SECTION 331000

WATER UTILITIES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Furnish all waterline pipe and fittings meeting the Contract documents or specified as follows.

B. Furnish and install valves and fire hydrants for waterlines, together with related appurtenances.

C. Construct water services, including water service piping, tapping mains, corporation stops, curb stops, meter pits and related items.

D. Related Sections:

1. Section 312333 – Trenching and Backfill

1.02 CERTIFICATION BY MANUFACTURER

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

1.03 REFERENCES

ANSI B16.1	Tapping Sleeves
ASTM B88-62	Copper Pipe
ASTM PE3406-3408	Polyethylene Pressure Pipe
AWWA B300	Hypochlorite for Disinfecting
AWWA B301	Liquid Chlorine for Disinfecting
AWWA C 104	Ductile Iron Cement-Mortar Lining
AWWA C110	Ductile Iron Fittings
AWWA C111	Ductile Iron Joints
AWWA C151	Ductile Iron Pipe
AWWA C153	Ductile Iron Compact Fittings
AWWA C500	Gate Valves
AWWA C502	Fire Hydrants
AWWA C509	Gate Valves
AWWA C65 1	Disinfecting Water Mains
AWWA C900	PVC Water Main Pipe

PART 2 - PRODUCTS

2.01 GENERAL

A. Furnish waterline pipe and fittings as specified in the Contract Documents and meeting the material and testing requirements of this Section. Pipe strength classifications are shown on plan drawings and/or are listed in the Contract Documents.

B. References made to ASTM, ANSI, AWWA, USASI or AASHTO designations are the latest revision at the time of call for bids.

2.02 PIPE MATERIALS

A. General

1. Furnish the pipe specified in the contract documents meeting the materials and testing requirements as outlined in this section.
2. Assure all pipe is clearly marked showing type, class and/or thickness Lettering must be legible and permanent under normal handling and storage conditions.

B. Ductile Iron Pipe

1. Furnish meeting AWWA C151, American National Standard for Ductile Iron Pipe for Water.
   a. 3 inches to 12 inches Pressure Class 350
   b. 14 inches to 20 inches Pressure Class 250
   c. 24 inches Pressure Class 200
   d. 30 inches to 64 inches Pressure Class 150

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2. Assure the pipe interior is cement mortar lined meeting AWWA C104 requirements. Assure the outside pipe surface for underground service is bituminous coal tar base coated 1 mil thick.
3. Ductile Iron Fittings
   a. Furnish fittings meeting one of the following;
      1) Class 250 fittings meeting AWWA C110, latest edition, Gray-Iron and Ductile Iron Fittings For Water And Other Liquids
      2) Compact fittings meeting AWWA C 153.
4. Joints
   a. Assure joints are mechanical joints meeting AWWA C111. Assure the fitting interior is cement mortar lined meeting AWWA C104. Assure the fitting exterior is bituminous tar coated 1 mil thick. Use compact fittings having a rated working pressure of 350 psi (2410 kPa) following manufacturer recommended laying lengths.
   b. Restrained joint systems and mechanical restrained joint fittings shall be installed where specifically indicated in the drawings. Restrained joints may also be allowed in applications not specifically identified in the drawings in lieu of concrete thrust blocks with Contracting Officer approval.
      1) Restrained joints shall be Flex-Ring or Lok-Ring as manufactured by AMERICAN Ductile Iron Pipe, TR Flex as manufactured by U.S.Pipe, or approved equal.
      2) Restrained joints may also be internally restrained joint systems utilizing restraining gaskets as manufactured by US Pipe (Field Lok 350 Gaskets), American Pipe (Fast-Grip Gaskets), or an approved equivalent.
      3) Provide mechanical restrained joint fitting constructed of ductile iron and conforming to the material and performance requirements of AWWA C153. Assure all mechanical restrained joint fittings have seals conforming to ASTM F477 and the physical testing requirements of AWWA C111. Provide mechanical restrained joint fittings coated with fusion bonded epoxy coatings meeting the requirements of AWWA C116. Install all restrained joints in full conformance with manufacturer's recommendation, and assure the assembly of fitting joints does require beveling of the plain end of a cut pipe or the use of jacks or power equipment to force the pipe end past the gasket. Furnish mechanically restrained joint fittings as manufactured by One Bolt, Inc. (OneBolt), EBAA Iron, Inc. (Mega-Lug mechanical joint restraint), or an approved equivalent.
5. Couplings
   a. Use pipe couplings meeting one of the following:
      1) Cast type with cast iron or ductile iron sleeves and malleable or ductile iron flanges.
      2) Gray iron or ductile iron, mechanical joint solid sleeves, with a minimum 12 inch lengths.
      3) Limit use of the first type to a maximum 16 inch diameter. Use the manufacturers' standard gasket for use in potable water systems. Use stainless steel bolts and nuts. Coating to be "manufacturers ' standard".

