Technical Specification 022

WASTEWATER FORCE MAINS

1.0 General

a) It is the intent of this specification to provide technical guidance for the proper material selection and installation for all waste water force mains that are installed in the service area of the Brunswick County Public Utilities Department.

b) The design engineer should have a thorough understanding of the North Carolina DEQ/DWQ document "*Minimum Design Criteria for the Fast Track Permitting of Pump Stations and Force Mains"* in order to ensure state rules are met for force main design.

c) Refer to Design Section Part C of this *Brunswick County Engineering Design Manual, Technical Specification and Standard Details for Water and Sewer Systems* for design guidance for waste water force mains permitted and constructed in the service area of Brunswick County Public Utilities.

d) Except when necessary in making connections to other lines the contractor shall install all force main piping with the pipe bells facing in the upstream direction within the bell-and-spigot assembly.

2.0 Materials for Construction

a) All materials used for force main construction shall be of good quality and, to the maximum extent possible, manufactured in the United States. Any materials deemed unsuitable by county staff or the Engineer shall not be used by the contractor.

3.0 References

a) ASTM D1784 – Rigid PVC Compounds and Chlorinated PVC (CPVC) compounds

b) ASTM D1785 - PVC plastic pipe, schedules 40, 80 and 120

c) ASTM D2241 - Poly (Vinyl Chloride) (PVC) plastic pipe (SDR-PR)

d) ASTM D3139 - Joints for plastic pipe using elastomeric seals

e) ASTM F477 - Elastomeric seals for jointing plastic pipe

f) ASTM D2467 - Socket Type PVC plastic pipe fittings - Schedule 80

g) ANSI / AWWA C151 / A21.51 – Ductile Iron Pipe (DIP)

h) AWWA C600 - Standard for Installation of Ductile Iron Pipe (DIP)

i) AWWA C605 - Standard for Installation of Polyvinyl Chloride Pipe (PVC)

4.0 Pipe Materials

a) Force main piping shall be:

1) 4 – 60 inches: Polyvinyl Chloride (PVC), AWWA C900, DR-18 minimum

2) Ductile Iron Pipe, (DIP), ANSI/AWWA C150/A21.50, ANSI/AWWA C151/A21.51 (only with express written permission of Brunswick County Utilities or Engineering Department)

3) Fusible Polyvinyl Chloride, (FPVC), ASTM cell classification 12454, Fusible C900 with minimum DR 18 for 4 – 12-inch diameter; Fusible C905 with minimum DR 18 for 14 – 24-inch diameter; Fusible C905 with DR 25 for 30-inch diameter; Fusible C905 with DR 32.5 for 36-inch diameter

4) High Density Polyethylene, (HDPE), PE 4710, ASTM D2239, minimum DR-9

5) Polyvinyl Chloride (PVC), Schedules 40 and 80, ASTM D1785.

b) Minimum force main piping size: 4 inch (unless written approved low-pressure sewer mains).

c) DIP shall be lined internally with Protecto 401, Ceramapure PL90, ceramic epoxy lining or written approved equal for internal corrosion resistance.

d) DIP shall have an exterior bituminous asphaltic coating for corrosion resistivity.

e) DIP pressure class per pipe size shall be:

Pipe Size (inches)	Pressure Class (psi)
4 - 12	350
14 - 20	250
24 - 64	200

f) PVC sewer force main piping shall be factory dyed industry standard green to aid in field identification. PVC reuse effluent transmission piping shall be factory dyed industry standard purple to aid in field identification. HDPE piping shall have a factory applied green strip. All pipe used for force main construction shall be labeled or otherwise identified as conveying wastewater per NCDEQ *"Minimum Design Criteria for the Fast Track Permitting of Pump Stations and Force Mains".*

g) HDPE pipe shall conform to ASTM D3035 and ASTM F714 with PE 4710 material

h) HDPE force mains shall be joined by the thermal butt fusion method in accordance with ASTM A2657 and the manufacturer's installation recommendations.

i) Fusible PVC force mains shall be joined by the thermal butt fusion method in accordance with ASTM D638 and the manufacturer's installation recommendations.

j) All piping shall be clearly marked with Manufacturer, Type, Pressure Class and/or DR number, and date of production.

k) Avoid prolonged exposure of PVC and Fusible PVC piping to ultraviolet (UV) exposure. Any piping obviously "dulled" in color due to prolonged sun exposure shall be not be used.

l) All PVC force main piping installed within the NCDOT rights-of-way shall be a minimum DR-18 rated pipe.

