the Engineer.
 - B. Valves for buried service shall be 200 p.s.i. iron body, non-rising stem, bronze mounted, metal seated, Mueller A-2360, Kennedy 1571X, 1579X, or an equivalent resilient seat type specifically approved by the Engineer. Provide standard 2" square operating nut on all valves for buried service.
- 2.9 Ball Valves 4" and Smaller: Two-way, lever-operated bronze body Ball Valve, Standard Port size, Pittsburgh Brass Manufacturing Company, Watts, Milwaukee Valve, or equal. Specifically approval by the Engineer. PVC ball valves, if specified, shall be Full-Flo True Union Ball Valves as manufactured by Hayward Manufacturing Company, Inc. or equal specifically approved by the Engineer..
- 2.10 Check Valves: In-line swing-check style shall conform to AWWA C508, ductile iron body, mechanical joint ends, resilient material-to-metal type seat. Check valves shall be rated for 200 p.s.i. working pressure. Provide outside

spring and level unless shown otherwise on the Drawings. Epoxy coating, interior and exterior, shall conform to AWWA C550.

- 2.11 Backflow Preventer for Fill Valve Assembly: Double check valve assembly conforming to AWWA C510, bronze body, ball type test cock, ball valve shut offs with tee handles. Watts Series 007, Hersey Model No. FDC, Conbraco Series 40-100, or equal specifically approved by the Engineer.
- 2.12 Air Release Valves: Air valves for release of air under pressure shall conform to AWWA C512 for Air Release Valves rated to withstand 300 p.s.i. working pressure. Provide ductile iron body, threaded connections, stainless steel float and compound lever system, Buna N seat; with all internal trim stainless steel or bronze. Valve size shall be 1" inlet ½" outlet unless otherwise specified; orifice size to be determined by working pressure. Provide Crispin Model PL10, APCO Model 200A, or ValMatic Model 38.
- 2.13 Combination Air Valves: Shall conform to AWWA C512 for Combination Air Valves rated to withstand 300 p.s.i. working pressure. Provide ductile iron body, threaded connections, stainless steel floats and compound lever system, Buna N seat; with all internal trim stainless steel or bronze. Valve shall have 1" inlet and outlet, unless larger size is indicated on the Drawings. Provide Crispin Model UL10, APCO Model 143C, or ValMatic Model 201C.
- 2.14 Fire Hydrants: Shall conform to AWWA C502 for dry-barrel fire hydrants, traffic type, with safety flange which allows the valve to remain closed when the hydrant is broken or damaged above or near the grade level. Hydrants shall be Mueller Super Centurion A-423 with Tamper-Proof Option 114.
- A. Size: Hydrant main valve opening shall be 5 ¼". Inlet shall be 6", mechanical joint with strapping lugs.
 - B. Bury: Unless otherwise specified, or required by water main diameter, bury shall be 3½' and shall provide 18" from centerline of nozzles to the bury line of installed hydrant. However, vertical extensions shall be provided as required to bring the hydrant to its proper finished grade.
 - C. Outlet Nozzles: Two (2) at 2½" diameter; one (1) at 4½" diameter. Nozzle threads shall conform to those in service where the hydrant is to be installed unless otherwise specified. Provide field replaceable nozzle threads.
 - D. Stem Seals: O-ring.
 - E. Valve: Shall be compression type closing with pressure. Facings shall be rubber.
 - F. Color: Top bonnet: Silver; Barrel: Yellow.
 - G. Barrel Drain: Provide integral drain outlet.
 - H. Anchoring: Provide harnessing lugs. Use mechanical joint anchoring coupling (up to 36" in length) or ¾" galvanized, threaded rods, with galvanized bolts and washers.
- 2.15 Piping Accessories: Any accessories required shall be compatible with pipe and fittings used. Small valves, pipe and fittings shall conform to AWWA Standard C800.
- A. Tapping saddle for pipe 6" and smaller: Dresser Style 91, double strap, JCM Model 402, Smith-Blair No. 313, or equal specifically approved by the Engineer. (For tapping pipe larger than 6" in diameter, use a ductile iron tapping saddle or tee.)
 - B. Couplings for 3" and smaller pipe: Dresser Style 38.
- 2.16 Manhole for Air Valves or Check Valves: Precast concrete conforming to ASTM C478-03a, with cast iron cover, NEENAH R-6041-A for cast-in-slab, or R-1776 if not cast-in-slab type. Cover shall read, "WATER VALVE".
- 2.17 Vault for Air Valves: For air valves installed in vault in non-vehicular traffic areas only, use Carson Industries L Series 24 light duty HDPE vault, with extension for 24" minimum depth, with 24" sq. x 3" thick polymer concrete lid.

- 2.18 Valves Boxes: Cast iron, 5¼” diameter, suitable for the valve installed; two-piece screw type adjustable to suit the depth of bury. Provide extension stem as required for deep valves so that no operating nut is deeper than 1 ½’ below the cover. Cover shall be cast iron, marked “WATER”.
- 2.19 Valve Collars: Reinforced concrete. Provide pre-cast 24” diameter x 6” thick pad for non-traffic areas. If directed by the Engineer, provide poured-in-place , 24” square or round x 6” thick pad for valve boxes located in traffic and/or paved areas.

PART 3 – EXECUTION

3.1 Preparation:

- A. Perform demolition, clearing and grubbing as required.
- B. Install erosion and sediment control measures as required.
- C. Strip and stockpile all sod topsoil suitable for refuse in restoration.
- D. Remove pavement only as necessary for excavating the trench and installing the pipeline and appurtenances. Cut asphalt pavement in straight, uniform lines by means of a suitable pavement saw. Cut concrete pavements to a depth of at least 2” along the cut line with a rotary saw, after which the pavement may be broken with a jack hammer.
- E. Provide protection of utilities by notifying all local utility owners and, with an electronic pipe locator and their assistance, locate underground structures, pipes and utility lines, and mark them in advance of trenching operation. Excavate and expose underground utilities in test pits to verify locations and depths. As excavation approaches the marked areas, dig with extreme care if using conventional trenching machines. Promptly restore utilities or structures damaged by construction activities to their original condition before the damage occurred. Upon Contractor’s failure to promptly correct such damage, Owner may correct the damage and back-charge the Contractor for costs incurred.
- F. As part of the trenching operations, perform removal, relocation, or relaying of pipes, utility lines, and appurtenances which will obstruct the completed water mains or appurtenances.

3.2 Trenching, Backfilling and Compaction: Conform to requirements of Specification SECTION 02221.

3.3 Bedding: Bedding shall conform to the individual requirements for the pipe of conduit material being used. Unless otherwise specified or shown on the Drawings, bedding shall be Class C for Plastic Pipe (4” of stone under pipe) and Class D for ductile iron pipe.

3.4 Alignment, Grade and Cover:

- A. Install pipe and appurtenances at the locations, positions, alignments and grades shown on the In the event of conflict, install as directed by the Engineer.
- B. Provide **48” of cover** measured from finished grade to top of pipe unless otherwise shown on the Drawings. Where obstructions are encountered, the depth may be greater than 48”. Depths of cover less than 48” may be used only when directed by the Engineer.
- C. Install pipe such that valve stems and hydrants will be plumb (vertical).
- D. Maintain pipe curvatures using the horizontal or vertical permissible deflection at joints as specified by the manufacturer or AWWA Specifications C600. Use fittings only if curvature cannot be maintained by deflection. Do not bend PVC pipe.

3.5 Installing Pipe: Install pipe and appurtenances only when trench conditions are suitable. Trenches must not contain water that can enter open end of pipe. Proper implements, tools and facilities shall be provided by the Contractor for the safe and convenient performance of the Work.

