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SECTION 02550

WATER DISTRIBUTION SYSTEM

PART 1 - PRODUCTS

Products and materials used in the work shall conform to the following:

1.01 PIPE

A. Ductile Iron Pipe - Shall conform to ANSI/AWWA C150/A21.50 latest revision and ANSI/AWWA C151/A21.51 latest revision for laying condition two. All pipes shall be cement lined in accordance with ANSI/AWWA C104/A21.4 latest revision.

B. P.V.C. Pipe - All P.V.C. pipe shall bear the seal of the National Sanitation Foundation. All waterline pipes shall be blue in color. Certificates of conformance with the following specifications shall be furnished with each lot of pipe supplied.

Pipe 4-inches through 12-inches shall conform to all requirements of ANSI/AWWA C900, latest revision, and shall be DR-18 with a minimum pressure rating of 150 psi.

Pipe larger than 12-inches shall conform to all requirements of ANSI/AWWA C905, latest revision, and shall be DR-18 with a minimum pressure rating of 150 psi.

C. Tubing - Tubing shall conform to the following:

1. Polyethylene – 1-inch polyethylene tubing shall conform to all requirements of ASTM D1248, grade P34, Class C; ASTM D2737, PE3408: ASTM D3350, cell class 335424C; and AWWA C901. The tubing shall be pressure class 200 with SDR 9. Marking of the tubing shall include: nominal pipe size, PE 3408, SDR 9, PC 200, AWWA C901, Manufacturers name and seal or mark of testing agency certifying suitability of the pipe material for potable water products as per AWWA C901 Section 6.1.2.

   2" water service line shall be polyethylene conforming to AWWA C901.88/ASTM D-1248, ASTM D-2239, ASTM D-2737, ASTM D-3035. No 1.5”, 2.5” or 3” will be allowed.

2. Copper Tubing – One (1) inch and two (2) inch Copper tubing shall be seamless and shall conform to ANSI/AWWA C800 and ASTM B88, Type K, containing not less than 99.90% copper and not more than 0.04% phosphorus, suitable for use with a working pressure of 150 psi. No 1.5”, 2.5”, or 3” will be allowed.

3. All water service tubing two (2) inches and smaller shall be copper tube size (cts).

1.02 JOINTS

A. Flanged Joints - Shall conform to ANSI/AWWA C115/A21.15 latest revision. Bolts shall conform to ANSI B18.2.1 and nuts shall conform to ANSI B18.2.2. Gaskets shall be rubber, either ring or full face, and shall be 1/8-inch thick. Gaskets shall conform to the dimensions recommended by ANSI/AWWA C115/A21.15 latest revision. Flanged joints shall not be used for buried installations.

B. Mechanical Joints - In ductile iron pipe shall conform to ANSI/AWWA C111/A21.11 latest revision.

C. Push-On Joints - In ductile iron pipe shall conform to ANSI/AWWA C111/A21.11 latest revision.

D. Fluorinated Hydrocarbon Gaskets - Fluorinated hydrocarbon gaskets for ductile iron pipe shall conform to the requirements of ANSI/AWWA C111/A21.11-90 (Trade names may include, but are not limited to "Fluoral" or "Viton") and shall be required where petroleum exposure may occur.

E. Plastic Pipe

1. Joints in plastic pipe four (4) inches and larger shall meet all requirements of ANSI/AWWA C900/C905 latest revision. The integral bell joint system (push-on joints) shall meet the requirements of ASTM D-3139 and utilize an elastomeric seal conforming to ASTM F-477.

2. Joints in one (1) inch and two (2) inch plastic tubing shall conform to ASTM D3139 latest revision. Solvent joints shall not be used. Compression joints with no lead brass are acceptable only for one (1) inch and two (2) inch pipes.

3. Butt-fused joints for FPVC pipe are acceptable when performed in accordance with manufacturers’ guidelines.

F. Restrained Joints - Restrained joints for pipe, valves and fittings shall be mechanical joints with ductile iron retainer glands equivalent to "Megalug" or push-on type joints equivalent to "Lock-Ring," "TR Flex", or "Super Lock" and shall have a minimum rated working pressure of 250 psi. Mechanical joint retainer glands shall comply with the manufacturer's specifications for the pipe material (ductile iron vs. PVC). The joints shall be in accordance with the applicable portions of ANSI/AWWA C111/A21.11. The manufacturer of the joints shall furnish certification, witnessed by an independent laboratory, that the joints furnished have been tested at a pressure of 500 psi without signs of leakage or failure. All wedge assemblies and related parts of restraint devices shall be processed through an iron-phosphate spray, rinse and drying operation in preparation for coating application. The coating shall consist of a minimum of two coats of liquid Xylan® fluoropolymer coating with heat cure to follow each coat. All casting bodies of restrained joints shall be surface pretreated with an iron-phosphate spray, rinse and sealer before drying. The coating shall be electrostatically applied and heat cured. The coating shall be a polyester based powder to provide corrosion, impact and UV resistance. The coating system shall be Mega-Bond™ by EBAA Iron, or approved equal. Restrained joints shall be capable of being deflected after assembly. Restrained joints shall have a preset deflection of no more than 5° and shall be able to take up 3° of deflection after burial.

1.03 FITTINGS

A. Fittings for Ductile Iron or Plastic Pipe - Shall be compact ductile iron, manufactured in accordance with ANSI/AWWA C153/A21.53 latest revision. They shall be cement lined in accordance with ANSI/AWWA C104/A21.4 latest revision. An asphaltic coating with a thickness of 1 mil shall be applied to all fittings. Fittings shall be designed to accommodate the type of pipe used.

B. Fittings for Flanged Pipe - Shall be manufactured in accordance with ANSI/AWWA C110/A21.10, latest revision and pressure rated at 150 psi.

C. Fittings for plastic tubing - Shall be low lead brass, compression type.

1.04 POLYETHYLENE ENCASEMENT

Polyethylene encasement shall be used on all ductile iron pipe and shall be in tube form conforming to the requirements of ANSI/AWWA C105/A21.5 latest revision. The polyethylene film shall have the following characteristics:

Tensile Strength:	1,200 psi minimum
Elongation:	300 percent minimum
Dielectric Strength:	800V/mil thickness minimum
Thickness:	Nominal thickness of 0.008 inch (8 mil)

1.05 CAUTION TAPE

Caution tape shall consist of a minimum 4.0 mil thickness inert polyethylene plastic that is resistant to alkalis, acids and other destructive elements found in the soil. The tape shall have a minimum three (3) inch width and a minimum tensile strength of 2,800 psi. A continuous warning message repeated every 16 to 36-inches shall be imprinted on the tape surface. The tape shall contain an opaque color concentrate designating the color code appropriate to the line being buried (Water Systems - Safety Precaution Blue with "Caution - Buried Water Line Below" imprinted in black). Caution tape shall be installed 24-inches above the pipe on all water mains

1.06 TRACER WIRE AND CONNECTORS

A. Tracer Wire

Tracer wire shall be installed on all water mains and service laterals from the main to the meter, with direct burial connectors, and provide continuous electrified conductivity. Area markers shall be at least every 500 feet with tracer wire attached, unless a manhole or fire hydrant is available. A six (6) foot lead attached to the inside of the ring and cover shall be provided at manholes. On laterals, the tracer wire shall terminate inside the meter box.

1. Tracer wire shall be copper clad steel with high-density, high molecular weight polyethylene (HDPE) insulation, and rated for direct burial use at 30 volts. Conductor must meet 21% conductivity for locate ability purposes. HDPE insulation shall be RoHS compliant and utilize virgin grade material. Insulation color shall meet the APWA color code standard for identification of buried utilities.

2. Tracer wire for direct burial shall be a #12 AWG HS-CCS high-strength copper clad steel conductor (HS-CCS), insulated with a 30 mil, HDPE insulation. Minimum break load shall be 380 lbs. Wire must be installed in the 3 o'clock position during installation. Tracer wire shall be Boar Tough High Strength CCS PE30 UL by Agave Wire Ltd or Copperhead HS-CCS HDPE 30 MIL or Pre-Approved Equal.

3. Tracer wire for directional drilling/boring shall be #12 AWG extra-high-strength copper clad steel conductor (EHS-CCS), insulated with a 45 mil, HDPE insulation. Minimum break load shall be 1,150 lbs. Tracer wire shall be Boar Tough Extra High Strength by Agave Wire Ltd, Copperhead EHS-CCS HDPE 45 MIL or Pre-Approved Equal.

B. Connectors

1. Wire connectors shall be UL 486D listed, one-piece direct bury twist-on type, UL designation MDB, sealed wire connectors. Max voltage shall be 600 Volts. Connectors shall be rated to 105° C and sized to accommodate a minimum of four (4) #12 copper / steel core tracer wires. Silicone sealant shall be rated for temperatures from -45° F to 400° F. Connector shall be DryConn King 6 Blue by King Innovation, or pre-approved equal.

2. Spliced connectors shall be direct bury design, with a maximum voltage of 50-volts. Spliced connectors shall have a tin plated high conductivity aluminum lug, zinc-plated steel screws, high-impact polypropylene housing, and a non-hardening viscous dielectric silicone sealant. Silicone sealant shall be rated for temperatures from -45° F to 400° F. Spliced connector shall be DryConn Direct Bury Lug Aqua, or pre-approved equal.

C. Area Markers - Utility marker posts equal to Rhino TriView Plus Test Station shall be installed every 500-foot along water mains. Posts shall be marked as “Water Pipeline”.

1.07 CASING AND CASING SPACERS

A. Casing pipe shall be steel conforming to ASTM A139, latest revision, minimum yield point of 35,000 psi, and of the diameter and thickness shown on the contract drawings at each crossing. The pipe ends shall be tapered where welding is required. Full pipe lengths shall be provided. No pipe casing lengths less than eight (8) feet shall be allowed unless approved by the Owner. All casing welds shall be continuous and made by a certified welder.

For casing pipe crossings under roadways/railroads, the Contractor shall comply with the regulations of said authority in regard to design, specifications, and construction. State highway casing installations shall be as specified in the GDOT, “Utility Accommodation Manual,” and for railroads, the American Railway Engineering and Maintenance-of-Way Association (AREMA) manual for Railway Engineering, Chapter 1,

Part 5, Section 5.3, “Specifications for Pipelines Conveying Non-Flammable Substances,” shall be applicable.

Where allowed by the affected utility owner(s), fusible PVC casing may be used with fusible PVC carrier pipe. The design engineer shall calculate the appropriate piping dimension ratio (DR) for fusible PVC casing considering earth, live, and groundwater, service loads and pullback forces.

Use of PVC casing shall require the use of rubber boots for end seals. End seals shall be neoprene with 304 SS banding clamps as manufactured by Cascade CCES, or approved equal. End seals shall be installed per manufacturer’s recommendations, to include casing spacer spacing to provide adequate reinforcement at end of casing pipe.

All carrier pipes shall be restrained joint ductile iron or fusible PVC.