5.0 Materials and Requirements for Restrained Joints, Piping, and Fittings

a) Restrained joints are required to prevent movement of system piping caused by forces in or on buried piping, tees, valves, branches, bends, plugs, etc.

b) Restrained joints shall be installed as shown on the approved plans, standard details, or as directed by county staff or the engineer.

c) Concrete thrust blocking shall be installed as shown on the approved plans, standard details, or as directed by county staff or the engineer.

d) All carrier pipe installed inside a casing shall be pressure class 350 ductile iron pipes per county standard details with restrained joints.

e) All restrained joint systems shall have a pressure rating equal to or greater than that of the pipe on which they are installed.

f) Restraint type gaskets that provide internal restraint by means of stainless-steel inserts embedded within the gasket are not permitted for use in Brunswick County.

g) <u>Polyvinyl Chloride Pipe (PVC)</u>

1) Install restraints in strict accordance with the manufacturer's recommendations.

2) External bell restraint harness shall have ductile iron glands. The dimensions of the gland shall be such that it can be used with the standard mechanical joint bell. Twist off nuts with preset factory torque setting shall be used to ensure proper actuation of the restraint device. All nuts, bolts, and fasteners shall be high strength alloy steel.

Mechanical joint restraints shall conform to ANSI/AWWA A21.11/ C111 and ANSI/AWWA A21.53/C153, latest revision.

The restrained joint system shall be a manufacturer's standard restrained joint system manufactured by EBAA Iron, Inc., Smith-Blair, Inc., JCM, Inc., or written approved equal.

3) Restraint for valves and fittings shall have ductile iron glands. Twist off nuts with preset factory torque setting shall be used to ensure proper actuation of the restraint device. All nuts, bolts, and fasteners shall be high strength alloy steel.

Mechanical joint restraints shall conform to ANSI/AWWA A21.11/C111 and ANSI/AWWA A21.53/C153, latest revision.

The restrained joint system shall be a manufacturer's standard restrained joint system manufactured by EBAA Iron, Inc., Smith-Blair, Inc., JCM, Inc., or written approved equal.

4) Stainless steel rodding and fasteners, Type 304 minimum, is acceptable per county standard details. Manufacturer's restraint system and/or glands are preferred in lieu of rodding.

h) Ductile Iron Pipe (DIP)

1) Must have written permission of county staff to use DIP.

2) Install restraints in strict accordance with the manufacturer's recommendations.

3) All ductile iron horizontal directional drill and bore-and-jack installations shall use boltless, integral, positive locking restraint systems that allow for joint deflection and disassembly should the need arise. The restrained joint system shall be a manufacturer's standard restrained joint system such as American (Flex-Ring or Lok-Ring), U S Pipe (TR-Flex), or Griffin (Snap-Lok), or written approved equal.

Note: the boltless, integral, positive locking restraint systems are also acceptable for use in open cut pipe installations.

4) External bell restraint harness shall have ductile iron glands. The dimensions of the gland shall be such that it can be used with the standard mechanical joint bell. Twist off nuts with preset factory torque setting shall be used to ensure proper actuation of the restraint device. All nuts, bolts, and fasteners shall be high strength alloy steel. Mechanical joint restraints shall conform to ANSI/AWWA A21.11/C111 and ANSI/AWWA A21.53/C153, latest revision.

The restrained joint system shall be a manufacturer's standard restrained joint system manufactured by EBAA Iron, Inc., Smith-Blair, Inc., JCM, Inc., or written approved equal.

5) Restraint for valves and fittings shall have ductile iron glands. Twist off nuts with preset factory torque setting shall be used to ensure proper actuation of the restraint device. All nuts, bolts, and fasteners shall be high strength alloy steel. Mechanical joint restraints shall conform to ANSI/AWWA A21.11/C111 and ANSI/AWWA A21.53/C153, latest revision.

The restrained joint system shall be a manufacturer's standard restrained joint system manufactured by EBAA Iron, Inc., Smith-Blair, Inc., JCM, Inc., or written approved equal.

6) Stainless steel rodding and fasteners, Type 304 minimum, is acceptable per county standard details. Manufacturer's restraint system and/or glands are preferred in lieu of rodding.

6.0 Push On, Mechanical, and Flanged Pipe Joints

a) DIP joints (all joints shall have a minimum two hundred (200) psi pressure rating or be equal to the pressure rating of the pipe):

1) Push on joints with elastomeric gaskets shall conform to ANSI A21.11 / AWWA C111. Joints shall be the integral bell and spigot type connection. Gaskets shall be factory installed integral with the bell joint.

