SANITARY SEWER FORCE MAINS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Sanitary sewer force mains, fittings, accessories, and bedding

B. Construction procedures

1.2 RELATED SECTIONS

A. Section 02110 – Site Clearing and Grubbing

B. Section 02111 – Site Protection and Restoration

C. Section 02200 – Earthwork

D. Section 02511 – Flowable Fill

E. Section 02900 – Erosion Control

F. Section 02936 – Seeding

G. Section 02730 – Sanitary Gravity Sewer Lines

H. Section 02734 – Sanitary Sewer Force Main Testing

1.3 REGULATORY REQUIREMENTS

A. Conform to SCDHEC Standards for Wastewater Facility Construction: R.61-67.

PART 2 PRODUCTS

2.1 GENERAL

A. Ductile Iron Force Main:

1. Pipe: AWWA C150 (ANSI A 21.50), thickness class 52 for all sizes, except as otherwise set forth in the Drawings; and AWWA C151 (ANSI A 21.51), bell & spigot end and mechanical end.

2. Joints: Push-on joints, mechanical joints, and flanged joints as indicated in the drawings. Push-on and mechanical joints shall conform to AWWA C111 (ANSI A21.11). Provide gasket composition suitable for exposure to sanitary sewage. Flanged joints shall conform to AWWA C115 (ANSI A21.15).

Component flanges shall be rated for a working pressure of 250 psi or greater.

3. Fittings: Ductile iron, manufactured in accordance with AWWA C110 Class 350; or compact ductile iron, manufactured with AWWA C153 Class 350. Fittings to be designed to accommodate the type of pipe used. All DIP pipe and fittings to be wrapped in green poly encasement.

4. Lining: Protecto 401™ by Vulcan Painters or TNEMEC Perma-Shield series 431 for all ductile iron pipe, joints, and fittings in accordance with specifications provided by manufacturer.

5. Coat exterior of pipe intended for below grade installation with an asphaltic material approximately one (1) mil thick.

6. BCWS accepts two paint manufacturers, Sherwin Williams and Tnemec for above grade paint products. Ductile iron pipe intended for above grade installation shall be painted as follows:

   SHERWIN WILLIAMS SPEC:

   a. Surface Preparation: Remove all dirt, dust, grease, oils, and all other foreign matter from the surface. Clean the surface in accordance to National Association of Pipe Fabricators NAPF 500-03 - NAPF 500-03-04 SURFACE PREPARATION STANDARD FOR DUCTILE IRON PIPE Cleaning. The surface shall be clean and dry prior to painting. Fill all unwelded seams or joints as needed per the manufacturer's recommendations.

   b. Caulking: Apply to gap where flange is connected to pipe and coating cannot be applied using Sherwin Williams Loxon S1 Urethane Sealant.

   c. First Coat: Apply Sherwin Williams Macropoxy 646 at 4.0-6.0 dry mils. Allow coat to dry overnight, minimum 12 hours, to cure.

   d. Second Coat: Apply Sherwin Williams Macropoxy 646 at 4.0-6.0 dry mils. Allow coat to dry overnight, minimum of 12 hours.

   e. Third Coat: Apply Sherwin Williams Hi Solids Polyurethane Color: "Charleston Green" at 3.0-5.0 dry mils.

   f. *Apply coats of varying color to clearly distinguish 1st, 2nd, and 3rd coat from one another.

TNEMEC SPEC:

a. Surface Preparation: Remove all dirt, dust, grease, oils, and all other foreign matter from the surface. Clean the surface in accordance with SSPC SP-6/NACE3 Commercial Blast Cleaning. The surface shall be clean and dry prior to painting. Fill all unwelded seams or joints as needed per the manufacturer's recommendations.

b. First Coat: Apply Tnemec Series 66HS Hi-Build Epoxoline/Series 161HS TnemeFascure at 4.0-6.0 dry mils. Allow coat to dry overnight, minimum 12 hours, to cure.

c. Second Coat: Apply Tnemec Series 66HS Hi-Build Epoxoline/Series 161HS TnemeFascure at 4.0-6.0 dry mils. Allow coat to dry overnight, minimum of 12 hours.

d. Third Coat: Apply Tnemec Series 740-UVX GR33 or pre-approved alternate color at 3.0-5.0 dry mils. Contractor to confirm final above ground piping color with BCWS prior to final coat at least 72hrs in advance.

Note:

1. A NACE Level 3 certified technical representative from the paint manufacturer shall visit the job site to support the Contractor's personnel and/or the Owner as needed. A letter from the manufacturer shall be provided with the closeout submittal stating the project was completed in compliance with the manufacturer's recommendation and the project specifications.
2. Alternate paint products and methods will require prior approval and acceptance by BCWS before installation.