B. Casing Spacers shall be bolt on style with a shell made in two (2) sections of Heavy T-304 Stainless Steel. Connecting flanges shall be ribbed for extra strength. The shell shall be lined with a PVC liner. All nuts and bolts shall be 18-8 Stainless Steel. Runners shall be made of Ultra High Molecular Weight Polymer with inherently high abrasion resistance and a low coefficient of friction. Runners shall be supported by risers made of Heavy T-304 Stainless Steel. The combined height of the supports and runners shall keep the carrier pipe a minimum of 0.75" from the casing pipe at all times. Installation and spacing of casing spacers shall be as required by the manufacturer. Casing spacers shall be as manufactured by Cascade Waterworks Manufacturing Company, or approved equal.

   Casing spacers for fusible PVC carrier pipe should be of a projection type that has a minimum number of projections around the circumference that total the number of diameter inches. For example: 8” pipe should have a minimum of 8 projections and 18” pipe should have a minimum of 18 projections. Spacing between spacer rings (span) should be calculated based on the actual installed load (weight of pipe filled with liquid) but should not exceed 10 feet. Refer to the manufacturer’s tables for the load carrying capacity of each type of spacer used. Casing spacers should be projection type – non metallic spacers constructed of preformed sections of high-density polyethylene. Spacers should be ISO 9001:2000 certified for strength and quality. Casing spacers should be installed using double backed tape provided with the spacers in order to fasten them tightly to the carrier pipe. Casing spacers for fusible PVC carrier pipe shall be as manufactured by Raci North America, or approved equal.

1.08 VALVE MANHOLES

A. Manholes shall be precast concrete, unless authorized by the Water Department. Manhole diameter shall be large enough to allow an eighteen (18) inch clearance between any bolts necessary for valve / actuator removal or in-situ maintenance or repair, and the manhole inner wall.

B. Brick manholes shall be new whole brick of good quality laid in cement mortar. The bottom of the manhole shall be concrete. Brick manholes shall only be allowed where precast manholes cannot be used.

1. Concrete - Concrete shall have a compressive strength of 3,000 psi in 28 days. Concrete shall be ready-mixed conforming to ASTM C904. Reinforcing steel shall conform to ASTM C615, Grade 60. Mesh reinforcing shall conform to ASTM A185. Concrete covering deposited directly against the ground shall have a minimum thickness of three (3) inches between the reinforcing and the ground.

2. Mortar - Mortar shall be composed of one part by volume of Portland cement and two parts of sand. The Portland cement shall conform to ASTM C160, Type I. The sand shall conform to AASHTO Standard A45 and shall be of an acceptable gradation. The quantity of water in the mixture shall be sufficient to produce a workable mortar, but in no case exceed 7 gallons of water per sack of cement. Water for mixing shall be potable water, clean and free of harmful acids, alkalies and organic impurities. The mortar shall be used within 30 minutes from the time the ingredients are mixed with water.

3. Brick Masonry - Brick shall conform to ASTM C62, Grade SW or C-55, Grade P-I or P-II. The joints shall be completely filled with mortar and shall be smooth and free from surplus mortar on the inside of the structure. Brick structures shall be plastered with ½-inch of mortar over the entire outside surface of the walls. For square or rectangular structures, brick shall be laid in stretcher courses with a header course every sixth course, and for round structures, brick shall be laid radially with every sixth course a stretcher course.

C. Precast concrete manholes with four (4) feet internal diameter shall be used for lines 8” in diameter or less and have a minimum wall thickness of five (5) inches. Precast concrete manholes with six (6) feet internal diameter shall be used for lines 10” in diameter or more and have a minimum wall thickness of seven (7) inches. Manholes shall be manufactured with 4,000 P.S.I. concrete, type II cement. Wall reinforcement

shall meet ASTM-478 and also have a No. 4 rebar hoop around each pipe opening. Top slabs shall be six (6) inches thick and be reinforced with No. 6 rebar at 6" O.C.E.W. Bottom slabs shall be six (6) inches thick and be reinforced with No. 4 rebar at 9" O.C.E.W. All items shall be wet cast. Dry casting or low slump concrete will not be allowed. All bases will have proper lifting hooks in the bottom slabs (min. of 3) and there shall be no penetrating lifting holes on any structures. No holes will be allowed within six (6) inches of any joint on structures.

It shall be the responsibility of the Contractor to ensure that the manhole(s) are designed properly for the loading conditions as indicated on the plans. Should the loading conditions require greater structural integrity than the minimum, as herein specified, it shall be the responsibility of the Contractor to utilize a design with greater strength.

Gaskets shall be O-Ring or Type A or B "Tylox," or equivalent, conforming to ASTM C-443; Mastic shall be "Ram-nek," or equivalent, with primer. The primer shall be applied to all contact surfaces of the manhole joint at the factory in accordance with the manufacturer's instructions.

D. Ring and Cover - Manhole ring and cover shall be gray cast iron per ASTM A48, Class 35B without perforations and suitable for addition of cast iron or steel rings for upward adjustment of top. The words "CITY OF SAVANNAH WATER GEORGIA" shall be cast into the face of the cover in 1.5-inch to 2-inch letters raised flush with the top of the cover. Ring and cover shall have machine ground seats and be an approved equal to model V1327-1 RG V1327GS EPIC SAVANNAH SN as manufactured by E.J. All manhole rings and covers shall be made water resistant by means of dovetail grooves and gaskets in the cover. Provide circular cover with two (2) pick slots for removing cover spaced at 180° and weighing not less than 138 pounds. No stacking lugs shall be allowed.

   Proof Load Testing - Traffic service castings shall have a first article proof load test conducted and the results of that proof load test shall be made available to the City upon request. The proof load test shall be conducted in accordance with the methods and procedures outlined in AASHTO M306-10, Section 6, Proof Load Testing. The casting shall be tested on a suitable and calibrated load testing machine and the casting shall hold a 40,000 pound proof load for one minute without experiencing any cracks or detrimental permanent deformation.

E. Manhole Steps – Manhole steps shall be provided at 16-inches O.C. for manholes greater than five (5) feet deep. Steps shall have impact resistant co-polymer

polypropylene plastic molded around ½" diameter, grade 60 reinforcing steel. Manhole steps shall be M.A. Industries PS1-PF reinforced plastic step complying with the requirements of ASTM C 478, or approved equal.

F. Final Grade - Manholes in roads, streets, or highways shall be built to the pavement grade, the grade designated on the plans, or as directed by the Engineer. Tops of manholes outside of roads, streets, and highways shall be flush with the finished ground surface unless otherwise shown on the plans. Manholes shall not be located in areas where ponding or the collection of surface water may occur.

1.09 GATE VALVES

A. Valves shall conform to the latest revision of AWWA Standard C515 covering resilient seated gate valves for water supply service. Valves shall be as manufactured by the Clow Valve Company, or approved equal.

B. The valves shall have a ductile iron body, bonnet, and O-ring plate. The wedge shall be totally encapsulated with rubber.

C. The sealing rubber shall be permanently bonded to the wedge per ASTM D429.

D. Valves shall be supplied with O-ring seals at all pressure retaining joints.

E. The valves shall be non-rising stem, opening by turning left or right, and provided with 2" square operating nut with the word "Open" and an arrow to indicate the direction to open.

F. Stems shall be cast copper alloy with integral collars in full compliance with AWWA. All stems shall operate with copper alloy stem nuts independent of wedge and of stem. Stems shall have two O-rings located above thrust collar and one O-ring below. Stem O-rings shall be replaceable with valve fully opened and subjected to full pressure. The stems on 4" – 20" shall also have two low torque thrust bearings located above and below the stem collar to reduce friction during operation.

G. Waterway shall be smooth, unobstructed and free of all pockets, cavities and depressions in the seat area. Valves 4" and larger shall accept a full size tapping cutter.

H. The body, bonnet and O-ring plate shall be fusion-bond epoxy coated, both interior and exterior on body and bonnet. Epoxy shall be applied in accordance with AWWA C550 and be NSF 61 Certified.

I. Bolts, studs, and nuts shall be made of 304 stainless-steel. Stainless steel bolts and studs shall not be used on stainless nuts unless the threads are coated with an anti-seize compound.

J. Each valve shall have maker's name, pressure rating, and year in which it was manufactured cast in the body. Prior to shipment from the factory, each valve shall be tested by hydrostatic pressure equal to the requirements of AWWA C515 (and UL/FM where applicable). Gate valves shall be installed in a manhole per Details W-25A, B, C, or D.

1.10 BUTTERFLY VALVES

A. All butterfly valves shall be of the rubber-seated, tight-closing type. They shall meet or exceed AWWA standard C504, latest edition, Class 150. Butterfly valves shall not be used on pipe smaller than 14-inches unless, otherwise specified, and shall be installed in a manhole per Detail W-26. All valves shall be M&H 4500/1450 butterfly valves, or approved equal.

B. Both ends shall be flanged per ANSI B16.1 (or as otherwise noted on plans and specs).

C. Valve shafts shall be ASTM A276 Type 304 stainless steel. Valve shafts shall have a minimum diameter extending through the valve bearings and into the valve disc as specified in AWWA C504. All valve shafts must meet or exceed the minimum connection torque requirement set forth in AWWA C504.

D. Valve body and vane shall be high-strength cast iron to ASTM A126, Class B or high-strength ductile iron to ASTM A536 with ASTM A276 Type 304 stainless steel body seats. For valves 18" and larger, valve body and vane shall be of high-strength ductile iron to ASTM A536, Grade 70-50-05 with ASTM A276 Type 304 stainless steel body seat.

E. Rubber valve seats shall be a full-circle 360 degree, seat not penetrated by the valve shaft. Valve seat shall be EPDM for cold or high water temperature applications. The valve seat will be attached to the valve vane by 18-8 Type 304 stainless steel self-locking fasteners. The valve seat must be easily field adjustable and replaceable without any special tools or lengthy curing time.

F. Valve shaft seals shall be of the O-ring type and utilize the same elastomer as specified for the valve seats and for the intended service. All valve shaft seals must be easily field replaceable.

G. Valve actuator shall be of the traveling nut type, sealed and lubricated for underground or in-plant service. Operator shall be capable of withstanding an overload input torque of 450 ft-lbs. at full-open or full-closed position without damage to the valve operator. Operators must have a 304 stainless steel external stop limiting device and travel adjustment. The travel adjustments must be able to be operated without removing the valve from the line or removing the actuator cover. All valve actuators must be sized per AWWA C504. Certification of proof of design and torque requirements shall be submitted to the owner upon request.

H. The valve interior and exterior surfaces shall be coated in accordance with the latest revisions of AWWA C504 and must be NSF 61 Certified.

1.11 TAPPING VALVES

All tapping valves shall be provided with a standard flange on one end for bolting to the tapping sleeve. The outlet end shall be mechanical joint, flanged for bolting to a standard tapping machine. All tapping valves shall be resilient seat. No double disc shall be permitted. In all other respects, tapping valves shall comply with the requirements for gate valves.

