

SECTION 33 46 13

FOUNDATION DRAINAGE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Solid Storm Drain Pipe Portion of Perforated Subdrain Pipe System.
- B. Perforated Subdrain Pipe System.
- C. Clean-outs for Perforated Drainage.

1.2 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Samples: For each type of filter fabric, pipe, and fitting indicated.
- C. Product Data: Certifications from the manufacturers attesting that materials meet specification requirements.
- D. Test Reports: Sand backfill sieve and compaction results.
- E. As-built Drawings:
 - 1. Include changes, substitutions, and manufacturer's names and catalog numbers for materials and equipment.
 - 2. Show constructed locations of drains, grates, clean-outs and piping.
 - 3. Show dimensions from easily-identifiable permanent structures such as walls, curbs, buildings or walks.

1.3 RELATED WORK:

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Safety requirements: Section 00 72 00, GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.
- C. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.
- D. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article, PHYSICAL DATA.

1.4 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred in the text by basic designation only.

B. American Association of State Highway and Transportation Officials (AASHTO):

HB17-02.....Standard Spec for Highway Bridges, Div II, Section 36.4.2.4,
Joint Properties.

M6-03.....Fine Aggregate for Portland Cement Concrete

M86/M86M-06.....Concrete Sewer, Storm Drain, and Culvert Pipe

M175/M175M-05.....Perforated Concrete Pipe

M288-06.....Geotextile Specification for Highway Applications

T281-06.....Vitrified Clay Pipe

C. American Society for Testing and Materials (ASTM):

A74-05Standard Specification for Cast Iron Soil Pipe and Fittings

A746-03Standard Specification for Ductile Iron Gravity Sewer Pipe

C14/C14M-05aStandard Specification for Non-reinforced Concrete Sewer,
Storm Drain, and Culvert Pipe

C118/C118M-05a.....Standard Specification for Concrete Pipe for Irrigation or
Drainage

C443/C443M-05a.....Standard Specification for Joints for Concrete Pipe and
Manholes, Using Rubber Gaskets

C444/C444M-03.....Standard Specification for Perforated Concrete Pipe

D448-03aStandard Classification for Sizes of Aggregate for Road and
Bridge Construction

D2321-05Standard Practice for Underground Installation of Thermoplastic
Pipe for Sewers and Other Gravity-Flow Applications

D2729-03Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer
Pipe and Fittings

D2737-03Standard Specification for Polyethylene (PE) Plastic Tubing

D3034-06Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC)
Sewer Pipe and Fittings

D4216-03Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) and
Related PVC and Chlorinated Poly (Vinyl Chloride) (CPVC)
Building Products Compounds

F477-02e1.....Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

F758-95(2000)Standard Specification for Smooth-Wall Poly (Vinyl Chloride)(PVC)Plastic Underdrain Systems for Highway, Airport, and Similar Drainage.

1.5 QUALITY ASSURANCE

- A. Contractor Qualifications: Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.
- B. Regulatory Requirements: Meet requirements of applicable laws, codes, and regulations required by authorities having jurisdiction over work.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Storage:
 - 1. Store products with protection from weather or other conditions which would damage or impair the effectiveness of the product.
 - 2. Protect PVC pipes and fittings from direct sunlight.
 - 3. Store pipe on firm, well-draining, continuous surface equal to or longer than pipe.

1.7 SITE CONDITIONS

- A. Environmental requirements: Lay and join pipe in dry trenches.
- B. Existing Conditions:
 - 1. Prior to work commencement, review and clearly mark in field, horizontal and vertical locations of existing public underground utilities and structures with appropriate utility company and with the Owner's representatives.

1.8 WARRANTY

- A. General Description: In addition to Manufacturers warranties, warrant work for a period of one year from date of Substantial Completion of entire project against defects in materials and workmanship.
- B. Additional Items Covered: Warranty shall also cover repair of damage to other materials and workmanship resulting from defects in materials and workmanship and trench backfill settlement.
- C. Exceptions: Contractor shall not be held responsible for failures due to ordinary wear, abuse or neglect by others, vandalism and other outside causes outside the Contractor's control.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Drainage Conduit and Underslab Headers:

1. Polyvinyl chloride (PVC) corrugated pipe with a smooth interior. PVC Corrugated pipe with a smooth interior shall conform to the requirements of ASTM Designation F949. Pipe and fittings shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions or other injurious defects. Pipe shall be manufactured to 46 PSI stiffness (minimum) when tested in accordance with ASTM Test Method D2412. The pipe shall be made of PVC compound having a minimum cell classification of 12454 as defined in ASTM Specification D1784.
2. All fittings for PVC corrugated pipe shall have a smooth interior shall conform to ASTM F949, Section 5.2.3 or F794, Section 7.2.4. To ensure compatibility, the pipe manufacturer shall provide all fittings.
3. All joints shall be made with integrally-formed bell and spigot gasketed connections. The manufacturer shall provide documentation showing no leakage when gasketed pipe joints are tested in accordance with ASTM Test Method D3212. Elastomeric seals (gaskets) shall meet the requirements of ASTM Designation F477.

B. Perforated Drainage Pipe:

1. Perforated, PVC pipe with a smooth interior shall conform to the requirements of ASTM Designation F949. Pipe and fittings shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions or other injurious defects. Pipe shall be manufactured to 46 PSI stiffness (minimum) when tested in accordance with ASTM Test Method D2412. The pipe shall be made of PVC compound having a minimum cell classification of 12454 as defined in ASTM Specification D1784.
2. All fittings for PVC corrugated pipe shall have a smooth interior shall conform to ASTM F949, Section 5.2.3 or F794, Section 7.2.4. To ensure compatibility, the pipe manufacturer shall provide all fittings.
3. All joints shall be made with integrally-formed bell and spigot gasketed connections. The manufacturer shall provide documentation showing no leakage when gasketed pipe joints are tested in accordance with ASTM Test Method D3212. Elastomeric seals (gaskets) shall meet the requirements of ASTM Designation F477.
4. Perforation dimensions for slotted, standard perforated pipe shall be in accordance with ASTM F949, Table 5 and Section 7.9.

C. Cleanouts in planting areas: pipe, plugs, and couplings PVC; Schedule 40 with brass male pipe thread plug. Gravity Sewer pipes shall have a neoprene gasket joints and long sweep elbow fittings.