C. Polyvinyl Chloride (PVC) Pressure Pipe
1. Furnish PVC water main pipe meeting AWWA C900 requirements, made to ductile iron O.D.'s for "Push-On" joints. Assure pipe joints are bell and spigot having an elastomeric gasket. Use DR 18 Class 235 pipe.

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D. Water Service Pipe

1. Use polyethylene pipe in water service line construction as specified in the contract documents and meeting the following specifications.

   a. Furnish service pipe of the size or sizes specified. Service lines are considered 2-inch (51 mm) size and under. Service lines over 2- inch (51 mm) size are considered as water mains and are specified under the applicable sections.

   b. Furnish and install the service pipe from the main to the building installing a curb stop and curb box.

   c. Polyethylene Service Pipe

      1) Use pipe meeting AWWA Specification C901, “Polyethylene (PE) Pressure Pipe, Tubing and Fittings, ½ inch through 3 inch for Water” and ASTM PE3406-3408. PE pipe to be pressure tubing meeting Table 6 requirements of said specification. Use class 200 with a DR of 7 Polyethylene pipe.,

      2) For all polyethylene service pipe, assure corporation stops, curb stops, couplings and all other fittings have pressure connections designed specifically for polyethylene pipe as manufactured by Mueller or an approved equivalent.

2.03 TAPPING SLEEVES AND VALVES

A. Use tapping sleeves meeting either:

1. Gray iron or ductile iron, split-sleeve, mechanical joint type with end and side gaskets,
2. Split-body type with circular gasket forming a seal around the circumference of the outlet.
3. Assure both types have a class 125, ANSI B16.1 outlet flange, are rated for a minimum 150 psi (1030 kPa) working pressure and contain a threaded test plug on the neck or body of the tapping sleeve. Assure gaskets are manufacturers' standard for use in potable water systems. Use stainless steel bolts and nuts. Assure mechanical joint type is fusion-bonded, 12-mil thickness, and epoxy coated. Limit the use of mechanical joint type to metal pipe. Assure tapping valves meet the applicable requirements for gate valves, as outlined in this section, with flanged inlets compatible with the flange of the tapping sleeve and mechanical joint outlet.

2.04 CORPORATION STOPS

A. Furnish brass corporation stops with inlet end to meet tapping requirements and flared outlet for copper tubing.

B. Acceptable manufacturers include: Mueller, Ford or equal.

2.05 SERVICE CLAMPS

A. Furnish flat, double strap, bronze metal service clamps with Neoprene gaskets and corporation stop threads. Assure service clamps for PVC provide full support around the pipe circumference with a bearing area of the width along the axis of the pipe so the pipe is not distorted when the clamp is tightened.

B. Acceptable manufacturers include: Mueller, Ford or equal.

2.06 CURB STOPS

A. Furnish curb stops with bronze plug, tee head key with Minneapolis pattern and screw box mount.

B. Acceptable manufacturers include: Mueller, Ford or equal.

2.07 CURB BOXES

A. Furnish extension type curb boxes having a 6- 1/2 foot (2 meters) extended length or length as required to bring curb box to finished grade.

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2.08 VALVES

A. Gate Valves

1. Furnish iron body gate valves, resilient seat or double disc gate valves with non-rising stems with design, construction and pressure rating meeting AWWA C500 or AWWA C509 requirements and the following.
2. Assure stem seals are double "O" ring seals capable of replacing the seal above the stem collar with the valve under pressure in full open position.
3. Furnish gate valves for underground installation equipped with a 2-inch (3 1 mm) square operating nut for key operation. All valves to open COUNTERCLOCKWISE. Valves to be equipped with mechanical joints for pipe connections.

2.09 VALVE BOXES

A. Furnish cast iron valve boxes, 5-1/4-inch (13 cm) diameter, adjustable valve boxes with the required base for the valve size used. Assure valve boxes are screw type and of the specified length for the pipe bury. All water valve boxes shall not be extended by more than 50%. Assure the valve box cast iron cover has an arrow indicating the opening direction and stamped with the word "Water". All water valve boxes shall be aligned to allow a 4-inch diameter PVC pipe to be inserted in the valve box and centered over the valve nut.

2.10 FIRE HYDRANTS

A. Furnish fire hydrants meeting AWWA C502; “Standard Specifications for Fire Hydrants for Ordinary Water Works Service”, and the Contract requirements.

