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SECTION 8 SANITARY SEWAGE FORCE MAIN

8.1 GENERAL

- A) This section includes the general requirements for design and installation of force main system serving sanitary sewage pumping stations.
- B) The relevant provisions of other sections of The Standard Specifications shall be applicable to this section unless otherwise indicated herein or approved by the City.

8.2 DESIGN STANDARDS

8.2.1 Reference

The Developer shall comply with the applicable criteria set forth in Water Environment Federation (WEF) Manual of Practice No. 9, Latest Edition; Great Lakes Upper Mississippi River Board of State Public Health & Environmental Managers, "Recommended Standards for Wastewater Systems," Latest Edition (Ten States Standards) and as established by the Florida Department of Environmental Protection.

8.2.2 System Design

Force main systems shall be of adequate size to efficiently transmit the total ultimate peak operational flows from the connected sewage pumping station(s) to the effluent point. Future connections of other pump stations and force mains shall be taken into consideration and coordinated with the City of Groveland. Calculations shall be made for the initially proposed pumping system(s), along with any future flow requirements, if applicable in order to provide adequate pipeline cleansing. Force main flow velocity shall not be less than 2 feet per second at ultimate design capacity. However, with multiple pumping station systems or phase development, this requirement may be difficult to meet. Consequently, special attention shall be given to the interim conditions, as regards cleaning, maintenance, pumping rates, future upgrading of systems by changing impellers, pump changes, parallel force mains and other ways to increase future capability.

Materials

The materials used in this work shall be all new and conform to the requirements for class, kind, size and material as specified below.

Polyvinyl Chloride (PVC) Pressure Pipe and Fittings

- a. PVC Pipe: PVC pipe for force mains shall conform to the requirements of AWWA C-900 (4" through 12"), AWWA C-905 (14" through 36"), and AWWA C-909 (4" through 24") and shall be Class 150 DR 18 for all open cut and direct bury installations with a minimum of forty-eight (48) inches of cover. For shallower depth, the type of pipe and installation shall require prior approval. The manufacturer shall insure all quality control test and AWWA requirements are complied with during the production of PVC pipe.

- b. C-900, C-905, and C-909 pipes shall have an integral bell formed with a race designed to accept the gasket in accordance with their respective AWWA requirements. The spigot end shall have a bevel and a stop mark on the outside diameter to indicate proper insertion depth. Provisions shall be made for expansion and contraction at each joint. All surfaces of the joint where the gasket may bear shall be smooth, free of cracks, fractures, or imperfections that could adversely affect the performance of the joint.
- c. Pipe Color: All C-900, C-905, and C-909 force main pipes shall be green in color with a PVC ASTM D-1120 and ASTM D-2241 reference, the class pressure rating, and the DR number permanently and plainly marked on the pipe.
- d. Rubber Gasket Joints: C-900, C-905, and C-909 polyvinylchloride pipe joints shall be the bell and spigot type using rubber gasket push-on type joints. Rubber gaskets shall be molded to a circular form to the proper cross section and shall consist of a vulcanized high grade elastomeric compound conforming to ASTM D-1869 and AWWA C-900 elastomeric seals for joining plastic pipe.
- e. Fittings: All ductile iron fittings shall be in accordance with AWWA Specification C-153 and as a minimum have the same pressure rating of the connecting pipe. All ductile iron fittings shall be either:
 - Fusion bonded epoxy coated as per AWWA Specification C-116
 - or
 - Ceramic epoxy coated as per ASTM Specifications F-4176-95A, G-95, B-117, D-1308, and E-96

All exposed fasteners such as bolts, nuts, washers, and threaded rod shall be Type 316 stainless steel and all buried fasteners such as bolts, nuts, fasteners, washers, and threaded rod shall be "Cor-Ten" steel or Cor-blue coated. Mechanical joint bolts shall not protrude more than ½ inch through the nut after joints are assembled.

- f. Fastener Threads: All stainless steel fastener threads shall be coated with an anti-seize compound as approved by the City.

Fittings

The mechanical connection to MJ fittings and sleeves shall use mechanical restraints that meet specification requirements. Size-on-size mechanical connection to PVC or DI pipe shall be by compact ductile iron solid sleeves with Mega-Lug restrainers.

No electro fusion fittings shall be used with HDPE unless specific written approval is provided.

HDPE molded butt fittings and couplings for non-standard fittings and coupling shall require special approval for installation.

Ductile Iron Pipe Fittings

- a. The ductile iron pipe covered by this specification shall be the push-on joint type of mechanical joint type, centrifugally cast to conform to all requirements of AWWA Specifications C-151 and C-153, latest revisions.
The maximum allowable deflection of the pipe shall not exceed two percent (2%) of the pipe diameter. Ductile iron pipe will be fully encased in an 8 mil polyethylene sleeve, in accordance with AWWA C-105, Method A. The pipe and polyethylene sleeve shall be color coded green by a means acceptable to the City.
- b. All piping and fittings shall be either:
 - Fusion bonded epoxy coated as per AWWA Specification latest revision
or
 - Ceramic epoxy coated as per ASTM Specifications F-4176-95A, G-95, B-117, D-1308 and E-96
- c. Polyethylene material shall conform to ASTM Standard Specification D1248-68, latest revision. All ductile iron piping shall be marked "DUCTILE IRON" in large letters. The nominal wall thickness shall be plainly marked on each piece of pipe and the pipe installed so that the markings can be read from the top of the trench.