D. Geotextile: Class D, nonwoven, needle-punched geotextile, manufactured for subsurface drainage, composed of at least 85 percent by weight (mass) of polyolefins, polyesters, or polyamides; with a water flow rate greater than or equal to 100 gal/min/sf; complying with the Louisiana Standard Specifications for Roads and Bridges, (LADOTD) 2006 edition.

E. Drainage Material:

1. Bedding: Washed, crushed stone, 3/4 inch to No. 4 per ASTM D448.
2. Fill to a minimum 12 inches above pipe: Washed, crushed stone, 3/4 inch to No. 4 per ASTM D448.

F. Sand backfill for solid pipe trenches and perforated pipe trenches. Trench excavation shall be backfilled with granular fill. Clean river sand having less than 10% passing a #200 sieve may be

used as backfill. Fill shall be compacted to at least 95% of the standard proctor maximum dry density as determined by ASTM D-698.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Protection:

1. Use every possible precaution to prevent damage to existing conditions to remain.
2. Provide barricades, fences or other barriers as necessary to protect existing conditions to remain from damage during construction.
3. Use every possible precaution to prevent excessive compaction of planting area soil within or adjacent to the areas of work.
4. Do not store materials or operate/park equipment under the drip line of existing trees adjacent to the project site.
5. Submit written notification of conditions damaged during construction to the Owner's Representative within one working day of observed damage and before damage is covered.

B. General Installation Sequence:

1. Install fabric on trench bottom and trench walls.
2. Tack geotextile fabric on trench walls
3. Install drain rock and perforated pipe, as indicated on the drawings.
4. Cover drain rock and overlap fabric ends 12 inches.
5. Terminate fabric ends as indicated on the Drawings.

C. Laying: Prior to installation of bedding materials or piping, examination of excavation and subgrades are to be observed by the Resident Engineer. A sufficient amount of grade stakes shall be provided to install piping, and cleanouts to elevations, slopes, and horizontal locations indicated on the Drawings. Invert elevation of drain pipe shall not be higher than top of lowest footing elevation nor lower than a 45 degree line projected from bottom of any adjacent footing. Lay drain lines and firmly bed in granular material a minimum of 3 inches below invert to top of pipe to true grades and alignment with bells facing upgrade, and to slope uniformly between elevations shown on foundation drainage drawings. Keep trenches dry by pumping until pipe is in place and granular material backfill is completed to 1 foot above top of pipe, unless otherwise noted.

1. Install gaskets, seals, sleeves, and couplings according to manufacturers written instructions and per the applicable standards.
 - a. PVC pipe installation shall be per ASTM D2321 and ASTM F949, Section 5.2.3 or F794, Section 7.2.4.
 - b. PVC joint construction shall be per ASTM D3212 with elastomeric seals gaskets per ASTM F477.
 - c. Perforated PVC joint construction shall be per ASTM D2729, with loose bell and spigot joints.
2. Lay perforated pipe with perforations down. Lay plain end pipe with closed joints held in place with two No. 9 spring steel wire clips at each joint or by standard clay collars.
3. For foundation subdrainage, install piping pitched down in direction of flow, at a minimum slope of 0.4 percent and with a minimum cover of 3 feet, unless otherwise indicated.
4. Install cleanout extensions where shown on the Contract Documents.
5. Prior to backfilling, check drain lines to assure free flow. Remove obstructions and recheck lines until satisfactory.
6. Connect sections of perforated pipe to solid wall piping with prefabricated fittings provided by the manufacturer.
7. Remove and dispose of excavated materials not required or satisfactory for backfill.

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- C. Backfilling: Place a minimum of 12 inches of granular material, hand tamped, extending in width a minimum of 2 feet from foundations, or as indicated on the drawings. Then place a minimum of 6 inches of clean river sand, well tamped. Continue backfill with riversand to within 3 feet of finished grade in planting areas. Remainder of backfill shall be topsoil as specified in the landscaping plans.
 - D. When drain lines are left open for connection to discharge line, the open ends shall be temporarily closed and their location marked with wooden stakes.

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SECTION 33 30 00
SANITARY SEWERAGE UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. Outside, underground sanitary sewer system, complete, ready for operation, including all gravity flow lines, manholes, cleanouts, frames, covers, structures, appurtenances, connections to new building and structure, service lines, connections to existing sanitary sewer lines and manholes, and all other incidentals.

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 Work Reinforcing, Placement and Finishing; Section 03 30 01, CAST-IN-PLACE CONCRETE (SITE STRUCTURES).
- D. Fabrication of Steel Ladders: Section 05 50 00, METAL FABRICATIONS.
- E. Protection of Materials and Equipment: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

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.

- B. American Society for Testing and Materials (ASTM):

A48/A48M-03	Gray Iron Castings
A536-84(2004)	Ductile Iron Castings
A615/A615M-06	Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
A625/A625M-03	Tin Mill Products, Black Plate, Single Reduced
A746-03	Ductile Iron Gravity Sewer Pipe
C12-06	Installing Vitrified Clay Pipe Lines
C76-05b/C76M-05b	Reinforced Concrete Culvert, Storm Drain and Sewer Pipe
C139-05	Concrete Masonry Units for Construction of Catch Basins and Manholes
C150-05	Portland Cement
C425-04	Compression Joints for Vitrified Clay Pipe and Fittings
C478-06a/C478M-06a	Precast Reinforced Concrete Manhole Sections
C700-05	Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
C828-03	Low-Pressure Air Test of Vitrified Clay Pipe Lines
C857-95(2001)	Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
D698-00ae1	Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft ³ (600 kN-m/m ³))
D2321-05	Underground Installation of Thermoplastic Pipes for Sewers and Other Gravity-Flow Applications
D2412-02	Determination of External Loading Characteristics of Plastic Pipe by Parallel- Plate Loading
D2992-01	Practice for Obtaining Hydrostatic or Pressure Design Basis for Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Fittings

D3034-04a	Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
D3212-96a (2003) e1.....	Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
D3261-03	Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
D3350-05	Polyethylene Plastics Pipe and Fittings Materials
D4101-05a.	Polypropylene Injection and Extrusion Materials
F477-02e1.....	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
F679-06.....	Poly (vinyl chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
F714-05.....	Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
F794-03.....	Poly (Vinyl Chloride)(PVC) Ribbed Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
F894-05.....	Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
F949-03.....	Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with Smooth Interior and Fittings

