

SANITARY GRAVITY SEWER LINES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Sanitary sewer lines, manholes, fittings, accessories, and bedding
- B. Municipal sewer service connections and clean-out access
- C. Bore and jack casing
- D. Creek crossing

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 02731 – Sanitary Gravity Sewer Lines Testing
- H. Section 02733 – Sanitary Sewer Force Mains

1.3 DEFINITIONS

- A. Bedding: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.
- B. Foundation Stone: Aggregate material placed under bedding material due to over excavation, or removal of unsuitable material.

1.4 REGULATORY REQUIREMENTS

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

PART 2 PRODUCTS

2.1 GENERAL

- A. Unless otherwise specified, all methods of work and materials used in the work under this contract will conform to the current specifications of the American Society for Testing Materials (ASTM), the American Water Works Association (AWWA), the American National Standard Institute (ANSI), Commercial Standards (CS), or other design standards as approved by SCDHEC.

2.2 PIPE MATERIALS

- A. Ductile Iron Gravity Sewer Pipe:
 - 1. Pipe: ASTM A-746, latest revision, AWWA C150 (ANSI A 21.50), thickness class 52 for all sizes.
 - 2. Joints: AWWA C111 (ANSI A21.11), push-on joints, push-on restrained joints, and mechanical joints as required, except as otherwise specified or indicated on the Drawings, such as carrier pipe threaded through steel casing under highways and railroads.
 - 3. Fittings: Conform to AWWA C110 (ANSI A21.10).
 - 4. Lining: Protecto 401™ by Vulcan Painters for all ductile iron pipe, joints, and fittings in accordance with specifications provided by Protecto 401 Ceramic Epoxy Company.
 - 5. Coat exterior of the pipe and fittings with an asphaltic material approximately one (1) mil thick.
- B. PVC Gravity Sewer Pipe:
 - 1. Pipe: ASTM D3034, D1784 and D2241, latest revision, (SDR-26), cell classification 12454-B or C, with factory fabricated integral bell, 8 inch through 15 inch sizes. DR-18 C900 PVC for deep sewer installation (greater than 15 feet), and DR-18 C905 PVC for pipes 14" and larger. PVC pipes shall be green in color.
 - 2. Joints: AWWA C111 (ANSI A21.11), push-on type rubber gasket joint devices.
 - 3. Fittings: ASTM D3033 and D3034. Same materials as pipe. Must be molded. Welded or fabricated fittings are not approved.

C. Plastic Service Pipe: ASTM D3034, SDR-26, , Poly Vinyl Chloride (PVC) material; 4 inch and 6 inch sizes, push-on joint.

D. Steel Casing Pipe:

1. Pipe: ASTM A139, grade B with minimum yield strength of 35,000 psi; Exterior of the pipe shall be coated with coal tar epoxy coating or bituminous coating.
2. Material and installation method: Conform to applicable highway encroachment permits and SCDOT Utility Accommodations Policy.
3. Size: The diameter of the casing shall be at least 12" larger than the maximum carrier pipe diameter (including all fittings).
4. Spacers: A minimum of two spacers per joint of pipe shall be used.
5. Minimum wall thickness:

D.I. Carrier Pipe (Push-on Restrained Joint) Nominal Diameter (Inches)	Coated Casing Pipe (Welded Steel) Nominal Diameter (Inches)	Coated Casing Pipe (Welded Steel) Nominal Thickness (Inches)
6	24	0.407
8	24	0.407
10	30	0.469
12	30	0.469
14	30	0.469
16	36	0.532
18	36	0.532
24	42	0.563
30	48	0.688

Note:

1. Casing pipe specifications and carrier pipe clearances are more stringent for railroad crossings.
2. For piped drainage crossings, downsizing of casing will be considered and accepted by BCWS on a case by case basis as long as load bearing capacity is reviewed and determined by Design Engineer. Steel casing is not required when crossing above piped drainage.

2.3 PRECAST MANHOLES

A. General:

1. Construct all sanitary sewer structures of precast reinforced concrete manhole sections conforming to standard specification ASTM C478 with circular confined rubber "O-ring" gasket joints or mastic seal, and flexible pipe connectors, both conforming to ASTM C443, C990 and C923.
2. Clear inside diameters:

Pipe Size	Manhole Diameter
8" - 12"	4'
14" - 18"	5'
21" - 30"	6'
36" or Larger	7'

Additionally, 5 feet minimum inside diameter for manholes over 12' deep and 5 feet minimum for inside drop manholes on main line runs. Manholes between 8' and 12' deep may require 5 feet minimum diameter manholes if determined by BCWS.