1.12 TAPPING SLEEVES

Tapping Sleeves shall be compact ductile iron mechanical joint type conforming to ANSI/AWWA C153/A21.53 for fittings four (4) inches to 16-inches or ANSI/AWWA C110/A21.10 for fittings larger than 16-inches, latest revision. All tapping sleeves and valves shall be pressure tested prior to tapping. The tapping sleeve shall include the necessary pressure test port.

1.13 AIR RELEASE VALVE

A. General:

Air Release Valves (ARV's) shall be provided as required by the Engineer, who shall specify ARV type (or function), size, and location. The ARV's specified below are one-inch air release valves suitable for most water main applications and larger combination air and vacuum release valves suitable for water transmission mains.

The specification of these two (2) valves below does not relieve the Engineer of the responsibility to select and locate ARV's for proper main operation and long-term durability. ARV selection shall be in accordance with AWWA Manual of Water Supply

Practices M51 - Air-Release, Air/Vacuum & Combination Air Valves, the manufacturer's published information, and the Engineer's experience.

The manhole and installation of the one-inch air release valve shall be in accordance with the City of Savannah Standard Construction Detail W40. Prior to deciding on the location of any air release valve, the Contractor shall provide the Engineer with an accurate profile of the installed mains so that high points in the system can be determined. The locations of the valves shall be field adjusted based on the locations of the high points.

B. Small (1") Air Release Valves for Water Mains

Air release valves shall be designed to vent small amounts of air from the system while it is pressurized.

1. The valve(s) shall operate through a compound lever system and shall have a 1/4-inch orifice with valve sealing faces of an adjustable Buna-N rubber valve and PVC seat. It shall operate at 150 PSIG, and be capable of passing 98 SCFM of air.

3. The valve(s) shall be one-inch NPT screwed inlet connection and shall have a cast iron body and top, a stainless steel float and trim. Valves which use a needle to seal the orifice will not be acceptable.

4. The body and cover shall be cast iron conforming to ASTM 126, Class B and have a maximum operating pressure of 300 psi.

5. The valve(s) shall be Crispin Model PL10 Pressure Air Valve(s), Type N, as manufactured by Crispin-Multiplex Manufacturing Co., Berwick, PA.

6. A turn-down, or snorkel, shall be provided to prevent dirt and other debris from falling into the orifice while allowing the free discharge of air or water.

7. When submergence of the air release valve is possible, a Vacuum Check Valve shall be supplied on the outlet to eliminate the possibility of water (or air) from entering the system when the pressure decreases, or if a vacuum is drawn.

8. Corporation stops for air release valves shall be 1" Brass or Bronze with one (1) inch inlet and one (1) inch outlet outside iron pipe threads equivalent to Mueller Model #H-10013.

9. Tapping saddles for combination air release valves shall be equivalent to Smith-Blair No. 313-015.

C. Large (4”) Combination Air Valves for Water Transmission Mains

Combination Air Valves shall be automatic float operated valves designed to exhaust large quantities of air during the filling of a piping system and close upon liquid entry. The valve shall open during draining or if a negative pressure occurs. The valve shall also release accumulated air from a piping system while the system is in operation and under pressure.

Valves shall be manufactured and tested in accordance with American Water Works Association (AWWA) Standard C512 and shall be certified to NSF/ANSI 61.

1. Connections - Air valves shall have full size NPT inlets and outlets equal to the nominal valve size. The valve shall have two additional NPT connections for the connection to gauges, testing, and draining.

2. Design - Valve shall provide a through flow area equal to the nominal size. Floats shall be unconditionally guaranteed against failure including pressure surges. The cover shall be bolted to the body and sealed with a flat gasket. A resilient bumper shall be provided to cushion the float during sudden opening conditions. The resilient seat shall be replaceable and provide drop tight shut off to the full valve pressure rating.

   Single body combination valves shall have an expanded outlet to provide full flow area around the guide mechanism. The valve shall have a double guided plug and an adjustable threaded orifice button. The plug shall be protected against direct water impact by an internal baffle. The plug shall have a precision orifice drilled through the center stem. A protective hood shall be provided to prevent debris from entering the valve.

   All air (Release, Vacuum, etc) valves installed in vaults or flood prone locations (where submergence of the valve is possible) shall include an inflow preventer to prevent the introduction of contaminated water through the air valve outlet. The inflow preventer shall allow the admittance and exhausting of air while preventing contaminated water from entering during normal operating conditions. The inflow preventer shall be flow tested by an independent third party testing lab, approved by the American Society of Sanitary Engineers, to certify performance.

3. Materials - The valve body and cover shall be constructed of ASTM A126 Class B cast iron. All wetted or internal parts shall be constructed of Type 316 stainless steel. Non-metallic floats, linkage, or bushings are not acceptable. Resilient seats shall be Buna-N.

4. Manufacture - Combination Air Release Valves shall be Series 204C.2 as manufactured by Val-Matic Valve and Manufacturing Corporation, Elmhurst, Il, USA or approved equal.

1.14 SMALL BALL VALVE

Ball Valves two (2) inch and smaller shall be designed for a working pressure of not less than 175 psi. End connection shall be threaded. The body and all parts shall be no lead brass in accordance with AWWA C800 and ASTM B62 latest revision. The ball shall be fluorocarbon coated brass with molded Nitrile (BUNA-N) seats sealed in place. All internal parts shall be permanently assembled by way of a metal to metal body joints with sealed threads.

1.15 VALVE BOXES

Valve Boxes - Underground two (2) inch valves and fire hydrant valves shall be installed in accepted valve boxes. The valve boxes shall be embedded in No. 57 stone wrapped with filter fabric, with shaft extension sections to cover and protect the valve and permit easy access and operation. The cover shall be cast iron and shall be marked "WATER". The box and any extensions needed shall be cast iron having a crushing strength of 1500 psi. The top section shall be the screw type, adjustable for elevation. When installed in paved areas or sidewalks, the top shall be set flush into the pavement or sidewalk. When installed in unpaved areas, a pre-cast concrete collar edge shall be set flush at finished grade level. Valve boxes and collars shall conform to the detail shown.

1.16 POST TYPE FIRE HYDRANTS

Post Type Fire Hydrants shall be equivalent to Mueller 2-1/8-inch Post Type Fire Hydrant, have one way main valve opening and one 2½-inch hose nozzle. All internal and external parts shall conform to Section 1.17 Fire Hydrants.

1.17 FIRE HYDRANTS

A. General - Hydrants shall be manufacturer's current model design and construction. All units are to be complete including joint assemblies. Physical characteristics and

compositions of various metal used in the hydrant components shall meet the requirements as specified in ANSI/AWWA C502 latest revision. Hydrant shall be suitable for working pressure of 150 psi and shall be hydrostatically factory tested to 300 psi.

B. Bonnet - Bonnet shall be of the dry reservoir type. Bonnet must have a lubricating fitting for ease of lubrication. All parts shall be removable through top of hydrant without removing entire barrel section from safety flange.

C. Nozzles and Caps - The hydrant shall have two (2) 2¼-inch connection and one (1) 4½-inch steamer connection, National standard threads. Nozzles shall be bronze and have interlocking lugs to prevent blowout. Nozzle caps shall not be equipped with chains.

D. Seat Ring - Seat ring shall be bronze to bronze. The bronze shall be Grade A, B, D, or E.

E. Drain Valves and Openings - Positive operating drain valves shall be provided to assure drainage of fire hydrant when the main valve is closed. Drain openings shall have bronze bushings.

F. Main Valve - Valve shall be designed to close with the pressure and remain closed. Valve shall be bronze Grade A, B, D, or E, that will resist rocks or other foreign matter. Valve shall have a full 4½-inch opening.

G. Barrel and Safety Flanges - Hydrant shall have a safety-type vertical barrel with a minimum approximate bury of 3½-foot and be designed with safety flange and/or bolts to protect the barrel and stem from damage and to eliminate flooding when hydrant is struck. Bury depth shall be cast on barrel of hydrant. All risers necessary for deeper bury applications shall be provided by the hydrant manufacturer. A maximum riser height of one (1) foot shall be allowed.

H. Operating Stop and Nut - Hydrant shall have a positive stop feature to permit opening of hydrant without over travel of stem. The operating stop shall be located at the bottom of the hydrant by means of a cap nut or stop nut at the end of the main valve stem. Operating nut shall be bronze, 1¼-inches, point to flat, pentagon.

I. Bolts and Nuts - Bolting materials shall develop the physical strength requirements of ASTM A307. Bolts, studs, washers and nuts shall be made from a corrosion-resistant material such as low zinc bronze, monel, stainless steel or low alloy steel conforming to ASTM A242.

J. Inlet - Bottom inlet of hydrant shall be provided with mechanical joint connection as

specified and shall be six (6) inch nominal diameter.

K. Direction of Opening - Hydrants shall be designed to close "right" or clockwise and open "left" or counter-clockwise.

L. Coatings - All inside portions of the hydrant shall be coated in accordance with ANSI/AWWA C550 latest revision. The exterior portion of hydrant above ground level shall be painted with two (2) coats of red primer paint equivalent to Hydrant Hide Red Setter #9050 as manufactured by Pennsbury Coatings Corporation. After the hydrant has been accepted and placed in service, the exterior, above-ground portion of the hydrant shall be painted with two (2) coats of yellow hydrant enamel equivalent to Hydrant Hide Old Yeller #9032 as manufactured by Pennsbury Coatings Corporation.

M. Joint Assemblies - Mechanical joint assemblies shall conform to ANSI/AWWA C111/A21.11 latest revision.

N. Inspection and Affidavit - Hydrants furnished under this specification shall be subject to inspection and acceptance by City personnel, and, if required, shall have full access to manufacturer's facilities for inspection and observation of tests. Manufacturer is also required to furnish the City with an affidavit of compliance with specifications covering all materials and test procedures relating to construction of the hydrants.

1.18 CORPORATION STOPS

Corporation stops shall be no lead brass composition and shall be manufactured in conformance with ANSI/AWWA C800 and ASTM B62. The key and body seating surfaces shall be accurately machined and fit to a taper of 1¾-inches per foot. The stem and retaining nut shall be so designed that failure from over-tightening of the retaining nut results in thread stripping rather than stem fracture. Corporation stops shall be equivalent to Mueller or Ford.

1.19 CURB STOPS

Curb stops shall be a one (1) inch no lead brass ball valve with a ball valve lock provided for each valve manufactured in conformance with ANSI/AWWA C800. The curb stop shall be closed bottom design and sealed against external leakage at the top by means of a non-adjustable resilient pressure actuated seal, and shall be provided with a secondary resilient seal disposed above the pressure seal for added protection of the bearing surfaces against ground water infiltration. Shut off shall be effected by a

resilient pressure actuated seal so disposed in the key as to completely enclose the inlet body port in the closed position. All ball valves shall be ¼ turn valves and the full open and closed position shall be controlled by check lugs which are integral parts of the key and body. The pressure rating shall be 175 psi. The ball valves shall be equivalent to Ford or Mueller or equal. Valves shall be full part, packed joint with one (1) inch diameter locking grip compression connection on the inlet side and one (1) inch diameter female iron pipe thread connection on the meter side.