C. American Water Works Association (AWWA):

C105/A21.5-05.....	Polyethylene Encasement for Ductile Iron Pipe Systems
C110/A21.10-03.....	Ductile-Iron and Gray-Iron Fittings for Water
C111/A21.11-00.....	Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings
C115-99	Flanged Ductile-Iron Pipe with Threaded Flanges
C116-03	Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile Iron Pipe and Gray Iron Fittings for Water Supply Service
C151-/A21.51-02	Ductile-Iron Pipe, Centrifugally Cast for Water
C153-00	Ductile-Iron Compact Fittings for Water Services
C508-01	Swing Check Valves for Waterworks, 2 inches (50 mm) Through 24 inches (600 mm) NPS
C509-01	Resilient Seated Gate Valves for Water-Supply Service
C515-01	Reduced-Wall, Resilient-Seated Gate Valves For Water Supply Service
C512-04	Air Release, Air/Vacuum, and Combination Air Valves for Waterworks Service
C550-05	Protective Epoxy Interior Coatings for Valves and Hydrants

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- C600-05 Installation for Ductile-Iron Water Mains and Their Appurtenances
- C605-94 Underground Installation of Polyvinyl (PVC) Pressure Pipe and Fittings for Water
- C900-97 Polyvinyl Chloride (PVC) Pressure Pipe, 100 mm (4 inches) Through 300 mm (12 inches) for Water Distribution
- C905-97 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 350 mm through 1,200 mm (14 Inches through 48 Inches), for Water Transmission and Distribution
- C906-99 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):
- M198-05..... Joints for Concrete Pipe, Manholes, and Precast Box Sections using Preformed Flexible Joint Sealants
- E. Uni-Bell PVC Pipe Association:
- Uni-B-6-98..... 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, 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.
 2. Ductile Iron Pipe (DIP) for Sanitary Sewer:
 - a. Shall conform to ASTM A746, thickness Class 51 unless otherwise shown or specified. Joints on pipe and fittings shall be push-on style and conform to AWWA C110 and AWWA C111, rated for 150 psi. Exterior coating shall be approximately 1 mil asphaltic coating as specified in ASTM A746. Interior lining shall be a catalyzed coal tar epoxy, having a minimum thickness of 24 mils, a permeability rating of 0.13 perms, direct impact rating of 100 in-lbs, an abrasion resistance of 20 liters of sand per mil, and dielectric strength of 250 volts per mil. Pipe and fittings shall be polyethylene encased with 8 mil polyethylene sheeting per AWWA C105. Color of polyethylene encasement shall be green.
- B. Pressure (Force) Lines (Pipe and Fittings):
1. Ductile Iron Pipe (DIP)
 - a. All pipe and fittings used in the construction of force mains shall be rated for a minimum of 150 psi.

- b. Ductile Iron: Pipe shall conform to AWWA C151 and C111 with polyethylene lining. Flange joints shall conform to AWWA C115. Lining shall be heat-fused mechanical bond polyethylene having a dielectric strength of 250 volts per mil when fully cured. Lining shall be holiday tested in accordance with AWWA C116. The lining shall be a minimum of 1mm (40 mil) in the barrel of the pipe, and a minimum of 0.25 mm (10 mil) on the bell and spigot area of the pipe. The lining shall be repaired at all field cuts per manufacture's recommendations. Joints shall conform to AWWA C116. Pipe shall be polyethylene encased per AWWA C105.
- c. Ductile iron fittings shall comply with AWWA C110 and AWWA C111. Fittings shall be polyethylene line, as specified for ductile iron pipe. Ductile iron fittings shall be polyethylene encased per AWWA C105.

2.2 JOINTING MATERIAL:

A. Gravity Flow Lines:

- 1. Ductile Iron Pipe: Push-on or mechanical joints, AWWA C111, AWWA C110. Flange joints shall comply with AWWA C115. Flange joints shall only be used in vaults or above-grade.
- 2. Polyvinyl Chloride (PVC) Pipe (Gravity Use): Joints, ASTM D3212. Elastomeric gasket, ASTM F477.

B. Pressure (Force) Main:

- 1. All joints indicated on the drawings as being "restrained" shall be fully restrained and capable of restraining 50 percent above all loads acting on the joint, but not less than 150 psi. Thrust blocks are not permitted.
- 2. Ductile iron pipe fittings: mechanical joint conforming to AWWA C110 and C111.
- 3. Ductile iron pipe, mechanical or push-on, conforming to AWWA C110 and C111. Restrained joints shall meet the following requirements:
 - a. Push-on joints shall be restrained by a mechanical locking slot cast integrally in the bell of the pipe or fitting. The spigot shall have a retainer weldment or band. Locking segments, placed in the slots in the bell, shall form a mechanical restraint and prevent the opening of the joint.
 - b. Mechanical joint restraints shall be incorporated into the design of the follower gland. The restraining mechanism shall consist of individually actuated wedges that increase their resistance to pull-out as pressure or external forces increase. The device shall be capable of full mechanical joint deflection during assembly and the flexibility of the joint shall be maintained after burial. The joint restraint ring and its wedging components shall be made of Grade 60-42-10 ductile iron conforming to ASTM A536. The wedges shall be iron heat treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be such that it can be used with standardized mechanical joint bell conforming to AWWA C111 and AWWA C153 of the latest revision. Torque limiting twist-off nuts shall be used to insure proper actuation of the restraining wedge. The gland shall be specifically designed for the type of (DIP or PVC) connected to the fitting.

2.3 MANHOLES AND VAULTS:

- A. Manholes and vaults shall be constructed of precast reinforced concrete rings, precast reinforced sections, cast-in-place concrete, or brick. The manholes and vaults shall be in accordance with State Department of Transportation or State Roads Commission 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 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. 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 indicated on the drawings.
4. Vaults: Reinforced concrete, as indicated on the plans, or precast reinforced concrete. 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 HS20-44 loading with 30 percent impact, and conform to ASTM C857.
5. Mortar:
 - a. Precast Concrete Segmental Block Structures: By volume, 1 part of Portland cement, 1/4 part lime hydrate, and 3 parts sand.
 - b. 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.
6. 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.
7. 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 include a watertite bolted assembly with a neoprene gasketed seal. 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.
8. 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.
9. Ladders, brackets and hardware shall be constructed of welded aluminum, rails shall be 3/8 inch by 2-1/2 inches spaced a minimum of 16 inches apart. Rungs shall be 1-3/8 inches in diameter and have a non-slip surface. Standoffs shall offset the ladder 7 inches from the wall. The ladder assembly shall be rated for a minimum of 500 pounds.