B. Furnish hydrants with 5-1/4-inch (13 cm) valve openings, 6-inch (15 cm) mechanical joint or push-on inlet, one “Storz” pumper connection and two, 2-1/2-inch (63 cm) hose connections. Assure hose nozzle threads meet ASA Specification B26 for National Standard Fire Hose Coupling Screw Threads, 7 1/2 threads per inch. Assure pumper nozzle size and threads match City’s existing pattern. Furnish National Standard operating nut. Furnish hydrants opening counter clockwise and having an arrow on the hydrant top designating the opening direction.

C. Furnish “Compression” type hydrants with safety flange and safety stem coupling above the ground line permitting repair without shutting off the water. Assure hydrants are of the dry top design with two or more “O” rings sealing the water from the operating mechanism. Assure the operating mechanism is automatically lubricated from a sealed, self-contained lubricating reservoir.

D. Paint the hydrant portion above the ground line meeting the City’s standards.

E. Fire hydrants shall be by Mueller or equal.

2.11 SPECIAL FITTINGS

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

2.12 TRACER WIRE

A. Tracer wire shall be #12 AWG copper clad steel wire by Copperhead Industries, #12 AWG solid copper wire with 30 mil polyethylene insulation by Agave Wire or equal.

2.13 POLYETHYLENE ENCASEMENT

A. Furnish polyethylene encasement in accordance with AWWA C105, "Polyethylene Encasement for Fray and Ductile Cast - Iron Pipe for Water and other Liquids".

PART 3 - EXECUTION

3.01 TRENCH EXCAVATION AND BACKFILL FOR WATER MAINS

A. This work includes all excavation, backfilling, disposal of surplus and unsuitable material, and all other work incidental to trench construction, including excavation for valves,

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fittings, hydrants, thrust blocks or other pipeline structures and not classified as "Structural Excavation."

B. Perform this work in accordance with Section 312333: TRENCHING AND BACKFILLING.

3.02 PIPE INSTALLATION FOR WATERLINES

A. General

1. Install pipe following the manufacturer's specifications and instructions. Provide all tools and equipment required to install each type of pipe used.
2. The Contractor is responsible for all contractor furnished material. Replace all defective material or material damaged by handling after delivery by the manufacturer. This includes the furnishing of all materials and labor required to replace installed material discovered damaged or defective before final acceptance of the work, or during the guarantee period.
3. Store all material safely and to prevent damage. Keep pipe interior and other accessories free from dirt and foreign matter at all times.
4. Deliver and distribute all Contractor furnished pipe at the site. Load and unload pipe, fittings, specials, valves and accessories to prevent damage. Do not permit pipe handled on skidways to skid or roll against pipe already on the ground.
5. When distributing material at the work site, lay each piece adjacent to its installation point. Repair or replace all damaged pipe at Contractor's expense on the jobsite.

B. Dewatering of Trench

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

C. Laying of Pipe

1. Inspect the pipe and pipe coating for damage or defects before installation. Lay pipe without damaging the pipe coating. Repair all pipe coating damage following the manufacturer's instructions before laying the pipe. When using belt slings to lower the pipe into the trench, remove the slings without damaging the pipe coating.
2. Lay pipe to the specified lines and grades with fittings and valves at the required locations. Plumb all valve stems.
3. Excavate pipe trenches to the lines and grades given or to the standard cover depth specified. Transfer lines and grades to the pipe from hubs or from existing concrete curbs or sidewalks as an incidental part of this work.
4. Use implements, tools and facilities satisfactory to the Contracting Officer for the safe and convenient prosecution of the work. Carefully lower all pipe, fittings and valves into the trench using a derrick, rope or other tools or equipment, without damaging pipe materials and protective coatings and linings. Do not drop or dump materials into the trench.
5. Take every precaution to prevent foreign material from entering the pipe as it is placed in the line. During laying operations, do not permit debris, tools, clothing or other materials to be placed in the pipe. At times when pipe laying is not in progress, close the open ends of the pipe using a watertight plug or other approved methods to prevent material entering the pipe.
6. Place pipe bedding in the bottom of the trench meeting Section 312333; TRENCHING AND BACKFILLING. Voids may be left in the bedding material to remove pipe slings and for pipe bells to allow support along the full length of the pipe barrel.
7. Long radius curves, either horizontal or vertical, may be laid with standard pipe with deflections at the joints where approved. If the pipe is shown curved on the plans and no special fittings are shown, assume that the curves can be made by deflection of the joints with standard lengths of pipe. If shorter lengths are required, the plan will indicate maximum lengths that can be used.