For 6" service installation in manholes 10' deep or greater, inside drops are allowed. In those cases 5 feet minimum inside diameter is required. All other services tying into manholes shallower than 10' should enter near invert of manhole and only requires 4 feet diameter manhole.

3. Use larger manhole diameter if number of pipes entering and exiting or if the inlet and outlet angles reduce concrete between openings to less than 12 inches.
4. Wall thickness: 1/12th the inside diameter, but not less than four (4) inches.
5. Monolithic base thickness: 6 inches or greater for 4 foot diameter manholes; 8 inches or greater for 5 foot and 6 foot diameter manholes.
6. Eccentric cones: Use for all manholes 5 feet deep and greater; cone height not less than 32 inches nor greater than 48 inches.

7. Concentric cones: Avoid use if possible; use for manholes less than 5 feet deep or when drop inlets create a conflict with manhole joint locations; cone height not less than 16 inches nor greater than 20 inches.
8. Alternate for concentric cones or when less vertical height is necessary: flat top slabs with 24 inch diameter eccentric circular opening; thickness to be same as monolithic base but not less than 8 inches.
9. Minimum outside diameter at top of cone: Not less than 37.5 inches; allow for adjustment to finished grade with standard size concrete rings; limit adjustment to 2 rings maximum (not to exceed 8 inches).
10. Minimum access diameter: 24 inches.

B. Materials:

1. Aggregate: Sound, crushed, angular stone only; reference ASTM C-33, except that requirement for gradation does not apply; smooth or rounded stone (river rock) is not acceptable.
2. Cement: Type II, with a maximum tricalcium aluminate content of 8%. Submit certification and mill reports to the Engineer to assure cement quality.
3. Fly Ash: ASTM Designation C618 for Class C Fly Ash; may be added to concrete mix, but not as replacement for more than 10% of the cement; strengths as required by ASTM C478.
4. Compression tests: Furnish test results to the Engineer on one section for every production day in which fifteen or more sections are poured.
5. Absorption test: Furnish test reports to the Engineer showing that absorption does not exceed 6%.

C. Flexible Pipe Connections:

1. Join inlet and outlet pipes to the manhole with a synthetic rubber boot; boot must create a watertight seal with both manhole and pipe while allowing differential settlement.
2. Minimum material thickness: 0.375 inch.

3. Allowable deflection: Shall be within the manufacturer's recommendations.
4. Conform to ASTM C923.
5. Metallic accessories: Series 300 stainless steel.

D. Sealants:

1. Joint manhole sections with RAM-NEK joint sealant as directed by the manufacturer. See Appendix F29 BCWS Approved Parts list.
2. Wrap outside of the bell and spigot joint with RUB'R-NEK or WrapidSeal by Canusa.

E. Frames and Covers:

1. Conform to ASTM Specification A-48.
2. Frame and cover design: Pattern approved by the Engineer with the word(s) "Sewer" and "BCWS" cast in the cover. (Sewer Panel 2H).
3. Please see Appendix F29 BCWS Approved Parts List for approved standard, traffic-rated, watertight and hinged frames and covers.
4. Manhole steps: Plastic reinforced (M.A. Ind. PS1), extruded aluminum, or cast iron; spacing and orientation as indicated on drawing details. Manhole steps are not required but can be installed.
5. Private Manholes: All manholes that are permitted on the private side of a sewer main project shall not have BCWS stamped on the cover installed. Private manholes shall follow all other public manhole specifications.
6. Manholes that fall within paved or concrete areas must have watertight frame and cover. Should existing MHs that are used for new project tie-ins now fall under pavement or concrete, developer/contractor would be responsible for replacing frame and cover with watertight models.

F. Coatings:

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. 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. Coat receiving manholes at pump station sites approved Epoxy Coating at 125 mils for Sherwin Williams or 120 mils nominal thickness for Raven. 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. Additional coating of manholes may be required.