2.4 CONCRETE:

- A. Concrete shall have a minimum compressive strength of 4000 psi at 28 days. The cement shall be Type III conforming to ASTM C150. Concrete shall conform with the provisions of Division 03, Section 03 30 01 CAST-IN-PLACE CONCRETE (SS), of these specifications.

2.5 REINFORCING STEEL:

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

2.6 CLEANOUT FRAMES AND COVERS:

- A. Frames and covers shall be gray iron casting conforming to ASTM C48. 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 Resident Engineer. 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 ABANDONED MANHOLES STRUCTURES AND PIPING:

- A. Manholes and Structures Outside of Building Areas: Remove frame and cover, cut and remove the top of an elevation of 2 feet below finished grade. Fill the remaining portion with compacted gravel, crushed rock, pumped river sand, or concrete.
- B. Manholes and Structures within Building Areas: Remove frame and cover and remove the entire structure and the base.
- C. Piping under and within 5 feet of building areas shall be completely removed.
- D. Piping outside of building areas shall be completely removed.
- E. The Contractor shall comply with all OSHA confined space requirements while working within existing manholes and structures.
- F. When the limit of the abandonment terminates in an existing manhole to remain, the flow line in the bench of the manhole to the abandoned line shall be filled with concrete and shaped to maintain the flowline of the lines to remain.

3.3 REGRADING:

- A. Raise or lower existing manholes and structures frames and covers, cleanout frames and covers and valve boxes in regraded areas to finish grade. Carefully remove, clean and salvage cast iron frames and covers. Adjust the elevation of the top of the manhole or structure as detailed on the drawings. Adjust the elevation of the cleanout pipe riser, and reinstall the cap or plug. Reset cast iron frame and cover, grouting below and around the frame.
- B. During periods when work is progressing on adjusting manholes or structures cover elevations, the Contractor shall install a temporary cover above the bench of the structure or manhole. The temporary cover shall be installed above the high flow elevation within the structure, and shall prevent debris from entering the wastewater stream.
- C. The Contractor shall comply with all OSHA confined space requirements when working within existing structures.

3.4 CONNECTIONS TO EXISTING PUBLIC UTILITY 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.

3.5 PIPE SEPARATION:

- A. Horizontal Separation - Water Mains and Sewers:
 - 1. Existing and proposed water mains shall be at least 6 feet horizontally from any proposed gravity flow and pressure (force main) sanitary sewer or sewer service connection.
 - 2. When it is impossible to meet (1), both the water main and sanitary sewer main shall be constructed of push-on or mechanical joint ductile iron pipe. The pipe for the sanitary sewer main shall comply with the specifications for pressure (force) mains, and the water main material shall conform to requirements of AWWA C151, pressure class 350, with standard thickness cement mortar lining interior, and interior asphaltic seal coat and exterior asphaltic coating, in accordance with AWWA and ANSI standards. The sewer shall be pressure tested as specified for pressure (force) mains before backfilling.
- B. Vertical Separation - Water Mains and Sewers at Crossings:
 - 1. Water mains shall be separated from sewer mains so that the invert of the water main is a minimum of 24 inches above the crown of gravity flow sewer. The vertical separation shall be maintained within 10 feet horizontally of the sewer and water crossing. When these vertical separations are met, no additional protection is required.
 - 2. In no case, shall pressure (force) sanitary main cross above, or within 24 inches of water lines.
 - 3. When it is impossible to meet (1) above, the gravity flow sewer may be installed 18 inches above or 12 inches below the water main, provided that both the water main and sewer shall be constructed of push-on or mechanical ductile iron pipe. Pressure (force) sewers may be installed 24 inches the water line provided both the waterline and sewer line are constructed of ductile iron pipe. The pipe for the sewer shall conform to the requirements for pressure sewers specified herein. Piping for the water main shall conform to requirements of AWWA C151, pressure class 350, with standard thickness cement mortar lining interior, and interior asphaltic seal coat and exterior asphaltic coating, in accordance with AWWA and ANSI standards.
 - 4. The required vertical separation between the sewer and the water main shall extend on each side of the crossing utility the perpendicular distance from the water main to the sewer line is at least 10 feet.

3.6 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. Sanitary sewers shall cross at least 2 feet below water lines.
- 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. Ductile Iron Piping: AWWA C111 and C600.
 - 2. Vitrified Clay Piping: ASTM C12.
 - 3. Polyvinyl Chloride (PVC) Piping: ASTM D2321.
 - 4. High Density Polyethylene (HDPE) Piping: Comply with manufacturer's recommendations with gasketed joints.
- 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 twists of nuts, the twist of nuts shall be placed on top of the fitting for the Engineer's inspection. The Contractor shall torque test all bolts, set screws, identified by the Resident Engineer.
 - 2. Thrust blocks are not permitted.
 - 3. Install pressure force main in accordance with the provisions of these specifications and the following standards: Ductile Iron Piping: AWWA C111 and C600 and Polyvinyl Chloride (PVC) Piping: AWWA C605.

3.7 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.
2. Rectangular Structures:
 - a. Reinforced concrete structures shall be installed in accordance with Division 03, Section 03 30 01 CAST-IN-PLACE (SS).
 - b. Precast concrete structures shall be placed on an 8 inch reinforced concrete pad, or be provided with a precast concrete base section. Structures provided with a base section shall be set on 12 inches thick aggregate base course compacted to a minimum of 95 percent of the maximum density as determined by ASTM D698. Set precast section true and plumb. Seal all joints with preform flexible gasket material.
3. Do not build structures when air temperature is 0 degrees C (32 degrees F), or below.
4. 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:
 - a. Forming directly in concrete base of structure.
 - b. Building up with brick and mortar.
5. Floor of structure outside the channels shall be smooth and slope toward channels not less than 1-inch per foot nor more than 2 inches per foot. Bottom slab and benches shall be concrete.
6. The wall that supports access rungs or ladder shall be 90 degrees vertical from the floor of structure to manhole cover.
7. Install steps and ladders per the manufacturer's recommendations. Steps and ladders shall not move or flex when used. All loose steps and ladders shall be replaced by the Contractor.
8. Install manhole frames and covers 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 be 2 inches above the adjacent finish grade.