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8. The Contracting Officer will determine the method of deflection or curving where required but not specified. No additional payment will be made for laying pipe on planned curves, nor for field changes involving standard pipe lengths deflected at the joints.
9. Do not exceed the applicable material and joint specifications of AWWA or the pipe manufacturer's recommendations at pipe joints for various types of pipe. When rubber gasketed pipe is laid on a curve, joint the pipe in a straight alignment and then deflect to the curved alignment. Excavate trenches to accommodate deflections and curves.
10. Construct reaction or thrust blocks at all tees, plugs, valves, reducers, caps and at bends deflecting 22-1/2 degrees or more. Construct thrust blocks at tapping sleeves where the outlet diameter exceeds one-half the diameter of the main being tapped. Limit using metal rods or straps for thrust restraint to those specified on the plans, or where the use of concrete thrust blocks would be impractical. Do not use metal rods or straps without the Contracting Officer's approval. Construct reaction blocks from concrete having a minimum compressive strength of 2,000 pounds per square inch (14,000 kPa) at 28 days. Place blocking between undisturbed ground and the fitting to be anchored. Place the blocking so that the pipe and fitting joints are accessible for repair.
11. Cut pipe for inserting valves, fittings or closure pieces in a neat and workmanlike manner without damaging the pipe or coating and leaving a smooth end at right angles to the pipe axis. Do not cut pipe using an oxyacetylene torch.

D. Pipe Jointing

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

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

   d. Apply the torque loads with torque measuring or indicating wrenches, or apply using regular socket wrenches, checked with torque wrenches.
   e. If the joint is not sealed using the maximum torque indicated above, disassemble and re assemble the joint after thorough cleaning. Do not overstress bolts to provide the seal.
3. Connections to Existing Mains
   a. Make all connections to existing water mains in use unless otherwise specified. Furnish the special fittings, as shown on the plans, and all oth-

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er material required. Make all necessary excavations to assure gradual transition between the new and existing water main and perform all necessary backfilling.

b. Where the connection of new work to old requires a service interruption and customer notification, the Contracting Officer and the Contractor are to mutually agree upon a date for connections to permit adequate time to assemble labor and materials, and to notify all affected customers. All notifications are the Contractor's responsibility and shall be provided a minimum of 48 hours prior to performing the work.

3.03 POLYETHYLENE ENCASEMENT

A. Double wrap all direct bury cast iron or ductile iron pipe and fittings including hydrants, valve boxes, curb boxes, and all other metal parts and surfaces, in polyethylene encasement.

3.04 TESTING, CLEANING & DISINFECTING WATER MAINS, FIRE HYDRANT LATERALS, VALVES & FITTINGS

A. Hydrostatic and Leakage Testing

1. Perform hydrostatic and leakage testing in accordance with AWWA C600. Once the pipe is laid and backfilled, test for at least 2 hours, all newly laid pipe, or any valved section, to a hydrostatic pressure of at least 1.5 times the normal operating pressure at the test point or 1.25 times the normal operating pressure at the highest point along the test section.
2. Slowly fill the pipe with water, purging all air, and apply the test pressure using a pump hooked up so that the pressure and leakage can be measured. To purge the pipe of air during the test, it is necessary to tap the pipe at its highest points if permanent air vents, water services, hydrants, etc. are not located at the high points. Use corporation stops for this purpose. Furnish the pump connections, gauges, stops, and all necessary apparatus for testing.
3. Disassemble and reassemble all joints showing leakage after thorough cleaning. Remove and replace all cracked or defective pipes or fittings discovered in during the pressure test with sound material and repeat the test.
4. Conduct the leakage test concurrently with the pressure test for 2 hours. Leakage is defined as the quantity of water supplied into the pipe, or any valved section thereof, necessary to maintain pressure within 5 PSI of the pressure test after the pipe has been filled with water and purged of air.
5. The pipe installation will be rejected if the leakage exceeds that determined by the following formula:

$$L = \frac{SD(P)^{1/2}}{148{,}000}$$

6. In which L equals the allowable leakage in gallons per hour; S is the length of pipe tested, in feet; D is the nominal diameter of the pipe, in inches; and P is the average test pressure during the leakage test, in pounds per square inch gauge.
7. Should any test of pipe laid disclose leakage exceeding that specified above, locate and repair the defective joints until the leakage is within the specified allowance.
8. Conduct the pressure and leakage tests with the Contracting Officer present.
9. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gallon per hour per inch of nominal valve size is allowed. Repair all visible leaks regardless of the amount of leakage.
10. Pressure test tapping sleeves after installation and before tapping.

B. Cleaning Water Mains and Fire Hydrant Laterals

1. Before chlorination, except when hypochlorite tablets are used, flush the mains thoroughly after the pressure and leakage test are completed.
2. It is understood that such flushing removes only the lighter solids and cannot be relied upon to remove heavy material allowed to get into the main during laying. Use a minimum flushing velocity in the main of 2.5 feet per second (0.7

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meters/second). If no hydrant is installed at the end of the main, provide a tap of the size to produce a velocity in the main of at least 2.5 feet per second (0.7 meters/second). Table 2 shows the rates of flow required to produce a velocity of 2.5 feet per second (0.7 meters/second) in various size pipes.

