

SECTION 33 10 00 WATER UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

This section specified underground water distribution system complete, ready for operation, including all appurtenant structures, and connections to both new building service lines and to existing potable water supply.

1.2 RELATED WORK

- A. Maintenance of Existing Utilities: Section 01 00 00, GENERAL REQUIREMENTS.
- B. Excavation, trench widths, pipe bedding, backfill, shoring, sheeting, bracing: Section 31 20 00, EARTH MOVING.
- C. Concrete: Section 03 30 53, (SHORT-FORM) CAST-IN-PLACE CONCRETE.
- D. Building Plumbing starting 5 feet outside of the building: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- E. Flower Watering Spigot Assemblies: Section 32 30 00, SITE FURNISHINGS.

1.3 DEFINITIONS

- A. Water Distribution: Pipelines and appurtenances which are part of the distribution system. The distribution system comprises the network of piping located throughout the site, as applicable, and in the building areas that provides water from the potable water supply source for the project, including hydrants, valves, and other appurtenances used to supply water for domestic and fire-fighting/fire protection purposes only when required due to Life Safety issues.
- B. Water Service Line: Pipe line connecting building piping to water distribution lines.

1.4 QUALITY ASSURANCE

- A. Products Criteria:
 - 1. Multiple Units: When two or more units of the same type or class of materials or equipment are required, these units shall be product of one manufacturer.
 - 2. Nameplate: Nameplate bearing manufacturer's name or identifiable trademark securely affixed in a conspicuous place on equipment or name or trademark cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.
- B. Comply with the rules and regulations of the Public Utility having jurisdiction over the connection to Public Water lines and the extension, and/or modifications to Public Utility

systems. The Public Utility is the City of Johnson City, Water & Sewer Services Department.

C. All material surfaces in contact with potable water shall comply with NSF 61.

1.5 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturers' Literature and Data (Submit all items as one package):
(Polyvinyl Chloride (PVC) shall be in accordance with AWWA C605.)

1. Piping.
2. Fittings
3. Gaskets.
4. Valves.
5. Fire hydrants.
6. Meter.
7. Vaults, frames and covers.
8. Backflow Preventer
9. Valve boxes.
10. Corporation and curb stops.
11. Curb stop boxes.
12. Joint restraint.
13. Disinfection products.
14. Warning Tape

C. Testing Certifications:

1. Certification of Backflow Devices.
2. Hydrostatic Testing.
3. Certification of Disinfection, including free chlorine residuals, and bacteriological examinations.

1.6 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Refer to the latest edition of all referenced Standards and codes unless otherwise specified.

B. ASTM International (ASTM):

A536..... Standard Specifications for Ductile Iron Castings

- B61..... Standard Specifications for Steam or Valve Bronze Castings
- B62..... Standard Specifications for Composition Bronze or Ounce Metal Castings
- D1784..... Standard Specifications for Rigid PVC Compounds and CPVC Compounds
- D1785..... Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
- D2241..... Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
- D2464..... Standard Specifications for Threaded PVC Pipe Fittings, Schedule 80
- D2466..... Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
- D2467..... Standard Specifications for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
- D2564..... Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
- D2855..... Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
- D3139..... Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
- F441/F441M..... Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
- F477 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- F1674..... Standard Test Method for Joint Restraint Products for Use With PVC Pipe
- C. American Water Works Association (AWWA):
- B300..... Hypochlorites
- B301..... Liquid Chlorine
- C104/A21.4 Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water

C110/A21.10	Ductile-Iron and Gray-Iron Fittings, 80 mm Through 1200 mm (3 Inches Through 48 Inches) for Water and Other Liquids
C111/A21.11	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
C153/A21.53	Ductile-Iron Compact Fittings, 80 mm Through 300 mm (3 inches Through 12 inches) for Water and Other Liquids
C502	Dry-Barrel Fire Hydrants
C503	Wet-Barrel Fire Hydrants
C504	Standard for Rubber-Seated Butterfly Valves
C508	Swing-Check Valves for Waterworks Service, 50 mm thru 600 mm (2 inches through 24 inches) NPS
C509	Resilient Seated Gate Valve for Water SupplyService
C510	Double Check Valve Back-Flow Prevention Assembly
C511	Reduced Pressure Principle Back-Flow Prevention Assembly
C550	Standard for Protective Interior Coatings for Valves and Hydrants
C600	Installation of Ductile-Iron Water Mains and Their Appurtenances
C605	Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
C651	Standard for Disinfecting Water Mains
C700	Standard for Cold-Water Meters – Displacement Type, Bronze Main Case
C701	Standard for Cold-Water Meters – Turbine Type for Customer Service
C702	Cold-Water Meters – Compound Type
C800	Underground Service Line Valves and Fittings
C900	Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 100 mm Through 300mm (4 inches Through 12 inches), for Water Distribution

D. National Fire Protection Association (NFPA):

- 24 Installation of Private Fire Service Mains and Their
Appurtenances
- 291 Fire Flow Testing and Marking of Hydrants
- 1141 Fire Protection in Planned Building Groups

E. NSF International:

- 14 Plastics Piping Components and Related Materials
- 61 Drinking Water System Components-Health Effects
(Sections 1-9)

F. Foundation for Cross-Connection Control and Hydraulic Research

PART 2 - PRODUCTS

2.1 POLYVINYL CHLORIDE PIPE AND FITTINGS

A. Class-Rated Polyvinyl Chloride (PVC) Pipe: Pipe and accessories shall bear the NSF mark indicating pipe size, manufacturer's name, AWWA and/or ASTM Specification number, working pressure and production code.

- 1. PVC pipe and accessories 4 inches to 14 inches in diameter, AWWA C900 "Polyvinyl Chloride (PVC) Pressure Pipe", Class 200, DR 14, cast iron outside diameters, unless otherwise shown or specified.
- 2. PVC Pipe and Accessories Smaller than 4 inches: Schedule 80, meeting the requirements of ASTM D1785, Type 1, Grade 1. All exposed piping shall be CPVC meeting requirements of ASTM F441.

B. Joints:

- 1. Pipe 3 inches and Greater in Diameter: Push-on type with factory installed solid cross section elastomeric ring meeting the requirements of ASTM F477.
- 2. Pipe Less Than 3 inches in Diameter: Threaded (ASTM D2464) or solvent welded (ASTM 2467). Use Teflon tape or liquid Teflon thread lubricant approved for use on plastic on all threaded joints.

C. Fittings:

- 1. Class-Rated Pipe 3 inches in Diameter and Greater: Ductile iron with mechanical joints conforming to the requirements of AWWA C153. Mechanical joint fittings shall include retainer glands, unless otherwise noted.

2. For Schedule 80 Pipe less than 3 inches in Diameter: Threaded or solvent weld.
Threaded PVC fittings shall conform to ASTM D2464. CPVC fittings shall conform to ASTM F437 for threaded fittings and ASTM F439 for solvent weld fittings.