2) Mechanical joints shall conform to AWWA C111. Bolts shall be high strength alloy steel per AWWA C111.

3) Flanged joints shall conform to ANSI A21.11 / AWWA C115. Bolts shall be high strength alloy steel per AWWA C111.

b) PVC joints (all joints shall have a minimum one hundred fifty (150) psi pressure rating or be equal to the pressure rating of the pipe):

1) Push on joints with elastomeric gaskets conforming to ASTM D3139 and ASTM F477. Joints shall be the integral bell and spigot type connection. Gaskets shall be factory installed integral with the bell joint.

7.0 Fittings and Specials

a) Fittings and specials shall be class 54 ductile iron, mechanical joint in accordance with ANSI/AWWA C111/A21.11, ANSI/AWWA CI53/A21.53, with a (200) pounds per square inch minimum pressure rating unless otherwise shown or specified. Ductile iron fittings and specials shall be lined on the interior with ceramic epoxy Protecto 401, Ceramapure PL90, or equal and coated on the exterior with a bituminous asphaltic coating for corrosion resistivity.

b) Provide adaptor glands, gaskets, etc, as required to accommodate any differences in pipe and fitting dimensions.

c) Fittings and specials for HDPE and Fusible PVC shall conform to all applicable ASTM D3261 (HDPE) and other ASTM specifications and all manufacturers' recommendations.

d) In corrosive soils sacrificial corrosion anodes and / or poly wrap shall be required around ductile iron pipe and DIP fittings at the direction of either county staff and/or the engineer.

8.0 Gate Valves

a) Cast iron body, bronze mounted, double disc, resilient seated in conformance with AWWA C509 or C515, with a minimum working pressure of one hundred fifty (150) psi. Valves shall have a two (2) inch operating nut and open left and shall have O-ring seals. Valve ends shall be mechanical joint or push on joint. Gate valves shall be installed in the upright vertical position. Valves shall be manufactured by Mueller, American Darling, Clow Corporation, or written approved equal.

b) Resilient gate valves may be used for tapping an existing, active force main.

c) All force main gate valves shall be set true and plumb and have a valve box centered over the valve per county standard detail.

d) To the maximum extent possible all gate valves shall be located outside of roads, streets, driveways, and other paved areas.

e) Earth fill shall be carefully tamped around each valve box to a distance of four (4) feet on all sides of the box, or to the undisturbed trench face if less than four (4) feet from the valve box.

9.0 Plug Valves

a) Non-lubricated eccentric type with resilient faced plugs, furnished with flanged joint connections for above ground connection and mechanical joints for underground connections, ports shall be 100% port, with a minimum one-hundred fifty (150) psi pressure rating, cast iron body, plugs shall be cast iron or Ductile Iron, of one piece construction, resilient faced, with all exposed nuts, bolts, springs, washers, etc, a minimum Type 316 stainless steel. Plug valves shall be DeZurik, Kennedy, Milliken, Pratt or written approved equal.

b) Valves shall be resilient faced plug valves unless otherwise noted on the plans.

c) All force main plug valves shall be set true and plumb and have a valve box centered over the valve per county standard detail.

d) To the maximum extent possible all plug valves shall be located outside of roads, streets, driveways, and other paved areas.

e) Earth fill shall be carefully tamped around each valve box to a distance of four (4) feet on all sides of the box, or to the undisturbed trench face if less than four (4) feet from the valve box.

10.0 Location of Initial Isolation Valve from a Pump Station

a) Unless otherwise shown on the approved plans, or as directed by the Engineer and/or county staff, the contractor shall install a force main isolation valve within one hundred and fifty (150) feet from a sewer pump station valve vault, and thereafter as shown on the approved plans.

11.0 Valve Boxes and Collars

a) Install per county standard details at each force main valve.

b) Cast iron or ductile iron, screw type, with flared base, length as required for the buried valve, set plumb and true.

c) The word “SEWER” or “REUSE” shall be cast in the cover.

d) The contractor shall spray paint the cover green (sewer) or purple (reuse) after installation.

e) No part of the valve box is to rest on the buried valve bonnet – use masonry support per county standard detail.

f) Install precast concrete ring around valve box in unpaved non-traffic areas per county standard detail.

g) Valve boxes in traffic areas to be AASHTO H-20 load rated and installed per county standard detail.