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

Flow Required To Produce		Size of Tap (inch) (mm)			Hydrant Outlet	
		1 (25)	1-1/2 (38)	2 (51)		
Inches (cm)	2.5fps (approx.) gpm (epm)	number of taps on pipe2/			Number	Size in. (mm)
4 (10)	100 (380)	1			1	2-1/2 (63)
6 (15)	200 (760)		1		1	2-1/2 (63)
8 (20)	400 (1510)		2	1	1	2-1/2 (63)
10 (25)	600 (2270)		3	2	1	2-1/2 (63)
12 (30)	900 (3400)			3	2	2-1/2 (63)
16 (41)	1600 (6060)			4	2	2-1/2 (63)

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

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

3. Exercise extreme care and conduct a thorough inspection during the water main laying to prevent and detect small stones, pieces of concrete, particles of material, or other foreign material that may have entered the mains. To remove this material, flush and inspect all hydrants on the lines to assure that the entire valve operating mechanism of each hydrant is in good condition.

4. In 24-inch (61 cm) or larger diameter mains, in addition to flushing, broom-sweep the main, removing all sweepings before chlorinating the main.

C. Disinfecting Water Mains and Fire Hydrant Laterals

1. General

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

2. Forms of Chlorine

a. The forms of chlorine that may be used, subject to the approval of the Contracting Officer, are:

1) Liquid chlorine containing 100 percent available chlorine under pressure in steel containers. Meet AWWA B301 requirements and use only in combination with appropriate gas-flow chlorinators and ejectors.

2) Sodium hypochlorite in liquid form containing approximately 5 to 15 percent available chlorine. Meet AWWA B300 requirements.

3) Calcium hypochlorite in granular form or in 5g tablets containing approximately 65 percent available chlorine by weight. Meet AWWA B300 requirements.

3. Methods of Chlorination

a. Three (3) methods of chlorination may be used. The tablet method gives an average chlorine dose of approximately 25 mg./L; the continuous feed method gives a 24 hour chlorine residual of not less than 10 mg./L; and

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the slug method provides a three hour exposure of not less than 50 mg./L free chlorine.

1) Tablet Method

a) This method may be used if the pipes and appurtenances are kept clean and dry during construction.

b) During construction, place calcium hypochlorite granules at the upstream end of the first section of pipe, at the upstream end of each branch main, and at 500-foot (150 meter) intervals. Use the quantity of granules shown in Table 2.

c) Warning: Do not use this procedure on solvent welded plastic or on screwed joint steel pipe because of fire or explosion hazard from the reaction of the joint compounds with the calcium hypochlorite.

TABLE 2
OUNCES OF CALCIUM HYPOCHLORITE GRANULES TO BE PLACED AT BEGINNING OF MAIN AND AT EACH 500-FOOT (150 METER) INTERVAL

Pipe Diameter		Calcium Hypochlorite Granules
Inches	(cm)	oz
4	(10)	0.5
6	(15)	1.0
8	(12)	2.0
12	(30)	4.0
16 and larger	(41)	8.0

d) During construction, place 5g calcium hypochlorite tablets in each section of pipe and also place one tablet in each hydrant, hydrant branch and other appurtenance. Use the number of 5g tablets for each pipe section required to provide a minimum chlorine concentration of 25 mg/L. Appendix B provides information on the number of tablets required for commonly used sizes of pipe. Attach tablets to the inside of the pipe using an adhesive such as Permatex No.1 or equal. Assure no adhesive is on the tablet except on the broad side attached to the surface of the pipe. Attach all the tablets at the inside top of the main, with approximately equal numbers of tablets at each end of a given pipe length. If the tablets are attached before the pipe section is placed in the trench, mark their position on the section so it can be readily determined that the pipe is installed with the tablets at the top.

e) When installation has been completed, fill the main with water at a velocity not exceeding 1 fps (0.3 mps). Take precautions to assure that air pockets are eliminated. Leave this water in the pipe for at least 24 hours. If the water temperature is less than 41° F (5 ° C), leave the water in the pipe for at least 48 hours. Position valves so that the chlorine solution in the main being treated will not flow into water mains in active service.

2) Continuous Feed Method

a) Before chlorinating, fill the main with water to eliminate air pockets and flush as specified above.