- A. Lower all pipe, fittings, valves and hydrants carefully into the trench piece by piece by means of a derrick, ropes or other suitable tools or equipment. Prevent damage to water main materials and protective coatings and linings. Do not drop or dump waterline materials into the trench.
 - B. Carefully examine all pipe and fittings for cracks and other defects while suspended above the trench immediately before installation in final position. Defective pipe or fittings shall be clearly marked and shall be removed from the site.
 - C. Clean the bell and spigot ends of each piece of pipe thoroughly before the pipe is laid.
 - D. Prevent foreign material from entering the pipe while it is being placed in the line. If necessary, provide protective covering for the ends of the pipe until the connection is to be made to the adjacent pipe. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe.
 - E. As each length of pipe is place in the trench, center the spigot end in the bell, force the pipe home and bring to correct line and grade. Secure the pipe in place with approved backfill material tamped around it. Take precautions to prevent dirt from entering the joint space.
 - F. At times when pipe laying is not in progress, close the open ends of pipe with a watertight plug. Maintain plug in place until the trench is pumped completely dry.
 - G. Lay pipe with bell ends facing in the direction of laying unless directed otherwise by the Engineer. Where pipe is laid on a grade of 10% or greater, start the laying at the bottom and shall proceed upward with the bell ends of the pipe upgrade.
- 3.6 Cutting Pipe: Use pipe-cutter for inserting valves, fittings or closure in a neat and workmanlike manner without damage to the pipe or lining. Cut at right angles to the axis of the pipe.
- 3.7 Detection of Non-ferrous Pipe: Install one (1) continuous strand of approved detection tape directly over all non-ferrous pipe, approximately 18" above the pipe and one (1) continuous strand of No. 12 solid copper wire in blue insulation directly under the pipe. Pull wire up into valve boxes to within 2" of top of valve box. Installed detection device shall be such that Owner can locate installed pipe using a standard electronic detector.
- 3.8 Jointing: Provide jointing of all pipe, fittings, valves and hydrants in strict compliance with manufacturer's instructions.
- A. Mechanical Joints (MJ): Thoroughly clean outside of spigot and inside of bell. Clean and lubricate gasket. Tighten all nuts with torque limiting wrench. Nuts spaced 180° apart shall be tightened alternately in order to produce equal pressure.
 - B. Push-on Joints (P-O): Furnish and install adapters as required to join bells and spigots of different sizes. Thoroughly clean inside of bell and outside of the spigot end. Insert and lubricate gasket using lubricant furnished or recommended by pipe manufacturer. The spigot end of the pipe shall be entered into the socket with care to keep the joint from contacting the ground. Complete joint by forcing the plain end to the bottom of the socket with a forked tool or jack-type tool.
 - C. Restrained Joints (RJ): Follow same procedure as for push-on joints and manufacturer's procedure for type of restrained joint installed.
- 3.9 Setting of Valves and Fittings:
- A. Set valves plumb. Tamp backfill around valves and boxes carefully in 6" layers for the full depth of trench.
 - B. Provide a valve box, cast iron lid and concrete collar for every valve. For valves in areas that will not be paved, use 6" PVC pipe riser in lieu of C.I. box. The valve box or riser shall not transmit shock or stress to the valve, with the box cover flush with the surface of the finished pavement or such other level as may be directed.
 - C. Provide an extension stem on any operating nut that is greater than five (5) feet below the valve box lid.

- D. Upon final completion of valve and valve box, including surface restoration, operate each valve in presence of Owner's Representative to demonstrate proper installation and operation of the valve.
 - E. Provide and install concrete valve marker only for valves specifically designate by Owner's Representative.
 - F. Provide accurate and complete sketch for each valve showing measured distances to at least three (3) permanent points. Submit valve sketches with each valve submitted for payment.
- 3.10 Setting of Hydrants: Set all hydrants plumb with nozzles parallel with, or at right angles to, the street with the pumper nozzle facing the street unless otherwise specified.
- A. Provide and install vertical extensions if required to match the "bury line" with finished grade after backfill. Immediately upon installation, install burlap (or other approved cover) over all fire hydrants, new or existing, that are not in service.
 - B. Upon final completion of fire hydrant ready for service, operate each hydrant under flowing conditions to demonstrate proper installation and operation.
- 3.11 Thrust (Reaction) Blocking: Provide reaction blocking for all plugs, caps, tees, bends, valves, hydrants, etc. unless otherwise specified. Generally, concrete thrust blocking is required whether or not restrained joints are used.
- A. Blocking shall be purchased Ready-Mix concrete having a compressive strength of not less than 3,000 p.s.i. at 28 days. Place blocking between solid, unexcavated earth and the fitting to be anchored. The area of bearing on the pipe and on the ground in each instance shall withstand thrust forces created by the specified test pressure. In no instance shall the bearing area be small than shown on the Drawings for firm, dry clay (3,000 lb. per sq. ft.) Where soils of lesser bearing capacity are encountered, increase bearing area dimensions as necessary. All blocking shall be placed such that the joints will be accessible for repair, unless otherwise shown or directed.
 - B. Metal harness, tie rods or clamps may not be used except in special situations specifically approved by the Engineer. Steel rods or clamps, if their use is approved, shall be galvanized.
- 3.12 Stream and Utility Crossings: Where indicated on the Drawings, or required by conditions encountered, place pipe beneath stream beds or ditches, around, over, or under storm sewers, culverts, gas mains, telephone ducts, buried cables, other water mains, or other structures.
- A. Do not pass pipe through any structure, drainage pipe, culvert, sewer, manhole, etc.
 - B. Provide minimum cover of 36" under bottom of stream beds or ditches, except that required cover at stream crossing in rock may be reduced to 18" where approved by the Engineer.
 - C. Provide minimum of 6" cushion of earth or sand between proposed water pipe and any other utility or structure.
 - D. If practical, provide at least ten (10) feet horizontal and 18" clear vertical separation at all structures and other pipelines or utilities.
- 3.13 River Crossings: Where indicated on the Drawings, place ball joint river crossing pipe beneath the stream bed to maintain minimum 18" of cover. Install river crossing pipe by means and methods of Contractor's choice while ensuring that all conditions of applicable permits are complied with. Handle, install and join ball joint pipe strictly in accordance with manufacturer's written instructions. Use extreme care to avoid flotation of pipe under all conditions.
- 3.14 Sanitary Sewer Separation: Use special precautions to maintain minimum separation distances between water main and any existing or proposed gravity or pressure, sanitary sewer.
- A. Where practical, maintain a minimum vertical separation of 18" between the outside of the water main and the outside of any sanitary sewer. Arrange the crossing so that the water main joints will be equidistant and as far as possible from the sewer joints. Where a water pipe must cross under a sewer, provide adequate structural support and protection for the sewer to prevent damage during pipe laying and backfilling operations.

- B. Notify Owner's Representative immediately upon encountering field conditions that do not allow at least 18" vertical separation between the water main and any existing or proposed sewer. Where it is not possible to obtain at least 18" vertical separation, use 18 feet length of DIP, or copper pipe, for the water main centered on the sewer at the point of crossing.
 - C. To the maximum extent practical, maintain at least ten (10) feet of horizontal separation between the water main and any existing or proposed sewer. Under no circumstances shall a sewer and a water main be laid within the same trench.
- 3.15 Gas Main Separation: Use special precautions to maintain minimum separation distances between water main and any existing or proposed natural gas mains.
- A. Where practical, maintain a minimum vertical separation of five (5) feet and minimum horizontal separation of ten (10) feet between the water main and any ferrous gas main which may be subject to cathodic protection currents.
 - B. Notify Owner's Representative immediately upon encountering field conditions that do not allow the specified minimum distances.
- 3.16 Connection to Existing Mains:
- A. Coordinate connections to existing water facilities with officials of the existing water system and do not make connections to existing mains without specific approval of time of day and allowable duration of service disruption.
 - B. Make all connections to existing mains at approved times that will minimize disruption of water service to the public.
 - C. Ascertain the exact locations and depths of existing mains prior to connection. Locations of required connections to existing mains shown on the Drawings may be approximate only.
 - D. Make connections to existing mains in a complete and workmanlike manner using only approved fittings and specials to suit conditions encountered.
 - E. Repair, reconnect and return to service in equal or better condition all existing pipes which are cut or damaged.
- 3.17 Filling for Testing: Connect temporary fill valve assembly to existing water main or hydrant as shown on the Drawings. Coordinate with Owner's forces and/or other public utility supplying water for filling and testing. Provide adequate backflow protection on fill line between potable water supply source and new water main. Fill slowly as directed by the Owner
- 3.18 Hydrostatic Tests: Perform pressure and leakage tests on each section of the line between valves in accordance with AWWA C600. All thrust blocking shall be in place and properly cured prior to start of hydrostatic testing. If directed by the Engineer, pipelines may be tested before the trench is completely backfilled.
- A. Furnish and install corporation stops at all high points on the line to release air as pipe is slowly filled with test water. When a segment of pipe between two valves is filled and ready for testing, the segment of pipe shall be thoroughly blown free of air and prepared for testing. Air must be removed prior to testing.
 - B. Furnish suitable test pump, meters, connections, pressure gages approved by the Engineer, and all necessary apparatus including means for accurately measuring water introduced into the pipe during testing.
 - C. Maintain full test pressure for a minimum of 8 hours. Maintain 200 pounds per square inch (p.s.i.) for pipe 16" and smaller; maintain 150 p.s.i. for pipe larger than 16". Pressure shall not vary by more than 5 p.s.i. during the test.
 - D. The length of pipe included in each pressure test shall be limited to the segment between two valves, unless otherwise directed by the Engineer because of topography or other conditions which might prevent a valid test.