B. WET WELL CONCRETE WALLS, PIPE AND RECEIVING MANHOLES

1. BCWS accepts two paint manufacturers, Sherwin Williams and Raven for below grade paint products. Ductile iron pipe intended for below grade installation, wet wells, and receiving manholes of FM discharge shall be painted as follows:

Sherwin Williams Duraplate 6100:

A. Surface Prep: Clean and prepare concrete per ICRI CSP 4-5.

B. Bughole Filler: AW Cook Thin Patch

C. Build back Mortar: AW Cook Micro Silica Mortar applied at ½ inch minimum

H2S Resistant Coating: Coat wet wells, manholes receiving discharge from force mains and the next manhole downstream with **Sherwin Williams Duraplate 6100** at 125 mils Dry Film Thickness.

Raven Epoxy 405:

1. See Manufacturers recommended surface preparation.

H2S Resistant Coating: Coat wet wells, manholes receiving discharge from force mains and the next manhole downstream with **Raven 405** at 120 mils Dry Film Thickness.

C. PVC Force Main:

1. Pipe: ASTM D-2241, pipe 14” to 48” in diameter must conform to AWWA C905 with cast iron pipe equivalent outside diameters, class 165 (DR 25). Pipe 4” to 12” in diameter must conform to AWWA C900, with cast iron pipe equivalent outside diameters, Class 150 (DR 18). Pipe smaller than 4” in diameter must conform to ASTM D1784, D2241, and F477. PVC force main shall be green.

2. Joints: Join by means of a push on bell joint which is to be an integral part of the barrel in conformance with AWWA C900. Provide gasket composition suitable for exposure to sanitary sewage.

3. Fittings: For pipe less than 4” in diameter, PVC fittings to conform to the material requirements for PVC pipe described herein. For pipe 4” to 8” in diameter, use PVC molded fittings with restraint joints. For pipe diameters 8” or greater, provide mechanical joint fittings conforming to 2.1.A.3. of this Section. Provide gasket composition suitable for exposure to sanitary sewage.

4. Pipe to bear the National Sanitation Foundation seal of approval. Comply with the requirements of Type I, Grade I of the ASTM resin specification D-1784. Certificates of conformance with the foregoing specifications to be furnished with each lot of pipe supplied.

5. Thermoplastic pipe shall not be used above grade.

D. Steel Casing Pipe:

Refer to Appendix G Section 02665 Potable Water Mains for casing requirements.

2.2 RECEIVING MANHOLES

1. Coat manholes receiving discharge from force mains and the next manhole downstream with approved Epoxy Coating at 125 mils for Sherwin Williams or 120 mils nominal thickness for Raven. Other manholes within close proximity to discharge manhole may require epoxy coating as well and will be called out on plans during review. Entire manhole shall be coated below the frame all the way to the flow channel. No steel should be coated. See Appendix F29 BCWS Approved Parts List.
2. No inside drops allowed for force main installation connecting to existing manholes unless specifically approved by BCWS.
3. Any manhole epoxy coated, new or existing, will require composite frame and cover be installed prior to coating. Any exceptions to be approved by BCWS.

2.3 AIR RELEASE VALVES AND MANHOLES

A. A.R.I. Flow Control Accessories SAAR short version D-025 P Duel ARV or approved equal, see Appendix F29 BCWS approved parts list. Inlet size 2" NPT, with backwash accessories or size called out/approved on construction plans. Air release valves shall be ARI Model No. D-025 or equivalent. Size and location shall be as indicated on the drawings based on pumping flow rates and manufacturer's recommendations. ARI Model No. D-26 may be required based on flow rates. Design engineer to verify with manufacturer appropriate number and location of all ARVs installed on line and on pump station header piping as additional ARVs may be necessary for optimum pump performance.

B. For underground ARV installations, provide precast manhole with composite cover and frame as specified and a concrete valve marker post for each valve location. Tracer wire box shall be located within 3' of ARV MH. No above grade ARV installations allowed unless specifically approved by BCWS.

C. Coat air release manholes and pipes inside air release manholes with approved Epoxy Coating at 40-50 mils Dry Film Thickness for Sherwin Williams Duraplate 6100 or 120 mils nominal thickness for Raven Epoxy 405. Entire manhole shall be coated below the frame. No part of the

manhole frame should be coated. See Appendix F29 BCWS Approved Parts List.