1.20 TAPPING SADDLES

Tapping saddles shall be equivalent to Smith-Blair 313-015 with a one (1) inch AWWA tapped connection. All one (1) inch and two (2) inch taps on water lines smaller than six (6) inches will require a tapping saddle. Brass saddle shall be Ford 202B Brass Saddle or equal. No service taps shall be allowed on transmission mains larger than 12-inches unless approved by the City.

1.21 PERMANENT SAMPLING STATION

Sampling Stations shall be 36-inch minimum bury, with a 3/4-inch FIP Inlet and a 3/4-inch unthreaded nozzle. The station shall be enclosed in a lockable, non-removable, aluminum-cast housing. When opened, the station shall require no key for operation, and the water shall flow in an all-brass waterway. All working parts shall be made of brass and shall be removable from above ground without digging. A copper vent tube shall allow the station to be pumped free of standing water. The vent tube shall be opened or closed via an easily accessible pet cock. Exterior piping shall be galvanized. The sampling station shall be Kupferle "Eclipse No. 88", or approved equal.

1.22 STANDARD METER BOX

A. Meter boxes for all 5/8”, 1”, and 1-1/2” water meters will be provided by the City of Savannah Water Distribution Department upon purchase of the meter.

B. For 2” water meter installations, please refer to the City of Savannah Standard Construction Detail W-5A.

C. For 3” and larger water meter installations, please refer to the City of Savannah Standard Construction Detail W-5B.

1.23 COUPLINGS

All couplings shall be mechanical joint solid sleeves. All Couplings shall be compact Class 350 ductile iron, manufactured in accordance with ANSI / AWWA A21.53 / C153, latest revision. Mechanical joints shall be manufactured in accordance with ANSI / AWWA A21.11/C111. All couplings shall be cement lined in accordance with ANSI/AWWA A21.4/C104. Mechanical joint nuts and bolts shall be Corten or ductile iron, high strength, low alloy steel per ANSI/AWWA A21.11/C111. An asphaltic coating with a thickness of one (1) mil shall be applied to all couplings. Couplings shall be designed to accommodate the type of pipe used. Couplings or fittings in accordance with Part 1.03 shall be used at all transitions from ductile iron to PVC pipe.

1.24 BLOW-OFF HYDRANTS

All blow-off hydrants shall be manufactured to fit in a standard 5¼" valve box and shall include a two (2) inch coupling riser and a self draining valve with a two (2) inch FIP inlet connection. The operating screw shall fit a standard 3/4" bolt socket or a 7/8" pentagon. All working parts shall be brass, and shall be removable without excavation. All blow-off hydrants shall be equal to the TF500 Blow Off Hydrant by The Kupferle Foundry Company of St. Louis, Missouri.

1.25 BACKFLOW PREVENTION DEVICES

All service laterals shall include backflow prevention devices in accordance with the City of Savannah Cross Connection Control Policy.

1.26 BEDDING AND BACKFILL

A. Classification of Materials – ASTM D-2321 classifies soils using the Unified Soils Classification System (ASTM D-2487). For the purpose of this specification, soils to be used as backfill material are grouped into five classes according to soil properties and characteristics.

1. Class I - Angular, 1/4 to 1-1/2 inch graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, crushed gravel, and crushed shells.

2. Class II - Coarse sands and gravels with maximum practical size of 1-1/2 inch, including variously graded sands and gravels containing small percentages of fines,

generally granular and non-cohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class.

3. Class III - Fine sand and clayey gravels, including fine sands, sand-clay mixtures, and gravel-clay mixtures. Soil Types GM, GC, SM, and SC are included in this class. These materials are not to be used for bedding or haunching.

4. Class IV - Silt, silty clays, and clays, including inorganic clays and silts of medium to high plasticity and liquid limits. Soil Types MH, ML, CH, and CL are included in this class. These materials are not to be used for bedding, haunching, or initial backfill.

5. Class V - This class includes the organic soil, OL, OH, PT as well as soils containing frozen earth, debris, rocks, larger than 1-1/2 inch in diameter, and other foreign materials. These materials are not to be used.

B. Stone Bedding - Stone used for foundation and bedding shall be shall be crushed stone or gravel conforming to ASTM C33, Size #57, with size range of ¼ to 1-inch, free from debris, roots, trash, stones, or other harmful substances.

C. Backfill – Whether imported borrow material or from on-site excavations, backfill shall be suitable Class II or Class III material. Backfill material shall be free from debris, roots, trash, stones, or other harmful substances. Suitable soils are those complying with ASTM-2487 soil classification groups GW, GP, GM, SW, SP, and SM, as defined in ASTM D2487.

1. Common Backfill

   Common backfill shall consist of mineral soil, substantially free of clay, organic material, loam, wood, trash, and other objectionable material which may be compressible or which cannot be compacted properly. Common backfill shall not contain stones larger than 6 inches in any dimension, asphalt, broken concrete, masonry, rubble, or other similar materials.

   The backfill shall have physical properties such that it can be readily spread and compacted during filling. Additionally, common backfill shall be no more than 12 percent by weight finer than the No. 200 mesh sieve unless finer material is approved for use in a specific location by the City.

   Material falling within the above specifications, encountered during the excavation, may be stored in segregated stockpiles for reuse. All material which, in the opinion

of the Engineer, is not suitable for reuse on the site shall be removed and disposed of by the Contractor.

2. Select Backfill

   Select Backfill shall be as specified above for common backfill, except that the material shall contain no stones larger than 1-1/2 inches in largest dimension, and shall be no more than 5 percent by weight finer than the No. 200 mesh sieve.

3. Borrow Material

   Where it is determined that sufficient suitable material is not available from the site to satisfactorily backfill the pipe to at least two (2) feet above the top of the pipe, suitable borrow material meeting the requirements of this specification unless otherwise noted, shall be provided by the Contractor from other sources at Contractor's expense. All material from the excavation unsuitable for bedding, backfill, or other uses as directed by the Engineer and approved by the Owner, shall be removed and disposed of by the Contractor.

1.27 PRODUCT REVIEW

The Contractor shall provide the Engineer with a complete description of all products before ordering. The Engineer shall review and approve all products before they are ordered.

PART 2 – EXECUTION

2.01 USE OF STANDARD CONSTRUCTION TECHNIQUES

A. Responsibility for Proper Construction - The standard construction techniques presented herein for bedding, backfill, and compaction are suitable in areas of favorable soils. However, the ENGINEER SHALL REMAIN RESPONSIBLE FOR CONDUCTING ON-SITE SOILS INVESTIGATIONS appropriate for the nature of the project at hand. The ENGINEER SHALL REMAIN FURTHER RESPONSIBLE for providing the procedures and details necessary for proper waterline installation throughout the entire project corridor.

B. Minimum Site Soils Investigation Requirements - All projects requiring the installation of any water or sanitary pipe other than service laterals shall require a minimum of one (1) soil boring every 300 linear feet along the proposed utility corridor. Borings shall be to a depth of two (2) feet deeper than the deepest proposed line within 150 feet. A

Geotechnical Report identifying the type(s) of soils found on the project site shall be provided with the construction plan submittal. The report shall include, at a minimum, boring logs, (types of soils encountered, e.g. - type GW, GP, SW, SP, etc., depths of soil types, observed groundwater, seasonal high groundwater, etc.), and any special requirements for pipe bedding, backfill, or compaction. The location of the boring(s) shall be clearly shown on the construction plans.

C. Use of Standard Procedures and Details - If site-specific procedures or details for bedding, backfill, compaction, and joint restraint are not provided in the contract documents and the Engineer includes only the standard City of Savannah specifications and details for pipe bedding and joint restraints, the ENGINEER IS ATTESTING THAT SOIL CONDITIONS ARE FAVORABLE, and that the STANDARD METHODS ARE ACCEPTABLE based on the soil conditions observed and the Engineer's experience.

2.02 INSTALLATION

Ductile iron pipe shall be laid in accordance with ANSI/AWWA C600; Plastic pipe shall be laid in accordance with AWWA M23, ASTM D2774, UNI-Bell UNI-B-3 and the pipe manufacturer's recommendations.

A. Alignment and Grade - The water mains shall be laid and maintained to lines and grades established by the plans and specifications, with fittings, valves, and hydrants at the required locations unless otherwise accepted by the owner. Valve-operating stems shall be oriented in a manner to allow proper operation. Hydrants shall be installed plumb.

1. Prior Investigation - Prior to excavation, locate request shall be called into Georgia 811, and investigation shall be made to the extent necessary to determine the location of existing underground structures and conflicts. Care shall be exercised by the contractor during excavation to avoid damage to existing structures. The pipe manufacturer's recommendations shall be used when the watermain being installed is adjacent to a facility that is cathodically protected.

2. Unforeseen obstructions - When obstructions that are not shown on the plans are encountered during the progress of work and interfere so that an alteration of the plans is required, the owner will alter the plans, or order a deviation in line and grade, or arrange for removal, relocation, or reconstruction of the obstructions.

3. Clearance - When crossing existing pipelines or other structures, alignment and grade shall be adjusted as necessary, with the acceptance of the owner, to provide

clearance as required by federal, state, and local regulations or as deemed necessary by the owner to prevent future damage or contamination of either structure.

4. Depth of Pipe - The Contractor shall perform excavation of whatever substances are encountered to a depth that will provide a minimum cover over the top of the pipe from the finished grade:

Pipe	Minimum Cover
Diameter ≤ 12-inches	36-inches
Diameter > 12-inches	48-inches
Laterals	36-inches under paved or traffic areas or 24-inches under non-paved, non-traffic areas

   A maximum cover of 60-inches from finished grade shall be used unless approved by the City to avoid a conflict. If the depth of cover will be less than the minimum required, ductile iron pipe shall be used.

5. Fluorinated Hydrocarbon Gaskets -Fluorinated hydrocarbon gaskets are intended for use in soils where a possibility of petroleum contamination is present. Fluorinated hydrocarbon gaskets shall only be used where specifically called for on the drawings.

B. Trench Construction - The trench shall be excavated to the alignment, depth, and width specified or shown on the plans and shall be in conformance with all federal (i.e. OSHA), state, and local regulations for the protection of the workers.

1. Trench Preparation - Trench preparation shall proceed in advance of pipe installation only as far as stated in the specifications or as directed by the Owner. Discharge from any trench-dewatering pumps shall be conducted to natural drainage channels, storm sewers, or as directed by applicable regulatory agencies.