- E. Concurrently with the pressure tests, conduct leakage tests on all pipe. Maximum allowable leakage shall be six (6) gallons/inch of nominal pipe diameter/mile of pipe/day.
 - F. Locate, remove and replace any defective pipe, valves, fittings and hydrants. Clamps or other repair devices shall not be used for repair.
 - G. Repeat pressure and leakage tests until results are satisfactory to the Engineer.
- 3.19 Initial Flushing: After completion of hydrostatic testing, and prior to disinfection, thoroughly flush the pipelines, in the presence of Engineer's Representative. Produce a minimum velocity of 3 feet/second in pipe for as long as necessary to clean out silt and debris.
- A. Provide 48-hour notice to Owner and Engineer prior to start of flushing operations.
 - B. Provide adequate outlet piping and/or diffuser nozzle for disposal of flush water without damage or erosion.
 - C. Provide adequate backflow protection for the flushing water source to be approved by the Engineer prior to testing.
- 3.20 Disinfection: After flushing has been completed and approved, disinfect all installed pipe, fittings, valves and appurtenances or other facilities exposed to contamination by the construction. Disinfect strictly in accordance with AWWA Specification C651, except as otherwise specified.
- A. Disinfect all pipe and appurtenances using liquid chlorine or hypochlorite to produce a dosage of 25 mg/L for a 24-hour contact period. Use of a calcium hypochlorite intended for swimming pool disinfection is not allowed.
 - B. After at least 24-hour retention period, flush chlorinated water from the line until chlorine concentration of water leaving the main is no higher than that generally prevailing in the existing system, less than 1.0 mg/L. Provide proper treatment and disposal of chlorinated water.
 - C. Repeat disinfection procedure until bacteriological analysis results are acceptable to the Owner and local Health Department.
- 3.21 Clean-up and Restoration: Before the Work shall be considered complete, remove all material not used and rubbish of every character from the job site. All fences and other private or public facilities and structures disturbed must be in essentially as good condition as existed before the Work was done. Any subsequent settlement of pavement, backfill or erosion over or in the trenches shall be replaced or repaired by the Contractor and the surface brought to grade. Special precautions shall be taken to prevent stormwater erosion of trenching. Stormwater culverts and structures shall be kept cleaned of mud, debris and silt caused by the construction. Any and all items disturbed by the construction shall, in every case, be restored to their original conditions as closely as possible after completion of the construction.

SECTION 02718 – WATER SERVICE CONNECTIONS

PART 1 – GENERAL

- 1.1 Section Includes: Making water service connections and/or reconnections, including replacing existing service laterals and reconnecting the new water main.
- 1.2 Reference Standards:
 - A. Underground Service Line Valves and Fittings (AWWA C800-01).
 - B. Seamless Copper Water Tube (ASTM B-88-92)
 - C. Fabricated Steel and Stainless Steel Tapping Sleeves (AWWA C223-02)
 - D. Cold-Water Meters – Displacement Type (AWWA C700-95)

- E. Specifications for Gray Iron Castings (ASTM A48-94a)
- F. Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe (SDR-PR and Class T) (ASTM D2241-96b)
- 1.3 Submittals: Prior to start of any service connections, submit product data, catalog numbers and manufacturer's certifications for all products to be used in the Work.
- 1.4 Site Conditions: The number and size of service reconnections and the total length of service tubing to be provided under the Contract is estimated. The required number may be more or less than shown on the Bid Form.

PART 2 – PRODUCTS

- 2.1 Service Tubing: ASTM B-88 copper tubing Type-K, ¾" minimum size, unless otherwise shown.
- 2.2 Casing for Service Tubing: 2" diameter, SDR 21 PVC conforming to all requirements of ASTM D2241, for ¾" and 1" tubing.
- 2.3 Water Meters: Owner will furnish water meters for 1" and smaller sizes, unless Owner's Representative directs the reuse of existing meter.
- 2.4 Meter Boxes: Provide new plastic body meter box for each service connection. Boxes shall be reinforced at top and bottom with a plastic lid containing a cast iron meter reading lid. DFW D-1200 or Brooks 1914. Large meter boxes DFW D-1500 or Brooks 1220-12.
- 2.5 Accessories: Accessories shall conform to AWWA Standard C800 and Owner's standard practice.
 - A. Use County-approved service saddles for tapping all PVC pipe and DIP pipe which is 12" and larger. Ductile iron pipe, 6" and 8" only, may be direct tapped.
 - B. Corporation Stop: ¾" ball stop for ¾" service; 1" ball stop for 1" service or branch connector; AWWA taper thread x compression connection for CTS O.D. tubing. Mueller B-25008, Ford FB 1000-3 or equal approved by the County.
 - C. Branch connector: 1" x ¾" x ¾" for CTS O.D. tubing. Mueller H-15343, Ford Y44-243G or equal approved by the County.
 - D. Coupling: ¾" one-eighth bend coupling, F.I.P. thread x compression, CTS O.D. tubing. Mueller H15534, Ford LA 14-33-G or equal approved by the County.
 - E. Meter Yoke: Copper meter yoke with lock wing angle meter ball valve, ASSE dual cartridge check and MIP thread ends.
 - 1. For ¾" Service: 5/8" x ¾" x 9" riser, Mueller B2434-6A or McDonald 28-209WDPP 33.
 - 2. For 1" Service: 1 x 12" riser Mueller B2434F-2A, Ford VBHC74-18W MM 44, or McDonald 28-412WDpp44.
 - F. Customer Cut-off Valve: ¾" bronze gate valve, F.I.P. threads, 200 p.s.i. minimum working pressure with handwheel. NIBCO T-113, Hannond 606, or equal approved by the County. Provide PVC irrigation valve box and lid for standard service; At PRV services install in meter box, DFW D-1200 or Brooks 1914.
 - G. Pressure Reducing Valve (PRV): ¾" Conbraco Series 36.
 - H. Nipple Connection: 18" long, Schedule 80 PVC pipe with Schedule 80 PVC coupling, FIP x FIP.

PART 3 – EXECUTION

- 3.1 General:

- A. Service connections and reconnections shall be installed in the same manner as water distribution mains and in accordance with SECTION 02221 of these Specifications, except that depth of cover shall be 36" minimum.
- B. Service connections and reconnections shall be made where directed by the Owner's Representative and after the new main is fully installed, tested, disinfected and approved. It is intended that all service connections will be reconnected to the new water main using copper tubing and all existing polyethylene service tubing shall be abandoned.
- C. Standard service connections shall be made except where PRV service connections are directed by the Owner's Representative.
- D. Meter boxes for the water meter shall be installed on public right-of way at the property line, unless otherwise directed by Owner's Representative. Customer cut-off valves and PRV's shall be installed on customer's property, at the property line, unless otherwise directed by Owner's Representative.
- E. Provide and install all necessary fittings and couplings for reconnecting existing meters.
- F. Use a single 1" lateral under roadway pavement to serve two (2) standard residential meters whenever there are two (2) long-side, residential meters less than 15 feet apart.

3.2 Installation:

- A. Service reconnections shall be made in accordance with the County's Standard Detail Drawing for water service connections.
- B. Install 2" PVC casing pipe for all service tubing to be under existing or proposed pavements. For Georgia DOT maintained roads, extend casing ten (10) feet beyond each edge of pavement. For County maintained roads, extend casing five (5) feet beyond edge of pavement, unless otherwise directed. Install 2" PVC casing pipe with 36" cover under the road or shoulder surface.
- C. Normally, pavement cutting will not be permitted for installing service tubing or casing. Casings for service tubing under pavements shall be installed by jacking or boring where practical. However, where rock or other obstructions are encountered by attempts to install by jacking or boring, the 2" PVC casing may be installed by open cut methods. Where rock, as defined by SECTION 02221, Paragraph 2.6, is encountered during installation of service tubing or 2" casings, its removal and disposal will be paid under the Bid Item for Rock Removal and Disposal.
- D. Set meter boxes level, on well compacted earth, and in a manner such that stormwater will not accumulate on or in, or flow over, the meter box.
- E. Install the meters with extra fiber or rubber washers so that washers create at least 0.1" separation between the meter and coupler on each side of meter.
- F. Valves and meter setters that are installed without meters shall be securely capped to prevent damage to ends or entry of contamination.

SECTION 02722 – GRAVITY SANITARY SEWERS

PART 1- GENERAL

- 1.1 Work Included: The Work covered by this Section consists of furnishing, installing and testing gravity PVC and DIP sewers and service laterals. PVC is acceptable unless otherwise specified or indicating in the Drawings; however, only one (1) type of pipe shall be used for the entire project except as specifically shown on the Drawings. Ductile iron pipe shall be used only in special applications as indicated on the Drawing or as directed by the Engineer.
- 1.2 References:

- A. Standard Specifications for Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated (ASTM-C700-78).
- B. Standard Practice for Installed Vitrified Clay Pipe Lines (ASTM-C12-82).
- C. Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings (ASTM-C425-77).
- D. Standard Specification for Type PSM (Vinyl Chloride) (PVC) Sewer Pipe and Fittings (ASTM-D3034-85).
- E. Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe (ASTM-D2321).
- F. Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals (ASTM-D3212-76).
- G. Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe (ASTM-F477-76).
- H. Cement-Mortar Lining for Ductile-Iron and Gray-Iron Pipe and Fittings for Water (AWWA-C104-85).
- I. Ductile-Iron and Gray-Iron Fittings, 3” through 48”, for Water and Other Liquids (AWWA-C110).
- J. Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings (AWWA-C111-85).
- K. Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids (AWWA-C151-86).
- L. Ductile Iron Gravity Sewer Pipe (ASTM-A746-86).
- M. Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe (ASTM-C76-88).
- N. Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets (ASTM-C443-85a).
- O. Standard Methods of Testing Concrete Pipe, Manhole Sections or Tile (ASTM-C497-86).
- P. Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Polyvinyl Chloride (PVC) Composite Sewer Piping (ASTM-D2680-87).
- Q. Steel Water Pipe 6” and Larger (AWWA-C200-86).
- R. Coat Tar Protective Coatings and Linings for Steel Water Pipe Liner – Enamel and Tape – Hot Applied (AWWA-C203-86).
- S. Standard Specification for Polyvinyl Chloride (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings (ASTM-F679).
- T. Standard Specification for Polyvinyl Chloride (PVC) Ribbed Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter (ASTM-F794-88).

