SECTION 33 1000

WATER UTILITES

PART 1 GENERAL

1.1. DESCRIPTION

A. Provide all equipment and materials, and do all work necessary to construct the exterior water system complete, including connections to existing pipelines, testing and disinfection, all as indicated on the Drawings and as specified.

1.2. RELATED WORK

310000 - Earthwork

1.3. GENERAL PROVISIONS

A. The Contractor shall coordinate his work with the other trades so that all work may be installed in the most direct and workmanlike manner, and so that interference between piping, duct, equipment, architectural and structural features, and other work will be avoided.

1.4. SUBMITTALS

A. Shop Drawings

1. Provide shop drawings, details, manufacturers' data and catalog cuts for all elements of the sewer system including, but not limited to, pipes, fittings, manholes, castings, joint gaskets, and connections to existing pipes and structures in accordance with Specification 01 3300 Shop Drawings, Product Data and Samples.

2. Provide Certificates of Compliance to the Specifications and referenced Standards for all piping and precast structures. Include certified copies of all required test reports.

3. Manufacturer's Recommendations: The Contractor shall, as a part of the shop drawings, submit, as indicated in Specification 01 3300, the manufacturer's recommendations for each material or procedure to be utilized which is required to be in accordance with such recommendations. The Contractor shall have a copy of the manufacturers' instructions available at the construction site at all times and shall follow these instructions unless otherwise directed by the Engineer.

4. All pipe furnished under the contract shall be manufactured only in accordance with the Specifications and the reviewed Drawings.

B. Working Drawings

1. Working drawings shall show completely dimensioned piping layouts for all exposed piping. When any of the work is of special design, such work shall be

shown in large detail.

2. Schedules of pipe fittings and valves; such schedules shall show the material and thickness or class of all pipe, the material and class of all, fittings and the rating and description of all valves.

3. Details of quality, type, design and location of all hangers, supports, cradles, anchors, braces and guides required for the proper installation of the pipe lines. Design Computations shall be included in the submittal and certified by piping manufacturer.

4. Details and methods for joining all pipes, including but not limited to: expansion joints, mechanical joints and flexible couplings; soldered, brazed or welded joints; adhesive joints; where shown, specified or required for a complete working installation.

5. Other piping appurtenances and data pertinent to the layout of pipe lines whether specifically mentioned in the Specifications or shown on the Drawings.

C. Submit manufacturers' certificates of conformance.

D. Submit certified copies of test reports.

1.5. DELIVERY, STORAGE, AND HANDLING

A. Storage and Protection

1. All pipes shall be stored at the site until installation in accordance with the manufactures recommendations.

2. Care shall be taken in loading, transporting, unloading and storing to prevent injury to the pipes or coatings. Pipe or fittings shall not be dropped. All pipe and fitting shall be examined before laying and no piece shall be installed which is found to be defective. Any damage to the pipe shall be repaired in accordance with the pipe manufacturer's instructions.

1.6. SITE VISIT

A. Before submitting the Bid, visit and carefully examine the site to identify existing conditions and difficulties that will affect the work of this Document. No extra payment will be allowed for additional work caused by unfamiliarity with the site conditions that are visible or readily construed by an experienced observer.

1.7 REFERENCES

A. The following standards form a part of this specification as referenced:

American Water Works Association (AWWA)

AWWA C104	Cement-Mortar Lining for Ductile- Iron Pipe and Fittings for Water
AWWA C105	Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.
AWWA C110	Ductile-Iron and Gray-Iron Fittings, 3 inches through 48 inches, for Water and Other Liquid

AWWA C111	Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
AWWA C150	Thickness Design of Ductile-Iron Pipe
AWWA C151	Ductile-Iron Pipe, Centrifugally Cast for Water or Other Liquid
AWWA C153	Ductile-Iron Compact Fittings, 3 inches through 24 inches, and 54 inches through 64 inches for Water Service
AWWA C600	Installation of Ductile-Iron Water Mains
AWWA C65l	Disinfecting Water Mains

PART 2 PRODUCTS

2.1 DUCTILE IRON PIPE

A. The Contractor shall use push-on joint type cement lined ductile iron pipe unless otherwise indicated on the plans.

B. All ductile iron pipe shall be designed in accordance with AWWA C150 and shall be manufactured in accordance with AWWA C151.