2.4 PIPE ACCESSORIES

A. Pipe Joint Couplings: All joining of pipe for new construction shall be bell and spigot connections or gasketed fully molded fittings as indicated on BCWS Appendix F29. When mechanical joint (MJ) fittings or sleeves are necessary, see BCWS Appendix F29. For Fusible PVC, bell and spigot connections are authorized as well as mechanical joint (MJ) fittings. For HDPE connections, only butt fusion, electro-fused couplings, or butt fused MJ adaptors shall be used. No full circle repair clamps/bands shall be used to permanently join any sanitary sewer force main regardless of pipe material. Use of other repair sleeves, clamps, couplings must be approved BCWS prior to installation.

B. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tees, bends, elbows, reducers and other configurations.

C. Locator Tape: Magnetic detectable conductor, clear brightly colored plastic covering; imprinting to read CAUTION - BURIED SEWER LINE BELOW, or other similar wording approved by the Engineer, in large capital letters. Tape must be minimum 6” wide.

D. Copper Tracer Wire: Place continuous 12-guage insulated solid copper tracer wire over all sanitary sewer force mains. Insulation color shall be green.

2.5 EMBEDMENT MATERIALS

A. General: Embedment and foundation materials listed herein include a number of processed materials, plus the soil classifications listed under the Unified Soil Classification System (USCS; Method D 2487 and Practice D 2488). These materials are grouped into five broad categories according to their suitability for this application.

B. Aggregate Bedding and Foundation Stone: ASTM C33. Class I - Angular, 6 to 40-mm (1/4 to 1 1/2-in.) graded stone, including a number of fill materials that have regional significance such as coral, No. 57 granite, air cooled blast furnace slag, cinders, crushed stone, and crushed shells. Bedding shall be inert in that it shall not deteriorate over time due to chemical contact or electrolysis. Sanitary Sewer force mains and effluent lines must be bedded/haunched with Class 1 material up to spring line at a minimum. Larger diameter pipe may require additional

bedding/foundation stone as called out/approved on plans or recommended by pipe manufacturer.

C. Initial Backfill Over Pipe:
   1. Class II - Coarse sands and gravels with maximum particle size of 40 mm (1 1/2 in.), including variously graded sands and gravels containing a small percentage of fines, generally granular and non-cohesive, either wet or dry. Soil types GW, GP, SW, and SP are included in this class.

   2. Class III - Fine sand and clayey gravels, including fine sands, sand-clay mixtures, and gravel-clay mixtures. Soil types GM and SM are included in this class.

D. Unsuitable Materials: These materials are not recommended for bedding, haunching, or initial backfill:

   1. Class IV - Silt, silty clays, and clays, including inorganic clays and silts of medium to high plasticity and liquid limits. Soil Types MH, ML, CH and CL are included in this class.

   2. Class V - This class includes the organic soils OL, OH, and PT as well as soils containing frozen earth, debris, rocks larger than 40 mm (1 1/2 in.) in diameter, and other foreign materials.

PART 3 EXECUTION

3.1 PREPARATION

A. Excavate pipe trench in accordance with ASTM D2321 for work of this section. Hand trim excavation for accurate placement of pipe to elevations indicated.

B. Remove large stones or other hard matter that could damage pipe or impede consistent backfilling or compaction.

C. Trench width not to exceed that necessary for joining the pipe and placing and compacting the initial backfill. Compaction of the initial backfill to extent of trench wall.

D. Stabilize poor or running soil conditions. Select and utilize a suitable method of trench wall and trench bottom stabilization. Methods to be approved by the Engineer.

E. Utilize well points or under drain systems to control excessive ground or running water.

F. Correct over excavation with foundation stone.

3.2 EXAMINATION

A. Verify that trench cut and excavation base is ready to receive work and excavations, dimensions, and elevations are as indicated on the Drawings.

3.3 BEDDING

A. Hand trim excavations to required elevations.

B. Place bedding material at trench bottom, level materials in continuous layers not exceeding 8 inches compacted depth (95 percent compaction of modified proctor).

C. Maintain moisture content of bedding material at optimum or above to attain required compaction density.

3.4 INSTALLATION - PIPE

A. Install pipe, fittings, and accessories in accordance with ASTM D2321 and manufacturer's instructions. Internal epoxy coated DIP force main, fittings, and accessories to be installed in accordance with AWWA C-600. Seal joints watertight. Use of DIP in force main installation will only be installed if PVC/FPVC/HDPE pipe cannot be used and specifically approved by BCWS.

B. Lay pipe in an upstream direction to the appropriate line and slope gradients noted on profile drawings.

C. Refer to ASTM D2321 for additional trenching and backfill requirements. Do not displace or damage pipe when compacting.