2.2 MECHANICAL JOINT RETAINER GLANDS

- A. Restraint devices for mechanical joint fittings and appurtenances conforming to either ANSI/AWWA C111/A21.11 or ANSI/AWWA C153/A21.53, shall conform to the following:
 1. Restraint devices for nominal pipe sizes 3 inch through 36 inch shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110/A21.10.
 2. The devices shall have a working pressure rating equal to that of the pipe on which it is used. Ratings are for water pressure and must include a minimum safety factor of 2:1 in all sizes.
 3. Gland body, wedges and wedge actuating components shall be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536. Ductile iron gripping wedges shall be heat treated within a range of 370 to 470 BHN.
 4. An identification number consisting of year, day, plant and shift (YYDDD) (plant designation) (Shift number), shall be cast into each gland body. All physical and chemical test results shall be recorded such that they can be accessed via the identification number on the casting. All components shall be manufactured in the United States.
 5. Mechanical Joint restraint shall require conventional tools and installation procedures per AWWA C600, while retaining full mechanical joint deflection during assembly. Proper actuation of the gripping wedges shall be ensured with torque limiting twist off nuts.
 6. MJ restraints shall be listed by Underwriters Laboratories, and approved by Factory Mutual in the 3 inch through 12 inch sizes.
 7. All casting bodies shall be surface pretreated with a phosphate wash, 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.

2.3 VALVES

- A. Gate Valve:

1. Unless otherwise specified, valves shall conform to AWWA C509 with mechanical-joint ends. Valves 3 inches and larger shall be resilient seated, ductile iron body, bronze mounted inclined seats, non-rising stem type, turning counter-clockwise to open, with a minimum (200 pound WOG. The resilient seat shall be fastened to the gate with stainless steel fasteners or vulcanizing methods. The interior and exterior shall be coated with thermo-setting or fusion epoxy coating in accordance with AWWA C550. Stuffing boxes shall have O-ring stem seals. Stuffing boxes shall be bolted and constructed so as to permit easy removal of parts for repair. Asbestos packing is not allowed.
 2. Operator:
 - a. Underground: Furnish valves with 2 inch nut for socket wrench operation.
 - b. Above Ground and in Pits: Hand wheels.
 3. Joints: Ends of valves shall accommodate, or be adapted to, pipe installed.
- B. Check Valve: Check valves shall be designed for a minimum working pressure of 150 psi or as indicated. Valves shall have a clear waterway equal to the full nominal diameter of the valve. Valves shall open to permit flow when inlet pressure is greater than the discharge pressure, and shall close tightly to prevent return flow when discharge pressure exceeds inlet pressure. The size of the valve, working pressure, manufacturer's name, initials, or trademark shall be cast on the body of each valve.
1. Smaller than 4 inches: Bronze body and bonnet, ASTM B61 or B62, 200 pound WOG.
 2. 4 inches and Larger: Iron body, bronze trim, swing type, vertical or horizontal installation, flange connection, 200 pound WOG. Check valves for fire lines shall conform to AWWA C508 and shall be epoxy coated and lined per AWWA C550.
- C. Corporation stops and saddles: Ground key type; bronze, ASTM B 61 or ASTM B 62; and suitable for the working pressure of the system. Ends shall be suitable for solder-joint, or flared tube compression type joint. Threaded ends for inlet and outlet of corporation stops, AWWA C800.
- D. Curb or Service Stops - Ground key, round way, inverted key type; made of bronze, ASTM B 61 or ASTM B 62; and suitable for the working pressure of the system. Ends shall be as appropriate for connection to the service piping. Arrow shall be cast into body of the curb or service stop indicating direction of flow. Smaller than 3 inches. Waterworks standard for Type "K" copper, single piece cast bronze body with tee top operated plug sealed with O-ring gaskets, 200 pound WOG per AWWA C800.

- E. Vacuum and Air Relief Valves: Vacuum and air relief valves shall be of the size shown and shall be of a type that will release air and prevent the formation of a vacuum. The valves shall automatically release air when the lines are being filled with water and shall admit air into the line when water is being withdrawn in excess of the inflow. Valves shall be iron body with bronze trim and stainless steel float. Valves shall be rated for the same operating pressure as the pipeline.

2.4 WARNING TAPE

- A. Standard, 4-Mil polyethylene 3 inch wide tape, detectable type, blue with black letters, and imprinted with "CAUTION BURIED WATER LINE BELOW".

2.5 CURB STOP BOX

- A. Cast iron extension box with screw or slide type adjustment and flared base. Box shall be adapted, without full extension, to depth of cover required over pipe at stop location. Cast the word "WATER" in cover and set cover flush with finished grade. Curb stop shut-off rod shall extend 2 feet above top of deepest stop box.

2.6 VALVE BOX

- A. Cast iron extension box with screw or slide-type adjustment and flared base. Minimum thickness of metal shall be 3/16 inch. Box shall be adapted, without full extension, to depth of cover required over pipe at valve location. Cast the word "WATER" in cover. Provide one "T" handle socket wrenches of 5/8 inch round stock long enough to extend 2 feet above top of deepest valve box. The least diameter of the shaft of the box shall be 133 mm (5 1/4 inches). Cast-iron box shall have a heavy coat of bituminous paint. Valve box and cover shall be installed where indicated on the drawings to be utilized as access points for the tracer wire or detectable warning tape.

2.7 FIRE HYDRANTS

- A. Size of main valve opening of each hydrant shall be 5 inches, minimum. Hose thread, size of fire apparatus connection, and shape, size and direction of rotation of operating head of hydrant shall be identical with present local fire department and/or Public Utility standards or those in use at the facility as determined by the NCA.
- B. Hydrant shall be type AWWA C502, heavy construction, of proper length to connect pipe without extra fittings, and shall be the traffic type with safety flange on barrel and safety couplings on the valve stem with the following features:
 - 1. Interior removable without digging up hydrant; can be packed under pressure; 6 inch bell connection; one steamer nozzle and two hose nozzles with nozzle caps securely chained to barrel; suitable drainage device; single rubber or leather-faced valve in

- base; nozzles, stuffing boxes, wedge nuts, seat rings, clamp plates, etc. Threaded joints or spindles shall be bronze. Upper and lower barrels shall be of equal diameters. Upper barrel shall be of sufficient length to permit setting hydrant with barrel flange not more than 2 inches above finished grade. All fire hydrants shall have 6 inch bottom connection.
2. Provide fire hydrants with a finish paint identical to the existing fire hydrants. If there are no existing hydrants, contact the nearest fire department responder (fire department) for appropriate color.
- C. Provide 2 wrenches with handles not less than 14 inches long.