1.3 Delivery, Storage and Handling:

- A. Inspect pipe prior to acceptance of delivery for dimensions to ensure the absence of fractures, cracks, damaged ends, markings and other defects.
- B. Deliver pipe and joint materials to the job site and store in accordance with the manufacturer’s recommendations. Make whatever special arrangements are necessary to provide such storage.
- C. Take special care to avoid deformation or compressions of PVC pipe ends. Store pipe in unit packages provided by the manufacturer.

PART 2 – PRODUCTS

- 2.1 Smooth Wall Polyvinyl Chloride (PVC) Pipe: PVC sewer pipe and fittings shall be Type PSM SDR 26 or less. Pipe which is 15” or less in diameter and shall be manufactured in accordance with ASTM-D3034-85. Pipe greater than 15” in diameter shall be manufactured in accordance with ASTM-F679.
- A. Joints shall be “O”-ring gasketed joints and shall conform to ASTM-D3212-76 and ASTM-F477-76.
 - B. Fittings used for PVC sewer pipe shall be manufactured in accordance with the same Specification as the pipe.
- 2.2 Ductile Iron Pipe (DIP): Shall conform to the requirements of ANSI A21.51 Class 50 (AWWA-C151-81) and shall be cement-mortar lined in accordance with ANSI A21.4 (AWWA-C104) with a bitumastic coating on the outside.
- C. Fittings may be cast or ductile iron manufactured in accordance with AWWA-C110-87.
 - D. Unless otherwise specified, joints shall be push-on, compression type conforming to AWWA-C111-85.
 - E. Compression joint sealers and flexible couplings shall be provided for joining ductile iron pipe to different types of pipe less than 15” in diameter. Materials shall be equal to those manufactured by Fernco Joint Sealer Company.
- 2.3 Service Laterals:
- A. Service laterals and fittings shall be of the same material and conform to the same Specifications as the main sewer to which they are connected except for connections to PVC Truss pipe, ribbed PVC Pipe or RCP. Service laterals for these pipes shall be PVC SDR 26, unless otherwise shown on the Drawings or otherwise required by local code.
 - B. Service laterals shall be 4” or 6” diameter (I.D.) as shown on the Drawings or as directed by the Engineer.

PART 3 – EXECUTION

- 3.1 Preparation:
- A. Prepare trenches in accordance with SECTION 02221 and with the pipe manufacturer’s recommendations.
 - B. Provide construction stake-out and verify manhole inverts.
 - C. Mark any damaged pipe in such a manner that identification is permanent and easily recognizable, and remove such pipe from the job site as quickly as practical.
 - D. Clean all pipe of all debris prior to placing in the trench.
- 3.2 Bedding: Provide bedding appropriate for the pipe material being used and the site conditions encountered. Bedding shall conform to Class “A”, “B”, “C” or “D” as shown on the Drawings or specified herein. Specific bedding requirements are as follows:
- A. Smooth Wall PVC, Ribbed PVC and PVC Truss: Install and bed PVC sewer in accordance with ASTM Practice D2321. Provide Class “B” – Modified bedding using crushed stone or approved granular material from 4” below the pipe up to the centerline (springline) of the pipe.
 - B. DIP: Install Ductile Iron Sewer in Class “C” bedding of clean native material unless directed otherwise by the Engineer.
 - C. Carefully excavate areas under bells, sleeves, etc. for all types of pipe and backfill to ensure uniform support over the entire length of pipe.
 - D. Between manhole sections, the deepest cut will determine the class of bedding to be provided for that entire length between manholes.

- E. Limit trench widths as specified in SECTION 02221. If the maximum trench width is exceeded, the bedding must be increased by one (1) class at Contractor's expense.

3.3 Installation of Pipe: Install pipes and backfill in accordance with SECTION 02221.

- A. Unload, store, lay, joint and backfill all pipe in strict accordance with the manufacturer's printed instructions and recommendations.
- B. Carefully examine all pipe for cracks or other defects before being lowered into the trench. Any pipe found to be cracked or damaged shall be plainly marked in such a manner that the marking will not rub or wash off and shall be removed from the site immediately.
- C. Carefully grade the bottom of the trench and excavate all bell holes. Lay each pipe to the line and grade shown on the Drawings or as directed by the Engineer. The accuracy of the finish line and grade of the pipe shall be obtained in the preparation of the trench bottom. No pipe shall be laid on blocking of any kind. Where finished Work does not conform to the specified grades and inverts, the Contractor shall adjust the grades at his own expense.
- D. Lay pipe only in dry trenches.
- E. Lay pipe upgrade with the spigots pointing downwards. All pipe shall be straight and show a uniform grade between manholes.
- F. Take special care that each spigot is properly centered in the bell of the preceding pipe and that each pipe is solidly bedded so that settlement does not occur. The surfaces of the pipe to the joint shall be thoroughly cleaned and the jointing material shall be applied as recommended by the manufacturer. After each joint is made, check for proper position prior to installation of the next length of pipe.
- G. Keep the interior of the pipe clear of all dirt and superfluous material of every description as the Work progresses.
- H. When the pipe laying is suspended, either at night or at other times, close the end of the pipe with a tight cover keeping the pipe free of obstructions.

3.4 Installation of Sewers at Stream Utility and Drainage Structure Crossing: Where indicated on the Drawings or required by field conditions, place sewer beneath stream beds or ditches; and around, over or under other sewers, waterlines, culverts, gas mains, telephone ducts or other structures.

- A. Do not pass sewer through any drainage pipe, culvert, sewer or storm drainage structure.
- B. Use ductile iron pipe for sewer where minimum cover under stream beds or ditches cannot be 24" or more.
- C. Provide minimum of 6" thickness of earth or sand cushion bedding beneath proposed sewer and any other pipe or structure.
- D. Where practical, maintain a minimum vertical separation of 18" between outside of the water main and the outside of the sewer. Arrange the crossing so that the sewer joints will be equidistant and as far as possible from the water main joints. Where a water main crosses under a sewer, provide adequate structural support for the sewer to prevent damage to the water main. Where it is not possible to obtain 18" vertical separation, use ductile iron pipe 18 feet minimum length.

3.5 Installation of Service Laterals: (Applies to laterals in the street laterals and laterals on private property).

- A. Specific attention is called to the fact that the number of services and length of laterals to be provided under the construction contract is an estimate. The required quantity may be more or less than called for on the Bid Form.
- B. Confirm the locations for installation of service laterals with individual property owners prior to construction.

- C. Install laterals in the same manner as sewerlines with the same bedding and backfill in accordance with SECTION 02221 of the Specifications.
- D. Lay all laterals to a uniform line and grade. No service lateral shall be covered until it has been inspected and measured by the Owner or their representative.
- E. Provide non-degradable tape 6" x .004" with the words "Caution Sewer Pipe" placed not less than 18" above the pipe and not less than 12" below grade. End tape at the edge of street right-of-way. Cost shall be included in the cost of lateral installation.
- F. Install wyes at 45° from the horizontal except where the Engineer directs otherwise.
- G. In trenches eight (8) feet or more in depth, use a tee with a vertical riser as shown on the Drawings and 45° or less bends in all cases. No 90° bends will be permitted.
- H. Provide clean-outs at the edge of rights-of-way. Clean-outs shall be installed as detailed on the Drawings.
- I. Install street laterals from the collection sewer to the edge of the right-of-way or easement, or four (4) feet from the collection sewer, whichever is greater, prior to testing.
- J. Plug the end of all street laterals temporarily at the edge of the right-of-way or at the tie-in point for testing. A temporary clay, concrete or PVC plug with "O"-ring gaskets shall be provided.
- K. After street lateral construction has been completed to the edge of the street right-of-way, tested and approved, then extend and connect the on-site service laterals to the existing building sewers upstream of the septic tank complete with clean-outs, fittings and appurtenances.

3.6 Inspection and Tests:

- A. All material and Work shall be subject to inspection by the Engineer at any time. All inadequate, defective, or improper Work or materials will be rejected and the Contractor will be required to replace or reconstruct the Work.
- B. Before inspection of the pipe in place, flush clean of all water, sand, dirt, debris or other obstructions.
- C. Provide labor and supplies for lamping the completed sewers in the presence of the Engineer. Inspect each section of sewer by lamping from manhole to manhole. Any section of sewer which does not exhibit a smooth, "full-moon" bore shall be rejected.
- D. Conduct deflection tests on PVC sewers in the presence of the Engineer. Tests shall consist of free passage of a properly sized mandrel or sewer ball. Maximum allowable deflection shall be 5%.
- E. Conduct tests for water tightness of gravity flow pipelines in the presence of the Engineer by one of the following methods at the Engineer's option:
 - 1. Laterals shall be installed to the edge of the right-of-way prior to testing; however, they may be installed to the point of tie-in at the Contractor's option if approved by the Engineer. Temporary restraints may be required for clean-outs and plugs for testing.
 - 2. Infiltration Test: The pipe shall not leak under exterior ground water pressure in excess of a rate of 50 gallons/inch of pipe diameter/mile of pipeline/day. Leaks causing any sewer to fail this test shall be repaired until the infiltration comes within allowable limits. The test shall be done during a rainy season and shall be done with a calibrated V-notch weir.
 - 3. Exfiltration Test: When weather conditions will not permit infiltration testing due to low ground water table, exfiltration tests may be used. Leakage, under a 5-foot head, shall not exceed 50 gallons/inch of pipe diameter/mile of pipeline/day.