D. All sewers shall be constructed with a minimum of three (3) feet of cover, unless justified by the Engineer and approved by SCDHEC.

E. Sewer Line Relationship to Water Mains and Storm Drainage: In accordance with SCDHEC Regulation 61-67.

1. Force mains shall be laid at least 10 feet horizontally from any existing or proposed potable water main. The distance shall be measured edge to edge. In cases where it is not practical to maintain a 10 foot separation, SCDHEC may allow deviation on

a case-by-case basis, if supported by data from the Design Engineer.

2. Force mains crossing potable water mains shall be laid to provide a minimum vertical separation of 18 inches between the outside of the potable water main and the outside of the sewer. This shall be the case whether the potable water main is above or below the sewer, but preferably above the sewer. Where a new sewer line crosses a new potable water main, a full length of pipe shall be used for both the sewer line and potable water main and the crossing shall be arranged so that the joints of each line shall be as far as possible from the point of crossing and each other. Where a potable water main crosses under a sewer, adequate structural support shall be provided for the sewer line to prevent damage to the potable water main while maintaining line and grade.

3. When crossing over/under piped storm drainage, provide minimum vertical separation of 24". Steel casing will be required when 24" of vertical separation cannot be met crossing under piped storm drainage. For open drainage crossings, require 3' minimum cover under drainage crossing. Steel casing will be required if these conditions cannot be met. Any deviations must be approved by BCWS.

4. When it is impossible to obtain the distances specified above, SCDHEC may allow an alternative design. Consult SCDHEC's "Standards for Wastewater Facility Construction" for guidelines.

F. Tracer Wire: Install a continuous 12 gauge insulated tracing wire along all pressure pipelines (Refer to Sewer Panel 6). The wire shall be secured to the pipeline at 10' intervals. Access to the wire shall be provided at the pump station, air relief/vacuum breaker valves, and terminating manhole. Color of wire insulation shall be green. Maximum tracing wire length shall be 1000' without terminating in a valve box or intermediate detector site (Dummy Valve Box).Intermediate detector sites shall not be located in pavement areas. Place precast circular concrete collar over riser cap (Ref. Sewer Panel 6). Splices shall be kept to a minimum, but if required, shall be made with an underground connector rated for direct burial service. Should the type of pipe material transition to iron pipe, the tracing wire shall continue over material change and be terminated at an intermediate detector site or at next in-line valve box. Force mains that are installed by a trenchless method (i.e. directional drill), four #14 wires shall be installed with the pipe and connected to the tracer wire at both ends or cad welded to the existing iron pipe at both ends.

Prior to scheduling a final inspection with BCWS, the Contractor shall demonstrate that the locator wire functions properly by providing BCWS with a certificate of continuity test from a third party.

G. Force Main Manifolds: When necessary to manifold a FM to an existing FM the following criteria must be met in addition to approved design engineer's recommendations.

1. Connection to existing FM must be with P-401 coated DIP wyes/sleeve/bends or approved equal coating. Coordinate with BCWS for scheduled shutdown of appropriate lift stations at least 72 hours prior to scheduled tie-in. Should hold times not be enough to complete manifold work, contractor must have a bypass plan approved prior to work. Contractor responsible for installing additional line restraints where needed on existing line when making a manifold tie-in for FM.

2. 100% fully ported plug valve must be installed beyond wye connection on the new leg of force main and valve box installed to grade.

3. Tracer wire must be brought to grade out of valve box used for plug valve.

4. Any deviations to this connection type shall be specified on plans and approved by BCWS prior to any connection.

5. It must be determined by the Engineer of Record if there are differential pressures that would require a check valve as part of the manifold tie-in and approved by BCWS.

H. Force Main Hydrostatic Testing and final acceptance: FM testing specifications are outlined in Appendix G 02734 for acceptance unless otherwise specified and approved by BCWS. If newly installed line has successfully passed testing after construction but fails to receive a permit to operate issued by SCDHEC within 1 year, BCWS will require the line be hydrostatically tested again.

3.5 THRUST RESTRAINT

A. All sections of sanitary sewer force main identified as "PVC" or "DI" on the Drawings is to be constructed of standard pipe and ductile iron fittings as specified in this Section. All associated plugs, caps, valves, tees, branches, and bends utilized in conjunction with PVC or DI force mains are to be restrained.

B. All sections of force main that are to be restrained in accordance with BCWS standards are to be clearly identified on both the construction and record drawings.

C. Provide additional thrust restraint at any other points where, in the opinion of the Engineer, hydraulic thrust may develop (Refer to Common Panel 3).