2.8 TAPPING SLEEVES

- A. Unless otherwise required by the Public Utility, tapping sleeves of the sizes indicated for connection to existing main shall be the cast gray, ductile, stainless steel or malleable iron, split-sleeve type with flanged or grooved outlet, and with bolts, follower rings and gaskets on each end of the sleeve. Construction shall be suitable for a maximum working pressure of 150 psi. Bolts shall have square heads and hexagonal nuts. Longitudinal gaskets and mechanical joints with gaskets shall be as recommended by the manufacturer of the sleeve. When using grooved mechanical tee, it shall consist of an upper housing with full locating collar for rigid positioning which engages a machine-cut hole in pipe, encasing an elastomeric gasket which conforms to the pipe outside diameter around the hole and a lower housing with positioning lugs, secured together during assembly by nuts and bolts as specified, pre-torqued to 50 foot-pounds.

2.9 BACKFLOW PREVENTER

- A. Potable Water and Irrigation Water Service: Reduced Pressure Principle Type AWWA C511, except pressure drop at rated flow shall not exceed 15 psi. Gate valves installed on the assembly shall be resilient seated valve conforming to AWWA C509.
- B. Fire Service: Double detector check valve. AWWA C510 and NFPA 14.
- C. In cold climate areas, backflow assemblies and devices shall be protected from freezing by a method acceptable to local jurisdiction.
- D. Backflow preventers shall be approved by the Foundation for Cross-Connection Control and Hydraulic Research per current edition of the Manual of Cross-Connection Control.
- E. Backflow preventer shall not be located in any area containing fumes that are toxic, poisonous or corrosive.
- F. Direct connections between potable water piping and sewer connected wastes shall not exist under any condition with or without backflow protection.

- G. Backflow preventer shall be accessed and have clearance for the required testing, maintenance and repair. Access and clearance shall require a minimum of one foot between the lowest portion of the assembly and grade, floor or platform. Installations elevated more than 1500 mm (5 feet) above the floor or grade shall be provided with a permanent platform capable of supporting a tester or maintenance person.

2.10 WATER METER

- A. Irrigation water meter shall be paid for by the contractor, furnished and set by Public Utility.
- B. For domestic water meters, furnish and install meters approved by the Public Utility.

2.11 VAULTS (BACKFLOW PREVENTER OR METER)

- A Large meters and/or backflow preventer assemblies to be underground shall be installed in precast reinforced concrete vaults conforming to the requirements of the Public Utility as indicated on the standard detail included on the drawings.

2.12 POTABLE WATER

- A. Water used for filling, flushing, and disinfection of water mains and appurtenances shall conform to Safe Drinking Water Act.

2.13 DISINFECTION CHLORINE

- A. Liquid chlorine shall conform to AWWA B301 and AWWA C651.
- B. Sodium hypochlorite shall conform to AWWA B300 with 5 percent to 15 percent available chlorine.
- C. Calcium hypochlorite shall conform to AWWA B300 supplied in granular form or 5.g tablets, and shall contain 65 percent chlorine by weight.

PART 3 - EXECUTION

3.1 BUILDING SERVICE LINES

- A. Install water service lines to point of connection within approximately 5 feet outside of buildings to which such service is to be connected and make connections thereto. If building services have not been installed provide temporary caps.

3.2 PIPE LAYING, GENERAL

- A. Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe or coatings. Pipe or fittings shall not be dropped. All pipe or fittings shall be examined before laying, and no piece shall be installed which is found to be defective. Any damage to the pipe coatings shall be repaired as recommended by the manufacturer to maintain the product performance as if it were undamaged.

- B. All pipe and fittings shall be subjected to a careful inspection just prior to being laid or installed. If any defective piping is discovered after it has been laid, it shall be removed and replaced with a sound pipe in a satisfactory manner at no additional expense to the Government. All pipe and fittings shall be thoroughly cleaned before laying, shall be kept clean until they are used in the work, and when installed or laid, shall conform to the lines and grades required.
- C. All buried piping shall be installed to the lines and grades as shown on the drawings. All underground piping shall slope uniformly between joints where elevations are shown.
- D. Contractor shall exercise extreme care when installing piping to shore up and protect from damage all existing underground water lines and power lines, and all existing structures.
- E. Do not lay pipe on unstable material, in wet trench, or when trench or weather conditions are unsuitable.
- F. Do not lay pipe in same trench with other pipes or utilities unless shown otherwise on drawings.
- G. Hold pipe securely in place while joint is being made.
- H. Do not walk on pipes in trenches until covered by layers of earth well-tamped in place to a depth of 12 inches over pipe.
- I. Full length of each section of pipe shall rest solidly upon pipe bed with recesses excavated to accommodate bells or joints. Do not lay pipes on wood blocking.
- J. Tees, plugs, caps, bends and hydrants installed on underground pipe shall be anchored.
- K. Close pipe openings with caps or plugs during installation. Tightly cover and protect pipe and accessories against dirt, water and chemical, or mechanical injury. At completion of all work, thoroughly clean exposed materials and equipment.
- L. Good alignment shall be preserved in laying. The deflection at joints shall not exceed that recommended by the manufacturer.
- M. Warning tape shall be continuously placed 12 inches below finish grade above buried water pipes, or at bottom of subbase where roadways exist, whichever is deeper with overall depth not exceeding 24 inches. Detectable warning tape shall be locatable by the NCA staff from the finish grade above the pipe, utilizing existing locating equipment, or the approved locator equipment provided by the Contractor to the NCA as specified.

3.4 PVC PIPE

- A. PVC piping shall be installed in strict accordance with the manufacturer's instructions and AWWA C605. Place selected material and thoroughly compacted to one foot above the top of the pipe and thereafter backfilled as specified in Section 31 20 00.

3.5 RESTRAINED JOINTS

- A. Sections of piping requiring restrained joints shall be constructed using pipe and fittings with restrained "locked-type" joints and the joints shall be capable of holding against withdrawal for line pressures 50 percent above the normal working pressure but not less than 200 psi. The pipe and fittings shall be restrained push-on joints or restrained mechanical joints.
- B. The minimum number of restrained joints required for resisting force at fittings and changes in direction of pipe shall be determined from the length of retained pipe on each side of fittings and changes in direction necessary to develop adequate resisting friction with the soil. Restrained pipe length shall be as shown on the drawings.
- C. Thrust blocks shall be required, unless otherwise noted.
- D. Ductile iron mechanical joint fittings used with PVC pipe shall be restrained with the specified Mechanical Joint Restrainer Gland, or approved equal.

3.6 PIPE SEPARATION

- A. Horizontal Separation-Water Mains and Sewers:
 - 1. Water mains shall be located at least 10 feet horizontally from any proposed drain, storm sewer, sanitary or sewer service connection.
 - 2. Water mains may be located closer than 10 feet to a sewer line when:
 - a. Local conditions prevent a lateral separation of 10 feet; and
 - b. The water main invert is at least 18 inches above the crown of the sewer; and
 - c. The water main is either in a separate trench or in the same trench on an undisturbed earth shelf located one side of the sewer.
 - 3. When it is impossible to meet paragraphs 3.6.A.1 or A.2 above, both the water main and drain or sewer shall be constructed of mechanical joint ductile iron pipe. Ductile iron pipe shall comply with the requirements of the NCA Master Construction Specifications. The drain or sewer shall be pressure tested to the maximum expected surcharge head before back filling.
- B. Vertical Separation-Water Mains and Sewers:
 - 1. A water main shall be separated from a sewer so that its invert is a minimum of 18 inches above the crown of the drain or sewer whenever water mains cross storm

sewers, sanitary sewers or sewer service connections. The vertical separation shall be maintained for that portion of the water main located within 10 feet horizontally of any sewer or drain crossed. A length of water main pipe shall be centered over the sewer to be crossed with joints equidistant from the sewer or drain.

