SECTION 02551

WATER MAINS

02551.01 GENERAL

A. Description

Water main installation shall include, but not necessarily be limited to, furnishing and installing water pipe, fittings, and appurtenances of the size and type shown on the Plans, installed on a firm foundation true to line and grade in accordance with the Contract Documents.

B. Related Work Included Elsewhere

1. Protection of the environment; Section 01500.
2. Trench excavation, backfill, and compaction; Section 02250.
3. Water valve and appurtenance installation; Section 02552.
4. Water service installation; Section 02553.
5. Fire hydrant installation; Section 02554.
6. Tracer Wire; Section 02570.
7. Cast-in-place concrete; Section 03300.

C. Quality Assurance

1. Materials

   a. The Engineer will inspect all materials before and after installation to ensure compliance with the Contract Documents. When specific tests of materials are called for in the referenced standards and specifications, the Engineer has the option of requiring that any or all of these tests be performed for materials furnished for a specific project. When testing is required, it will be specified herein or in the "Special Provisions".

   b. Polyvinyl chloride (PVC) pipe and couplings shall be homogeneous throughout and free from visible cracks, bubbles, blisters, holes, foreign inclusions, cuts, or scrapes on inside or outside surfaces, or other imperfections, which may impair the performance or life of the pipe. Each pipe shall be straight-to-within 1 1/4 inch per 20-foot length of pipe when uniformly supp01ied along its entire length and shall have a true circular cross-section to within ±1/64 inch.

   c. Steel pipe shall be the furnished by manufacturers who are fully experienced,

ce1iified and qualified in the manufacture of steel pipe. Steel pipe shall be designed, manufactured, tested, inspected, and marked in accordance with the latest editions of AWWA C200 and AWWA M11

d. Cast iron fittings and ductile iron pipe (DIP) and fittings shall be sound and without defects that might impair its service. Defective areas shall not exceed the maximum allowable minus wall thickness tolerance specified in AWWA C110 or C151. Repair of defects by welding or other methods will not be allowed. Defective or damaged lining areas may be repaired by cutting out the defective or damaged lining to the metal so that the edges of the lining not removed are perpendicular or slightly undercut. The cutout area and the adjoining lining shall be thoroughly wetted, and a stiff mo1iar applied and troweled smooth with the adjoining lining. After any surface water has evaporated, but while the patch is still moist, it shall be cured by the application of a seal coat.

2. Chlorination and Field Tests

a. General

1) The Contractor shall furnish all labor, tools, materials, and equipment (except meters and turbidity and bacteriological test equipment which will be furnished by the County) necessary to perform the tests specified and to chlorinate the water mains.

2) The Contractor shall schedule all tests with the Engineer at least 48 hours in advance of the test and shall conduct all acceptance testing in the presence of the Engineer. On County Capital Projects, the County will witness one test at no cost to the Contractor. If the project is released for service following conditional acceptance tests, the County will perform a final inspection if required at no cost to the Contractor. Should the pipeline fail the first County witnessed test, the Contractor shall reimburse the County for all costs resulting from such additional tests if so required until the pipeline passes the test(s). The Contractor shall also reimburse the County for the cost of inspection if the Contractor is not prepared for any test, or for additional tests required following the final inspection of released projects.

3) The section of water main shall be filled from such existing fire hydrant or main as may be designated by the Engineer. The Contractor shall furnish a backflow preventer ahead of the new water main. When charging and testing water mains which are not sufficiently close to existing water mains carrying County water to pe1mit connection direct by pipe or hose lines, tank wagons shall be used to haul water and serve as suction wells. Any defective work which shows up while conducting tests or before conditional acceptance, and any leaks occurring after

conditional acceptance but before final acceptance due to either blown joints or cracked pipe or fittings shall be replaced or repaired by the Contractor at his expense. Should the work be done by the County in the case of an emergency, the Contractor shall reimburse the County for the actual cost of replacing such materials and making such installations.

b. Chlorination, Flushing, and Bacteriological Testing

1) When the water mains are completed, each section shall be chlorinated in accordance with AWWA C651. A solution of hypochlorite of lime shall be discharged into the water main near the point where the water main is being charged. This solution shall be of such strength and quantity as may be necessary to provide 10 parts per million (ppm) residual chlorine after 24 hours, in the section of water main being charged.