3.8 SEWER AND MANHOLE SUPPORTS, CONCRETE CRADLES:

- A. Reinforced concrete as detailed on the drawings. The concrete shall not restrict access for future maintenance of the joints within the piping system.

3.9 CLEANOUTS:

- A. 6 inches in diameter and consisting of a ductile iron 45 degree fitting on end of run, or combination Y fitting and 1/8 bend 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 flush with adjacent finished grade. Where cleanout is in force main, provide a blind flange top connection. The center of the flange shall be equipped with a 2 inches base valve to allow the pressure in the line to be relieved prior to removal of the blind flange. Frames and covers for pressure (force) mains shall be 24 inches in diameter.
- B. The top of the cleanout assembly shall be 2 inches below the bottom of the cover to prevent loads being transferred from the frame and cover to the piping.

3.10 GREASE TRAPS:

- A. Install precast units as indicated in accordance with manufacturer's installation guidelines.
- B. Manways and access manholes shall be set to finish grade providing adequate access to the unit. Slope pavement and grade around the access-way to prevent stormwater from ponding or entering the unit.

3.11 SETTING OF GATE VALVES:

- A. Avoid setting valves under pavement except where shown on the drawings.
- B. Clean valve interior before installation.
- C. Set valve plumb, restrain ends of valves with indicated on the drawings.
- D. Set valve box cover flush with the finished grade. Valve box shall be centered over the operating nut.

3.12 INSPECTION OF SEWERS:

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

3.13 TESTING OF SANITARY SEWERS:

- A. Gravity Sewers and Manholes (Contractor to Select one of the following):
 1. Air Test: Vitrified Clay Pipe ASTM C828. PVC Pipe, Uni-Bell Uni-B-6. Clean and isolate the section of sewer line to be tested. Plug or cap the ends of all branches, laterals, tees, wyes, and stubs to be included in the test to prevent air leakage. The line shall be pressurized to 4 psi and allowed to stabilize. After pressure stabilization, the pressure shall be dropped to 3.5 psi greater than the average back-pressure of any groundwater above the sewer. The minimum test time shall be as specified in Uni-Bell Uni-B-6.
 2. Exfiltration Test:
 - a. Subject pipe to hydrostatic pressure produced by head of water at depth of 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:

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

Where:

L = Maximum Allowable Leakage in Gallons per Hour

See RFI 03808: Smoke Testing in lieu of testing specified is not acceptable.

J = Number of Joints in Test Area

D = Diameter of Pipe in Inches

P = Average Test Pressure (Psi)

- C. Additional Testing of Fiberglass Wet Well: No leakage with the wet well completely filled with water for a duration of 4 hours.

--- E N D ---

SECTION 33 40 00
STORM DRAINAGE UTILITIES

PART 1 – GENERAL

1.1 DESCRIPTION:

- A. This section specifies construction of outside, underground storm sewer systems. The storm sewer systems shall be complete and ready for operation, including all drainage structures, frames, grate and covers, connections to new buildings, structure service lines, existing storm sewer lines, and existing drainage structures and all required incidentals.

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 Work, Reinforcing, Placement and Finishing: Section 03 30 01, CAST-IN-PLACE CONCRETE (SITE STRUCTURES).
- D. Fabrication of Steel Ladders: Section 05 50 00, METAL FABRICATIONS.
- E. Protection of Materials and Equipment: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- F. Drainage Conduit and Underslab Headers, Perforated Drainage Pipe: Section 33 46 13, FOUNDATION DRAINAGE.

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, 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 storm sewer lines and the extension, and/or modifications to Public Utility systems.
- C. Louisiana Standard Specifications: Comply with applicable standards of Louisiana Department of Public Works, unless requirements specified in this section are more restrictive.

- D. City of New Orleans Public Works Standards: Comply with applicable standards of the City of New Orleans public works, unless requirements in this section are less restrictive.
- E. Sewerage and Water Board of New Orleans Standards: Comply with applicable standards of the Sewerage and Water Board of New Orleans, unless requirements in this section are less restrictive.
- F. National Standard Plumbing Code: Comply with applicable standards of the National Standard Plumbing Code, unless requirements in this section are less restrictive.
- G. Department of Environmental Quality "DEQ": Comply with applicable standards of the Department of Environmental Quality (DEQ), unless requirements in this section are less restrictive.

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. Piping and fittings.
 - 2. Jointing material.
 - 3. Manhole, inlet and catch basin material.
 - 4. Frames and covers.
 - 5. Steps.
 - 6. Resilient connectors and downspout boots.
 - 7. PVC surface drainage inlets and ductile iron grates.
 - 8. Product data for drainage pipe specialties.
- C. Approved shop drawings are required before fabrication. Shop Drawings shall be submitted for each individual Plastic, Precast, Cast-in-Place Concrete, or Field Erected Masonry storm drainage structure shown on the plans. This includes manholes, drop inlets, catch basins, safety ends, cleanouts, inline drains, and drain basins. Information shall include frames, covers, box dimensions, reinforcing steel, pipe openings, inverts, top of casting "rim" elevations, etc.
- D. Coordination drawings: submit site layout drawings identifying each individual drainage structure located on site. Shop drawings of structures shall be referenced back to drawings to ensure proper size and location.