2. Both the water main and sewer shall be constructed of slip-on or mechanical joint ductile iron pipe or PVC pipe equivalent to water main standards of construction when:
 - a. It is impossible to obtain the proper vertical separations described in paragraph 3.6.B.1 above; or
 - b. The water main passes under a sewer or drain.
3. A vertical separation of 18 inches between the invert of the sewer or drain and the crown of the water main shall be maintained where a water main crosses under a sewer. Support the sewer or drain lines to prevent settling and breaking the water main.
4. Construction shall extend on each side of the crossing until the perpendicular distance from the water main to the sewer or drain line is at least 10 feet.

3.7 SETTING OF VALVES AND BOXES

- A. Provide a surface concrete pad 18 by 18 by 6 inches to protect valve box when valve is not located below pavement.
- B. Clean valve and curb stops interior before installation.
- C. Set valve and curb stop box cover flush with finished grade.
- D. Valves shall be installed plumb and level and in accordance with manufacturer's recommendations.

3.8 SETTING OF FIRE HYDRANTS

- A. Set center of each hydrant not less than 2 feet nor more than 6 feet back of edge of road or face of curb. Fire apparatus connection shall face road with center of nozzle 18 inches above finished grade. Set barrel flange not more than 2 inches above finished grade.
- B. Set each hydrant on a slab of stone or concrete not less than 4 inches thick and 15 inches square. The service line to the hydrant, between the tee and the shoe of the hydrant, shall be fully restrained.
- C. Set bases in not less than 1/2 cubic yard of crushed rock or gravel placed entirely below hydrant drainage device.
- D. Clean interiors of hydrants of all foreign matter before installation.

3.9 FLUSHING AND DISINFECTING

- A. Flush and disinfect new water lines in accordance with AWWA C651.
- B. Initial flushing shall obtain a minimum velocity in the main of 2.5 feet per second at 40 psi residual pressure in water main. The duration of the flushing shall be adequate to remove all particles from the line.

Pipe Diameter		Flow Required to Produce 76 cm/sec (2.5 ft/sec)(approx.) Velocity in Main		Number of Hydrant Outlets			
				Size of Tap. mm (in.)			
				25(1)	38 (1 ½)	51(2)	64 (2 1/2-in)
mm	(In)	L/sec	(gpm)	Number of taps on pipe			
100	(4)	6.3	(100)	1	--	--	1
150	(6)	12.6	(200)	--	1	--	1
200	(8)	25.2	(400)	--	2	1	1
250	(10)	37.9	(600)	--	3	2	1
300	(12)	56.8	(900)	--	--	3	2
400	(16)	100.9	(1600)	--	--	4	2

- C. The backflow preventers shall not be in place during the flushing.
- D. The Contractor shall be responsible to provide the water source for filling, flushing, and disinfecting the lines. Only potable water shall be used, and the Contractor shall provide all required temporary pumps, storage facilities required to complete the specified flushing, and disinfection operations.
- E. The Contractor shall be responsible for the disposal of all water used to flush and disinfect the system in accordance with all governing rules and regulations. The discharge water shall not be allowed to create a nuisance for activities occurring on or adjacent to the site.
- F. The bacteriological test specified in AWWA C651 shall be performed by a laboratory approved by the Public Utility. The cost of sampling, transportation, and testing shall be the responsibility of the Contractor.
- F. Re-disinfection and bacteriological testing of failed sections of the system shall be the sole responsibility of the Contractor.
- G. Before backflow preventers are installed, all upstream piping shall be thoroughly flushed.

3.10 HYDROSTATIC TESTING

- A. Hydrostatic testing of the system shall occur prior to disinfecting the system.

- B. After new system is installed, except for connections to existing system and building, backfill at least 12 inches above pipe barrel, leaving joints exposed. The depth of the backfill shall be adequate to prevent the horizontal and vertical movement of the pipe during testing.
- C. Prior to pressurizing the line, all joint restraints shall be completely installed and inspected.
- D. If the system is tested in sections, and at the temporary caps at connections to the existing system and buildings, the Contractor shall provide and install all required temporary thrust restraints required to safely conduct the test.
- E. The Contractor shall install corporation stops in the line as required to purge the air out of the system. At the completion of the test, all corporation stops shall be capped.
- F. The Contractor shall perform pressure and leakage tests for the new system for 2 hours to 200 psi. Leakage shall not exceed the following requirements.
 - 1. Copper Tubing: No leaks.
 - 2. Polyvinyl Chloride (PVC): Conform to AWWA C605.

3.11 BACKFLOW PREVENTOR TESTING

- A. All backflow preventers shall be installed, tested and certified for proper operation, prior to being placed in operation.
- B. Original copies of the certification shall be submitted to the COTR.

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SECTION 33 30 00 SANITARY SEWERAGE UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies materials and procedures for construction of outside, underground sanitary sewer system that are, complete and ready for operation. This includes all gravity flow lines pressure (force) lines, manholes, cleanouts, frames, covers, structures, appurtenances, and connections to new building and structure, service lines, existing sanitary sewer lines, and existing sanitary structures, and all other incidentals.

1.2 RELATED WORK

- A. Maintenance of Existing Utilities: Section 01 00 01, GENERAL REQUIREMENTS.
- B. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 00, EARTH MOVING
- C. Section 03 30 53, SHORT FORM CAST-IN-PLACE CONCRETE.
- D. Seeding, Topsoil: SECTION 32 90 00 PLANTING

1.3 QUALITY ASSURANCE

- A. Products Criteria:
1. Multiple Units: When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
 2. Nameplates: Nameplate bearing manufacturer's name, or identifiable trademark, including model number, securely affixed in a conspicuous place on equipment, or name or trademark, including model number cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.
- B. Comply with the rules and regulations of the Public Utility having jurisdiction over the connection to Public Sanitary Sewer lines and the extension, and/or modifications to Public Utility Systems.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturers' Literature and Data: Submit the following as one package:
1. Pipe, Fittings, and, Appurtenances.
 2. Jointing Material.

3. Manhole and Structure Material.
4. Frames and Covers.
5. Steps and Ladders.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Referenced standards shall be the current version as of the date of the advertisement of the project.