2) After the 24-hour (minimum) disinfection period, the Contractor shall flush the water main until:

a) Turbidity is below 2 NTU, and

b) Chlorine level is at or below 2 ppm.

3) Contractor shall obtain discharge permit for the discharge of flushing water. Contractor to dechlorinate flushing water to meet State environmental standards, prior to surface discharge.

4) Samples will be taken by the Engineer and tested for bacteriological contamination. Should the chlorine residual and bacteriological analysis not be satisfactory, the Contractor shall flush and re--chlorinate the water main until satisfactory results are obtained.

c. Hydrostatic Testing

1) Water mains and appurtenances shall be hydrostatically tested by the Contractor in accordance with AWWA C600 and as specified herein.

2.) The pressure in the water main shall be increased to 150 psi at the highest point of the section of main under test, provided the static pressure is under 100 psi. Where static pressure is over 100 psi, it shall be noted in the "Special Provisions" and the test pressure shall then be 50 psi above static pressure. This test pressure shall be maintained within ±5 pounds per square inch without pumping for at least 1 hour for acceptance. Should the hydrostatic test show the water main is defective, the Contractor shall remedy such defects and retest the water main as specified above. This procedure shall be repeated until the test requirements are met.

d. Continuity Testing for PVC Pipe

After backfilling, the Contractor shall test the tracer wire to demonstrate electrical continuity between test stations and through the length of the PVC pipeline installed. Any discontinuity shall be located, repaired, and retested at the Contractor's expense until continuity is achieved.

D. Submittals

1. Shop Drawings

Shop drawings shall be submitted as specified in the "General Provisions" for the following materials, and shall include the following information:

a. Polyvinyl chloride (PVC) pipe and couplings: product information and dimensions; pressure rating; storage, handling, and installation recommendations.

b. Submit piping layout drawings showing location and dimensions of pipe and fittings; submit after equipment and valve submittals have been reviewed and accepted. Include laying lengths of valves, meters and other equipment determining piping dimensions. Label or number each fitting or piece of pipe. Piping having identical design thickness class, laying lengths, and bell and spigot dimensions that are to be placed in long straight reaches of alignment may have the same identifying label or number.

c. Ductile iron pipe and fittings:

1) Submit details of special elbows and fittings (if any).

2) Submit joint details.

d. Cast iron fittings and ductile iron pipe (DIP) and fittings: product information and dimensions; pressure rating or class; storage, handling, and installation recommendations.

e. Steel pipe, couplings, and fittings: dimension drawings; lay schedule; product information and dimensions; pressure rating; storage, handling, and installation recommendations.

f. Tie rods, retainer glands, and associated hardware: product information and dimensions; pressure rating; installation recommendations.

2. Certificates of Compliance

Certificate of compliance shall be submitted in accordance with the "General Provisions" for the following materials stating that item supplied is in accordance with the requirements specified herein:

a. Polyvinyl chloride (PVC) pipe

b. Steel pipe

c. Cast iron fittings and ductile iron pipe and fittings

3. Certified Test Results

Certified test results shall be submitted as specified in the "General Provisions" for the following:

a. Polyvinyl chloride (PVC) pipe

b. Cast iron fittings and ductile iron pipe and fittings.

02551.02 MATERIALS

A. Materials Furnished by the County

1. The County will not furnish any materials for water main construction.

2. On Capital Projects, the Contractor may obtain potable water from the County's potable water system for one pipeline fill at no cost in accordance with current County policies and procedures. Any additional water used will be invoiced at the prevailing rates. The Contractor shall contact the County's Department of Public Works, Meter Section for requirements.

B. Contractor's Options

The Contractor may furnish any specified pipe material and compatible specified fittings of his choice, unless otherwise noted in the "Special Provisions".