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b) Use water from the existing distribution system or other approved source of supply to flow at a constant, measured rate into the newly laid water main. At a point not more than 10 feet (3 meters) downstream from the beginning of the new main, assure water entering the new main receives chlorine fed at a minimum 25 mg/L free chlorine. To assure that this concentration is provided, measure the chlorine concentration at regular intervals.

c) Appendix B provides information on the amounts of chlorine compound required for various pipe sizes.

d) During chlorine application, position valves so that the chlorine solution in the main being treated does not flow into water mains in active service. Do not stop chlorine application until the entire main is filled with chlorinated water. Retain the chlorinated water in the main for at least 24 hours, operating all valves and hydrants in the section treated to disinfect the appurtenances. At the end of the 24- hour period, the treated water in all portions of the main must have a minimum free chlorine residual of 10 mg/L free chlorine.

e) The preferred equipment for applying liquid chlorine is a solution feed vacuum operated chlorinator to mix the chlorine gas in solution water, in combination with a booster pump for injecting the chlorine gas solution water into the main to be disinfected. It is recommended that direct feed chlorinators not be used. Hypochlorite solutions may be applied to the water main with a chemical feed pump designed for feeding chlorine solutions.

f) If approved, an optional continuous feed method utilizing calcium hypochlorite granules may be used. Place the granules in the pipe sections as specified under the Tablet Method.

3) Slug Method

a) Before chlorinating, preliminary flush the main as specified herein.

b) Use water from the existing distribution system or other approved source of supply to flow at a constant measured rate into the newly laid water main.

c) Not more than 10 feet (3 meters) downstream from the beginning of the new main, add chlorine to the water entering the new main at a constant rate that the water will have a minimum 100 mg/L free chlorine. Measure this concentration at regular intervals. Apply the chlorine continuously and for the time required to develop a solid column or "slug" of chlorinated water that will, as it moves through the main, expose all interior surfaces to a 100 mg/L for at least 3 hours.

d) Measure the free chlorine residual in the slug as it moves through the main. If at any time it drops below 50 mg/L stop the flow and relocate the chlorination equipment at the head of the slug, and as flow is resumed, add chlorine to restore the free -chlorine in the slug to not less than 100 mg/L.

e) As the chlorinated water flows past fittings and valves, operate related valves and hydrants to disinfect appurtenances and pipe branches.

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4. Final Flushing
   a. After the retention period, flush the chlorinated water from the main until chlorine measurements show that the concentration in the water leaving the main is no higher than that in the system, or is acceptable for domestic use.

D. Bacteriological Tests
   1. After final flushing and before the water main is placed in service, test a sample, or samples, collected from the main(s) for turbidity and organisms. Collect at least one sample from the new main and one from each branch.
   2. Redisinfection
      a. If the initial disinfection fails to produce approved bacteriological or turbidity samples, re-flush and resample the main. If check samples show bacterial contamination, re-chlorinate the main until approved results are obtained.
   3. Swabbing
      a. Where connections are made to existing piping and the connections are not disinfected along with the newly installed main, swab or spray the interior of all pipe and fittings used in making the connections with a 1 percent hypochlorite solution before installation.

3.05 VALVES

A. Set and joint gate valves to the pipe as specified for pipe laying and jointing. Set valves with operating nut vertical. Center and plumb valve boxes over the operating nut to prevent shock or stress being transmitted to the valve.

B. Valve Boxes
   1. Center and plumb valve boxes over the valve operating nut. Set valve box tops flush with the ground surface or street surfacing.
   2. Place bedding gravel around all water main valves and under the valve box bottom to drain any water entering the valve box.

C. Valve Thrust Blocks
   1. When specified, install valves with thrust blocks.

3.06 FIRE HYDRANTS

A. Set all hydrants plumb with the pumper nozzle facing the street. Set the hydrant with the ground line at the location indicated by the hydrant manufacturer.

B. Provide drainage at the hydrant base by placing clean gravel under and around it. Place gravel at least 1 foot (30 cm) on all sides from the base of the hydrant to at least 6 inches (15 cm) above the drain opening. Brace the hydrant against unexcavated earth at the trench end with concrete backing as detailed on the plans. Furnish hydrants with the specified gate valves.

3.07 SERVICE LINE INSTALLATION

A. Provide all work and materials for the complete service line installation, including trench excavation and backfill; making the water main tap; furnishing and installing the corporation stop, curb stop and box, service clamp where necessary, service line with fittings to make the connections to the stops and meter pits. Bend the service line adjacent to the water main into a figure "S" in a horizontal or vertical plane to avoid a rigid connection.

3.08 TRACER WIRE

A. Tracer wire connections shall be made with direct bury wire nuts. When connecting two tracer wire ends to one another, strip 5/8”of wire insulation from end of each wire, insert each end of the wire into the nut and tighten. Twist the wire ends to reduce pull-out potential at the nut.