2.4 PIPE ACCESSORIES

- A. Pipe Joint Couplings: Mechanical clamp ring type, stainless steel expanding and contracting sleeve, neoprene-ribbed gasket for positive seal.
- B. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tees, bends, elbows, clean-outs, reducers, traps and other configurations.
- C. Locator Tape for Gravity Sewer: 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.
- D. Transition between DI and PVC: MJ sleeves or ductile iron push-on couplings with Protecto 401 lining on existing gravity main applications. Fernco or similar couplings are not allowed. Molded PVC or DI transition fittings may be used on the installation of new gravity mains. See Appendix F29 for approved fittings. For 6" service installation on gravity mains 10" or greater with depth over 15' deep, DIP tees with Protecto 401 lining are required. Currently there are no fully molded thick wall PVC fittings available for larger diameter pipe and fabricated thick wall fittings are no longer acceptable at that depth.

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, electric arc furnace slag material suitable for use in pipe bedding, cinders, crushed stone, and crushed shells. Bedding shall be inert in that it shall not deteriorate over time due to chemical contact or electrolysis.
- C. Haunching Stone:
1. Class I - Angular, 6 to 40-mm (1/4 to 1 1/2-in.) graded stone.
 2. 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.
- D. Initial Backfill to Top of Pipe:
1. Class I - Angular, 6 to 40-mm (1/4 to 1 1/2-in.) graded stone.
 2. 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.
- E. 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.
- F. 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 haunching and initial backfill. Compaction of the haunching and 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).
- 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, ASTM A746 and manufacturer's instructions.
- B. Lay pipe in an upstream direction to the appropriate line and slope gradients noted on profile drawings, with maximum variation from true slope of 0.02%. Final slope must meet or exceed SCDHEC minimum slope requirements. Position bell end of pipe in upgrade direction.
- C. Refer to ASTM D2321 for additional trenching and backfill requirements. Do not displace or damage pipe when compacting.
- D. Warning Tape for Gravity Sewer: Place continuous 6" wide brightly colored warning tape, imprinted to read in large capital letters "CAUTION - BURIED SEWER LINE BELOW", or other similar wording approved by BCWS, over all new piping, 24" below finish grade.
- E. Connect service tee-wyes, piping, and cleanouts as shown on the plan sheets.
- F. Water shall not be allowed to run through the pipe or stand in the trench.
- G. PVC in steel casing shall be used when:
 - 1. Crossing beneath storm drainage pipe with less than two feet of clearance;
 - 2. Crossing certain SCDOT maintained roads. See SCDOT Utilities Accommodation Manual for guidelines.
- H. Selection of pipe materials shall comply with the following:
 - 1. Less than three feet (< 3') of cover: class 52 DIP;
 - 2. Greater than 3 feet but less than 15 feet (>3' but <15') in depth: SDR-26 PVC and in accordance with the crossing requirements listed above.
 - 3. Greater than 15 feet but less than 24 feet (>15' but <24') in depth: DR-18 C900 PVC;
 - 4. Greater than 24 feet (>24') in depth: class 52 DIP.
- I. Sewer Line Relationship to Water Mains: In accordance with SCDHEC Regulation 61-67.
 - 1. There shall be no physical connections between a public or private potable water supply system and a sewer, or appurtenance thereto which may permit the passage of any sewage or polluted water into the potable supply. No potable water pipe shall pass through or come into contact with any part of a sewer manhole.
 - 2. Sewers 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 the sewer main is laid in a separate trench.

3. Sewers 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.
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.

3.5 INSTALLATION - MANHOLES

- A. Place precast manhole sections in accordance with ASTM C891 and manufacturer's recommended practice. Ensure that manhole steps are properly spaced and aligned. Begin construction of each manhole as soon as pipe laying is complete.
- B. Build up manhole inverts to properly take care of the flow through manholes and to lessen the drop from one sewer to another. Stop all water flowing through manholes before building inverts.
- C. Drop manholes are required where the invert differential is 18 inches or more.
- D. Set manhole tops at elevations shown on the drawings or as determined by the Engineer for each individual manhole. Leveling and final grading of manhole frames and covers shall be accomplished by using concrete rings. Concrete rings shall not exceed maximum of two 4" concrete grade rings or one 6" grade ring. The total height of grade rings shall not exceed 8" in thickness.
- E. Manhole top elevations shall be greater than or equal to the fifty (50) year flood elevation, unless watertight covers are provided. Watertight covers shall be provided if manhole is installed in an area that may be affected

by street runoff (i.e. pavement, driveway, sidewalk, etc.), a natural drainage area or ditch that is subject to flooding.