12.0 Valve Markers

a) Valve markers shall be installed in rights-of-way and utility easements as shown on the county standard details.

b) Valve markers shall be concrete if located in the right-of-way, extend thirty-six (36) inches above finished grade, with the cast MV (main Valve), AV (air release valve), or BO (blow off) facing the nearest street – refer to county standard details. Valve markers in utility easements shall be fiberglass, extend sixty (60) inches above finished grade, and be installed with the flat face facing the valve for installation of the marking decal on the valve marker.

c) Valve marker shall be painted green for sewer force mains and purple for reuse force mains.

d) Concrete valve markers shall have a bronze, stamped, insert on top of marker per county standard detail.

13.0 Force Main Air and Vacuum Release Valves (AVRVs)

a) Combination air / vacuum valves shall be installed on waste water force mains as follows:

1) Air and Vacuum Valve: The air and vacuum valve shall be an ARI, Inc, Model D-025 combination air / vacuum valve, or written approved equal.

2) The contractor shall install the AVRVs as shown on the plans and may need to adjust actual AVRV locations in the field based upon actual field conditions to ensure the AVRVs are installed at the true high points. Actual installed markup drawings shall be maintained by the contractor so that accurate asbuilts drawings can be prepared for the County.

3) The combination air / vacuum valve shall be installed in a five (5) foot diameter precast manhole with a ring and cover assembly, with the manhole lid offset from the AVRV such that the AVRV is not directly underneath the access opening, or in a Quazite or GlasMasters polymer concrete box, or written approved equal, Tier 22 rating for both the box and cover, with the box opening offset from the ARV such that that ARV is not directly underneath the access opening, per County Standard Details for air release valves.

4) Maintain adequate cover over force mains at AVRV installations to ensure top of manhole or polymer concrete box is flush with the surrounding ground. The contractor shall adjust the force main depth to ensure adequate cover for the AVRV assembly per County Standard Details.

5) The combination air / vacuum valve shall allow unrestricted venting or re-entry of air during filling or draining of force main. The valve shall have a large orifice for the air & vacuum function and a smaller orifice for the air release function contained within a single valve body.

6) The small air release orifice shall be a Type 304 stainless steel orifice rated for working pressures up to one hundred fifty (150) psi minimum.

7) The combination air / release valve shall exhaust large quantities of air during the filling of the pipeline and automatically close after all the air has been vented.

8) The valve shall continue to release small quantities of air under pressure as needed to vent entrained air, and shall also automatically open to allow atmospheric pressure to re-enter the force main during draining or whenever a negative pressure occurs.

9) The valve body shall have a one (1) inch NPT tap near the bottom to permit cleanout of accumulated debris from the valve body.

10) Valves shall be mounted on McDonald 3800 series stainless steel saddle with Type 304 stainless steel or better valve and nipples.

11) Provide two (2) inch inlet, outlet, and blowoff valve, and one (1) inch flushing drain piping to include a one (1) inch flushing valve.

12) Valve internals to be Type 304 stainless steel linkage with a single float design. Bronze or plastic internal components are not acceptable.

13) The AVRV assembly shall have a stainless-steel pressure gauge installed that is angled for ease of viewing from the manhole or box cover – see County Standard Details.

14.0 Pipe Marking Tape, Locating Wire, and Electronic Marker Balls

a) Marking tape shall be three (3) inches wide, green or purple in color, bearing continuous message "CAUTION SEWER LINE BURIED BELOW" or "CAUTION REUSE LINE BURIED BELOW". Tape shall be made of plastic or other permanent material and shall be buried continuously above the force main at a depth of eighteen (18) inches below finished grade.

b) All force mains shall have a #12 AWG, high strength copper clad steel conductor (HS–CCS) such as Copperhead Superflex, Pro Trace High Flex, or written approved equal, with HDPE insulation, and rated for direct burial. Listed and approved underground connectors shall be used for all splices. The wire shall be brought up into a valve box at 1,000 feet maximum intervals to provide wire access points. The wire shall be taped to the top of the force main at minimum ten (10) foot intervals.

The contractor shall be required to perform a signal strength test of the installed tracer wire at the end of the project with County Engineering and/or Public Utilities staff present. Refer to County Standard Details for tracer wire information.

c) In addition to the tracing wire, electronic marker balls shall be installed on the force main in accordance with Brunswick County Technical Specification TS 035: *Electronic Marker Balls for Water Mains and Sewer Force Mains.*

15.0 Adjacent Facilities

a) Separation of Sewer Force Mains and Water Mains

1) Horizontal and Vertical Separation

Minimum horizontal separation between water mains and sewer force mains shall be ten (10) feet. The distance shall be measured edge of pipe to edge of pipe.