C. Detailed Material Requirements

1. Portland cement concrete for pipe fitting buttresses and anchorages shall be Mix No. 1 for unreinforced concrete buttresses and Mix No. 3 for reinforced concrete buttresses. Concrete mixes shall be as specified in Section 03310.

2. Polyvinyl chloride (PVC) Pipe and couplings shall be manufactured in accordance with AWWA C900 and AWWA C905 with DIP outside diameter, Table 2 dimensions, and 20 foot length as modified herein. Pipe shall have a dimension ratio (DR) of 18, pressure class of 200 psi, and shall be furnished with rubber gasketed joints of either the integral thickened bell or twin gasketed coupling type. Pipe, gaskets, and gasket lubricant shall be suitable for potable water systems. Pipe and couplings shall be marked, and factory tested in accordance with AWWA C900 or C905, as appropriate.

3. Steel pipe shall be designed, manufactured, tested, inspected, and marked in accordance with the latest editions of AWWA C200 and AWWA M11 and shall have a minimum thickness of 0.3125-inches. The interior of the pipe and fittings shall be cement mortar lined in accordance with AWWA C205. Thickness of interior mortar

shall be 3/8" for 24" - 36" pipe and ½" for pipe larger than 36" in diameter as specified in AWWA C205. The pipe exterior shall be coated to prevent corrosion. Standard pipe shall be bell and spigot joint.

4. Cast Iron Fittings

   a. All fittings shall be manufactured in accordance with AWWA Cl 10. Fittings shall be designed and constructed to withstand a pressure not less than that for the adjacent pipe or as follows, whichever is greater: fittings 12-inch diameter and smaller shall have a minimum pressure rating of 250 psi. Those 16-inch diameter and larger shall have a minimum pressure rating 150 psi.

   b. All fittings shall be cement-lined in accordance with AWWA C104, double thickness. This lining shall be sealed with a bituminous seal coat. The outside surface shall be bituminous coated or zinc coated conforming to AWWA C150 and C151.

5. Ductile Iron Pipe and Fittings

   a. Pipe

      1) Pipe shall be manufactured in accordance with the requirements of AWWA C151 except that the metal thickness shall be as described herein. Pipe nominal lengths may be 16 through 20 feet. DIP pipe shall only be allowed with DPW approval.

      2) All pipe and fittings shall be designed and constructed to withstand all external pressure caused by overburden as indicated on the profile and traffic loads to which the pipe may be subjected.

   b. All ductile iron pipe will be designed for a minimum of 250 psi working pressure and Type 1 laying condition. The standard thickness class for pipe up to and including 24-inches in diameter shall be Class 50; for pipe diameter greater than 24-inches, the standard thickness class shall be Class 51; or as shown on the Plans or specified in the "Special Provisions".

   c. Joints

      1) Joints in aboveground or submerged piping or piping located in vaults and structures shall be grooved end or flanged.

      2) Joints in buried piping shall be push-on or mechanical-joint type per AWWA Cl 11 except where restrained joint is called for on the drawings or where other joints are required by specifications to connect to valves, meters, and other equipment.

3) Restrained joints for piping 6-inches and larger shall be American Cast Iron Company "Flex", American Cast Iron Pipe "Lok-Ring", US Pipe "TR-Flex" or accepted equal.

4) Other restrained joints such as "mega-lug" are acceptable for tie-ins, connections to valves and existing water mains subject to meeting requirements of this section and approval by the Engineer.

5) Joint deflections for buried pipe do not exceed 85% of the manufacturer's recommended maximum deflection; assemble joints in accordance with AWWA C600 and the manufacturer's recommendations.

d. Fittings

1) All fittings shall be manufactured in accordance with AWWA C110 or AWWA C 153 for compact fittings sizes 3 inch through 16 inch. Fittings shall be designed and constructed to withstand a pressure not less than that for the adjacent pipe.

2) Fittings 12-inch diameter and smaller shall have a minimum pressure rating of 250 psi, those 14-inch diameter and larger shall have a minimum pressure rating of 150 psi.

e. Lining and Coating

All pipe and fittings shall be cement-lined in accordance with AWWA C104, double thickness. This lining shall be sealed with a bituminous seal coat. The outside surface shall be bituminous coated or zinc coated conforming to AWWA C150 and C151.