Minimum thickness of ductile iron pipe shall be as follows:

3" Ductile Iron Pipe	0.25"	Class 51
4" Ductile Iron Pipe	0.26"	Class 51
6" Ductile Iron Pipe	0.25"	Class 50
8" Ductile Iron Pipe	0.27"	Class 50
10" Ductile Iron Pipe	0.29"	Class 50
12" Ductile Iron Pipe	0.31"	Class 50
14" Ductile Iron Pipe	0.33"	Class 50
16" Ductile Iron Pipe	0.34"	Class 50
18" Ductile Iron Pipe	0.35"	Class 50
20" Ductile Iron Pipe	0.36"	Class 50
24" Ductile Iron Pipe	0.38"	Class 50
30" Ductile Iron Pipe	0.39"	Class 50

8.2.3 Operational Cost Considerations

In addition to initial capital expenditure, long term pumping station operational costs shall be considered when sizing force main systems or making decisions concerning whether gravity service or lift station service is to be provided.

8.3 INSTALLATION

8.3.1 General

The materials of construction and general installation procedures shall comply with the specific applicable standards set forth under Section 2, "Utility Excavation, Trenching and Backfilling", Section 3, "Jacking and Boring", Section 4, "Directional Drilling", and Section 5, "Pipe, Fitting, Valves and Appurtenances".

Force main piping shall be 4" or larger.

8.3.2 Joint Restraining

"Mega-Lug" restrained joints shall be provided at all bends, wyes, tees, caps, valves, and reducers. If any joints are within the required restrained length they shall be restrained with a restraining harness as required. The restraints will be sized and placed according to the plans or according to the pipe manufacturer's recommendations when not shown on the plans.

8.3.3 Pipe Depth and Protection

The standard minimum cover for sewage force main systems shall be 36 inches from the top of the pipe to finish grade. Where this condition cannot be met, special consideration will be given. Additional depth may be required where future surface improvements are planned or anticipated.

8.3.4 Air and Vacuum Venting

Where the force main profile is such that air pockets or entrapment could occur, such as local high points in the line that could result in flow blockage, provisions for automatic air release and/or venting shall be provided. Where free flow will occur during operation of after pumping stops, combined air release and vacuum valve assemblies shall be provided.

8.3.5 Valve Locations

Valves shall be installed on all subsidiary force mains at the point of connection to the major main and where force mains are to be extended and at intervals not exceeding 1,000 feet. At future connection branches or ends, the valves shall be restrained by methods to facilitate said connection without system shut down.

8.3.6 Force Main Terminations

Force mains shall typically terminate at wet wells, or force mains. Terminations into gravity sewers are discouraged and shall be avoided whenever possible. When this is unavoidable, prior approval is required from the City and provisions shall be made to direct the flow into the flow channels. Branch connections are not permitted.

8.3.7 Clean Out Connections

Should force mains appear to be susceptible to sedimentation clogging, as created by depressed crossings or extended low flow (velocity) periods, suitable clean out connections shall be provided.

8.3.8 Terminal Discharge

Force mains shall enter the termination point at the operational water level of the connecting point. Should an elevation drop be required to obtain the outlet connection, the prior down-slope of the force main shall not exceed 45 degrees, and adequate air venting shall be provided at the profile breakpoint.

8.3.9 Identification

All installed underground sanitary sewage force mains shall be green (PVC) or HDPE, upsized to match or exceed the internal diameter of the connecting pipe and marked with a continuous green stripe located within the top 90 degrees of the pipe.

8.4 TESTING

- A) The Contractor shall perform hydrostatic testing of all sanitary sewage force mains, as set forth below. Testing shall be conducted in the presence of representatives from the City and other authorized agencies who shall be given 48 hours advance notice. The engineer of record shall also witness the testing.
- B) Piping and appurtenances shall be tested in sections between valves or adequate plugs, not exceeding 2000 feet with prior approval from the City. Testing shall not proceed until restraining devices are installed. All piping shall be thoroughly cleaned prior to testing, to clear the lines of all foreign matter. While the pipe is being filled with water, care shall be exercised to permit the escape of air from extremities of the test section and additional release cocks shall be provided where required.
- C) Hydrostatic testing shall be performed at 125 psi for all force mains, unless otherwise directed by the City. The testing procedure shall continue for an uninterrupted period of not less than two (2) hours. Testing shall be in accordance with the applicable AWWA provisions for PVC-AWWA Publication M-23 and for DIP-AWWA Standard C600, Section 4. The allowable rate of leakage shall be less than the number of gallons per hour determined by the following formulas:

PVC

$$L = \frac{ND p^{1/2}}{7400}$$

DIP

$$L = \frac{SDp^{1/2}}{133,200}$$

For 100 psi; test: $L = 0.00135 ND$ (PVC)

For 100 psi; test: $L = 0.000075 SD$ (DIP)

L = allowable leakage in gallons per hour

N = number of joints in section testing

S = length of pipe tested, in feet

D = nominal diameter of the pipe in inches

P = average test pressure in psi, gauge.

- 1) The testing procedure shall include maintaining the specified pressure to within 5 psi of the test pressure, for the two hour period, using a pump taking supply from a container suitable for measuring water loss. The amount of water pumped into the force main shall be determined by measuring the volume displaced from the container.
- 2) Should the test fail, necessary repairs shall be made by the contractor and the test repeated until the test results fall within the established limits. The

contractor shall furnish the necessary labor, water, pumps, gauges, and all other items required to conduct the required sanitary sewage force main testing and shall perform the necessary system repairs required to comply with the specified hydrostatic test.

- 3) Test gauges shall be tested and calibrated for accuracy by an approved method or agency prior to commencing the test.
- D) All tapping saddles/valves shall be subject to a minimum 15 minute pressure test at 125 psi with no allowable leakage.