D. Ductile Iron Push-on Joint Pipe, Fittings, and Valves – U.S. Pipe FIELD LOK® Gasket; American Cast Iron Pipe Company Fast-Grip® Gasket; or equal as approved by BCWS.

E. Ductile Iron Mechanical Joint Pipe, Fittings, and Valves – Provide retainer glands (Megalug®, Series 1100 manufactured by EBAA Iron, or equal approved by BCWS) where required and/or shown on the Drawings. Retainer glands shall be installed in accordance with the manufacturer's recommendations.

F. PVC Push-on Joint Pipe, Fittings, and Valves – EBAA Iron Sales, Inc. Series 2000PV, Series 2800, Series 1600, Series 2500; or equal as approved by BCWS.

3.6 INSTALLATION - BORE AND JACK CASING

Where required by SCDOT permit, install steel casing pipe under highway using the bore and jack, or similar tunneling method that has been reviewed and approved by the Engineer. Thread and support ductile iron sewer pipe through casing at location and grades as indicated on the Drawings. Refer to the additional specifications on steel casing pipe in Appendix G Section 02665 Potable Water Mains. Steel casing sizing for sewer force mains will be the same as potable water main casing sizing unless otherwise specified by BCWS

3.7 INSTALLATION – AIR RELEASE VALVES AND MANHOLES

A. Automatic air release valves shall be placed at high points in the sewer force main to prevent air locking. No above grade ARV pedestals allowed unless specifically approved by BCWS.

B. Install air release valves in precast flat top manholes with composite frames and covers. Install a tracer wire dummy valve box/intermediate detector site within 3 feet of ARV manhole. Concrete valve markers shall be installed at every valve location unless otherwise noted by BCWS.

C. Install valves and manholes as shown on the Drawings or as directed by the Engineer. ARV manhole cover to be offset of ARV assembly where entry into the manhole is possible for maintenance and ARV blow off

shall be pointed away from entry point. Shut off valve shall be oriented for ease of access from entry location. Clean valve interiors of all foreign matter before installation. Inspect valve in both opened and closed positions to ensure that all parts are in proper working condition.

D. Provide thrust restraint as specified in paragraph 3.5 of this Section.

E. Coat air release manholes and pipes inside air release manholes with approved Epoxy Coating at 40-50 mils Dry Film Thickness for Sherwin Williams Duraplate 6100 or 120 mils nominal thickness for Raven Epoxy 405. Entire manhole shall be coated below the frame. No portion of the ARV/valve assembly or frame and cover shall be epoxy coated. See Appendix F29 BCWS Approved Parts List.

3.8 INSTALLATION – PLUG VALVES

Install plug valves on force mains in lieu of gate valves. Plug valves shall be 100% port eccentric models. No exceptions.

3.9 PAVEMENT REPAIR AND REPLACEMENT

A. Replace or repair all surface courses on roads and routes, sidewalks and driveways that are removed or damaged in the construction of this project. Repair or replace pavements in accordance with S. C. Department of Transportation's Standard Specifications for Highway Construction.

B. Repair cuts transverse to surfaced roadways and driveways using a minimum of eight inch thick stabilized aggregate base course topped with (1) 200 lbs./sq. yd. of hot plant mix asphaltic concrete or (2) six inch thick cast-in-place concrete, as appropriate to match pre-existing condition and as required by the Engineer and permitting agency.

C. Maintain all replaced or repaired bituminous paving and concrete paving, for a period of two (2) year following acceptance of the project.

D. Maintain traffic on all roads and routes which must be crossed by sewer lines. If the open cut method is used, either (1) make two separate cuts to allow one lane open to traffic at all times, or (2) provide suitable detour.

E. Place excavated material on the traffic side of the trench forming a barrier between vehicular traffic and the construction trench. Otherwise, utilize moveable barricades, which can be relocated as the work progresses.

F. Provide construction signs, guards, flashing warning lights and flagmen in accordance with the S.C. Department of Transportation's regulations and guidelines.

3.10 PROTECTION OF FINISHED WORK

Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

3.11 WORK WITHIN PUBLIC RIGHT OF WAY

Work in public rights of way shall be in accordance with the encroachment permit issued by the controlling entity. All work in the rights of way shall be complete within 500 feet of the forward progress unless the encroachment permit dictates more stringent requirements. The Engineer will suspend work if the 500 feet requirement is not met. In determining this level of completion the Engineer will evaluate the final grading and erosion and sedimentation compliance.

3.12 BCWS UTILITY EASEMENT

Permanent BCWS easements shall require reasonable access at time of final acceptance for use of BCWS maintenance equipment. BCWS must have access to maintain lines in operation.

END OF SECTION