6. Joint Restraint

a. Retainer glands for use with mechanical type joints shall be of ductile iron with wedge-action restraining mechanisms incorporated into the mechanical joint follower gland. Wedges shall be hardened and activated glands with by bolts with torque-limiting twist-off torque bolts nuts. and furnished with hardened set screws and the completed restrained joint assembly shall have a rated minimum working pressure of 200 psi.

b. Rod for tie rod assemblies shall be 316 stainless steel rods and be threaded for at least 8 inches on both ends. Stainless steel rod shall be 3/4-inch diameter for pipe through 24-inch diameter unless otherwise noted. Nuts, washers and appurtenances shall also be 316 stainless steels. Manufactured tie rod and accessories shall result in the completed restrained joint assembly having a minimum working pressure rating of 200 psi.

c. Manufacturer’s proprietary restrained joints shall meet the performance requirements of AWWA C110 and AWWA C153 and shall meet the joint

deflection requirements of the project. All such proprietary systems shall be UL listed and FM approved.

d. Gaskets employing wedge-action elements to provide restraint, such as Amarillo Fast-Grip gasket by American, or the Field-Lok 350 gasket by US Pipe, shall utilize stainless steel wedge hardware embedded in a rubber gasket complying with the requirements of AWWA C111 and shall be rated for 350 psi for 4" through 16" and 250 psi for 20" and 24" diameter pipe. Gaskets shall only be used in bell fittings approved for use of such gaskets by the manufacturer.

7. Protective Coating

Field applied protective coating for underground applications shall be a bituminous coating meeting the requirements of Section 09900.02, Article C, Paragraph 8.

8. Corrosion Protection

If corrosive conditions are determined to be present, cathodic protections may be provided as determined by the Engineer and as shown on the construction drawings. Cathodic protection shall provide a minimum of 50 years of corrosion protection. Polyethylene encasement is not a substitute for cathodic protection.

9. Tracer Wire for Non-Metallic Pipelines

a. Tracer Wire shall be AWG No. 12 bare Copper or #2 jacketed, multistrand copper. AWG No. 12 bare Copper shall not be used for horizontal directional drilling operations. See Section 02570.

Tracer wire shall have mechanical connectors, and duct taped at 4-foot intervals for directional drilling operations. The wire ends are to be pulled up to the top, looped and continued through the valve boxes for future County access.

b. Marker Tape for Non-Metallic Pipelines

Marker Tape shall be minimum 3-inches wide blue plastic tape with metallic lining or coating lettered "WATER" in black graphics.

02551.03 EXECUTION

A. Preparation

1. Trench excavation, backfill, and compaction, and pipe bedding and haunching shall be as specified in Section 02250.

2. The pipeline trench excavation shall be dewatered sufficiently to allow pipe joints to be made under dry conditions. No joint shall be made under water.

3. No pipe shall be laid upon a foundation into which frost has penetrated, nor at any time when there is danger of ice formation or frost penetration at the bottom of the excavation. In freezing weather, open trench length shall be kept to a minimum and the excavation promptly backfilled after the pipe has been installed. Each pipe shall be bedded on a solid foundation acceptable to the Engineer. Bell holes shall be dug sufficiently large to ensure that joints are properly made, and the pipe is firmly bedded for the full length of the barrel.

B. Pipe Installation

1. All pipes shall be installed in accordance with the recommendations of the pipe manufacturer and as specified herein. These recommendations shall include maximum trench width, if more restrictive than that shown in the Standard Details; bedding requirements; backfill material and compaction, where applicable. In addition, the following shall apply unless otherwise noted:

   a. Polyvinyl chloride (PVC) pipe shall be installed in accordance with the Standard Details.

   b. Cast iron fittings and ductile iron pipe (DIP) and fittings shall be installed in accordance with the Standard Details and the recommendations of the Ductile Iron Pipe Research Association.