B. Install tracer wire 1 to 2-inches above the top of the waterline piping. Bury the wire entirely with pipe bedding.

C. Tracer wire installed on mains or service lines shall loop to the surface inside of gate valve or curb stop boxes. Tracer wire ends shall be easily accessible under valve box

SUPPLEMENTAL 1 SPECIFICATIONS

lids. Wires on dead end mains shall be brought to the surface and connected to tracer wire posts.

3.09 TAPPING

A. Perform tapping using an approved tapping machine using clean, sharp drill taps and/or shell cutters. Do not tap directly into AWWA C900 PVC pipe. 3/4-Inch (19 mm) and 1-inch (25 mm) taps may be made directly into the barrel of ductile iron pipe without using service saddles. Direct tap into the pipe barrel to the depth exposing a maximum three threads of the corporation stop. Use maximum direct tap sizes of l- 1/2-inch (3 8 mm) for 6-inch (1 5 cm) diameter mains and 2-inch (5 1 mm) for larger mains.

END OF SECTION

SECTION 333000

SANITARY SEWERAGE UTILITIES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Furnish and install sewer pipe and fittings including manholes, service lines and other appurtenant structures as specified in the Contract and this section. Pipe strength classifications are shown on the plans, listed in the Contract Documents or specified herein.

B. Related Sections:

1. Section 312333 – Trenching and Backfill

1.02 CERTIFICATION BY MANUFACATURER

A. Furnish a manufacturer's certification for all pipe and fittings, certifying that the pipe and fittings meet the contract requirements.

1.03 REFERENCES

ASTM C443	O-Ring Rubber Gaskets
ASTM C478	Precast Reinforced Concrete Manhole Sections
ASTM D1784	Rigid Polyvinyl Chloride Compounds
ASTM D2241	PVC Pressure Pipe
ASTM D3034	Polyvinyl Chloride Sewer Pipe and Fittings
ASTM F679	Large Diameter PVC Pipe

PART 2 - PRODUCTS

2.01 GENERAL

A. Furnish sewer pipe and fittings as specified in the Contract Documents and meeting the materials and testing requirements of this Section. Furnish wye or tee branches and service line piping of the same material and design as the sewer pipe unless specified otherwise. Pipe strength classifications are shown on the plans and/or are listed in the Contract Documents.

B. References made to ASTM, ANSI or AASHTO designation are the latest revision at the time of call for bids.

C. Assure all pipe is clearly marked with type, class and/or thickness as applicable. Assure lettering is legible and permanent under normal conditions of handling and storage.

D. Furnish the joint type, class, thickness designation, castings, lining, marking, testing, etc. as specified.

2.02 PIPE MATERIALS

A. Polyvinyl Chloride (PVC) Pipe

1. General

a. Furnish PVC pipe produced by a continuous extrusion process, employing a prime grade of un-plasticized polyvinyl chloride. Assure the grade used is highly resistant to hydrogen sulfide, sulfuric acid, gasoline, oil, detergents and other chemicals found in sewage and industrial wastes. Assure the material meets "Rigid Polyvinyl Chloride compounds", ASTM Designation D-1784 requirements. Assure the pipe has self-extinguishing flammability characteristics.

2. Gravity and Force Main Sewer Pipe

a. Furnish gravity and force main sewer pipe meeting the following requirements:

1) ASTM D-1785, "Standard Specifications for Polyvinyl Chloride Plastic Pipe", Schedule 40

3. Pipe Jointing

a. Furnish each length with a bell designed to provide a watertight joint when jointing the bell and spigot with a rubber ring.

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b. Make a rubber gasket joint for PVC pipe and fittings using a rubber gasket compressed between the outer surface of the spigot and the inner surface of the bell. Assure the joint is completely sealed by the gasket so that the assembly remains watertight under all service conditions, including expansion, contraction, settlement and pipe deformation. Follow the manufacturer's recommendations when assembling the rubber ring joint.

4. Fittings.
   a. Assure wye or tee fittings for connection service lines are of the same material, construction and joint design as the sewer pipe.

2.03 MANHOLES

A. General
   1. Construct manholes from precast concrete sections having frames, covers, and steps meeting details on Construction Plans.

B. Precast Concrete Sections
   1. Furnish manholes meeting ASTM C478; "Precast Reinforced Concrete Manhole Sections", specifically including mandatory rejection requirements.

C. Steps
   1. Furnish non-corrosive steps, 12-inches (30 cm) in width, of 1/2-inch (13 mm) steel rod encased with polypropylene. Assure steps withstand 400 pound (180 kg) vertical loads and 1,000 pound (450 kg) pull-out resistance.