   A four-inch layer of loose backfill shall be provided on the trench bottom to conform to and evenly support the pipe bottom. Material shall be Class II select backfill material (coarse clean sand), and shall remain un-compacted until placement of the pipe into the trench. In lieu of placing the four-inch loose backfill layer, and provided that the trench bottom will provide suitable pipe bedding material, the Contractor may loosen the bottom of the trench using an excavator bucket with four-inch teeth.

Excavated material shall be placed in a manner that will not obstruct the work nor endanger the workers or the public, or obstruct sidewalks, driveways, roadways, or other structures. Placement of excavated material shall be done in compliance with federal, state, and local regulations.

2. Pavement Removal - Removal of pavement and road surfaces shall be a part of the trench excavation. The amount removed shall depend on the width of trench required for installation of the pipe and the dimensions of the area into which valves, hydrants, manholes, or other structures will be installed. The dimensions of pavement removed shall not exceed the dimensions of the opening required for installation of pipe, valves, hydrants, specials, manholes, and other structures by more than six (6) inches in any direction, unless otherwise required or accepted by the owner. Methods such as sawing, drilling, or chipping shall be used to ensure the breakage of pavement along straight lines. Pavement removal shall occur in accordance with the City of Savannah standard details.

3. Width - The width of the trench at the top of the pipe shall be the same as that afforded by the single-pass capabilities of normally available excavating equipment, and shall be ample to permit the pipe to be laid and joined properly and to allow the backfill to be placed as specified. Trenches shall be of such extra width, when required, to permit the placement of timber supports, sheeting, bracing, and appurtenances as required by the safety requirements of the agency having jurisdiction.

4. Bell Holes - Holes for the bells shall be provided at each joint, but shall be no larger than necessary to allow joint assembly and to ensure that the pipe barrel will lie flat on the trench bottom. Push-on type joints require only minimum depressions for bell holes. Other than noted previously, the trench bottom shall be true and even to provide support for the full length of the pipe barrel, except that a slight depression may be provided to allow withdrawal of pipe slings or other lifting tackle without damaging coating or polyethylene encasement.

5. Clearances - Clearances and bedding procedures shall be observed for pieces of concrete or masonry and other debris or subterranean structures, such as masonry walls, piers, or foundations that may be encountered during excavation. When encountered, all structures shall be removed to provide a clearance below and on each side of all pipe, valves, and fittings of at least 18-inches for pipe sizes 24-inches or smaller and 24-inches for pipe sizes 30-inches or larger. When excavation is completed, Class II or better select backfill material (graded stone, gravel, or coarse

sands), shall be placed on the bottom of the trench to the previously mentioned depths, leveled, and tamped.

6. Previous excavations - Should the trench pass over a sewer or other previous excavation, the trench bottom shall be sufficiently compacted to provide support equal to that of the native soil or to conform to other regulatory requirements in a manner that will prevent damage to the existing installation.

7. Protection of Property - Trees, shrubs, fences, and all other property and surface structures shall be protected during construction, unless their removal is shown in the plans and specifications or directed by the owner. Any cutting of tree roots or branches shall be done only as directed by the City of Savannah Engineering Department. Temporary support, adequate protection, and maintenance of all underground and surface structures, drains, sewers, and other obstructions encountered in the progress of the work shall be provided in accordance with specifications or applicable regulations. All properties that have been disturbed shall be restored as nearly as practical to their original condition.

8. Unsuitable subgrade material - When the subgrade is found to include ashes, cinders, refuse, organic material, or other unsuitable material, such material shall be removed to a minimum of at least six (6) inches below the bottom of the pipe or to the depth ordered by the Engineer. The removed material shall be replaced, under the direction of the Engineer, with Class II or better select backfill material (coarse clean sands). The bedding shall be consolidated and leveled so that the pipe may be installed.

9. Safety - Appropriate traffic-control devices shall be provided in accordance with federal, state, and local regulations to regulate, warn, and guide traffic at the work site.

C. Pipe Installation - Proper implements, tools, and facilities shall be provided and used for the safe and convenient performance of the work. All pipe, fittings, valves, and hydrants shall be lowered carefully into the trench by means of a derrick, ropes, or other suitable tools or equipment, in such a manner as to prevent damage to water main materials and protective coatings and linings. Under no circumstances shall water main materials be dropped or dumped into the trench. Where necessary, the trench shall be dewatered prior to installation of the pipe. Chains shall not be allowed to transport or lower pipe into the trench or ditch.

1. Examination of material - All pipe, fittings, valves, hydrants, and other appurtenances shall be examined carefully for damage and other defects immediately before installation. Damaged or defective materials will not be accepted or installed.

2. Pipe ends - All lumps, blisters, and excess coating shall be removed from the socket and plain ends of each pipe, and the outside of the plain end and the inside of the bell shall be wiped clean and dry and be free from dirt, sand, grit, or any foreign materials before the pipe is laid.

3. Pipe cleanliness - Foreign material shall be prevented from entering the pipe while it is being placed in the trench. No debris, tools, clothing, or other materials shall be placed in the pipe at any time. Excessive flush water required to clean the pipe after installation may be charged to the Contractor.

4. Pipe placement - As each length of pipe is placed in the trench, the joint shall be assembled and the pipe brought to correct line and grade. The pipe shall be secured in place with acceptable backfill material.

5. Direction of bells - It is common practice to lay pipe with the bells facing the direction in which work is progressing; however, it is not mandatory. For example, when the main is being laid on a slope, the pipe is frequently laid with the bells facing uphill for ease of installation. The direction of the bells is not functionally related to the direction of flow within the main.

6. Pipe plugs - At times when pipe-laying is not in progress, the open ends of pipe shall be closed by a temporary watertight plug approved by the City. The plug shall be fitted with a means for venting. When practical, the temporary plug shall remain in place until the trench is pumped completely dry. Care must be taken to prevent pipe flotation, should the trench fill with water. Prior to removal of a permanent plug for extending the line or for any other reason, air and/or water pressure in the line shall be released.

7. Joint deflection - When it is necessary to deflect pipe from a straight line in either the horizontal or vertical plane, the amount of joint deflection shall not exceed that shown in Tables 1 or 2. The deflections listed are maximum deflections and shall not be exceeded.

8. Pipe cutting - Cutting pipe for insertion of valves, fittings, or closure pieces shall be

done in conformance with all safety recommendations of the manufacturer of the cutting equipment. Cutting shall be done in a safe, workmanlike manner without creating damage to the pipe or cement-mortar lining.

9. Cut ends and rough edges shall be ground smooth, and for push-on joint connections the cut end shall be beveled by methods recommended by the manufacturer and accepted by the City.

D. Valve and Fitting Installation

1. Examination of material - Prior to installation, valves shall be checked for direction of opening, number of turns to open, freedom of operation, tightness of bonnet bolts and test plugs, cleanliness of valve ports and especially seating surfaces, handling damage, and cracks. Valves shall be closed before being installed.

2. Placement - Valves, fittings, plugs, and caps shall be set and joined to the pipe in the manner specified in Sec. C for cleaning, laying and joining pipe, except that 12-inch and larger valves should be provided with special support, such as crushed stone, concrete pads, or a sufficiently tamped trench bottom so that the pipe will not be required to support the weight of the valve. Valves shall be installed in the closed position.

3. Valve location - Valves in water mains shall, where practical, be located within or immediately adjacent to the street property lines unless shown otherwise on the plans.

4. Mains shall be drained through drainage branches or blow-offs. Drainage branches, blow-offs, air vents, and appurtenances shall be provided with control valves and shall be located and installed as shown on the plans. Drainage branches or blow-offs shall not be directly connected to any storm or sanitary sewer, submerged in any stream, or be installed in any other manner that will permit back siphonage into the distribution system.

5. In no case shall valves be used to bring misaligned pipe into alignment during installation. Pipe shall be supported in such a manner as to prevent stress on the valve.

6. Plugs and Caps - All dead ends on new mains shall be closed with plugs or caps that are suitably restrained to prevent blowing off under test pressure. If a blow-off

valve precedes the plug or cap, it too shall be restrained against blowing off. All dead ends shall be equipped with suitable blow-off facilities.

TABLE 1

MAXIMUM JOINT DEFLECTION*
FULL-LENGTH PIPE PUSH-ON TYPE JOINT DUCTILE IRON PIPE

		Maximum Offset - S (in)		Approx. Radius of Curve R Produced by Succession of Joints (ft)	
Nominal Pipe Size (in)	Deflection Angle (Degrees)	L = 18 ft	L = 20 ft	L = 18 ft	L = 20 ft
4	5	19	21	205	230
6	5	19	21	205	230
8	5	19	21	205	230
10	5	19	21	205	230
12	5	19	21	205	230
14	3*	11	12	340	380
16	3*	11	12	340	380
18	3*	11	12	340	380
20	3*	11	12	240	380
24	3*	11	12	240	380
30	3*	11	12	340	380
36	3*	11	12	340	380
42	3*	11	12	340	380
48	3*	-	12	-	380

* For 14-inch and larger push-on joint, maximum deflection angle may be larger than shown above. Consult the manufacturer.

TABLE 2

MAXIMUM JOINT DEFLECTION
FULL-LENGTH PIPE-MECHANICAL-JOINT PIPE

		Maximum Offset - S (in)		Approx. Radius of Curve R Produced by Succession of Joints (ft)	
Nominal Pipe Size (in)	Deflection Angle (Degrees)	L = 18 ft	L =20 ft	L = 18 ft	L = 20 ft
4	8° 18’	31	35	125	140
6	7° 07’	27	30	145	160
8	5° 21’	20	22	195	220
10	5° 21’	20	22	195	220
12	5° 21’	20	22	195	220
14	3° 35’	13.5	15	285	320
16	3° 35’	13.5	15	285	320
18	3° 00’	11	12	340	380
20	3° 00’	11	12	340	380
24	2° 23’	9	10	450	500
30	2° 23’	9	10	450	500
36	2° 05’	8	9	500	550
42	2° 00’	7.5	8	510	570
48	2° 00’	7.5	8	510	570

E. Hydrants - Hydrants shall be set at such elevations that the connecting pipe and tee will have the same depth of cover as the distribution mains. Extensions on fire hydrants shall not be allowed, final grade adjustment must be made when hydrant is installed. Hydrants and valves shall have the interiors cleaned of all foreign matter before installation. Not less than seven (7) cubic feet of crushed stone shall be placed around the base of the hydrant. See Details W-36 or W-37 for hydrant installation.

1. Where hydrants are to be moved, the lateral shall be extended with six (6) inch pipe, and the hydrant reinstalled at the end of the lateral. Minimum clearance under steamer cap on fire hydrants shall be 18 inches from final grade.

2. Existing hydrants that are relocated, and therefore, temporarily out of service, shall be placed in service within a period of 24 hours. All preliminary connection requirements shall be completed as promptly as possible to insure that the hydrant is operational within the above time frame. The contractor shall be responsible for insuring that valves on the hydrant laterals are accessible and remain in an open position. Payment for relocated hydrants will not be made until the hydrant has been checked and is operational. In the event that the 24-hour time schedule cannot be met, due to conditions beyond the control of the contractor, then the contractor shall so notify the City Water Distribution Administrator. It shall then be the responsibility of the latter to notify the City Fire Department and identify the location of the inactive hydrant. Once the hydrant is in service, it shall be the responsibility of the Contractor to so advise the City Water Distribution Administrator.