B. ASTM International (ASTM):

A48/A48M	Gray Iron Castings
A536-	Ductile Iron Castings
A615/A615M.....	Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
A625/A625M.....	Tin Mill Products, Black Plate, Single Reduced
A746.....	Ductile Iron Gravity Sewer Pipe
C76-08b/C76M.....	Reinforced Concrete Culvert, Storm Drain and Sewer Pipe
C139	Concrete Masonry Units for Construction of Catch Basins and Manholes
C150	Portland Cement
C478-09a/C478M.....	Precast Reinforced Concrete Manhole Sections
C857	Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
D698	Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft ³ (600 kN-m/m ³))
D2321.....	Underground Installation of Thermoplastic Pipes for Sewers and Other Gravity-Flow Applications
D2412.....	Determination of External Loading Characteristics of Plastic Pipe by Parallel- Plate Loading
D3034.....	Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
D3212.....	Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

- D3261..... Butt Heat Fusion Polyethylene (PE) Plastic Fittings for
Polyethylene (PE) Plastic Pipe and Tubing
- D3350..... Polyethylene Plastics Pipe and Fittings Materials
- F477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- F679 Poly (vinyl chloride) (PVC) Large-Diameter Plastic Gravity
Sewer Pipe and Fittings
- F794 Poly (Vinyl Chloride)(PVC) Ribbed Gravity Sewer Pipe and
Fittings Based on Controlled Inside Diameter
- F894 Polyethylene (PE) Large Diameter Profile Wall Sewer and
Drain Pipe
- F949 Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with
Smooth Interior and Fittings
- C. American Water Works Association (AWWA):
- C508 Swing Check Valves for Waterworks, 2 inches (50 mm)
Through 24 inches (600 mm) NPS
- C509 Resilient Seated Gate Valves for Water-Supply Service
- C515 Reduced-Wall, Resilient-Seated Gate Valves For Water
Supply Service
- C512 Air Release, Air/Vacuum, and Combination Air Valves for
Waterworks Service
- C550 Protective Epoxy Interior Coatings for Valves and Hydrants
- C605 Underground Installation of Polyvinyl (PVC) Pressure Pipe
and Fittings for Water
- C900 Polyvinyl Chloride (PVC) Pressure Pipe, 100 mm (4
inches) Through 300 mm (12 inches) for Water
Distribution
- C905 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated
Fittings, 350 mm through 1,200 mm (14 Inches through 48
Inches), for Water Transmission and Distribution
- C906 Polyethylene (PE) Pressure Pipes and Fittings, 100 mm
through 1575 mm (4 Inches through 63 Inches), for Water
Distribution
- D. American Association of State Highway and Transportation Officials (AASHTO):

M198 Joints for Concrete Pipe, Manholes, and Precast Box
Sections using Preformed Flexible Joint Sealants

E. Uni-Bell PVC Pipe Association:

Uni-B-6 Recommended Practice Low Pressure Air Testing of
Installed Sewer Pipe

PART 2 - PRODUCTS

2.1 PIPING

A. Gravity Flow Lines (Pipe and Fittings):

1. Polyvinyl Chloride (PVC):

- a. Pipe and Fittings, 4 to 15 inches in diameter, shall conform to ASTM D3034, Type PSM, SDR 26. Pipe and fittings shall have elastomeric gasket joints providing a watertight seal when tested in accordance with ASTM D3212. Gaskets shall conform to ASTM F477. Solvent welded joints shall not be permitted.
- b. Pipe and fittings, 18 to 36 inches in diameter, shall be solid wall or have a corrugated or ribbed exterior profile and a smooth interior. Pipe shall conform to the following:
 - 1) Pipe and fittings shall conform to ASTM F949 corrugated sewer pipe with a smooth interior. The corrugated outer wall shall be fused to the smooth innerwall at the corrugation valley. Pipe and fitting shall have a smooth bell, elastomeric joints conforming to ASTM D3212, and shall have a minimum pipe stiffness of 50 psi at 5 percent deflection, when tested in accordance with ASTM D2412. Corrugation shall be perpendicular to the axis of the pipe to allow gaskets to be installed on field cut sections of pipe without the requirement for special fittings.
 - 2) Ribbed wall PVC pipe and fittings shall conform to ASTM F794 ribbed sewer pipe with smooth interior pipe and fittings shall have a smooth bell, elastomeric joints conforming to ASTM D3212, and shall have a minimum pipe stiffness of 46 psi when tested in accordance with ASTM D 2412, at 5 percent vertical deflection. Joints shall not leak at 25 feet of head under 5 percent deflection.

- 3) Solid wall pipe and fittings shall conform to ASTM F679, SDR 26 pipe and fittings shall gaskets conforming to ASTM F477, and shall be able to withstand a hydrostatic pressure of 50 psi.

B. Pressure (Force) Lines (Pipe and Fittings):

1. All pipe and fittings used in the construction of force mains shall be rated for a minimum of 150 psi.
2. Polyvinyl Chloride (PVC): PVC pipe 4 to 12 inches shall conform to AWWA C900, Class 150 (DR 18) minimum . PVC pipe larger than 12 inches shall conform to AWWA C905, Class 200 (DR 21). Fittings for PVC pipe shall be ductile iron.

2.2 JOINTING MATERIAL

A. Gravity Flow Lines:

1. Polyvinyl Chloride (PVC) Pipe (Gravity Use): Joints, ASTM D3212. Elastomeric gasket, ASTM F477.

B. Pressure (Force) Main:

1. Shall conform to AWWA C900.
2. Polyvinyl Chloride (PVC) Pipe (Pressure Use):
 - a. Push-on joints shall conform to AWWA C900, C905.
 - b. Push-on gaskets for pipe, ASTM F477.
 - c. Restrained joints shall comply with one of the following:
 - 1) Push-on bell and spigot joints shall be retained with retaining rings and thrust rods. The rings shall be ductile iron conforming to ASTM A536.

2.3 MANHOLES AND VAULTS

A. Manholes and vaults shall be constructed of precast reinforced concrete rings, precast reinforced sections, or cast-in-place concrete. The manholes and vaults shall be in accordance with TDOT standard details, and the following:

1. Precast Reinforced Concrete Rings: Rings or sections shall have an inside diameter as indicated on the drawings, and shall be not less than 48 inches in diameter. Wall thickness shall conform to requirements of ASTM C478, except that lengths of the sections may be shorter as conditions require. Tops shall conform to ASTM C478. Top section shall be eccentric cone type. Steps on inside wall shall be in the same plane from bottom of structure to manhole cover.
2. Precast Reinforced Concrete Manhole Risers and Tops: Design, material and installation shall conform to requirements of ASTM C478. Top sections shall be

- eccentric. Steps on inside wall shall be in the same plane from bottom of structure to manhole cover.
3. Flat top manhole tops shall be reinforced concrete as detailed on the Drawings.
 4. Mortar:
 - a. Precast Reinforced Concrete Ring and Riser Structures: By volume, 1 part of Portland cement and 2 parts sand. Water in mixture shall produce a stiff, workable mortar, but shall not exceed 5-1/2 gallons per sack of cement.
 5. Flexible sealing compound shall be packaged in extruded preformed shape, sized to completely fill the joint between precast sections, and form permanently flexible watertight seal. The sealing compound shall be non-shrink and meet AASHTO M198.
 6. Frames and covers shall be gray cast iron conforming to ASTM A48. The frame and cover shall be rated for HS20-44 loading, have a studded pattern on the cover, and the words "sanitary sewer". The studs and the lettering shall be raised 5/16 inch. The cover shall be a minimum of 24 inches in diameter and shall have four 3/4 inch vent holes and two lifting slots. The bearing surface of the frame and cover shall be machine finished. The cover shall fit firmly on the frame without movement when subject to traffic.
 7. Manhole steps shall be polypropylene plastic coated on a No. 4 deformed rebar conforming to ASTM C478, Polypropylene shall conform to ASTM D4101. Steps shall be a minimum of 16 inches wide and project a minimum of 7 inches away from the wall. The top surface of the step shall have a studded non-slip surface. Steps shall be placed at 12 inch centers.