4. Air Testing: Low pressure air testing in accordance with ASTM-C828 may be used. Allowable leakage will be based upon an allowable loss of .003 ft.³/ft.² of surface area/min. within an initial pressure of 3.5 p.s.i.
- 3.7 Clean-up and Restoration: Before the Work shall be considered complete, remove all material not used and rubbish of every character from the job site. Restore all fences and other private or public facilities and structures disturbed in essentially as good condition as existed before the Work was done. Replace or repair any subsequent settlement of pavement or backfill, or erosion, over or in the trenches and bring the surface to grade. Take special precautions to prevent stormwater erosion of trenching. Keep stormwater culverts and structures cleaned of mud, debris and silt caused by the construction. Restore any and all items disturbed by the construction to their original condition, as closely as possible, after completion of the construction.

SECTION 02725 – SEWER MANHOLES AND ACCESSORIES

PART 1- GENERAL

- 1.1 Work Included: The Work covered by this Section consists of furnishing all labor, materials, supplies and equipment necessary for the installation of manholes on sanitary sewerlines.
- 1.2 References:
 - A. Standard Specification for Precast Reinforced Concrete Manhole Section (ASTM-C478-88).
 - B. Standard methods of testing concrete pipe, manhole sections or Tile (ASTM-C497-86).
- 1.3 Delivery, Storage and Handling: Inspect sewer manholes and accessories immediately upon delivery to ensure that no damaged or unsatisfactory materials are allowed on the job.

PART 2 – PRODUCTS

- 2.1 Precast Manholes: Shall be manufactured in accordance with ASTM-C478-88.
 - A. Precast Sections: Base sections four (4), five (5) or six (6) feet in diameter as required with reducer rings for base sections of diameter greater than four (4) feet; riser sections four (4) feet in diameter; eccentric cone top sections for manholes deeper than 5.5 feet; and flat slab tops for manholes 5.5 feet or less in depth. Depth shall be measured from finished invert to top of cover.
 - B. Flat Slab Tops: Reinforced concrete, 8” minimum thickness, designed for traffic loading with eccentric manhole opening.
 - C. Base Sections: Monolithically cast wall and bottom slab for all new sewers. Precast dog house section with poured-in-place bottom for manholes on existing sewers.
 - D. Steps: Polypropylene plastic reinforced by 1/2” diameter steel rod, meeting requirements of ASTM-C478 and installed by the manufacturer.
 - E. Coating: Coal Tar-Epoxy Hi-Build Tneme-Tar Epoxy by Tnemec or Bitumastic No. 300-M Hi-Build by Koppers applied in accordance with coating manufacturer’s recommendations.
 - F. All manhole sections shall be manufactured by the same manufacturer unless otherwise approved by the Engineer.
- 2.2 Frames and Covers:
 - A. Standard: Solid lid with “SANITARY SEWER” lettering and concealed pick holes equal to Type “R” standard manhole ring and cover as manufactured by Griffin Foundry & Manufacturing Co., Rome, Georgia; Model R-1776 as manufactured by Neenah Foundry Company, Neenah, Wisconsin; USF 360E by U.S. Foundry & Manufacturing Co.; or Vulcan VM-3MOD by Higgins Foundry & Supply Company.

- B. Vented: Identical to those provided for standard frames and covers except that they shall have six (6), equally spaced, drilled holes ½” in diameter.
- C. Waterproof: Solid lid with stainless steel bolts, gasketed with “SANITARY SEWER” lettering on the lid equal to Type “R” Locking Manhole Ring and Cover by Griffin Foundry & Manufacturing Co., Rome, Georgia; 360E BWT by U.S. Foundry & Manufacturing Co.; or Model R-1915-E2, Type P with bolted cover by Neenah Foundry Company.
- D. Flat Slab Tops and Manholes in Unpaved Areas: Shall have the frame precast in the top slab.
- E. All manhole frames and covers shall be provided by the same manufacturer.

2.3 Joints:

- A. Riser Section Seals: Equal to Ram-Nek, ConSeal CS-302 or Kent-seal No. 2 joint sealer.
- B. Openings for Sewers:
 - 1. Flexible gaskets manufactured by Fernco Joint Sealer Company, A-Lok Corporation, Forsheda F-910 or the “Kor-N-Seal” as manufactured by NPC Systems, Incorporated.
 - 2. Grout: Embeco 167 Mortar.

PART 3 – EXECUTION

3.1 General:

- A. Construct and set all manholes in accordance with the details shown on the Drawings and in accordance with special notes provided for particular manholes.
- B. Provide standard frames and covers unless otherwise noted on the Drawings.
- C. Where no special instructions are provided on the Drawings or in the field by the Engineer, set the top of manholes as follows:
 - 1. Outside of roads or streets, set top 6” above grade.
 - 2. In roads, streets, sidewalks and lawns set the tops flush with the finished surface.
 - 3. On paved, sloped surfaces, slope tops of manholes as necessary to conform to slope or gradient of paved surface.

3.2 Installation:

- A. Provide a foundation of 6” (minimum) or crushed stone as shown on the Drawings.
- B. Install manholes vertical and in dry holes. Do not install manholes in water or on fluid soil.
- C. Set the bottom as near as practical to the required grade to ensure that a properly grouted channel can be provided.
- D. Whenever the difference in elevation between the inlet and outlet sewer inverts exceeds 24”, provide a drop connection in accordance with the detail shown on the Drawings.
- E. Carefully assemble manhole sections and sewer entrances using gasketed joints installed in accordance with the manufacturer’s recommendations. Leaks in manhole joints will not be permitted.
- F. Grout all sewer entrances around the gasket to ensure a tight and permanent fit. Install grout in strict accordance with the manufacturer’s recommendations.

- G. Grout all lift holes and section joints inside and out.
- H. Construct invert channels as shown on the Drawings with 1-part cement and 2-part sand grout to provide smooth channel through pipe inlets to true line and grade as shown on the Drawings. Concrete blocks or bricks may be used for fill in deep base sections under mortar.
- I. Provide brick leveling courses as required at top of conical section. Plaster inside and out with mortar equal to that used for sewer entrances. Maximum height of leveling course shall be 12”.
- J. Coat exterior of manhole including leveling courses and base of frame with one (1) coat of coal tar epoxy coating in accordance with coating manufacturer’s directions. If coating is brushed, rather than sprayed, take care to thoroughly coat all surface irregularities and joints. Allow time for coating to dry completely before backfilling.
- K. Backfill around manholes in accordance with SECTION 02221. Use clean native soil containing no rock or debris for manholes outside of paved areas. Use granular material or crushed stone for manholes in paved areas.

3.3 Inspection and Tests:

- A. Test all manholes for leakage by one of the following methods:
 - 1. Vacuum Test: This test must be conducted on completed sewer manhole, but prior to backfilling. Place a vacuum of 10” Mercury (Hg) on the sewer manhole. Maximum allowable vacuum loss shall be 1” of Mercury (Hg) in 60 seconds for 4-foot diameter manholes, 75 seconds for 5-foot diameter manholes and 90 seconds for 6-foot diameter manholes.
 - 2. Hydrostatic Test: This test shall be conducted by plugging all inlet and outlet sewers after completion of manhole construction. Fill sewer manhole with water to top rim of frame and cover. After concrete has been thoroughly moistened, monitor water loss over a 2-hour period. Maximum allowable loss shall be 2” of water at the rim.
- B. Repair all sewer manholes that fail the leakage test and retest until satisfactory results are obtained.

3.4 Clean-up and Restoration: Before the Work shall be considered complete, remove all material not used and rubbish of every character from the job site.

SECTION 03300 – CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

- 1.1 Section Includes: Formwork, reinforcement, cast-in place concrete, finishing, curing, and field quality control for structures. Concrete Work called for by other Sections of the Specifications, unless specified otherwise, shall comply with the requirements of this Section.
- 1.2 Referenced Standards: Perform all concrete Work in conformance with all requirements of the following documents except as modified herein:
 - A. ACI 301-99 Standard Specifications for Structural Concrete.
 - B. ACI 304R-00 Guide for Measuring, Mixing, Transporting and Placing Concrete.
 - C. ACI 304.2R-96 Placing Concrete by Pumping Methods.
 - D. ACI 305R-99 Hot Weather Concreting.
 - E. ACI 306R-88 Cold Weather Concreting.
 - F. ACI 308-01 Standard Practice for Curing Concrete.

- G. ACI 315-92 Details and Detailing of Concrete Reinforcement.
- H. ACI 381-02 Building Code Requirements for Structural Concrete and Commentary.
- I. ACI 347R-03 Guide to Formwork for Concrete.
- J. ACI 350R-01 Environmental Engineering Concrete Structures.
- K. ACI 350.1R-01 Tightness Testing of Environmental Engineering Concrete Structures.
- L. ASTM C94-04 Standard Specification for Ready-Mixed Concrete.
- M. ASTM C172-04 Sampling Freshly Mixed Concrete.
- N. CRSI MSP-1 Manual of Standard Practice.