C. Unless otherwise indicated or specified, ductile iron pipe shall be Pressure Class 350 and thickness Class 52

2.2 JOINTS

A. Joints for ductile iron pipe shall conform to AWWA C111.

B. Restraining glands will be required on all fittings.

C. Pipe, fittings and appurtenances for restrained joints shall be in accordance with the requirements of AWWA C10 or C152. Only restraining glands which impart multiple wedging action against the pipe increasing its pressure as the pipe pressure increases will be allowed. Flexibility of the joint shall be maintained after burial. Glands shall be manufactured of ductile iron conforming to ASTM A 536. Twist off nuts shall be used to insure proper actuating of the restraining device. The mechanical joint restraint shall have a working pressure of at least 250 psi., and shall be manufactured by EBAA Iron, Inc., Eastland, Texas, or equal.

D. Where restraining glands are utilized thrust blocks may also be required.

2.3 FITTINGS

A. Fittings shall conform to the requirements of AWWA C111 or C153 as appropriate and shall be of a pressure classification at least equal to that of the pipe with which they are used.

B. The Contractor shall use ductile iron fittings.

C. Unless otherwise indicated, fittings shall have all bell mechanical joint ends.

2.4 GASKETS, GLANDS, NUTS AND BOLTS

A. Gaskets, glands, nuts, bolts and accessories shall conform to AWWA C111 or C153 as appropriate.

B. Gaskets shall be of plain tipped rubber, suitable for exposure to the liquid within the pipe.

C. Glands shall be ductile or cast iron.

D. Bolts and nuts shall be high strength alloy.

2.5 LINING AND COATING

A. The inside of pipe and fittings shall be given a cement lining and asphaltic seal coat in accordance with AWWA C104. The thickness of the lining shall be double that specified in AWWA C104.

B. The outside of pipe and fittings shall be coated with the standard asphaltic coating specified under the appropriate AWWA Standard Specification for pipe and fittings.

C. Machined surfaces shall be cleaned and coated with a suitable rust preventative coating at the shop immediately after being machined.

2.6 FLEXIBLE COUPLINGS

A. All sleeve-type couplings and accessories shall be of a pressure rating at least equal to that of the pipeline in which they are to be installed.

B. Couplings shall be cast or ductile iron and shall be provided with gaskets of a composition suitable for exposure to the liquid within the pipe.

2.7 SOLID SLEEVE COUPLINGS

A. All solid sleeve-type couplings and accessories shall be of a pressure rating at least equal to that of the pipeline in which they are to be installed.

B. Couplings shall be cast or ductile iron and shall be provided with gaskets of a composition suitable for exposure to the liquid within the pipe.

2.8 JOINT RESTRAINTS

A. Where indicated or necessary to prevent joints or sleeve couplings from pulling apart under pressure, megalug restraint systems shall be utilized. Alternate methods shall be used only when shown on the drawings or with the approval of the Owner.

B. Location of restrained joints shall be based on Thrust Restraint Design for Ductile Iron Pipe (Second Edition), published by Ductile Iron Pipe Research Association.

PART 3 – EXECUTION

3.1 INSPECTION BEFORE INSTALLATION

A. Pipes and fittings shall be subjected to a careful inspection just before being laid or installed.

3.2 HANDLING AND CUTTING

A. Any pipe or fitting which has a damaged lining, scratched or marred machine surface

and/or abrasion of the pipe coating or lining shall be rejected and removed from the job-site.

B. Any fitting showing a crack and any fitting or pipe which has received a severe blow that may have caused incipient fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work. In any pipe showing a distinct crack and in which it is believed there is no incipient fracture beyond the limits of the visible crack, the cracked portions, if so approved, may be cut off by and at the expense of the Contractor before the pipe is laid so that the pipe used will be perfectly sound. The cut shall be made in the sound barrel at a point at least 12 inches from the visible limits of the crack.

C. Except as otherwise approved, all cutting shall be done with a machine suitable for cutting ductile iron pipe. Hydraulic squeeze cutters are not acceptable for cutting ductile iron pipe. Travel type cutters or rotary type abrasive saws may be used. All cut ends shall be examined for possible cracks caused by cutting.