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.
- B. American Society for Testing and Materials (ASTM):

A48-03/A48M-03.....Gray Iron Castings

A536-84(2004)	Ductile Iron Castings
A615-05/A615M-05	Deformed and Plain-Billet Steel Bars for Concrete Reinforcement
A655-04e1/A655M-04e1	Reinforced Concrete D-Load Culvert, Storm Drain and Sewer Pipe
A742-03/A742M-03	Steel Sheet, Metallic Coated and Polymer Precoated for Corrugated Steel Pipe
A760-01a/A760M-01a	Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains
A762-00/A762M-00	Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains
A798-01/M798M-01	Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications
A849-00	Post-Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe
A929-01/A929M-01	Steel Sheet, Metallic Coated by the Hot Dip Process for Corrugated Steel Pipe
C76-05a/C76M-05a	Reinforced Concrete Culvert, Storm Drain and Sewer Pipe
C139-03	Concrete Masonry Units for Construction of Catch Basins and Manholes
C150-04ae1	Portland Cement
C443-05/C443M-05	Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
C478-03a/C478M-03a	Precast Reinforced Concrete Manhole Sections
C506-05/C506M-05	Reinforced Concrete Arch Culvert, Storm Drain and Sewer Pipe
C507-05a/C507M-05a	Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe
C655-04e1/C655M-04e1	Reinforced Concrete D-Load Culvert, Storm Drain and Sewer Pipe
C1433-04e1/C1433M-04e1	Precast Reinforced Concrete Box Sections for Culverts, Storm Drains and Sewers
C828-03	Low-Pressure Air Test of Vitrified Clay Pipe Lines
C857-95(2001)	Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
C923-02/C923M-02	Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes and Materials

C924-02/C924M-02	Testing Concrete Pipe Sewer Lines by Low Pressure Air Test Method
C1103-03/C1103M-03	Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
D698-00ae1	Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft ³ (600 kN-m/m ³))
D1056-00	Flexible Cellular Materials-Sponge or Expanded Rubber
D2412-02	Determination of External Loading Characteristics of Plastic Pipe by Parallel Plate Loading
D2321-04e1	Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications .
D3034-04a	Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
D3212-96a(2003)e1.....	Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
D3350-04	Polyethylene Plastics Pipe and Fittings Materials
D4101-05a	Polypropylene Injection and Extrusion Materials
F477-02e1.....	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
F679-03.....	Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
F714-05.....	Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
F794-03.....	Poly (Vinyl Chloride)(PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
F894-98a.....	Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
F949-03.....	Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with Smooth Interior
F1417-92(2005)	Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air

NOTE: ASTM test methods shall be the current version as of the date of advertisement of the project.

- C. American Association of State Highway and Transportation Officials (AASHTO):
HB17 Standard Specifications for Highway Bridges

M190-04.....	Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches
M198-05.....	Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets
M294-04.....	Corrugated Polyethylene Pipe, 300-1500 mm (12 to 60 inches) Diameter

PART 2 - PRODUCTS

2.1 PIPING:

A. Gravity Lines (Pipe and Appurtenances):

1. Concrete:
 - a. Reinforced Concrete Pipe (RCP): ASTM C76, Class III, Wall B, for watertight flexible joints made with rubber-type gaskets, ASTM C443.
 - b. Reinforced Concrete Arch Pipe (RCPA): ASTM C506, Class A-III, for watertight flexible joints made with rubber-type gaskets, ASTM C443.
2. Polyvinyl Chloride (PVC): Pipe and Fittings shall conform to the following:
 - a. Pipe: PVC Corrugated pipe with a smooth interior shall conform to the requirements of ASTM F949. Pipe and fittings shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions or other injurious defects. Pipe shall be manufactured to 46 PSI stiffness (minimum) when tested in accordance with ASTM D2412. There shall be no evidence of splitting, cracking or breaking when the pipe is tested per ASTM D2412 in accordance with ASTM F949 Section 7.5 and ASTM F794 Section 8.5. The pipe shall be made of PVC compound having a minimum cell classification of 12454 as defined in ASTM D1784.
 - b. Fittings: All fittings for PVC corrugated sewer pipe with a smooth interior shall conform to ASTM F949, Section 5.2.3 or F794, Section 7.2.4. To insure compatibility, the pipe manufacturer shall provide all fittings.
 - c. Joints: All joints shall be made with integrally formed bell and spigot gasketed connections. The manufacturer shall provide documentation showing no leakage when gasketed pipe joints are tested in accordance with ASTM test method D3212. Elastomeric seals (gaskets) shall meet the requirements of ASTM designation F477.
 - d. Perforated PVC Pipe: See Section 33 46 13 FOUNDATION DRAINAGE.

2.2 JOINTING MATERIAL:

- A. Concrete Pipe: Rubber gasket ASTM C443.
- B. Polyvinyl Chloride (PVC) Pipe:
 1. PVC Plastic Pipe: Joints shall comply with ASTM D3212, Elastomeric Gaskets shall comply with ASTM F477 and as recommended by the manufacturer.

2.3 MANHOLES, INLETS AND CATCH BASINS:

- A. Manholes, inlets and catch basins shall be constructed of brick, precast reinforced sections, or cast-in-place concrete.
1. Brick: Brick shall conform to ASTM C32, grade 5 manhole bricks. Minimum wall thickness shall be 8" minimum, 48" diameter with tapered top for a 24" frame and cover. Thickness of section of wall deeper than 8" shall be 12" minimum.
 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. Precast Catch Basins: Concrete for precast sections shall have a minimum compressive strength of 4,000 psi at 28 days, ASTM A615, Grade 60 reinforcing steel, rated for AASHTO HS20-44 loading with 30 percent impact, and conform to ASTM C-857.
 5. Mortar:
 - a. Brick: ASTM C270, Type S, using ASTM C150, Type II Portland Cement.
 - b. 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 21L (5-1/2 gallons) per sack of cement.
 6. 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 M-198B.
 7. 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 "storm 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.
 8. 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 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.
 9. Ladders, brackets and hardware shall be constructed of welded aluminum, rails shall be 9 mm (3/8 inch) by 63 mm (2-1/2 inches) spaced a minimum of 16 inches apart. Rungs shall be 35 mm (1-3/8 inches) in diameter and have a non-slip surface. Standoffs shall offset the ladder 7 inches from the wall. The ladder assembly shall be rated for a minimum of 2200 N (500 pounds).
- B. Frame and Cover for Gratings: Frame and cover for gratings shall be cast gray iron conforming to ASTM A48; cast ductile iron conforming to ASTM A536. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the drawings.

2.4 REINFORCING STEEL:

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

2.5 SAFETY ENDS:

- A. Safety ends shall be cast-in-place concrete. Size and reinforcing shall be per the drawings. Concrete shall have a minimum compressive strength of 4000 psi at 28 days. Concrete shall conform with the provisions of Division 03 of these Specifications.