2.4 CONCRETE

Concrete shall have a minimum compressive strength of 3000 psi at 28 days. The cement shall be Type III conforming to ASTM C150. Concrete shall conform with the provisions of Section 03 30 53.

2.5 REINFORCING STEEL

- A. Reinforcing steel shall be deformed bars, ASTM A615, Grade 40 unless otherwise noted.

2.6 CLEANOUT FRAMES AND COVERS

- A. Frames and covers shall be gray iron casting conforming to ASTM A48. The frame and cover shall be rated for HS20-44 wheel loading, have a studded pattern on its cover,

vent holes, and lifting slots. The cover shall fit firmly on the frame without movement when subject to vehicular traffic. The word "SEWER" shall be cast on the cover.

2.7 WARNING TAPE

- A. Standard, 4Mil polyethylene 3 inch wide tape detectable type, green with black letters and imprinted with "CAUTION BURIED SEWER LINE BELOW".

PART 3 - EXECUTION

3.1 BUILDING SERVICE LINES

- A. Install sanitary sewer service lines to point of connection within approximately 5 feet outside of buildings where service is required and make connections. Coordinate the invert and location of the service line with the Contractor installing the building lines.
- B. Connections of service line to building piping shall be made after the new sanitary sewer system has been constructed, tested, and accepted for operation by the COTR. The Contractor shall install all temporary caps or plugs required for testing.
- C. When building services have not been installed at the time when the sanitary sewer system is complete, provide temporary plugs or caps at the ends of all service lines. Mark the location and depth of the service lines with continuous warning tape placed 12 inches above service lines.

3.2 CONNECTIONS TO EXISTING VA OWNED MANHOLES

- A. During construction of new connections to existing manholes, it shall be the sole responsibility of the Contractor to maintain continued sanitary sewer service to all buildings and users upstream. The contractor shall provide, install, and maintain all pumping, conveyance system, dams, weirs, etc. required to maintain the continuous flow of sewage. All temporary measures required to meet this requirement shall be subject to the review of the Resident Engineer.
- B. Core existing structure, install pipe at the design invert. Install an elastomeric gasket around the pipe, and grout the interstitial space between the pipe and the core.
- C. The bench of the manhole shall be cleaned and reshaped to provide a smooth flowline for all pipes connected to the manhole.
- D. Connections and alterations to existing manholes shall be constructed so that finished work conforms as nearly as practicable to the applicable requirements specified for new manholes, including concrete and masonry work, cutting and shaping.

3.3 CONNECTIONS TO EXISTING PUBLIC UTILITY COMPANY MANHOLES

- A. Comply with all rules and regulations of the public utility.
- B. The connection to the existing utility shall comply with the standard details and specifications of the public utility company, except as specifically modified on the plans and specifications.

3.4 PIPE SEPARATION

- A. Conform to the requirements of Section 33 10 00 for separation of sanitary sewer piping from water mains.

3.5 GENERAL PIPING INSTALLATION

- A. Lay pipes true to line and grade. Gravity flow sewer shall be laid with bells facing upgrade. Pressure (force) mains shall have the bells facing the direction of flow.
- B. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.
- C. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
- D. Inspect pipes and fittings, for defects before installation. Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.
- E. Clean interior of all pipe thoroughly before installation. When work is not in progress, open ends of pipe shall be closed securely to prevent entrance of storm water, dirt or other substances.
- F. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash or excess jointing materials.
- G. Do not lay sewer pipe in same trench with another pipe or other utility.
- H. Do not walk on pipe in trenches until covered by layers of bedding or backfill material to a depth of 12 inches over the crown of the pipe.
- I. Warning tape shall be continuously placed 12 inches above sewer pipe
- J. Install gravity sewer line in accordance with the provisions of these specifications and the following standards:
 - 1. Polyvinyl Chloride (PVC) Piping: ASTM D2321.
- K. Installation of Pressure (Force) Mains

1. Sections of piping listed on the drawings shall be fully restrained using approved joint restraint devices. Joint restraint devices shall be installed in accordance with the manufacturer's recommendations. For devices with twist of nuts, the twist of nuts shall be placed on top of the fitting for the COTR's inspection. The Contractor shall torque test all bolts, set screws, identified by the COTR.
2. Thrust blocks shall not be permitted.
3. Install pressure (force) mains in accordance with the provisions of these specifications and the following standards:
 - a. Polyvinyl Chloride (PVC) Piping: AWWA C605.

3.6 MANHOLES AND VAULTS

A. General:

1. Circular Structures:

- a. Precast reinforced concrete rings shall be installed true and plumb. The joints between rings and between rings and the base and top, shall be sealed with a preform flexible gasket material specifically manufactured for this type of application. Adjust the length of the rings so that the eccentric conical top section will be at the required elevation. Cutting the conical top section is not acceptable.
- b. Precast reinforced concrete manhole risers and tops. Install as specified for precast reinforced concrete rings.

3.7 CLEANOUTS

- A. Cleanouts shall be 6 inches in diameter and consisting of a ductile iron 45 degree fitting on end of run, or combination Y fitting and required elbow(s) in the run with ductile iron pipe extension, water tight plug or cap and cast frame and cover flush with finished grade. Center-set cleanouts, located in unpaved areas, shall be provided with a 12 by 12 by 6 inches thick concrete slab set flush with adjacent finished grade.
- B. The top of the cleanout assembly shall be 50 mm (2 inches) below the bottom of the cover to prevent loads being transferred from the frame and cover to the piping.

3.8 INSPECTION OF SEWERS

- A. Inspect and obtain the approval of the COTR. Thoroughly flush out before inspection. Lamp test between structures and show full bore indicating sewer is true to line and grade. Lip at joints on the inside of gravity sewer lines are not acceptable.

3.18 TESTING OF SANITARY SEWERS

A. Gravity Sewers:

1. Exfiltration Test:

- a. Subject pipe to hydrostatic pressure produced by head of water at depth of 900 mm (3 feet) above invert of sewer at upper manhole under test. In areas where ground water exists, head of water shall be 3 feet above existing water table. Maintain head of water for one hour for full absorption by pipe body before testing. During one hour test period, measured maximum allowable rate of exfiltration for any section of sewer shall be 3.0 gallons per hour per 100 feet.
- b. If measurements indicate exfiltration is greater than maximum allowable leakage, take additional measurements until leaks are located. Repair and retest.