1.3 Submittals: Under provisions of SECTION 01330, prior to use of concrete in the Work, submit the following for Engineer's review:

- A. Certified reports from Contractor's testing laboratory for mix design on all design mix determinations, all related services to the Contractor, and the cylinder check tests verifying the design mix. Indicate amount of water to be withheld for latter addition at project site.
- B. Name and location of "ready-mix" plant proposed for use.
- C. Mill certification certifying that cement, sand, aggregate, and reinforcing steel to be used comply with the requirements of the applicable ASTM Specifications.
- D. Shop drawings showing reinforcement, placing plans, bending details and bar lists. Show all pertinent dimensions. Indicate location and arrangement of accessories.
- E. One (1) sample of each type of joint filler, waterstop, anchor, bar splice device, bar support, etc.
- F. Product data for all admixtures, compounds, hardeners and sealers to be used.

1.4 Quality Assurances:

- A. Testing and inspection requirements are as specified in SECTION 01450 of these Specifications.
- B. Select, engage and pay the costs of an independent testing laboratory, approved by the Engineer, to design and verify concrete mix(es). Verification test results shall be at least 25% above specified strength. Send three (3) certified copies of all mix verifications, aggregate test results and ASTM C39-03 cylinder compression test results to the Engineer.
- C. Owner's testing laboratory may inspect the batching plant and file a report with the Engineer stating whether the ready-mix concrete supplier's equipment and methods meet the requirements of these Specifications.

PART 2 – PRODUCTS

2.1 Concrete: All concrete shall be furnished by a ready-mix producer certified for compliance to the standards of N.R.M.C.A. and approved by the Engineer. Ready-Mix concrete shall conform to ASTM C94. All concrete shall be watertight and chemical resistant for use in environmental structures.

A. Mix Design:

- 1. Mix design, proportioning, water/cement ratio and acceptance criteria shall conform to ACI 301. Concrete shall have a 28-day compressive strength (f_c') of 4,000 p.s.i., unless otherwise specified. The

slump, as measured at the point of placement, shall not exceed 3” for footings or 4” for slabs, beams, walls or columns.

2. Minimum cementitious materials content shall be 517 lb. of cement per cubic yard for coarse aggregate No. 467 (1½” maximum); and 536 lb. of cement per cubic yard for coarse aggregate No. 57 (1” maximum); or 564 lb. of cement per cubic yard for No. 67 (¾” maximum).
 3. The maximum water-cement ration shall be 0.45.
 4. Add air entraining agent to concrete mix for all concrete Work exposed to exterior. Air content by volume of concrete shall be 5% to 7% based upon measurements made immediately after discharge from mixer.
- 2.2 Cement: Use Portland Cement, ASTM C150-04, Type I. Type III (High Early Strength) Portland Cement may be used, subject to the prior approval of the Engineer in each instance for its proposed use. Cement which has become damp, lumpy, or otherwise affected as to reduce its strength shall not be used in the Work. Fly ash, if used, shall conform to ASTM C618-03, Class F, tested by methods in ASTM C311-02.
- 2.3 Aggregate: Shall conform to ASTM C33-03. Maximum aggregate size shall be No. 467 for footings, slabs on grade and mass concrete; No. 57 for all other concrete.
- 2.4 Water: Clean and not detrimental to concrete; free from acids, alkalies or organic materials.
- 2.5 Reinforcing:
- A. Steel Bars: ASTM A615-04a, deformed bars manufactured from new Billet steel, yield grade 60.
 - B. Reinforcing Wire Fabric – ASTM A185-02.
- 2.6 Expansion Joint Material: ASTM D1751-99 Preformed Expansion Joint Filler. Asphalt impregnated fiber strips ½” thick, unless otherwise shown on the Drawings. Flexcell by Celotex Corporation, Sealtight by W.R. Meadows, Incorporated, or joint filler by Servitized Products Corporation.
- 2.7 Admixtures: All admixtures proposed to be used shall be submitted and approved by the Engineer prior to use.
1. Air-entrainment admixtures shall conform to ASTM C260-01. The concrete mixtures shall contain 5.5 ± 1.0% air by volume as determined by ASTM C231-04.
 2. Water reducing admixtures, if submitted and approved for use, shall conform to ASTM C494-04. Calcium chloride shall not be used.
- 2.8 Surface Hardener: Ready-to-use dust-on non-metallic powder type, Floorcon, 55 lbs./100 sq. ft., or equal approved by the Engineer.
- 2.9 Curing Compounds: Surface membrane-forming type conforming to ASTM C309-03, Type 2, white pigmented membrane-forming, applied by spraying. Submit for approval. For potable water structures, compound must be non-toxic, NSF approved. Polyethylene film shall be white opaque complying with ASTM D2103-03.
- 2.10 Waterstops: Polyvinyl chloride (PVC), 6” wide, maximum possible length, profiled as required, Cat. No. RB6-38 manufactured by Vinylex Corporation, or equal approved by the Engineer.

PART 3 – EXECUTION

- 3.1 Preparation:
- A. Do not proceed with Work in the field prior to completion of shop drawing/submittals review.
 - B. Assure that all excavations and formwork are completed and properly prepared and braced to receive concrete.

- C. Check all reinforcement for placement and anchoring.
- D. Verify placement and anchoring of all joint material, sleeves, etc., and other embedded items.
- E. Demonstrate that all materials, supplies and equipment are on the site and ready for use as required for sampling, testing, placing, vibrating, curing and for hot or cold weather concreting, if necessary.

3.2 Installation:

- A. Framework: Design, erect, support, brace and maintain formwork as required to ensure stability and safety. Comply with ACI 347.
 - 1. Provide internal metal ties so that when the forms are removed, not metal shall be within 1½” of any surface and no holes larger than ½” diameter remain.
 - 2. Earth cuts may be used as forms for vertical surfaces of footings only when the soil is sufficiently stable to prevent caving in; otherwise, the sides of the footings shall be formed as specified. Should it become necessary to form footings, no wooden material shall be left permanently in the ground.
 - 3. Place a smooth ¾” chamfer strip at all exterior and interior exposed corners.
 - 4. Do not remove forms until the concrete has attained the necessary strength to support its own weight and all construction live loads.
- B. Reinforcing Steel: Comply with Concrete Reinforcing Steel Institute (CRSI) recommended practices for details and methods of reinforcement placement and support.
 - 1. Pre-cut reinforcing steel accurately to the dimensions shown on the Drawings. Bend all bars cold and do not injure by manner of straightening.
 - 2. Position all reinforcement accurately and, unless otherwise shown or specified, secure against displacement by using annealed iron wire of not less than 18 gauge or suitable metal clips at all intersections. Support by metal chairs, spacers, hangers or bolsters.
 - 3. Support reinforcement in slabs on earth by masonry blocking of suitable height to hold the reinforcement at the proper level.
 - 4. Splices in reinforcement shall conform to requirements of ACI 318 and shall be made by lapping.
- C. Mixing and Transporting Concrete:
 - 1. Job proportioned and mixed concrete will not be accepted. All concrete shall be obtained from a ‘ready-mixed’ concrete plant approved in advance by the Engineer.
 - 2. Do not add mixing water after a truck has left the plant. No concrete shall be used in the Work which has been held longer than 1½ hours in a mixer truck.
- D. Placement of Concrete: Place concrete in compliance with ACI 304R or 304.2R.
 - 1. Do not place until the forms, reinforcement, and other conditions are approved by the Engineer, and until all pipes, conduits, sleeves, thimbles, hangers, anchors, flashing, and other Work required to be placed in the concrete have been properly installed and securely anchored.
 - 2. Maintain the temperature of concrete placed below 85°F except when an approved retarder is used. The placing temperature shall not exceed 95°F at any time. Comply with ACI 305R for hot weather placement and curing.
 - 3. Do not place concrete when the temperature is 40°F and falling. It may be placed when the temperature is 45°F or more and rising provided there is no reason to expect a drop in temperature to below 40°F

within 12 hours of the conclusion of the pour. Make provisions for maintaining the concrete a minimum temperature of 50°F for a period of not less than 72 hours at a temperature above freezing for the remainder of the curing period. Comply with ACI 306.1 for cold weather placement and curing.

4. Concrete shall be placed in one continuous pour. CONSTRUCTION JOINTS WILL NOT BE ACCEPTED, UNLESS SPECIFICALLY SHOWN ON APPROVED SHOP DRAWINGS.
5. Deposit concrete in the forms as rapidly as practical to its final positions and in such a manner as to prevent flow of concrete and to maintain a plastic surface which is approximately horizontal. Maintain the rate of delivery of the mixed concrete such that the interval between placing fresh concrete in contact with concrete already placed from previous batches does not exceed 45 minutes.
6. Use vibrators to consolidate (compact) the concrete. Insert and remove vertically; do not use vibrator to move concrete horizontally.
7. Protect concrete from early drying and begin curing activities as soon as appropriate.

E. Finishing:

1. Fill all tie holes with non-metallic, non-shrink grout approved by the Engineer.
2. Concrete not exposed to view: Rough Form Finish.
3. Exterior surfaces exposed to view (except walks, ramps or steps): Smooth Rubbed Finish.
4. Exterior sidewalks, landings and ramps: Broom Finish.
5. Interior slabs and exterior slabs intended for walking surface: Integral and chemical hardener.