2. Proper and suitable tools and appliances for safe and convenient handling and joining of pipes and fittings shall be used. Slings shall not damage the exteriors and/or coating of the pipe, and shall be wide canvas or rubber-coated belts.

3. Pipe and fittings shall be carefully handled and lowered into the trench. Pipe shall be installed with special care to ensure that each length abuts against the next to produce no shoulder or unevenness of any kind along the inside bottom half of the pipeline. No wedging or blocking will be permitted in installing any pipe unless directed by written order or permission in writing is obtained from the Engineer.

4. No pipe shall be brought into position until the preceding length has been thoroughly bedded and secured in place. Care shall be used to secure water tightness and prevent damage to, or disturbing of, the joints during the refilling process. After pipes have been installed and joints have been made, there shall be no walking on or working over the pipe, except as may be necessary in tamping the backfill material, until the backfill is at least 2 feet over the top of the pipe.

5. The pipes shall be thoroughly cleaned before being installed and shall be kept clean until acceptance of the completed work. Open ends of all pipelines shall be provided with a stopper carefully fitted to keep dirt and other substances from entering. This stopper shall be kept in the end of the pipeline at all times when installation is not in progress.

6. Whenever a pipe requires cutting, to fit into the line or bring it to the required location,

the work shall be done in a manner that leaves a smooth, square end.

a. Cut PVC pipe ends shall have burrs removed and the end beveled to match factory bevel. Field spigots shall be stop-marked with a felt tip marker or wax crayon for the proper length of assembly insertion.

b. Any lining damaged due to field cutting shall be repaired by the Contractor as specified herein.

7. In addition to the other requirements specified herein, when installing PVC water mains, the Contractor shall also furnish and install the following:

a. A copper tracer wire along the top of the pipe prior to backfilling to allow line location and tracing. The copper wire shall be continuous for the full length of the pipeline and shall be connected to all fire hydrants on the pipeline.

~~b.~~ A 3-inch-wide blue marker tape shall be located in the trench, 2 feet below grade.

8. Minimum Pipe Cover and Clearances

a. Water mains shall have no less than 4 feet of cover measured from the existing and/or established grade to the top of the pipe whichever is lower, except as noted on the Plans. When crossing sub-surface obstructions, 12- inch minimum clearance shall be maintained between the pipe and the obstruction.

b. When crossing sanitary sewers with a water main, a 1-foot vertical clearance shall be maintained above the sewer pipe. The water main shall be centered over the sewer so that joints on both sides are the maximum distance from the sewer.

9. Joining Pipe

a. General

Before any joints are made in the trench, the Contractor shall demonstrate to the Engineer by making a sample joint that methods he will employ conform with the Specifications, will secure a watertight joint, and that the workmen whom he intends to use for this work are familiar with the requirements for making proper joints.

b. Push-On Gasketed Joints

Prior to making gasketed joints, both mating pipe ends and the gasket shall be cleaned of all foreign material. The gasket shall then be inserted in or stretched over the cleaned gasket seat and lubricant applied to the gasket and the mating pipe end. The pipe ends shall be carefully aligned and then driven home. The driving method shall be approved by the Engineer.

c. Mechanical Joints

A cast iron gland shall be positioned on the spigot end of the pipe, followed by a rubber gasket thoroughly lubricated with its tapered side facing the bell. The spigot shall then be inserted fully into the bell. The rubber gasket shall then be moved into position by hand until it is flush with the face of the bell. The gland shall then be placed against the face of the rubber gasket and the bolts inserted and made finger tight. Bolts shall be drawn up evenly on alternate sides beginning at the top, keeping the gland parallel to the face of the bell at all times. All nuts shall be tightened uniformly with a torque of not less than 60 or more than 90 foot-pounds.

d. Other methods of jointing pipe will be given consideration by the Engineer, provided the Contractor furnishes evidence that the proposed method is equal to or better than the specified methods, and further, provided that the proposed method has been successfully used and that the joint has previously been manufactured by the company from whom the Contractor proposes to purchase pipe.

e. Restrained joints and joint restraint systems shall be American Cast Iron Company "Flex", American Cast Iron Pipe "Lok-Ring", US Pipe "TR-Flex" or accepted equal.