3. Infiltration Test: If ground water level is greater than 3 feet above invert of the upper manhole, infiltration tests are acceptable. Allowable leakage for this test will be the same as for the exfiltration test.

- B. Pressure (Force) Mains: Test at 100 psi for two hours. Leakage shall be per the following:

$$L=J*D*\sqrt{P/4500}$$

Where:

L = Maximum Allowable Leakage in Gallons per Hour

J = Number of Joints in Test Area

D = Diameter of Pipe in Inches

P = Average Test Pressure (Psi)

- - - E N D - - -

SECTION 33 40 00

STORM SEWER UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies materials and procedures for construction of outside, underground storm sewer systems that are complete and ready for operation. This includes piping, structures and all other incidentals.

1.2 RELATED WORK

- A. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 00, EARTH MOVING.
- B. Concrete Work, Reinforcing, Placement and Finishing: Section 03 30 53, (SHORT-FORM) CAST-IN-PLACE CONCRETE.
- C. General plumbing, protection of Materials and Equipment, and quality assurance: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- D. Materials and Testing Report Submittals: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- E. Erosion and Sediment Control: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Handle manholes catch basins, and stormwater inlets according to manufacturer's written rigging instructions.

1.4 COORDINATION

- A. Coordinate connection to storm sewer main with the utility owner providing storm sewer off-site drainage.
- B. Coordinate exterior utility lines and connections to building services up to the actual extent of building wall.

1.5 QUALITY ASSURANCE:

- A. Products Criteria:
 - 1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.

2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

1.6 SUBMITTALS

- A. Manufacturers' Literature and Data shall be submitted, as one package, for pipes, fittings and appurtenances, including jointing materials, hydrants, valves and other miscellaneous items.

1.7 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Referenced standards shall be the current version as of the date of advertisement of the project.

- B. ASTM International (ASTM):

A185/A185M.....	Steel Welded Wire Reinforcement, Plain, for Concrete
A242/A242M.....	High-Strength Low-Alloy Structural Steel
A536.....	Ductile Iron Castings
A615/A615M.....	Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
C33/C33M.....	Concrete Aggregates
C76	Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
C139	Concrete Masonry Units for Construction of Catch Basins and Manholes
C150/C150M	Portland Cement
C443	Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
C478	Precast Reinforced Concrete Manhole Sections
C506	Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe

C507	Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
C655	Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
C857	Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
C891	Installation of Underground Precast Concrete Utility Structures
C913	Precast Concrete Water and Wastewater Structures
C923	Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
C924-02	Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
C990	Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
C1103.....	Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
C1173.....	Flexible Transition Couplings for Underground Piping Systems
C1433.....	Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers
C1479.....	Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations
D448	Sizes of Aggregate for Road and Bridge Construction
D698	Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft ³ (600 kN-m/m ³))
D1056.....	Flexible Cellular Materials—Sponge or Expanded Rubber
D1785.....	Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

- D2321..... Underground Installation of Thermoplastic Pipe for Sewers
and Other Gravity-Flow Applications
- D2774..... Underground Installation of Thermoplastic Pressure Piping
- D3034..... Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and
Fittings
- D5926..... Poly (Vinyl Chloride) (PVC) Gaskets for Drain, Waste, and
Vent (DWV), Sewer, Sanitary, and Storm Plumbing
Systems
- F477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- F679 Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity
Sewer Pipe and Fittings
- F794 Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and
Fittings Based on Controlled Inside Diameter
- F891 Coextruded Poly(Vinyl Chloride) (PVC) Plastic Pipe With a
Cellular Core
- F949 Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a
Smooth Interior and Fittings
- F1417 Installation Acceptance of Plastic Gravity Sewer Lines
Using Low-Pressure Air
- F1668..... Construction Procedures for Buried Plastic Pipe
- C. American Association of State Highway and Transportation Officials (AASHTO):
- M198 Joints for Concrete Pipe, Manholes, and Precast Box
Sections Using Preformed Flexible Joint Sealants
- M252 Corrugated Polyethylene Drainage Pipe
- M294 Corrugated Polyethylene Pipe, 12 to 60 In. (300 to 1500
mm) Diameter
- D. American Water Works Association(AWWA):

C900-07 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated
Fittings, 4 In. Through 12 In. (100 mm Through 300 mm),
for Water Transmission and Distribution

M23-2nd ed PVC Pipe "Design And Installation"

E. American Society of Mechanical Engineers (ASME):

A112.6.3-2001 Floor and Trench Drains

A112.14.1-2003 Backwater Valves

A112.36.2M-1991 Cleanouts

F. American Concrete Institute (ACI):

318 Building Code Requirements for Structural Concrete and
Commentary

350/350M Environmental Engineering Concrete Structures and
Commentary

G. National Stone, Sand and Gravel Association (NSSGA): Quarried Stone for Erosion and
Sediment Control

1.8 WARRANTY

The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting there from within a period of one year from final acceptance. Further, the Contractor will furnish all manufacturers' and suppliers' written guarantees and warranties covering materials and equipment furnished under this Contract.

PART 2 - PRODUCTS

2.1 FACTORY-ASSEMBLED PRODUCTS

A. Standardization of components shall be maximized to reduce spare part requirements.

The Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

2.2 CONCRETE PIPE AND FITTINGS

- A. Reinforced-Concrete sewer pipe and fittings shall be ASTM C76 or ASTM C655.
 - 1. Bell-and-spigot or tongue-and-groove ends and gasketed joints with ASTM rubber gaskets conforming to ASTM C443. Pipe shall be Class III unless otherwise indicated on the Drawings.

2.3 NONPRESSURE TRANSITION COUPLINGS

- A. Comply with ASTM C1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground non-pressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
- B. Sleeve Materials
 - 1. For concrete pipes: ASTM C443, rubber.
 - 2. For plastic pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
 - 3. For dissimilar pipes: ASTM D5926, PVC or other material compatible with pipe materials being joined.
- C. Unshielded, Flexible Couplings: Couplings shall be an elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
- D. Shielded, flexible couplings shall be elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
- E. Ring-Type, flexible couplings shall be elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

2.4 MANHOLES, INLETS AND CATCH BASINS

- A. Manholes, inlets and catch basins shall be constructed of precast reinforced concrete rings, precast reinforced Sections, or cast-in-place concrete. Manholes, inlets and catch basins shall be in accordance with the details shown on the Drawings, and the following OWNER requirements:
 - 1. Precast Reinforced Concrete Rings: Rings or Sections shall have an inside diameter as indicated on the drawings, and shall be not less than 1200 mm (48 inches) in diameter. Wall thickness shall conform to requirements of ASTM C76, except that lengths of the Sections may be shorter as conditions require. Tops shall conform to ASTM C478. Top Section shall be eccentric cone type. Steps on inside wall shall be in the same plane from bottom of structure to manhole cover.