2.6 PRECAST REINFORCED CONCRETE BOX.

- A. Precast Reinforced Concrete Box: For highway loadings with 600 mm (2 feet) of cover or more subjected to dead load only, conform to ASTM C1433; For less than 600 mm (2 feet) of cover subjected to highway loading, conform to ASTM C1433.

2.7 RESILIENT CONNECTORS AND DOWNSPOUT BOOTS:

- A. Resilient Connectors: Flexible, watertight connectors used for connecting pipe to manholes and inlets shall conform to ASTM C923.
- B. Downspout Boots: Boots used to connect exterior downspouts to the storm drainage system shall be of gray cast iron conforming to ASTM A48, Class 30B or 35B.

2.8 WARNING TAPE:

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

2.9 PVC SURFACE DRAINAGE INLETS:

- A. General

- 1. PVC surface drainage inlets shall include the drain basin type or inline drain type as indicated on the drawings.
 - 2. Ductile iron grates and fittings shall be furnished by the same manufacturer.

- B. Material

- 1. Drains shall be manufactured from PVC pipe stock, utilizing a thermo-molding process to reform the pipe stock to the furnished configuration. Raw material used to manufacture pipe stock shall conform to ASTM D1784 cell class 12454.
 - 2. Drainage pipe connection stubs shall provide a watertite connection with specified pipe system. The joint tightness shall conform to ASTM D3212 for joints for drain and sewer plastic pipe using flexible elastomeric seals. Elastomeric seals shall comply with ASTM F477. For inline drains, the pipe bell spigot shall be joined to the inline drain body by use of a swage mechanical joint.
 - 3. Grates furnished for all surface drains shall be ductile iron "painted black" and made specifically for each fitting so as to provide a round bottom flange that closely matches the diameter of the surface drainage inlet. Grates shall be capable of supporting H-20

wheel loading for traffic areas or H-10 loading for pedestrian areas. Metal used in the manufacture of the castings shall conform to ASTM A536 grate 70-50-05 for ductile iron.

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. Corrugated metal pipe bedding requirements shall conform to ASTM A798.

3.3 GENERAL PIPING INSTALLATION:

- A. Lay pipes true to line and grade. Gravity flow sewer shall be laid with bells facing upgrade.
- 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 shading to a depth of 12 inches over the crown of the pipe.

-
- I. Install gravity sewer line in accordance with the provisions of these specifications and the following standards:
 - 1. Reinforced Concrete Pipe: Comply with manufacturer's recommendations with gasketed joints.
 - 2. Polyvinyl Chloride (PVC) Piping: ASTM D2321.
 - 3. High Density Polyethylene (HDPE) Piping: Comply with manufacturer's recommendations with gaskets with fused joints.
 - 4. Corrugated Metal Pipe: ASTM A798.
 - J. Warning tape shall be continuously placed 300 mm (12 inches) above storm sewer piping.
 - K. Contractor is responsible for designing and constructing sheeting and shoring per OSHA requirements.

3.4 REGRADING:

- A. Raise or lower existing manholes and structures frames and covers in re-graded areas to finish grade. Carefully remove, clean and salvage cast iron frames and covers. Adjust the elevation of the top of the manhole or structure as detailed on the drawings. Reset cast iron frame and cover, grouting below and around the frame. Install concrete collar around reset frame and cover as specified for new construction.
- B. During periods when work is progressing on adjusting manholes or structures cover elevations, the Contractor shall install a temporary cover above the bench of the structure or manhole. The temporary cover shall be installed above the high flow elevation within the structure, and shall prevent debris from entering the wastewater stream.
- C. The Contractor shall comply with all OSHA confined space requirements when working within existing structures.

3.5 CONNECTIONS TO EXISTING VA-OWNED MANHOLES:

- A. 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.

3.6 CONNECTIONS TO EXISTING public utility 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.

3.7 MANHOLES, INLETS and catch basins:

A. General:

1. Circular Structures:

- a. Masonry bricks shall lay true and plumb. All horizontal and vertical joints shall be completely filled with mortar. Parge interior and exterior of structure with 1/2 inch or cement mortar applied with a trowel and finished to an even glazed surface.
- b. 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 perform 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.
- c. Precast reinforced concrete manhole risers and tops. Install as specified for precast reinforced concrete rings.

2. Rectangular Structures:

- a. Reinforced concrete structures shall be installed in accordance with Division 03, CONCRETE of these specifications.
 - b. Precast concrete structures shall be placed on a 8 inch reinforced concrete pad, or be provided with a precast concrete base section. Structures provided with a base section shall be set on a 12 inches thick aggregate base course compacted to a minimum of 95 percent of the maximum density as determined by ASTM D 1557. Set precast section true and plumb. Seal all joints with preform flexible gasket material.
3. Do not build structures when air temperature is 0 degrees C (32 degrees F), or below.
 4. 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:
 - a. Forming directly in concrete base of structure.
 - b. Building up with brick and mortar.
 5. Floor of structure outside the channels shall be smooth and slope toward channels. Bottom slab and benches shall be concrete.
 6. The wall that supports access rungs or ladder shall be 90 degrees vertical from the floor of structure to manhole cover.
 7. Install steps and ladders per the manufacturer's recommendations. Steps and ladders shall not move or flex when used. All loose steps and ladders shall be replaced by the Contractor.
 8. Install manhole frames and covers 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 be 2 inches above the adjacent finish grade.

3.8 CURB INLETS, CATCH BASINS, AND AREA DRAINS:

- A. Brick or Reinforced concrete as shown or precast concrete.

3.9 INSPECTION OF SEWERS:

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- A. Inspect and obtain the Resident Engineer's approval. Thoroughly flush out before inspection. Lamp between structures and show full bore indicating sewer is true to line and grade. Lip at joints on inside of sewer is prohibited.

3.10 TESTING OF STORM SEWERS:

- A. Gravity Sewers (Contractor to select one of the following):
1. Air Test: Concrete Pipes conform to ASTM C924, Plastic Pipes conform to ASTM F1417, all other pipe material conform to ASTM C828 or C924, after consulting with pipe manufacturer. Testing of individual joints shall conform to ASTM C1103.
 2. 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 1 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.