10. Tie rod nuts shall be tightened by hand and then tightened one additional turn by wrench. Joint restraint systems shall be field protective coated with two coats of a bituminous coating after assembly.

11. Connections to existing work shall be made by the Contractor in the presence of the Engineer at such a time and in such manner as directed and approved by the Engineer. Upon notification by the Engineer, the Contractor shall notify the consumers in the area to be affected by the shut-off. All valves necessary for making connections will be operated by the County. The Contractor shall complete the connections with the greatest possible speed and all work will proceed without interruption until the existing system is returned to operation, so that the public will be inconvenienced as little as possible. When specified in the "Special Provisions", the Contractor shall make connections at night. When a tapping sleeve and valve is to be used for making the connection, the Contractor shall not proceed with the installation until directed to do so by the Engineer. The tapping sleeve and valve shall be prepared in accordance with Section 02552.03. Where it is necessary to remove an existing buttress to make a connection, the removal shall be done by the Contractor without additional compensation therefore.

12. Buttresses and anchorages shall be installed at all caps, horizontal bends, tees, branches, and beneath all vertical bends. Buttresses and anchorages shall be of concrete or concrete and steel. Buttresses and anchorages shall extend to solid, undisturbed soil and shall be constructed in accordance with the Standard Details, as shown on the Plans.

13. All buried metal pipe and/or appurtenance that do not have factory applied protective coating or whose coatings have been damaged shall be field coated with two coats of

a bituminous coating after installation.

14. Abandonment of water mains will be in accordance with Chapter 9 of the County Design Manual and Standard Details. Water meters are to be returned to the DPW Meter Shop.

02551.04 METHOD OF MEASUREMENT

A. Water Mains

Measurement for furnishing and installing water mains will be made horizontally along the centerline of the pipe for each size and type of pipe without deduction for valves or fittings.

B. Fire Hydrant Connections

Measurement for furnishing and installing fire hydrant connections will be made horizontally along the centerline of the pipe from the centerline of the water main to the bell on the base of the fire hydrant without deduction for valve or other fittings.

02551.05 BASIS OF PAYMENT

A. General

1. Payment will be made at the unit and/or lump sum prices bid. The prices bid shall include and cover furnishing all labor, tools, equipment, and materials necessary to complete the work as shown and specified in strict accordance with the Contract Documents, and accepted by the Engineer.

2. The prices bid for furnishing and installing water mains and fire hydrant connections shall include the following:

    a. Trench excavation, backfill, compaction, and incidental items as specified in Section 02250.

    b. Furnishing and installing granular pipe bedding materials and concrete for pipe fitting anchorages and buttresses as shown on the Standard Details and as required elsewhere in the Contract Documents.

    c. Furnishing and installing restrained joints and/or joint restraint systems where required by the Contract Documents.

3. Payment will be made for contingent items when ordered by the Engineer. Payment will be as specified in Sections 02951, 02952, 02953, 02954, 02955, 02956, and 02957.

B. Water Mains

Payment for furnishing and installing water mains, complete and operational, will be made per

linear foot of the size and type of pipe installed. The price(s) bid shall include furnishing and installing all pipe, fittings, plugs, stoppers, and jointing materials; removing existing buttresses when necessary, and connecting to existing pipelines, structures, or valves; testing and disinfecting the water main; and all other incidental items of work necessary to satisfactorily complete and make the water mains operational.

C. Fire Hydrant Connections

Payment for furnishing and installing fire hydrant connections, complete and operational, will be made per linear foot of pipe installed. The price(s) bid shall include furnishing and installing all pipe and fittings; tie rods and retainer glands for anchoring fire hydrant connections; removal of existing buttresses; plugging or capping of existing pipe or fittings and all work necessary for making connection to existing water mains; testing; and all other incidental items of work necessary to satisfactorily complete and make the fire hydrant connection operational.

D. Valves and Fire Hydrants

Payment for furnishing and installing valves and fire hydrants will be made as specified in Sections 02552 and 02554.

END OF SECTION