D. Lined and coated pipe and fittings shall be assembled and installed with approved packing or gaskets of the type recommended by the pipe manufacturer for the particular lining used.

3.3 INSTALLATION

A. Depth

1. The pipe shall be installed with a minimum of 5 feet of cover, unless specifically indicated otherwise on the plans or directed by the Owner.

B. Pipe and Fittings

1. No defective pipe or fittings shall be laid or placed in the piping, and any piece discovered to be defective after having been laid or placed shall be removed and replaced by a sound and satisfactory piece.

2. Each pipe and fitting shall be cleared of all debris, dirt, etc., before being laid and shall be kept clean until accepted in the complete work.

3. Pipe may only be installed in dry conditions, and a temporary plug shall be installed after each pipe installation.

4. Pipe and fittings shall be laid accurately to the lines and grades indicated on the drawings or as required. Care shall be taken to ensure good alignment both horizontally and vertically.

5. In buried pipelines, each pipe shall have firm bearing along its entire length.

6. Castings to be encased in masonry shall be accurately set, with the bolt holes, if any, carefully aligned.

7. Immediately prior to being set, castings shall be thoroughly cleaned of all rust, scale and other foreign material.

8. Fittings shall not be used to clear beneath or above an existing structure or

pipeline unless approved by the Engineer. The water main shall be brought to a depth sufficient to clear the structure or pipeline without the use of bends.

E. Temporary Plugs

1. At all times when pipe laying is not actually in progress, the open ends of pipe shall be closed by temporary watertight plugs or by other approved means. If water is in the trench when work is resumed, the plug shall not be removed until all danger of water entering the pipe has passed.

F. Push On Joints

1. Joining of push-on joint pipe shall conform to AWWA C600.

2. If effective sealing of the joint is not attained, the joint shall be disassembled, thoroughly cleaned, a new gasket inserted and joint reassembled.

3. Deflection of alignment at a joint shall not exceed the appropriate permissible deflection as specified in AWWA C600. The tables in AWWA C600 indicate the maximum permissible deflection for 18 and 20-foot pipe lengths. Maximum permissible deflections for other lengths shall be in proportion to such lengths.

G. Mechanical Joints

1. Assembling of fittings with mechanical joint ends shall conform to AWWA C600.

2. If effective sealing of the joint is not attained at the maximum torque indicated in the above standard, the joint shall be disassembled and thoroughly cleaned, then reassembled. Bolts shall not be overstressed to tighten a leaking joint.

3. The deflection of alignment at a joint shall not exceed the appropriate permissible deflection as specified in the following table. These values indicate the maximum permissible deflection for 18-foot lengths. Maximum permissible deflections for other lengths shall be in proportion to such lengths.

4. Pipe Deflection Allowances

Maximum permissible deflection, inches

Diameter of Pipe, Inches	Mechanical-Joint
6	27
8-12	20
16	13.5
20	11
24	9

H. Restrained Joints

1. Joining of restrained joint piping shall conform to the manufacturer's recommendations.
2. If effective sealing of the joint is not attained, the joint shall be disassembled,

thoroughly cleaned, a new gasket inserted and joint reassembled.

3. Deflection of alignment at a joint shall not exceed the appropriate permissible deflection recommended by the manufacturer.

I. Sleeve-Type Couplings

1. Pipe ends shall be cleaned thoroughly prior to installation. After the bolts have been inserted and all nuts have been made up fingertight, diametrically opposite nuts shall be progressively and uniformly tightened all around the joint, preferable by use of a torque wrench of the appropriate size and torque for the bolts. The correct torque as indicated by a torque wrench shall not exceed 90 foot-lb.

3.4 TESTING

A. Prior to the pressure and leakage tests, the piping shall be thoroughly flushed clean of all dirt, dust, oil, grease and other foreign material. This work shall be done with care to avoid damage to linings and coatings.

B. Pressure and Leakage Tests

1. Except as otherwise directed, all pipelines shall be given combined pressure and leakage tests in section of approved length. The Contractor shall furnish and install suitable temporary testing plugs or caps; all necessary pressure pumps, pipe connections, meters, gates, and other necessary equipment; and all labor required. The Owner or Engineer shall have the privilege of using their own gages.