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SECTION 33 40 01
DIRECTIONAL DRILLING**PART 1 – GENERAL****1.1 SCOPE OF WORK**

- A. The work covered by this section of the Specifications consists of plant, labor, equipment, and materials, and of performing all operations in connection with the installation of high-density polyethylene pipe by the use of the horizontal directional drilling method complete. The work shall be done in strict accordance with this and other applicable sections of the Specifications, all applicable drawings, and subject to the terms and conditions of the contract.

1.2 QUALITY ASSURANCE

- A. Polyethylene pipe jointing shall be performed by personnel trained in the use of joint fusion recommended methods for pipe linear connections. Personnel directly involved with installing the pipe shall receive training in the proper methods for handling, inserting, trimming and finishing the pipe.

1.3 SUBMITTALS

- A. The Contractors shall develop a proposed profile drawing and drilling procedure for the installation by directional drilling and submittals as part of his proposed drilling plan. The Contractors' proposed profile shall be subject to review and written approval by Owner and Engineer. The profile drawing and drilling procedure shall be submitted to the Engineer at least fourteen (14) days prior to the start of construction. It will be the Contractors' responsibility to plan out the location of all boring and receiving pits based on space available for pipe layout and pull back procedures, physical obstructions, depth of installation and impact of traffic. All of this shall be discussed and detailed in the Contractors' submitted drilling plan.
- B. Shop drawings, catalog data and manufacturer's technical data showing complete information on material composition, physical properties and dimensions of pipe fittings shall be submitted. Include manufacturer's recommendations for handling, storage and repair of pipe fittings if damaged.
- C. Contractor shall coordinate with Resident Engineer during his layout, submittal and execution of the drilling procedure.
- D. Contractor shall also include pipe laying strategies into his boring plan submittal.

PART 2 – PRODUCTS**2.1 POLYETHYLENE PIPE**

- A. The wall thickness of the pipe shall be SDR 11.

PART 3 – EXECUTION**3.1 LAUNCHING AND RECEIVING PITS**

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- A. The approximate locations of all expected launching and receiving pits are to be shown in the boring plan. The actual number and location of the pits shall be decided by the Contractor and approved by the Engineer prior to excavation.
 - B. Launching and receiving pits shall be backfilled and the surrounding area restored in accordance with the appropriate sections of these specifications.

3.2 UTILITY COORDINATOR

- A. Before any excavation is done for any purpose, it will be the responsibility of the Contractor to check with the various utility companies and determine the location of their facilities. Any necessary temporary construction easements and/or right-of-way areas will be arranged by the Contractor at no cost to the Owner.

3.3 DIRECTIONAL DRILLED REQUIREMENTS

- A. The pilot hole shall be drilled along the path shown on the plan. The pilot hole tolerances are as follows:
 - 1. Elevation: + 0 feet, -0.1 feet
 - 2. Alignment: + or -12 inches
 - 3. Entry Point Locations: The pilot hole shall initially penetrate the ground surface area at the exact locations shown on the drawings or approved by the Engineer.
 - 4. Exit Point Location: The pilot hole shall finally penetrate the ground surface within + or – 1 foot of the alignment shown on the drawing and with +5 feet and -0 feet of the length shown on the drawings.
- B. The Contractor shall at all times provide and maintain instrumentation which will accurately locate the pilot hole (both horizontal and vertical displacement points), measure drill sting axial and torsional loads, and measure drilling fluid discharge rate and pressure. A wire line and wire line specialist shall be used to accurately locate the horizontal and vertical position of the pilot hole. The Engineer will have access to these instruments and their readings at all times during the drilling and pull back operations. A final “as-built” plan and profile shall be submitted to the Engineer within ten (10) days after completing the pull back. The Contractor shall also furnish a copy of the drilling at this time.
- C. Pre-reaming operations shall be conducted at the discretion of the contractor. All provisions of these specifications relating to simultaneous reaming and pulling back operations shall also pertain to pre-reaming operations.
- D. The maximum allowable tensile load imposed on the pull section shall not exceed 90% of the product of the specified minimum yield strength of the pipe and the area of the pipe section.
- E. A swivel shall be used to connect the pull section to the assembly to minimize torsional stress imposed on the section.
- F. The pull back section of the pipeline shall be supported as it proceeds during pull back so that it moves freely and the pipe is not damaged.
- G. The pull back section shall be installed in the reamed hole in such a manner that external pressures are minimized. Any damage to the pipe resulting from external pressure during installation shall be the responsibility of the Contractor.

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- H. Buoyancy modification shall be used at the discretion of the Contractor. Any buoyancy modification procedure proposed for use shall be submitted to the Engineer for approval. No procedure shall be used that has not been approved by the Engineer. The Contractor is responsible for any damage to the pull section resulting from buoyancy modification.

3.4 DRILLING FLUIDS AND WATER

- A. All drilling fluids, mud or other chemicals used by the Contractor must be submitted to the Engineer for approval. No fluid will be approved or utilized that does not comply with permit requirements and environmental regulations. The Contractor shall use a reclaimer to reclaim drilling fluids utilized for the installation.
- B. Operations shall be conducted to minimize blow through to the surface or "fracking out". Cleanup of drilling fluids and the associated cost and disposal shall be the responsibility of the Contractor. No additional payment will be made for any cleanup.
- C. Any damage caused by drilling equipment and/or "fracking out" shall be repaired by the Contractor at no expense to the Owner to a condition equal to or better than it's pre-existing condition. See 3.6 (A).

3.5 TESTING

- A. Pipe shall be tested both before and after installation in accordance with Section 334400.

3.6 GENERAL

- A. The Contractor shall be responsible for any damage to pipes, utilities, roadways, sidewalks, driveways, landscaping, canal banks, etc., that may be caused by his drilling operations. This includes any damage caused by "fracking out". The Contractor shall take all steps necessary to minimize or avoid "fracking out" and shall be responsible for cleanup of all drilling fluids and damage should it occur.
- B. The depth and slope of the pipe shall be installed as indicated on the plan. The Contractor shall take all steps necessary to mitigate "fracking out" while maintaining this depth. Submittal of a bid shall constitute acceptance of the depth requirement and responsibility for repairs to any damage resulting from boring operations.

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