- F. Where sewer main is installed in an overgrown area that will not be developed in the future (i.e. wetlands, heavily wooded area, buffer zones, etc.), manhole top elevation may be allowed to be installed 2' above the finish grade. Hinged or swivel manhole frame and cover shall be used. Water-tight hinged manhole frame and cover shall be used if the manhole top elevation is below the fifty (50) year flood elevation. Hinged manhole frames shall be red head anchored at two points.
- G. Set cast iron frames in mortar with even bearing.
- H. Ensure that manhole construction keeps pace with sewer line construction. If, in the Engineer's judgment, manhole construction is not keeping pace with the pipe laying, pipe laying may be stopped until the manhole construction catches up.
- I. Plug new connections to existing manholes and/or existing pump stations to minimize the inflow of water or materials into the existing collection system. Leave newly constructed manholes clean and in good working order. Maintain such conditions throughout the construction period. Unplug the new connections in the presence of a BCWS representative after the Permit to Operate for the new system has been obtained. BCWS open fixture ordinances will be enforced when a violation is discovered.
- J. Where a drop installation is required when tying into an existing manhole, use inside drop for 6" inlet for service installation or 8" and larger inlet for main lines. If the existing manhole is not a precast concrete manhole or is in poor condition as determined by BCWS, the existing manhole shall be replaced. Drop installation is prohibited on existing manholes less than 10' deep unless specifically approved by BCWS.
- K. Where a drop installation is required when constructing a new manhole, use inside drop and 5' minimum diameter manhole. Outside drop installation is prohibited. If more than one inside drop inlet is installed in one manhole, the manhole shall be 6' or larger in diameter. Drop installation is prohibited on manholes less than 10' deep unless specifically approved by BCWS.
- L. Contact BCWS for an inspection on a dog house manhole immediately after it is installed.

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.

3.7 INSTALLATION - WATER CROSSING

Install ductile iron sewer pipe below water level using subaqueous trenching and pipe laying techniques that have been reviewed and approved by the Engineer. Ensure that pipe is installed at location and grades indicated on the drawings.

3.8 INSTALLATION - SERVICE CONNECTIONS

- A. Location: Layout and install service connections as directed by the Engineer.
- B. Description of Service Connection Components: 8 inch by 6 inch service tee-wye; 6 inch fittings as required to achieve minimum slope and proper direction of flow; sufficient length of 6 inch service pipe to reach the property line of lot(s) to be served; end fitting(s) (6 inch by 4 inch wye or a 6 inch by 4 inch double-wye with plug(s) for residential services, and 6 inch by 6 inch wye or double-wye for commercial projects); five feet of metallic locator tape; and a two foot long marker stake (treated 2 inch by 4 inch lumber, two feet above grade).
- C. Install in accordance with ASTM D2321 and connection details shown on the Drawings.
- D. Required Record Measurements: Provide the Engineer with two measurements for each service: (1) distance from the nearest property corner to the cleanout, and (2) distance from the centerline of the gravity sewer main to the cleanout.
- E. New service connections to be made on existing mains requires the use of a DI tee where depth is greater than 15' and main line is 10" or larger. SDR-26 fully molded tee wye fitting for service connections less than 15' deep, and C900 DR-18 thick wall fully molded tee wye fittings for all other service connections greater than 15' but less than 24' on 8" gravity mains. All DI fittings are to be lined with Protecto 401 ceramic epoxy lining or approved equivalent. When depth allows, molded PVC repair couplings may be used for the sleeved joint connections with the existing main. When depth does not allow, DI MJ solid sleeves must be used for the sleeved joint connections. See F29 BCWS Approved Part List for approved fittings.

- F. Every commercial building or residential lot that may become a separate parcel under Berkeley County Code of Ordinances shall be served with individual potable water and/or sanitary sewer service connections. Multi-stories apartment complexes shall have a master service for each building. For commercial developments, consult with BCWS in the pre-design phase of the project.
- G. A 4" elder valve shall be installed on any residential sewer service that is installed in a project that BCWS will not own and operate the water system and does not have a service shut-off agreement with the water provider.
- H. Mark curb with the letter "X" for locations of sewer services. Markings shall be stamped and no more than 1/2" deep, located on top of the curb. Markings shall not be located too close to an existing joint in the curb and shall not extend across the whole curb/gutter section.
- I. Mark curb with the letter "MH" for locations of manholes. Markings shall be stamped and no more than 1/2" deep, located on top of the curb. Markings shall not be located too close to an existing joint in the curb and shall not extend across the whole curb/gutter section.

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 the current S. C. Department of Transportation's Standard Specifications for Highway Construction.
- B. Repair cuts transverse to surfaced roadways and driveways using a minimum of an 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 current 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.

END OF SECTION