2. Subject to approval and provided that the tests are made within a reasonable time considering the progress of the project as a whole, and the need to put the section into service, the Contractor may make the tests when he desires.

3. Unless it has already been done, the section of pipe to be tested shall be filled with water of approved quality, and all air shall be expelled from the pipe. The Contractor shall follow established procedures for filling the pipe and expelling trapped air to avoid exposing the piping system to water-hammer. If blow offs are not available at high points for releasing air, the Contractor shall excavate as required and install the necessary taps. After completion of the test, if so directed by the Engineer, he shall remove corporations used for testing; plug the holes and backfill as necessary.

4. The section under test shall be maintained full of water for a period of 24 hours prior to the combined pressure and leakage test being applied.

5. The pressure and leakage test shall consist of first raising the water pressure (based on the elevation of the lowest point of the section under test corrected to the gage location) to a pressure in pounds per square inch numerically equal to the pressure rating of the pipe not to exceed 200 psi. If the Contractor cannot achieve the specified pressure and maintain it for a period of two hour, the section shall be considered as having failed to pass the pressure test.

6. Following or during the pressure test, the Contractor shall make a leakage test by metering the flow of water into the pipe while maintaining in the section

being tested a pressure equal to the pressure rating of the pipe. If the average leakage during a two-hour period exceeds a rate of 11.6 gallons per inch of diameter per 24 hours per mile of pipeline, the section shall be considered as having failed the leakage test. For example, if 1,000 feet of 12-inch pipe is to be tested, the allowable leakage is 2.2 gallons over a 2-hour period, calculated as follows:

$$L = \frac{(11.6 \text{ gal}) \times (12") \times (2 \text{ hr.}) \times (1000')}{(1") \times (24 \text{ hr.}) \times (5280')} = 2.2 \text{ gal}$$

7. If the section fails to pass the pressure and leakage test, the Contractor shall do everything necessary to locate, uncover, and repair or replace the defective pipe, fitting, or joint, all at his own expense and without extension of time for completion of the work. Additional tests and repairs shall be made until the section passes the specified test.

8. If, in the judgment of the Engineer, it is impracticable to follow the foregoing procedure exactly for any reason, modifications in the procedure shall be made as required and approved, but in any event the Contractor shall be responsible for the ultimate tightness of the line within the above leakage and pressure requirements.

9. All testing required per the Contract Documents shall be witnessed by the Engineer. Any testing or testing results not witnessed by the Engineer shall not be considered as having met any of the Contract Document requirements for testing.

3.5 DISINFECTION AND FLUSHING

1. The Contractor shall disinfect the lines carrying potable water.

2. The Contractor shall furnish all equipment and materials necessary to do the work of disinfecting, and shall perform the work in accordance with the procedure outlined in AWWA C651 and all amendments thereto.

3. In general, the procedure of disinfecting the main shall be to apply the chlorine through a tap in one end of the section and bleed it off through a tap at the other end.

4. The applied dosage shall be such as to produce a chlorine concentration of not less than 10 mg/l after a contact time of not less than 24 hours.

5. During the disinfection period, care shall be exercised to prevent contamination of water in existing mains.

6. Any temporary connection to the mains or other facilities required to accomplish the disinfection of the mains shall be at the Contractor's expense.

7. After treatment, the main shall be flushed with clean water until the residual chlorine concentration is less than 0.2 mg/l.

8. Before disposing of the water used in disinfecting and flushing water mains the Contractor shall thoroughly neutralize it through the application of a reducing agent, as referenced in AWWA C651.

9. Bacteriological sampling and testing shall be done in accordance with AWWA C651 for each main and each branch. Sampling shall be accomplished with sterile bottles

treated with sodium thiosulfate, as required by Standard Methods. No hose or fire hydrants shall be used in collection of samples. A corporation stop installed on the main, with a removable copper tube gooseneck assembly, is the recommended method.

10. Testing shall be done by a laboratory approved by the Engineer, in accordance with Standard Methods, and shall show the absence of coli form organisms. A standard plate count may be required at the option of the Engineer.

END OF SECTION 33 1000