2. Precast Reinforced Concrete Manhole Risers and Tops: Design, material and installation shall conform to requirements of ASTM C478. Top Sections shall be eccentric unless otherwise indicated on the Drawings. Steps on inside wall shall be in the same plane from bottom of structure to manhole cover.
 3. Flat top manhole tops shall be reinforced concrete as detailed on the Drawings.
 4. Precast Catch Basins: Concrete for precast Sections shall have a minimum compressive strength of 5,000 psi at 28 days, ASTM A615, Grade 60 reinforcing steel, rated for AASHTO HS20 loading with 30 percent impact, and conform to ASTM C857.
 5. Flexible sealing compound shall be packaged in extruded preformed shape, sized to completely fill the joint between precast Sections, and form permanently flexible watertight seal. The sealing compound shall be non-shrink and meet ASTM C990.
 6. Frames and covers shall be gray cast iron conforming to ASTM A48. The frame and cover shall be rated for HS20 loading, and shall conform to the details shown on the Drawings. The bearing surface of the frame and cover shall be machine finished. The cover shall fit firmly on the frame without movement when subject to traffic.
 7. Manhole steps, if required, shall be polypropylene plastic coated on a No. 4 deformed rebar conforming to ASTM C478. Steps shall be a minimum of 10 inches wide and project a minimum of 5 inches away from the wall. The top surface of the step shall have a studded non-slip surface. Steps shall be placed at 12 inch centers.
- B. Frame and Cover for Gratings: Frame and cover for gratings shall be cast gray iron conforming to ASTM A48 or ductile iron conforming to ASTM A536. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the Drawings.

2.5 CONCRETE

- A. Concrete shall have a minimum compressive strength of 3500 psi at 28 days. The cement shall be Type III conforming to ASTM C150. Concrete shall conform to the provisions of Section 03 30 53, CAST-IN-PLACE CONCRETE.

2.6 REINFORCING STEEL

- A. Reinforcing steel shall be deformed bars, ASTM A615, Grade 60 unless otherwise noted.

2.7 RESILIENT CONNECTORS AND DOWNSPOUT BOOTS FOR BUILDING ROOF DRAINS

- A. Resilient connectors and downspout boots: Flexible, watertight connectors used for connecting pipe to manholes and inlets, and shall conform to ASTM C923.

2.8 WARNING TAPE

- Standard, 4-Mil polyethylene 3 inch wide tape non-detectable type, purple with black letters, and imprinted with "CAUTION BURIED STORM SEWER BELOW".

PART 3 - EXECUTION

3.1 EXCAVATION FOR STORM DRAINS AND DRAINAGE STRUCTURES

- A. Excavation of trenches and for appurtenances and backfilling for storm drains shall be in accordance with the applicable portions of Section 31 20 00, EARTH MOVING.

3.2 PIPE BEDDING

- A. The bedding surface of the pipe shall provide a firm foundation of uniform density throughout the entire length of pipe. Concrete pipe requirements are such that when no bedding class is specified, concrete pipe shall be bedded in a soil foundation accurately shaped and rounded to conform with the lowest one-fourth of the outside portion of circular pipe. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall not be more than the length, depth, and width required for properly making the particular type of joint. Plastic pipe bedding requirements shall meet the requirements of ASTM D2321. Bedding, haunching and initial backfill shall be either Class IB or Class II material.

3.3 PIPING INSTALLATION

- A. Drawings plans and details alignment and locations of underground storm drainage piping. Install piping as indicated. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping with required cover as shown on the Drawings.
- C. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
- D. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.

- E. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
- F. Inspect pipes and fittings, for defects before installation. Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.
- G. Clean interior of all pipe thoroughly before installation. When work is not in progress, open ends of pipe shall be closed securely to prevent entrance of storm water, dirt or other substances.
- H. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash or excess jointing materials.
- I. Do not walk on pipe in trenches until covered by trench backfill to a depth of 12 inches (300 mm) over the crown of the pipe.
- H. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
- D. Install gravity-flow, non-pressure drainage piping according to the following:

3.4 CONNECTIONS TO EXISTING VA-OWNED MANHOLES

Make pipe connections and alterations to existing manholes so that finished work will conform as nearly as practicable to the applicable requirements specified for new manholes, including concrete and masonry work, cutting, and shaping.

3.5 DRAINAGE STRUCTURE INSTALLATION

A. General:

1. Circular Structures:

- a. Precast reinforced concrete rings shall be installed true and plumb. The joints between rings and between rings and the base and top shall be sealed with a preform flexible gasket material specifically manufactured for this type of application. Adjust the length of the rings so that the eccentric conical top Section will be at the required elevation. Cutting the conical top Section is not acceptable.
- b. Precast reinforced concrete manhole risers and tops. Install as specified for precast reinforced concrete rings.

B. Rectangular Structures:

1. Concrete work for cast-in-place reinforced concrete structures shall be constructed in accordance with Section 03 30 53, CAST-IN-PLACE CONCRETE, and as specified in Section 609 of the AHTD Standard Specifications.
 2. Precast concrete base section of structures shall be set on an 8-inch thick aggregate base course compacted to a minimum of 95 percent of the maximum density as determined by ASTM D698. Set precast concrete section(s) on base section (as applicable) true and plumb. Seal all joints with preform flexible gasket material.
- C. Do not construct cast-in-place concrete structures when air temperature is 32 degrees F or below.
- D. Invert channels shall be smooth and semicircular in shape conforming to inside of adjacent sewer section. Make changes in direction of flow with a smooth curve of as large a radius as size of structure will permit. Make changes in size and grade of channels gradually and evenly. Construct invert channels by one of the listed methods:
1. Forming directly in concrete base of structure.
 2. Building up with brick and mortar.
- E. Floor of structure outside the invert channels shall be smooth and slope toward channels not less than 1:12 (1 inch per foot) nor more than 1:6 (2 inches per foot). Bottom slab and benches shall be concrete.
- F. The wall that supports access steps shall be 90 degrees vertical from the floor of structure to manhole cover. Install steps per the manufacturer's recommendations. Steps shall not move or flex when used. All loose steps shall be replaced by the Contractor.
- G. Install each drop inlet and catch basin frame and grate on a mortar bed, and flush with the finish pavement. Frames and covers shall not move when subject to vehicular traffic. Install a concrete collar around the frame to protect the frame from moving until the adjacent pavement is placed. In unpaved areas, the rim elevation shall at finish grade. Install an 8-inch thick by 12-inch diameter concrete collar around the perimeter of the frame. Slope the top of the collar away from the frame.

3.6 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Pipelines shall be free from obstructions, properly sloped and joined.
1. Defects requiring correction include the following:

- a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
- 2. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - 3. Re-inspect and repeat procedure until results are satisfactory.

3.7 CLEANING

- A. Clean interior of piping of silt and other debris.

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