F. Curing:

1. Curing shall be in accordance with ACI 308.
2. Protect freshly placed concrete with premature drying and excessively cold and hot temperatures.
3. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

3.3 Field Quality Control:

- A. Perform field quality control testing and inspection in accordance with Specification SECTION 01450. Take representative job control sample specimens of the concrete in accordance with ASTM C172 at the point of placement. All sampling, sample preparation and field testing shall be performed by an A.C.I. certified technician.
1. Perform at least one (1) slump test per delivery truck. Handle and test in conformance with ASTM C143-03. Perform additional tests whenever consistence changes.
 2. Perform at least one (1) air content test from pouring operation each day, but not less than one (1) test for each 75 cubic yards of concrete poured. Handle and test in conformance with ASTM C173-94.
 3. Perform one (1) sampling, consisting of three (3) cylinders, from each pouring operation each day, but not less than one (1) sampling for each 75 cubic yards of concrete poured. Collect and cure samples in accordance with ASTM C31-96. During cold weather concreting, take one (1) additional test cylinder and cure on job site under same conditions as concrete it represents.
 4. Measure and record concrete temperature hourly during hot and cold weather conditions. Also test concrete temperature each time a set of compression test specimens are made.

5. Transport cylinders to the testing laboratory designated by the Owner for curing and testing in accordance with ASTM C39-03.
 6. When directed, or otherwise required, obtain drilled core tests in accordance with ASTM C42-04.
 7. Submit duplicate field reports of sampling and testing results to the Engineer on a daily basis.
- 3.4 Defective Concrete: Modify or replace, as directed by the Engineer, any concrete placed outside the requirements of these Specifications or found not to conform to required lines, details and elevations.

SECTION 13414 – PRESTRESSED CONCRETE RESERVOIR

PART 1 – GENERAL

- 1.1 Section Includes: Design, fabrication and erection of a circular wire-wrapped prestressed concrete reservoir; foundation, floor, roof, piping, fittings, accessories, painting, testing and disinfection.
- 1.2 Related Sections:

SECTION 03300 – CAST-IN-PLACE CONCRETE
- 1.3 Quality Assurance:

E. Testing and inspection requirements are as specified by SECTION 01450 of these Specifications.

F. The reservoir design and surveillance of construction shall be under direct supervision of a Professional Engineer, registered in Georgia, and qualified in the design of prestressed concrete structures, who shall perform, stamp and sign all design calculations, drawings, reports and certifications relating to the reservoir design and construction.
- 1.4 Reference Standards: Work under this Section shall conform to referenced parts of the following documents:
 - a. ACI 372R-03 Design and Construction of Circular-Wire and Strand-Wrapped Prestressed Concrete Structures.
 - b. AWWA Standard for Wire- and Strand-Wound Circular, Prestressed Concrete Water Tanks (AWWA D110-95).
 - c. AWWA Standard for Disinfection of Water Storage Facilities (AWWA C652-02).
 - d. ACI 506.2-95 Specification for Shotcrete.
 - e. ACI 506R-90(1995) Guide to Shotcrete.
- 1.5 Submittals: Submit under provisions of SECTION 01330.
 - G. Each bidder shall provide the information applicable to design-construct contracts as listed in the Foreword to AWWA D110.
 - H. After award of contract, but prior to start of field work, submit for approval six (6) copies of complete and detailed foundation and tank design drawings, calculations, and related information about all procedures and materials to be used in the Work, including the shotcrete and concrete mix designs, prepared and stamped by a Professional Engineer registered in Georgia.
 - I. Prior to shipment of any materials or products to the job site, submit for approval detailed information on shop drawings on the materials and products.
 - J. At the conclusion of the Work, submit two (2) copies of a report to the Engineer certifying that the Work conforms to all applicable conditions of this Specification, and applicable ACI and AWWA standards.

- K. Report of inspection at one (1) year after completion and acceptance of the Work.
- 1.6 Delivery, Storage and Handling: Unload and store all materials in a manner to avoid physical damage or detrimental effects of exposure to weather. Where applicable, store materials in accordance with manufacturer's recommendations.
- 1.7 Site Conditions:
- A. The reservoir will be located in Seismic Zone 2A.
 - B. Provide temporary water, power and other utilities necessary for construction of the reservoir. Availability of Owner's water may be subject to completion of new waterlines by others. Delays caused by non-availability of water will not justify claims for increased Contract Amount or extension of Contract Time.
- 1.8 Qualifications of Fabricator/Erector: The reservoir Fabricator/Erector shall be a specialist in the design and construction of wire-wound circular prestressed concrete tanks, having had at least five (5) years experience in this specialty, and having designed and constructed at least five (5) reservoirs similar to the reservoir specified herein.
- 1.9 Warranty: The Contractor shall warrant the workmanship and materials on the entire structure for a period of five (5) years from the date of acceptance of the Work. During this period, Contractor shall promptly repair any leakage or other defects upon written notice from the Owner that such defects have been found.

PART 2 – PRODUCTS

- 2.1 General: Design and construction shall conform to AWWA D110 and ACI 372R, except as otherwise specified herein, for a water reservoir with a usable capacity as designated on the Drawings. Seismic design shall conform to requirements for Seismic Zone 2A.
- 2.2 Foundation:
- A. Provide foundation design. A maximum net allowable soil bearing capacity of 3,000 psf shall be assumed for foundation design, unless otherwise designated on the Drawings.
 - B. Provide 5" layer of clean, washed No. 57 stone base for drainage beneath the concrete floor in accordance with AWWA D110, Section 3.8.5 Provide leveling course of sand, minimum 1" thickness, over the No. 57 stone base. Sand shall be cleaned washed sand of the same quality utilized for concrete work and by same supplier. Also install compacted No. 57 stone backfill for all other excavated areas under reservoir floor.
 - C. Underdrain Pipe: Polyethylene (PE) plastic corrugated underdrain pipe conforming to Georgia Department of Transportation Standard Specification Section 839.
 - D. Aggregate for Underdrain: Size No. 78 conforming to Georgia Department of Transportation Standard Specification Section 800 and wrapped in filter plastic.
 - E. Filter Fabric: Nonwoven filter fabric to be equal to Mirafi 140N or Trevira Spunbond 1114.
- 2.3 Cast-in-Place Concrete: Shall conform to Specification SECTION 03300, minimum 28-day compressive strength shall be 4,000 p.s.i..
- 2.4 Shotcrete: Shotcrete and shotcrete application shall conform to the requirements of ACI 506.2 Specification for Shotcrete, except as modified by requirements of these Contract Documents. Shotcrete shall have a minimum compressive strength of 4,500 p.s.i. at 28 days ($f'g$); allowable compressive stress of $0.45 f'g$; and a maximum compressive stress due to initial prestress of 0.50 times the compressive strength at the time that the initial prestressing force was applied, but not greater than 2,000 p.s.i..
- 2.5 Prestressing Wire: Shall be cold drawn high carbon steel wire complying with ASTM A821-99, Type B, having a minimum diameter of 0.162" (8 gauge) and a maximum diameter of ¼" ; maximum effective prestress of 115,000

p.s.i. at wall and 120,000 p.s.i. at dome ring (fs); maximum prestress before losses of 145,600 p.s.i. but no greater than 0.70 (fs'); and minimum ultimate strength per ASTM A821-99, Class II.

2.6 Reinforcing Steel: ASTM A615, deformed billet steel bars, yield grade 60.

2.7 Steel Shell Disphragm: ASTM A586-03 cold rolled sheet steel, 26 gauge minimum. Horizontal splices are not permitted.

2.8 Reservoir Accessories:

- A. Self-supporting dome type roof. Dome shall be a free-span, spherical thin shell with a one-tenth rise and with a ring girder. The high water level in the tank shall be permitted to encroach on the dome shell not higher than the upper horizontal plane of the dome ring girder.
- B. Two (2) stainless steel elliptical or rectangular manholes in shell with hinged covers. Minimum clear opening shall be 18" height by 30" length each manhole.
- C. A telemetering enclosure, Hoffman Stainless Steel NEMA 4X Enclosure, 36" x 30" x 16" with hinged door. Provide 1" nipple for telemetry conduit in bottom of box, a 1" drain and plug in bottom of box, and 3" thick rigid Styrofoam insulation on interior top, bottom front and sides. (Provide no insulation on back side against tank wall.) Unit shall be mounted flush against tank. Provide a 3/4" Schedule 80 nipple through tank wall with brass glove valve. Provide watertight permanent seal for all penetrations of the enclosure. Coordinate required dimensions with telemetry equipment supplier and with Owner prior to shipment to site.
- D. Exterior, screened overflow ports (minimum of 2 ports) sized for a total pumping rate as designated on the Drawings. Provide removable stainless steel insect screens; all stainless steel hardware.
- E. Two (2) fixed vertical ladders: an aluminum ladder outside and a fiberglass ladder inside, each with a complete rigid rail fall prevention system as manufactured by North Specialty Products, 2664-B Saturn Street, Brea, CA 92621. The fall protection system shall include Aluminum 6061-T6 carrier rails, locking sleeves and two (2) safety harnesses. All ladders, safety railings and harnesses shall conform to all applicable OSHA regulations. Exterior ladder shall have an aluminum climb prevention shield as manufactured by North Specialty Products.
- F. Roof access hatch, 30" x 30" minimum clear opening, with 6" curb, all stainless steel hardware, hasp for padlock.
- G. Removable roof ventilation, 24" diameter minimum opening in center of roof, with type 304 stainless steel screen wire and hardware. Screen shall be 20" x 20" mesh and accessible for cleaning.
- H. Water level indicator, one-half travel, with fiberglass guageboard, float and target; stainless steel float guide cable and type 316 stainless steel hardware. Guageboard to be white with 4" black numerals at 2-foot (maximum) graduations calibrated to reservoir depth. Provide oversize target, painted red.
- I. All through-wall pipe sleeves shall be stainless steel with neoprene Link-Seal units and stainless steel hardware.
- J. All screens shall be fastened in place by stainless steel retainer strips and screws for ease of field replacement.
- K. Support brackets for one (1) telemetering radio antenna at roof edge; support brackets for telemetering conduit from antenna to telemetering enclosure. Coordinate with telemetry equipment supplier prior to fabrication.
- L. Only if specified: A curtain wall baffle system with stainless steel baffle support system custom designed to support the specified curtain wall baffles in accordance with recommendations of the baffle system manufacturer.