3. The time frame and procedures outlined in the above paragraph shall also apply for old hydrants replaced with new hydrants. Old hydrants shall be removed as soon as new hydrants are placed in service and shall be delivered to the City Lot.

4. Anchorage for hydrants shall be provided using Megalug joint restraints or equal.

F. Backfill and Compaction - All trenches and excavation shall be backfilled immediately after the pipes are laid therein, unless other protection of the pipe line is directed.

1. Initial Backfill – Initial backfill shall be from the bottom of the pipe (above loose bedding layer) to two (2) feet above the pipe.

   From the bottom of the pipe to the top of the pipe, Class II select backfill material (coarse clean sand) shall be placed and compacted into six (6) inch lifts. The backfilling of the trench above the pipe shall be carried on simultaneously on both sides of the pipe in such a manner that injurious side pressure does not occur. From the top of the pipe to two (2) feet above the pipe, Class III or better select backfill material (coarse clean sand with some silt) shall be placed and compacted into twelve (12) inch lifts. Each layer shall be spread uniformly and tamped until thoroughly compacted.

   Initial backfill material shall be selected and deposited with special reference to the future safety of the pipes. The material shall be select backfill completely void of rocks, stones, bricks, roots, sticks or any other debris that might cause damage to the pipe and tubing or that might prevent proper compaction of the backfill.

2. Final Backfill - Except where special methods of bedding and tamping are provided, common backfill material (Class IV or better) shall be placed in lifts from two-feet above the top of the pipe to final grade. Backfill may be selected from excavated material anywhere on the work if any of the material is suitable. Backfill may be by hand or mechanical placement. Trench backfill above the embedment zone shall be compacted in twelve (12) inch lifts.

2. Compaction - Under traffic areas, the top 12-inches of backfill material shall be compacted to a density of not less than 100% as determined by ASTM D1556 or D-2922. Below the 12-inch line to, and including the area around the pipe, the density shall not be less than 95% at optimum moisture. In areas other than traffic areas, the backfill shall be compacted to 95% density, at optimum moisture. Laboratory test shall conform to ASTM-D-698.

3. Whenever the trenches have not been properly filled, or if settlement occurs, they shall be refilled, smoothed off and finally made to conform to the surface of the ground. Backfilling shall be carefully performed, and the original surface restored to the full satisfaction of the Engineer immediately after installation. The finished surface shall be free of depressions and shall not allow ponding of stormwater runoff above utility lines.

4. Where PVC pipe is installed, the Contractor shall take precautions, in accordance with ASTM D2321, during the backfill operations so as not to create excessive side pressures, horizontal or vertical deflection of the pipe so as not to impair flow capacity.

G. Joint Restraint - All bends, plugs, valves, caps and tees on four (4) inch pipe and larger, shall be provided with joint restraints equivalent to Megalugs. Additional restraint shall be as indicated on the drawings.

H. New Service Connections - The Contractor shall tap the main and install a service connection to each vacant lot or as directed by the Engineer in accordance with the detail shown on the plans for Water Service Connections. Plastic or copper tubing for service lines shall be installed in a manner that will prevent abrupt changes or bends in any direction. Tracer wire in accordance with Part 1.06 shall be installed on all service laterals extending from the main to the curb stop. The Contractor shall exercise extreme caution to prevent crimping of the tubing during handling, storage and installation. All one (1) inch and two (2) inch service laterals shall be of one piece construction, no couplings or sectional lines will be allowed from the corporation stop to

the curb stop. The tubing shall have an absolute positive connection to the water main to prevent leakage. Taps shall be made perpendicular to the main. A water service connection shall be marked on the curb with a "W". The mark shall be made with a branding iron on the vertical face of the curb and shall be a minimum of 1/4-inch in depth. All laterals shall be locked during construction, testing and disinfection. The Contractor may unlock the laterals only when water is being blown off to prepare for testing. When the water system is accepted by the City, all laterals shall be completed by removing the locks and placing the curb stop in a Standard Meter Box as shown on the Detail. Copper tubing is intended for use in soils where a possibility of petroleum contamination is present and shall only be used where specifically called for on the drawings.

I. Connect Existing House Service - The Contractor shall tap the main and install a house service connection to each existing water meter. Taps shall be made perpendicular to the main and opposite the existing meter. Plastic tubing for house service lines shall be installed in a manner that will prevent abrupt changes or bends in any direction. The Contractor shall exercise extreme caution to prevent crimping of the tubing during handling, storage, and installation. All one (1) inch and two (2) inch service laterals shall be of one piece construction; no couplings or sectional lines will be allowed from the corporation stop to the curb stop. The tubing shall have an absolute positive connection to the water main to prevent leakage. The Contractor shall locate and excavate the existing lateral connections, cut and plug the existing lateral at the main, remove the existing curb stop, and connect the new lateral to the meter. The new work shall be tested, cleaned and disinfected prior to connecting to the existing meter. All laterals shall be locked during construction, testing and disinfection. The contractor may unlock the laterals only when water is being blown off to prepare for testing or when the laterals are being connected to the existing meters.

J. Jacking and Boring - Steel casing of the diameter shown on the plans shall be jacked or bored in the location indicated. Joints between sections of the steel casing shall be of a continuous weld made by a certified welder. Boring or jacking shall be in accordance with the provisions of Section 615 of the Georgia DOT Standard Specifications. Carrier pipe shall be installed as shown on the Detail. After the carrier pipe has been installed, the ends of the casing shall be sealed with Class "C" concrete after being checked by the Engineer.

Where the work involves a highway, the Resident Engineer of the State Department of Transportation shall be notified three (3) days before the crossing is started. Where the work involves a railroad, the work shall conform to the requirements of AREMA

specifications and the Division Superintendent of the Railroad shall be notified three (3) days prior to beginning the work. Before commencing work within the rights-of-way of the railroads or highways, the Contractor shall verify that the Owner has obtained the required permits.

K. Detection Tape - Detection tape will be used over all pipe and tubing two (2) inch or larger. The tape shall be laid 24" above existing main. Tracer wire shall be securely fastened to fire hydrants, valves, and valve covers according to the specification. Locate wire for laterals shall extend one (1) foot beyond the curb stop.

L. Tracer Wire - Tracer wire will be installed on all water mains and connected with direct burial sealed connection on all water service laterals directly on top of the water line. Tracer wire shall be attached directly to the pipe in the 3 o'clock position and shall be securely fastened to fire hydrants, valves, and valve covers according to the specification. Locate wire for laterals shall extend one (1) foot beyond the curb stop. The wire shall be secured to the pipe with tape or other acceptable methods at spacing of no more than 36" apart. Where water service laterals connect to water mains, the specified spliced connector shall used. The insulated wire must maintain electrical continuity. This tracer wire system shall be checked and tested by the contractor, in the presence of City personnel, prior to acceptance of the water main installation. All equipment, meters, detectors, etc., needed for testing shall be furnished by the Contractor.

M. Polyethylene Encasement - Polyethylene encasement shall be used on all ductile iron piping, fittings, valves and appurtenances and installed according to the requirements of ANSI/AWWA C105/A21.5, Sec. 5.4, Method A.

N. Air Relief Valves - Tapping saddles shall be used when installing air relief valves on non-metallic pipe less than six (6) inches in diameter. A direct tap shall be made on all pipe six (6) inches in diameter and larger.

2.03 LOWERING WATER MAINS

A. The existing water lines shall be lowered to the control elevations shown on the plans or as specified by the Engineer. The water mains that are to be lowered shall be completely uncovered to the bottom of the main. At all changes in grade or line, the pipe shall be firmly wedged against the vertical face of the trench to prevent a joint from blowing off. The main shall be lowered to its new elevations by removing the earth from under the main and along-side the pipe uniformly. Deflections in the joints

of the main, while lowering or when its final lowered position shall not exceed three (3) degrees for an 18 foot length of pipe. All joints shall be reworked with Megalugs so that they do not leak. The joint work shall be done in such a manner as to secure tight joints without over straining the bell. The lowered pipe shall be true to line and grade.

B. Trench Excavation - Trenches shall be of necessary width for the proper lowering of the pipe. The bottom of the trenches shall be accurately graded to provide uniform bearing and support for each section of the pipe on undisturbed soil at every point along its entire length, except for the portions of the pipe sections where it is necessary to excavate for bell holes and for the proper sealing of pipe joints. Bell holes and depressions for joints shall be dug after the trench bottom has been graded. In order that the pipe rests upon the prepared bottom for as nearly its full length as practicable, the depressions shall be only of such length, depth, and width as required for properly making the particular type of joint. Care shall be taken not to excavate below the depths indicated. Unauthorized over excavation shall be backfilled with accepted backfill material and compacted per Section 2.02, Paragraph B.8, at no cost to the Owner. Unstable soil that is not capable of properly supporting the pipe shall be removed to a minimum of at least 6 inches below the bottom of the pipe or to the depth ordered by the Engineer, and replaced with accepted backfill material and compacted per Section 2.02, Paragraph B.8.

2.04 OFFSET EXISTING WATER MAINS

Where water mains must be offset to avoid interference with new structure or pipe the contractor shall notify the Engineer for instructions and methods for said work. Prior to any work on existing mains, the Contractor shall notify the Water Distribution Administrator a minimum of four (4) days in advance of required shut-off.

2.05 SEPARATION BETWEEN WATER AND SEWER

Water mains and/or laterals shall not be laid closer than 10 feet horizontally to a sanitary or storm sewer without written instruction from the engineer. Some deviation may be allowed on a case by case basis if approved by the City for installation of the water main closer to a sewer, provided that the water main is laid in a separate trench, such that the bottom of the water main is at least 18 inches above the top of the sewer. In no case, shall the water and sewer lines be closer than five (5) feet horizontally edge to edge. Water mains crossing sewers should be laid to provide a minimum vertical distance of 18 inches between the invert of the water main and the top of the sewer line. The water and sewer lines must be ductile iron when laid in violation of the

separation requirements. One full length of water pipe shall be located so both joints will be as far from the sewer as possible.

2.06 PROCEDURES FOR CONNECTIONS OF WATER MAINS

A. Purpose - To insure that there is a physical disconnection of any new untested water main from existing water mains owned and operated by the City of Savannah.

B. Procedure - Any physical connection of untested water mains with existing City of Savannah water mains is prohibited except when acceptable backflow prevention devices have been installed, tested and checked by City personnel.

1. Any new water main to be tested must be capped and restrained with retaining glands to prevent blow out or leakage during the pressure testing.