D. Frames and Covers
   1. Furnish cast iron frames and covers. Furnish 2-hole type covers unless specified otherwise.

E. Concrete Base
   1. Furnish precast concrete bases or field poured on undisturbed earth. Use concrete meeting Section 033000; CAST-IN-PLACE CONCRETE (SITE).

PART 3 - EXECUTION

3.01 PIPE AND SERVICE LINE INSTALLATION

A. Excavation and Backfill
   1. Perform pipeline excavation and backfill meeting the applicable requirements of Section 312333 ; TRENCHING AND BACKFILLING.

B. Responsibility for Material
   1. Replace all material found defective in manufacture or damaged in handling after delivery. This includes furnishing all material and labor required for the replacement of installed material discovered defective before final acceptance of the work or during the guarantee period.
   2. Contractor shall be responsible for the safe storage of material intended for the work until it has been incorporated into the completed project.

C. Handling of Pipe
   1. Deliver and distribute all pipe to the site. Load and unload pipe, fittings and accessories by lifting with hoists or skidding to avoid shock or damage. Do not drop any materials. Do not roll or skid pipe handled on skidways against pipe already on the ground.
   2. In distributing the material at the site of the work, unload each piece opposite or near the place where it is to be laid in the trench. Keep the interior of all pipe and other accessories free from dirt and foreign matter at all times.
   3. Handle pipe to prevent damaging coating or lining. If any part of the coating or lining is damaged, make all repairs in a manner satisfactory to the Contracting Officer.

D. Laying Pipe
   1. Lay and maintain all pipe to the specified lines and grades with fittings, tees and manholes at the required locations. Establish line and grade using batter boards

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and string line, laser equipment or other approved methods. When batter boards and string line are used, use a minimum of 3 batterboards at all times.

2. Install wye or tee fittings in the mainline sewer for service line connections. Furnish wye or tee fittings of the same material, design and specifications as the sewer main pipe. Joint service pipe to tee branches or main line pipe other than PVC using special joint adapters manufactured specifically for jointing the two types of pipe.
3. Use tools and equipment, satisfactory to the Contracting Officer, for the safe and convenient prosecution of the work. Carefully lower all pipe and fittings into the trench to prevent damage to pipe materials and protective coatings and linings. Do not drop or dump any materials into the trench.
4. Take every precaution to prevent foreign material from entering the pipe while it is being installed. At times when pipe laying is not in progress, close the open ends of pipe using a plug or other means approved by the Contracting Officer. Clean and remove all sand, gravel, concrete and cement grout that has entered the lines during construction.

E. Tolerances

1. Install the pipe within 1/2-inch (13 mm) of the specified alignment and within 1/4-inch (6 mm) of the specified grade.

3.02 MANHOLES

A. Construction

1. Construct manholes to the specified dimensions. Make invert channels smooth and semi circular in shape conforming to the inside of the adjacent sewer section. Make changes in flow direction with a smooth curve of as large a radius as the manhole size will permit. Make changes in channel grade and size gradually and evenly. The invert channels may be formed directly in the manhole base concrete or by laying half-pipe in the concrete. Make the floor of the manhole outside the channel smooth and slope toward the channel at one inch per foot (8 cm per meter).
2. Joint all connections between manhole walls and base and between wall sections adjusting rings, and frame making the manhole watertight. For all horizontal joints, install a preformed, resilient, O-ring type, neoprene gasket in the joint. For all sewer pipe to manhole joints, use gasketed, flexible, watertight connections that will accommodate differential settlement. Acceptable options for these connections to the manhole are as follows:
   a. Adjacent Joints: bell and spigot pipe joints with rubber sealing rings located within 12 inches (30 cm) of the manhole wall.
   b. Compression-Type Flexible Connector: a resilient, flexible connection, cast into manhole wall, providing 10 degrees deflection.
   c. Boot-Type Flexible Connector: a flexible, watertight connection consisting of a rubber gasket or boot, metal expansion ring and a metal take-up clamp. Assure the expansion ring holds the gasket in the manhole wall, with the take-up clamp holding the gasket to the pipe.
   d. Options (b) and (c) are limited to precast manhole base inverts and other installations where the flexibility of the connection is not compromised.
   e. Construct manholes meeting ASTM C478, and the rejection criteria stated therein.
   f. Keep manhole construction within one manhole distant behind sewer pipeline construction.
3. Install adjusting rings on each manhole to bring the manhole top elevation to match the existing or specified ground elevations. Use manhole rings with a 2-inch minimum (5 cm) and 12-inch (30 cm) maximum height. Furnish adjusting rings reinforced with the same percentage of steel as the riser and top.

END OF SECTION

SUPPLEMENTAL 1 SPECIFICATIONS