2.9 Inlet, Outlet and Overflow Connections:

- A. Inlet, outlet and drain piping shall be ductile iron, cement mortar lined, with flanged ends, conforming to AWWA C110 for fittings and AWWA C151, Class 350, for pipe. Provide stainless steel bolts, nuts and washers.

- B. Inlet and outlet pipes shall extend from inside the reservoir wall to a point at least five (5) feet outside the foundation with an end connection suitable for connection to M.J. or slip-on type of water pipe. Provide temporary plugs for pressure testing and removable ductile iron silt stops (top 4" above floor). Provide recesses in floor to allow the reservoir to drain completely when silt stop is removed.
- C. Provide poured-in-place concrete splash pad at each overflow port as indicated on the Drawings.

2.10 Paint:

- A. Interior coating materials used, if any, shall comply with ANSI/NSF Standard 60/61. Furnish Affidavit of Compliance.
- B. Deliver all materials to the fabrication shop and the job site in the original sealed containers of the manufacturer and store in accordance with the manufacturer's recommendations.
- C. Colors will be selected by Owner.
- D. Paint exterior surface of tank only. Paint shall be two (2) coats of TNEMEC Series 66 at 3.0 dry mils per coat, or equal if submitted and approved by the Engineer.

2.11 Sealant: 100% solids, moisture insensitive, low modulus epoxy system conforming to ASTM C881, Type II Grade I.

PART 3 – EXECUTION

3.1 Preparation:

- A. Stake out foundation in conformance with approved shop drawings and obtain Engineer's approval.
- B. Demonstrate that all shorcrete will be applied by experienced nozzle men certified in accordance with the guidelines of ACI Committee 506.

3.2 Inspection of Foundation Excavation: Prior to construction, allow Owner's geotechnical consultant to inspect the foundation excavation and verify the soil bearing capacity.

3.3 Construction:

- A. Construct foundation in accordance with approved shop drawings. Provide membrane vapor barrier over foundation to receive concrete floor.
- B. Provide monolithic, cast-in-place concrete floor, 6" minimum thickness, 8" minimum thickness over pipe encasements. Provide minimum 0.6% reinforcement area in each horizontal orthogonal direction. Locate reinforcement in the upper 2 1/2" of the slab with 1" cover from the top. Extend reinforcement 2 feet into thin sections. Place in one (1) continuous pour; no construction joints will be allowed. The floor shall be kept saturated by flooding until the structure is placed in service.
- C. Provide a core wall with minimum thickness of 4". Horizontal sections of the wall shall form true circles without flats, excessive bumps or hollows.
- D. Provide steel shell diaphragm and reinforcing bars as required by design computations. A minimum cover of 1" of shortcrete shall be provided for the diaphragm. Provide a positive waterstop, and seal all joints in the diaphragm watertight by injection of proven sealant which will allow no through wall leakage. Sealant system shall be submitted to and approved by Engineer prior to use. Conduct nighttime test for holes in diaphragm, using high-intensity lights and witnessed by the Engineer. No holes will be permitted in the diaphragm except as required for tank accessories. No horizontal joints or splices will be permitted in the diaphragm.
- E. Prestress the tank walls using continuous, uniform helix with pitch as required on tank design drawings. Splicing of wire will be permitted only when completing a full roll of wire or when removing a defective section of wire.

- F. Prestress using a machine capable of continuously inducing a uniform initial tension in the wire as it is positioned on the tank wall. Tension in the wire shall be generated by methods not dependent on cold working or redrawing of the wire. In determining compliance with design requirements, the aggregate force shall be no less than that required by the Drawings. No circumferential movement of the wire along the tank wall will be permitted during or after tensioning. Shortcrete encasement shall be used to permanently bond the wire to the tank wall and protect it from corrosion. To facilitate this encasement, the clear space between adjacent wires shall be no less than one (1) wire diameter.
- G. Provide special equipment at the construction site to measure the tension in the wire after it is positioned on the tank wall. This stress-measuring equipment shall include: stressometer complete with accurate dial indicator, calibrated dynamometers, and test stand to field verify the accuracy of the stressometer which must be within 1%. The initial tension in each wire shall be recorded.
- H. After circumferential prestressing wires have been placed, protect and permanently bond wires to the tank wall by encasement in shorcrete. The shorcrete cover shall have a thickness of no less than 1" over the wire. When multiple layers of wire are required, shortcrete cover between layers shall be no less than 1/8" thick. Shortcrete shall have broomed finish.
- I. Insofar as possible, place all pipe openings into the tank through the floor slab. When it is necessary for a pipe to pass through the tank wall, the invert of such pipe shall be no less than 18" above the floor slab, and the prestressing wires required at the pipe elevation shall be disturbed above and below the opening, leaving an entire strip around the tank unbanded. Unbanded strips shall have a vertical dimension of no more than 36". A design analysis will be required for unbanded wall spaces having a vertical dimension greater than 36".
- J. Construct the dome roof of reinforced cast-in-place concrete, 4" minimum thickness, circumferentially prestressed with shell reinforcement. Provide 0.25% minimum reinforcement. Provide air-entrainment for all concrete in accordance with Specification SECTION 03300.
- K. Furnish and install tank accessories as specified herein and shown on the Drawings. All fasteners and hardware for accessories shall be stainless steel.

3.4 Quality Control:

- A. Test preconstruction mix design cast-in-place specimens of concrete in accordance with Specification SECTION 03300.
- B. Test preconstruction test specimens of shortcrete in accordance with ACI 506.2, paragraph 1.6.1.
- C. During construction, perform cast-in-place field quality control in accordance with Specification SECTION 03300.
- D. During construction, perform shortcrete field quality control in accordance with ACI 506.2, paragraph 1.6.2., except that a test panel is required for every 50 cubic yards only.
- E. Obtain, cure, transport and test specimens in accordance with applicable specifications.
- F. Sampling and sample preparation shall be by a ACI certified technician.

3.5 Field Painting:

- A. Cure concrete and shorcrete surfaces for at least 30 days at 75°F minimum prior to field painting.
- B. Clean all surfaces of all dirt and foreign matter prior to painting.
- C. Paint the exposed exterior surfaces of the reservoir with primer and one finish coat strictly in accordance with the manufacturer's recommendations for a total dry film thickness of 6 mils (3 dry mils coat).
- D. Paint all exposed metal, except stainless steel, aluminum and fiberglass in accordance with manufacturer's recommendations for the approved painting products.

- 3.6 Lettering: If required, paint lettering on the tank as shown on the approved Shop Drawings, except that location of the lettering may be modified in the field by the Owner.
- 3.7 Hydrostatic Testing:
- A. Temporarily plug inlet/outlet pipes and perform hydrostatic test at 50 p.s.i. with no leakage for four (4) hours. Pressure test must be witnessed by the Engineer.
 - B. Conduct water leakage test for filled reservoir in presence of Engineer in conjunction with the disinfection procedure referenced below. ***No leakage will be accepted.*** If leaks are detected, drain, repair and repaint as necessary, and then re-disinfect and retest.
- 3.8 Cleaning and Disinfection:
- A. Thoroughly clean and remove all debris and dirt from the inside of the completed reservoir.
 - B. After cleaning has been approved by the Engineer, disinfect the tank in accordance with AWWA 652, Method Two. *Include roof interior surfaces to be spray treated.* Provide means to dispose of chlorinated water in a manner that will not result in erosion, siltation, or toxic damage to adjacent property or other detrimental effects on the environment. If necessary, neutralize residual chlorine in disposed water in accordance with AWWA C652, Appendix B.
 - C. After filling tank, request Owner to collect three (3) samples and test for chlorine residual and coliform organisms. If coliform organism are present, drain the tank, rinse thoroughly, and repeat the disinfection and testing procedure until acceptable.
- 3.9 Water for Testing and Disinfection: The Owner will provide one (1) tank-full of water after completion of connection piping by others for testing and disinfection. If subsequent draining the tank is necessary for repairs, testing, or disinfection, the Contractor shall reimburse the Owner for water used at the rate of \$4.77 per 1,000 gallons.
- 3.10 Final Clean-up: After completion of testing and disinfection, clean and landscape the site as required by these Specifications and the Drawings.