2. Water for filling and flushing the new water main will be obtained from only approved and specified fire hydrant or special wet tap of the existing City main. This physical connection for obtaining water for the new untested main shall be protected by a RPZ backflow preventer. Appropriate taps of sufficient size must be made at the end of the new system to allow air to escape during the filling sequence.

3. This physical tie-in with the existing City System must be physically disconnected after sufficient water for hydrostatic testing and disinfection has been obtained.

4. Once the new water system has passed hydrostatic testing requirements and has been chlorinated in accordance with paragraph 2.07, the new system must be flushed using the filling method in Step Two (2). The system or main will then be subjected to bacteriological testing. After bacteriological test the system must be open flushed and connected to existing system within 72 hours.

5. The permanent connection to the new system must be made with clean materials. The connection will be made with solid ductile iron sleeves. Any connection with stainless steel or similar metal full circle clamps is prohibited. Once the connection has been made, the new system must be flushed using water from the existing system to insure adequate flow and velocity into the new water system.

6. If a wet tap is required, the contractor will be responsible for preparing the site. This preparation includes the excavation and installation of the tapping sleeve. The Contractor will make available a lifting device for the tapping machine.

The City will provide the tapping machine, the air compressor, and one man to operate the unit. All taps of 12" and smaller diameter will be made by the City Water Distribution Department unless authority has been granted in writing by the Water Distribution Superintendent for a private firm to perform the wet tap for a particular new main.

C. Water for Construction - Metering Requirements

1. All water used for construction shall be metered. Water meters, either temporary or permanent, shall be the responsibility of the contractor to purchase from the City.

2. Fire hydrant meters obtained from the City of Savannah shall be obtained by submitting an application to the Water and Sewer Planning and Engineering Department with a deposit of $ 1,000.00 to cover the cost of any damage or theft of meters.

3. Fire hydrant meters shall be picked up at the Water Operations Department by presenting the receipt for the $ 1,000.00 deposit noted above.

   Fire hydrant meters shall be brought to the Water Distribution Department for inspection and testing at least twice a year.

4. A double check valve will be installed on the fire hydrant meter prior to usage. The double check assembly provided shall be the responsibility of the contractor to remain connected at all times. No fire hydrant meter shall be used without a double check valve assembly. The fire hydrant meter shall be directly connected to the fire hydrant and the double check assembly shall be connected to the meter with the 4-inch fire hose provided by the City in order to relieve weight on the fire hydrant 2½-inch outlet.

5. The contractor shall be responsible to notify the Water Revenue Office of the location of the fire hydrant meter on a bi-monthly basis for the purpose of billing. Water Revenue will inform the contractor of the required date for the call-in during the initial meter application process. Failure to call in on the required date shall result in immediate confiscation of the meter and return of the deposit minus the cost of the water used and/or damages to the meter.

6. It shall be the responsibility of the contractor to estimate the volume of water required during construction and include the cost in the installation price of the water main.

7. When fire hydrant meters are returned to the Water Distribution Department, an inspection and test will be made on the meter. Any damage to the meter shall be deducted from the deposit made by the Contractor.

D. All permanent or temporary meters installed shall be equipped with double check valves or RPZ which will be the responsibility of the contractor to install in accordance to the specifications. Construction meters shall be obtained through the normal meter application process. Construction meters shall be used during all phases of the construction project. Upon completion of the project, the meter must be disconnected and returned to the Water Distribution Department for final processing and return of the deposit for the meter. All laterals to the meter shall be removed from the tap at the main to the meter location.

2.07 TESTING, FLUSHING, AND DISINFECTION OF NEW WATER MAINS

A. Filling and Hydrostatic Testing of New Mains:

Upon complete installation and prior to connection to the City's existing water mains, all new water mains shall be hydrostatically tested in accordance with Section 02550, Part 3.01 of these specifications. Where any portion of the line fails to meet the hydrostatic requirements of Section 02550, Part 3.01, repairs shall be made and the entire new main shall be retested. All filling and hydrostatic testing of new mains shall be coordinated with and witnessed by the City's inspector.

Temporary connections to the City's existing water system for the purpose of filling and/or flushing of new mains shall be approved by the City's inspector prior to installation of said connections. A City of Savannah approved double detector check valve backflow prevention device shall be used for all such temporary connections. A test certification shall be required on all backflow prevention devices not supplied by the City of Savannah prior to their use. The test certification shall indicate that the backflow prevention device has been tested and approved within the previous 12 months, by an individual holding a valid State of Georgia Backflow Prevention Assembly Tester license.

The rate at which new mains are filled shall be controlled to allow air to escape the mains during the filling process and to prevent sudden increases in system pressure due to water hammer at such time as the line becomes full. The rate of filling may also be limited by system operation requirements as determined by the City's Water Supply and Treatment Department.

Under NO circumstance, other than a life threatening emergency, shall the contractor, his employees, and/or representatives operate any valve which will allow flow into or out of the City's existing water system. In the event of a non-life threatening emergency condition, the Contractor shall contact the City's inspector or the City's Water Supply and Treatment Department (912-351-3434) for approval prior to valve operation.

B. Flushing of New Mains

Upon successful completion of hydrostatic testing, all new mains shall be flushed to remove all foreign material from within the mains. Flushing shall generally be accomplished at the highest practical flow rate. However, limitations of existing water system operational demand and pressure, as well as drainage areas receiving flush water may exist. Such flow rate limitations shall not relieve the contractor from providing a clean water main and all requirements of chlorination and bacteriologic sampling shall remain in full force (see Section 02550, Parts 2.07 C and 2.07 E).

Not less than 48 hours (2 working days) prior to the desired commencement of flushing, the Contractor shall contact the City's inspector for the purpose of coordinating the flushing effort.

Prior to flushing, the Contractor shall identify the area(s) into which flushed water will be drained. Such drainage area shall be approved by the City's inspector prior to flushing. The Contractor shall provide sufficient supervision to monitor the designated drainage area and to insure that flooding and/or erosion of private property does not occur. Where public roadways are to be used, the Contractor shall monitor water volumes and traffic to insure flushing does not create a traffic hazard. The Contractor may request that an affected street be closed to traffic during the flushing period. However, such closings shall be subject to the requirements and approval of the City's Traffic Engineering Department.

Under NO circumstance, other than a life threatening emergency is the contractor, his employees, and/or representatives to operate any valve which will allow flow into or out of the City's existing water system. In the event of a non-life threatening emergency condition, the Contractor shall contact the City's inspector or the City's Water Supply and Treatment Department (912-351-3434) for approval prior to valve operation.

1. Water Mains 10" and Smaller

For water mains with a nominal diameter up to and including 10 inches, the double

detector check valve installed between the existing City's water main and the new main to be flushed shall be no less than 6 inches in diameter.

Flushing shall continue until the water is clear to the eye and no foreign material is observed. Examination for sediment in a sample collected in a clear container and allowed to stand for approximately 5 minutes will provide an indication of the necessity to continue flushing. Termination of flushing based on such an indication shall not relieve the contractor from providing a clean water main and all requirements of chlorination and bacteriologic sampling shall remain in full force (see Section 02550, Parts 2.07 C and 2.07 E).

2. Water Mains 12" and Larger

For water mains with a nominal diameter of 12 inches and larger, the double detector check valve installed between the existing City's water main and the new main to be flushed shall be no less than 10 inches in diameter.

For new water mains 12 inches in diameter and larger, the Contractor shall collect a sample from the flushed main that is apparently clear and shall deliver same to the Water Supply and Treatment laboratory located at the I&D Water Plant for examination and determination of apparent successful flushing. Review of the sample by the laboratory is only an indication of apparent successful flushing and shall in no way imply that disinfection will be successful or that satisfactory bacteriological tests will be obtained. Termination of flushing based on such an indication shall not relieve the contractor from providing a clean water main and all requirements of chlorination and bacteriologic sampling shall remain in full force (see Section 02550, Parts 2.07 C and 2.07 E).

C. Disinfection of New Mains

All new water mains shall be disinfected in accordance with these specifications prior to being connected to the City's existing water system.

1. Chemicals to be used in the disinfection of new water mains shall be as follows:

   a. Liquid (gas) Chlorine – conforming to ANSI/AWWA B301 containing 100% available chlorine and packaged in steel containers. Liquid chlorine shall be used only 1) in combination with appropriate gas-flow chlorinators and ejectors to provide a controlled high-concentration solution feed to the water be

chlorinated; 2) under the direct supervision of someone familiar with the physiological, chemical, and physical properties of liquid chlorine and who is trained and equipped to handle any emergency that may arise; and 3) when appropriate safety practices are observed to protect working personnel and the public.

b. Sodium hypochlorite – conforming to ANSI/AWWA B300. The granular or tablet form of sodium hypochlorite shall NOT be introduced directly into water lines. The use of sodium hypochlorite shall require that all granules or tablets shall be completely dissolved in an appropriate amount of water to obtain the desired chlorine concentration. The sodium hypochlorite solution may then be pumped into the new mains to achieve required levels of free chlorine for disinfection.

c. Calcium hypochlorite – conforming to ANSI/AWWA B300. The granular or tablet form of sodium hypochlorite shall NOT be introduced directly into water lines. The use of calcium hypochlorite shall require that all granules or tablets shall be completely dissolved in an appropriate amount of water to obtain the desired chlorine concentration. The calcium hypochlorite solution may then be pumped into the new mains to achieve required levels of free chlorine for disinfection.

d. No pool treatment chemicals containing algaecide will be allowed for use of disinfecting of potable water lines.

2. Method of Chlorination

a. Tablet Method – Shall NOT be used.

b. Continuous Feed Method – Prior to chlorination, the main(s) and all stub outs, fire hydrants and other appurtenances to the main(s) shall be filled with water and all air shall have be removed. Chlorine shall be fed into the new main(s) on a continuous basis such that the available free chlorine shall be not less than 50 mg/L throughout the entire length of the main(s). Minimum chlorine residual shall be confirmed by sampling at each end of the main(s) plus one sample for every 1200 feet of pipe. Upon successful introduction of chlorine to the minimum concentration, all valves shall be closed such that no water may enter or exit the main(s) being disinfected. Said chlorinated water shall be allowed to sit undisturbed within the main(s) for a period not less than 24 hours. During the aforementioned 24 hour period no additional disinfectant (i.e. chlorine) shall be added to the main(s) at any point. After 24 hours, samples shall be collected

from each of the initial sampling points and each sample shall be checked for free chlorine residual. The residual free chlorine in each of the "24-hour" samples shall be not less than 25 mg/L.