2) Should ten (10) foot separation not be feasible, then the water main may be located closer to the sewer force main provided that:

a) It is laid in a separate trench,

b) It is laid in the same trench with the water main located at one side on a bench of undisturbed earth,

c) In either of case (a) or (b) above, the crown elevation of the force main shall be at least eighteen (18) inches below the invert elevation of water line.

3) When installing a force main above or below a water main or storm drain, all minimum separations and material requirements must be met, as defined by 15 NCAC 02T .0305 and 15A NCAC 18C .0906 (b) and (c); outlined below:

a) Sewer mains shall be laid at least ten (10) feet horizontally from existing or proposed water mains, unless local conditions or barriers prevent a 10-foot separation, in which case;

b) The sewer main shall be DR-18 or better and shall be laid in a separate trench, with eighteen (18) inch minimum separation between the invert of the water main and the crown of the sewer main; or the water main shall be laid in the same trench as the sewer, with the water main located at one side on a bench of undisturbed earth and with the elevation of the bottom of the water main at least eighteen (18) inches above the top of the sewer.

c) When a pressurized sewer main crosses a water main, the sewer main will be built to water main rules (15A NCAC 18C .0906); where one full length of water pipe shall be located so that both joints will be as far from the sewer as possible. If separation requirements cannot be achieved, the sewer main shall be constructed in a manner concurrent with Brunswick County standard detail S-15.

5) Mechanical joints will be required for the transition in the force main at water main / force main crossings. Fernco couplings are not permitted to be used. Special structural support for the water and force mains may be required at the discretion of County staff.

6) Force mains shall not be laid in the same trench with gas lines or electric wiring.

7) No force main shall be placed within twenty-five (25) feet of a well utilized for potable water purposes.

8) Minimum specifications for force mains placed between twenty-five (25) feet and fifty (50) feet of a well utilized for potable water shall meet or exceed the requirements of Class 350 ductile iron pipe with watertight joints conforming to ANSI A21.50/A21.51.

16.0 General Construction Installation

a) Install all force mains as shown on the approved plans to line and grade.

b) Where unsuitable soils are encountered pipe shall be bedded on #57 stone.

c) The contractor is responsible for dewatering all trenches prior to force main installation. Include cost of dewatering, backfill, and erosion control in unit cost for pipe – separate payment for these items will not be made by the County. Stone installation shall not be used as a dewatering device.

d) All jointing of pipe shall be in conformance with the manufacturer's recommendations.

e) Defective pipe and / or fittings shall not be utilized in force main construction.

f) Install all restrained joints in accordance with manufacturer's recommendations.

g) Existing gravity manholes that have sewer force mains entering them shall be polymer concrete or plastic polypropylene to protect against hydrogen sulfide corrosion per Brunswick County Technical Specification TS 020: *Gravity Sanitary Sewer Systems* – Section 5.0 (c) (11). If the existing manhole is concrete, it will be required to either replace the existing concrete manhole with a plastic polypropylene or precast polymer concrete manhole or add an additional polymer concrete or polypropylene transitioning manhole. If a transitioning manhole is installed, the distance between the existing manhole and the transitioning manhole shall be no less than thirty-six (36) inches, unless approved in writing by Brunswick County.

h) New gravity manholes, and transitioning manholes installed to allow a new force main to connect to an existing sewer system, shall be plastic polypropylene or precast polymer concrete sections conforming to ASTM C478 as manufactured by Nyloplast ® ADS, Armorock, Meyer Polycrete, or written approved equal. Riser section joints shall be bell and spigot / ship-lap design with butyl mastic and / or rubber gaskets (ASTM C990) so that on assembly the manhole base, riser(s), and top sections make a continuous and uniform manhole structure. All fasteners, wedge anchors, bolts, hooks, etc., within the manhole shall be Type 316 stainless steel or better – no mild steel will be allowed.

i) County staff must be present at all connections to existing force mains. Forty-eight (48) hours' notice is required to schedule a force main connection.

17.0 Hydrostatic Testing of Force Mains

a) All force mains shall be successfully hydrostatically pressure tested per AWWA standards at a pressure of one and one-half times the rated working pressure, but in no case shall the test pressure be less than one hundred fifty (150) psig for a minimum of two (2) hours.

b) All force main pressure testing shall be witnessed and approved by county staff and / or the engineer.

c) Minimum forty-eight (48) hours' notice is required to schedule a force main pressure test with county staff.

d) Horizontal directional drills (HDD) shall be pressure tested as noted on the county HDD standard details and will be tested a second time as part of the overall system pressure test once the HDD force main has been connected to the installed force main system with the required valves in place at each end of the HDD.