In the event that the residual free chlorine in any of the "24-hour" samples is less than 25 mg/L, the entire main(s), including stub outs, fire hydrants and appurtenances shall be flushed and dechlorinated in accordance with Section 02550, Part 2.07 D. Upon completion of the required flushing, the entire main(s), including stub outs, fire hydrants and appurtenances shall be rechlorinated in accordance with Section 02550, Part 2.07 C.

c. Slug Method - The slug method shall ONLY be used where the total volume of the new water main to be disinfected is greater than 500,000 gallons. When the slug method is used for disinfection, all stub outs, laterals and other appurtenances to the main(s) shall be filled with water and all air shall be removed prior to the commencement of chlorine injection. Chlorine shall be fed into the new main(s) on a continuous basis such that a continuous slug of heavily chlorinated water shall be developed. The available free chlorine residual shall be not less than 100 mg/L throughout the length of the slug. The length of the chlorinated slug shall be not less than twenty (20) percent of the entire length of the main to be disinfected. After the heavily chlorinated slug has been developed, water from the existing water system shall be introduced into the new main to move the slug throughout the entire length of the new main as well as into all stub outs, laterals, and appurtenances. The rate of movement of the slug shall be such that all portions of the new main, including stub outs, laterals and appurtenances shall be in contact with the slug for a period of not less than three (3) hours. As the slug moves through the main, sampling shall occur at each end of the slug and at intervals of not more than 1,000 feet throughout the length of the slug. All sample locations, sample times, and sample results shall be recorded and verification of the minimum three (3) hour contact time shall be provided in a sampling report.

d. If at any time during the disinfection process the free chlorine residual of the slug falls below 75 mg/L, the flow shall be stopped and chlorination equipment shall be moved to the head of the slug. Flow shall resume and additional chlorine applied to restore the free chlorine within the slug to 100 mg/L or more.

D. Removal of Heavily Chlorinated Water

Upon successful chlorination as described in Section 02550, Part 2.07 C, the contractor shall thoroughly flush the new main(s) so as to reduce free chlorine residuals to water system background levels. Flushing of the heavily chlorinated water shall require dechlorination. Hydrogen Peroxide (H_2O_2) shall be used for all dechlorination processes. Sulfur Dioxide (SO2), Sodium Bisulfite (NaHSO3), Sodium Sulfite (Na_2SO_3), and/or Sodium Thiosulfate ($Na_2S_2O_3 \bullet 5H_20$) shall **not** be used.

Note: Hydrogen peroxide (H_2O_2) dechlorination, requires approximately 0.5 lbs of 100% hydrogen peroxide solution to neutralize 1.0 lbs of 100% chlorine. Appropriate adjustments must be made for actual solution concentration of hydrogen peroxide to be used and residual chlorine to be neutralized to obtain necessary hydrogen peroxide feed rates.

The following can be used as a guide for determining necessary feed rates:

H_2O_2 (gal/hr) = (Cl_2 x GPM x 0.003) / % Concentration

Where:

Cl_2 – Free chlorine residual (mg/L) of water to be neutralized
GPM – Flow rate of water (gallons / minute) to be neutralized
% Concentration – Concentration of H_2O_2 used (10% solution is 10 not 0.1)

Gallons of Hydrogen Peroxide (H_2O_2) required to neutralize various residual chlorine concentrations in 100,000 gallons of water.

Free Chlorine	H_2O_2 Concentration		
(mg/L)	**10%**	**15%**	**20%**
	Gallons of H_2O_2 Solution / 100,000 Gallon of Water		
1	0.5	0.33	0.25
2	1	0.67	0.5
10	5	3.4	2.5
50	25	17	12.5

E. Bacteriological Sampling

All bacteriological samples shall be collected by the City's inspector. All bacteriological

testing shall be performed by the City of Savannah Water Supply and Treatment Laboratory. BACTERIOLOGICAL TESTING BY ANY OTHER ENTITY SHALL NOT BE ACCEPTABLE. Results of the bacteriological testing shall be e-mailed or faxed to the City's inspector as soon as they are available. THE LAB SHALL NOT GIVE RESULTS OF BACTERIOLOGICAL TESTING DIRECTLY TO THE CONTRACTOR.

Upon successful completion of proper chlorination/dechlorination in accordance with Section 02550, Parts 2.07 C and 2.07 D, the new main(s) shall be sampled for bacteriological contamination in TWO STAGES as follows:

1. Stage 1 Sampling

   At a minimum, bacteriological samples shall be collected at each end of the new main(s) for mains less than 500 feet in length. Where new main(s) exceed 500 feet in length, but are less than 1200 feet in length an intermediate sample shall be taken. Where new mains exceed 1200 feet in length intermediate samples shall be collected at intervals of no more than 1200 feet along the entire length of the new main(s). Intermediate samples shall be evenly distributed through the main(s) to the extent possible.

Example of Required Number of Sampling and Location

Length of Line	# of Samples	Location of Samples
0 - 500 feet	2	Beginning, End
501 - 1200 feet	3	Beginning, End, 1 Intermediate
1201 -2400 feet	4	Beginning, End, 2 Intermediate
2401 - 3600 feet	5	Beginning, End, 3 Intermediate
3601 - 4800 feet	6	Beginning, End, 4 Intermediate
4801 - 6000 feet	7	Beginning, End, 5 Intermediate

In the event that Stage 1 bacteriological testing fails the contractor may re-flush the main(s) in accordance with section 02550, Part 2.07 B and collect a ONE TIME ONLY re-sample of the Stage 1 bacteriological samples. If the Stage 2 bacteriological samples are collected before the results of the failed Stage 1 samples are received by the City's inspector those samples become the resample of the Stage 1 sampling and the opportunity to flush without re-chlorinating is forfeited. Therefore, it is

strongly recommended not too begin the Stage 2 sampling until confirmations of acceptable Stage 1 sampling results have been obtained.

2. Stage 2 Sampling

Not less than 24 hours following the collection of the Stage 1 bacteriological sample(s) a second set (Stage 2) of bacteriological samples shall be collected from the same sampling points as the Stage 1 bacteriological sampling. The main(s) being disinfected shall be ABSOLUTELY UNDISTURBED; this means NO FLUSHING OR OTHER USE OF WATER, between Stage 1 and Stage 2 samplings.

Bacteriological tests shall be failed as follows:

a. Where bacteriological tests indicate too much trash exists within the sample.
b. Where more than ten (10) non-coliform bacteria are found in any tested sample.
c. Where any coliform bacteria are found in any tested sample.
d. In the event that lab personnel have suspicion that the samples and or test results are not of sufficient quality to warrant acceptance.

F. Disinfection and Bacteriological Phasing of New Mains

The new main(s) to be sampled shall be considered as a single unit such that failure of a single bacteriological sample shall constitute a failure of the entire new main(s). Where new mains are being chlorinated and tested in phases, each phase shall be considered as a single unit and the failure of one phase shall not impact the acceptance or failure of any other phase. However, phasing of a system of new mains, or phasing of a single long main shall be established prior to the commencement of disinfection and shall proceed in geometric order beginning at the existing water system, such that water from an untested or failed phase shall not pass through a phase which has been accepted.

2.08 DISPOSAL AND TREATMENT OF HEAVILY CHLORINATED WATER

A. The waters and/or environment into which the chlorinated water is to be discharged shall be inspected and analyzed. If there is any possibility that the chlorinated discharge will cause damage to the environment, the chlorinated water may be discharged by either of the following two (2) methods:

1. Should a City of Savannah Sanitary Sewer manhole be in the vicinity and after confirmation and approval of the City of Savannah Water Quality Department, the chlorinated water may be discharged into the manhole.

2. A neutralizing chemical shall be added to the discharge water to neutralize thoroughly or decrease the chlorine residual to less than 0.5 mg/L. Refer to Section 02550, Part 2.07 D for the information on the chemical requirements. In cases where lower chlorine residual is required by environmental permit, more neutralizing chemical may be required to further lower the residual chlorine levels in the discharge.

B. Containers

Depending on the chemical used for dechlorination, the storage containers will vary from gas cylinders, liquid in 50 gallon (190 L) drums, or dry compounds. Dilution tanks and mixing tanks will be required when using dry compounds and may be necessary when using liquid compounds to deliver the proper dosage. Solution containers should be covered to prevent evaporation and spills.

C. Mixing and Contact Requirements

Concentrated hydrogen peroxide shall be diluted prior to use. Mix the concentrated hydrogen peroxide into potable solution water in a well ventilated area. Always add hydrogen peroxide to water, NOT water to hydrogen peroxide.

The reaction is rapid at alkaline pH and the dechlorination rate is directly proportional to the concentrations of free chlorine and hydrogen peroxide, e.g. – at a starting pH of 7 and 2 mg/L of free chlorine, the reaction is over within 3 minutes using 5% excess hydrogen peroxide.

Field testing shall be performed (to the satisfaction of the City) to determine the contact time required for dechlorination of the heavily chlorinated water prior to discharge. The dechlorination system shall be large enough to provide a contact time of 120% of the experimentally determined contact time. Adequate mixing shall be provided, either by mechanical means or hydraulic turbulence.

D. Sampling and Control

City personnel will be responsible for the collection of water samples from new water lines or systems.

A minimum of 48 hours notice prior to chlorination/dechlorination (where required) shall be required for the contractor to contact the City Water Supply & Treatment at 912-351-3434, so Water/Sewer may schedule the collection of the required sample(s). For Private Development projects, contractors shall contact the City Engineer's office at 912-651-6510.

Facilities shall be included for sampling the dechlorinated effluent for residual chlorine. When using hydrogen peroxide for dechlorination, use an ortho-tolidine test method to check the chlorine residual. Unlike other chlorine test methods, the presence of excess hydrogen peroxide does not interfere with the ortho-tolidine method.

2.09 EXISTING SYSTEM

The existing water distribution system in service shall be kept in service until the new system has been constructed, sterilized, and accepted by the City of Savannah Water and Sewer Bureau.

2.10 GRASSING

All disturbed areas shall be grassed in accordance with Section 02485 "GRASSING" unless otherwise indicated.

PART 3 - TESTING

3.01 HYDROSTATIC TESTS

A. The new main(s), including stub outs, laterals, fire hydrants, and appurtenances shall be hydrostatically tested to a minimum of 150 psi at the highest point of the main(s) for a period of not less than 2 hours in accordance with ANSI/AWWA C600. In the event that a pressure gauge cannot be placed at the highest point of the new main(s) the test pressure at the gauge shall be increased by 1 psi for every 2.31 feet of rise between the elevation of the gauge and the elevation of the highest point of the new main(s).

B. A maximum loss of 3 psi will be allowed during static testing. The contractor shall notify the City inspector not less than 48 hours (2 working days) prior to applying pressure for testing. Pressure tests shall be witnessed by the City's inspector. A LEAKAGE RECOVERY TEST WILL NOT BE ACCEPTABLE.

3.02 COMPACTION TESTING

Laboratory tests of the soil shall be made in accordance with ASTM D-698. In-place density tests shall be made in accordance with ASTM D-1556 or D-2922. Results of the tests shall be furnished to the Engineer by the testing laboratory.

A. The minimum number of tests required for backfill over water in traffic area shall be 1 per 100 LF for each 4 feet of depth or portion thereof.

B. The minimum number of tests required for backfill over water in non-traffic areas shall be 1 per 200 LF for each 6 feet of depth or portion thereof.

END OF SECTION 02550