

## **CHAPTER 3 - DESIGN STANDARDS FOR SEWAGE PUMPING STATION AND FORCE MAINS**

### **3.1 GENERAL REQUIREMENTS**

3.1.01 The design of sewage pumping stations and force mains is an engineering matter and is not lending to detailed recommendations or requirements, except as herein after stated.

3.1.02 Sewage pumping stations and force mains are to be provided solely for the conveyance of sanitary wastes. Under no circumstances shall any roof, foundation, surface or sub-surface or any other form of storm drainage be allowed to pass through the proposed facilities.

3.1.03 A detailed engineering report shall be submitted to and approved by the Department prior to design. The report shall fully evaluate the proposed sanitary drainage area and the overall effect upon present and future Department facilities.

3.1.04 The design must conform to the minimum standards set forth in the latest Commonwealth of Virginia "Sewerage Regulations." A letter of approval from the Virginia Department of Environmental Quality is required.

3.1.05 City requirements for specific equipment and submittals will be detailed during engineering review.

### **3.2.01 SYSTEM LAYOUT**

A. The sizing and configuration of the pumping stations and the sizing of the attendant force main shall be within the parameters set forth in the engineering report. The facilities to be provided shall be based on ultimate flows unless an interim flow design shall have been incorporated in the approved engineering report.

B. The type of equipment to be installed in the pumping station will be influenced by the interim and ultimate capacity of the station and an evaluation of the period of time that the service of the station will be required. All equipment including pumps, controls, SCADA, electrical, floats, and backup service shall be equal to what the City's Public Works Department is using for new and replacement equipment at the time of plan submittal.

C. An ample, all-weather road, including surface treatment, storm drainage and parking, shall be provided for easy access to the pumping station.

- D. The Architecture of the pumping station shall be considered. Site grading, seeding or sodding, trees or shrubs shall be provided to present a finished appearance, as approved by the Department, consistent with the zoning and general appearance of the surrounding area. Approved security fencing with gates shall be provided. A landscape buffer will be required.
- E. The Design Engineer shall determine the availability of electric service and coordinate the available electrical service with that required for the facility. The engineer shall also determine the need for primary service extension and advise the Department if an extension is necessary.
- F. Emergency pump backup shall be provided in the form of an automatic self-priming diesel powered pumpset.
- G. The Contractor shall provide and coordinate the services of the equipment manufacturer's field service technician for a minimum period of two (2) trips and two (2) days for each piece of equipment. This service shall be for the purposes of check-out, initial start-up, certification, verification of actual pumping rate, verification of pressure settings, and instruction of the Authority's personnel. A written report covering technician's findings and installation approval shall be submitted to the Authority covering all inspections and outline in detail any deficiencies noted. The Contractor shall provide the Authority within 10 days of start-up, a letter from the manufacturer of each item of equipment stating that the equipment has been properly installed and started and that nothing has been done that may violate the warrant.
- H. Contractor/Developer shall provide the City with an adequate supply of spare parts and lubricants to last the duration of the one (1) year warranty period. Spare parts shall include all bearings, gaskets, etc. recommended by the equipment manufacturer. An adequate supply shall be defined as the quantity, type, and grade recommended by the manufacturers who will provide the equipment contained in this section. Any special lubricants that may be required during the equipment break-in period shall also be provided.
- I. The Design Engineer shall determine the "Reliability Class" in accordance with the State "Sewerage Regulations" and shall comply with the requirements thereof.
- J. The Design Engineer shall consider the need for protection of the pumping station and force main against hydrogen sulfide attack

and shall provide the proper equipment if such protection is found necessary.

- K. All motors, motor control, and other electrical equipment shall be housed in a weatherproof, above-ground structure. Adequate provisions shall be incorporated for the proper ventilation, drainage and flood protection in order to insure maximum reliability, electrical and personnel safety.
- L. All pumping station wet wells shall be considered explosion hazardous. All electrical equipment installed therein shall be approved for Nema 7, Class I, Group D. In accordance with Article 500 of the National Electric Code (NFPA No. 70). The use of intrinsically safe controls in accordance with NFPA NO. 493 is satisfactory and its use is encouraged.
- M. Where structurally separate wet well and dry wells are provided, adequate provision for differential settlement shall be incorporated by means of flexible pipe joints consisting of a minimum of at least two standardized mechanical joint bell connections or their approved equivalent.
- N. All pumping stations and equipment replacement shall be of sufficient size and contain adequate clearances to provide ample room for maintenance and equipment replacement.
- O. Force main locations shall generally conform to Chapter 2.2.01 - "System Layout" of these Standards. Force mains shall have a positive slope from the pumping station to the point of discharge unless unusual conditions make it impractical. Extra depth of bury shall be provided in lieu of air or air/vacuum relief valves wherever feasible. Every effort shall be expended to maintain the force main below the hydraulic gradient. Where a relief valve is required, an automatic valve shall be provided and installed inside a standard manhole with adequate means of drainage.
- P. Every effort shall be made to maintain a full force main under operating conditions.
- Q. Sizing of a sewer main shall be such that velocity shall not be below 2 F.P.S. flushing facilities.
- R. All force mains shall be ductile iron.

- S. Design Engineer shall consider ground conditions in the case of metallic conduits and provide suitable cathodic protection where necessary.
- T. Steel casing pipe shall have a minimum yield strength of 35,000 p.s.i. and a minimum internal diameter of 12 inches greater than the largest external diameter of the carrier pipe.

### 3.2.02 Capacity Design

- A. Capacity design for the pumping station and force main shall be based on Chapter 2.2.02 - "System Design" of these Standards, and shall take into consideration such parameters as minimum, average and peak station inflows as well as minimum, average and maximum pumping rates.
- B. Pump selection and force main sizing shall be based on hydraulic analysis of the required flows, pipeline velocities and receiving gravity sewer capacities.
- C. Calculations shall be prepared to include a system friction chart which will show static head and total dynamic head for both single and multiple pump operation. The chart shall also show the pump performance curve for both single and multiple pump operation. Where variable speed pumping is contemplated, pump performance curves shall show performance at maximum speed, minimum speed just above static head, and several intermediate speeds which will clearly indicate pump operation. The system friction curves shall illustrate the effect of wet well level on system friction. Particular attention shall be given to the available versus required net positive suction head (NPSH).
- D. Consideration must be given to designs which produce minimum power requirements to accomplish the functions required. If requested, supporting data shall be furnished to the Department.

### 3.2.03 Structural Design

- A. In addition to conventional design procedure there are several specific areas that must be considered.
  - (1) The effect of hydraulic thrust must be countered by the use of thrust blocking, pipe anchorage or other suitable means to prevent movement of pumping equipment and pipelines.

- (2) Structural requirements for force mains include the proper selection of materials and strengths of pipe and pipe accessories. This will involve a study of anticipated trench conditions and bedding methods. The minimum depth of cover shall be governed by depths of other utilities and hydraulic gradient; however, not less than 3.5 feet of cover shall be provided.

#### 3.2.04 Drawings

- A. Drawings for pumping stations and plan and profiles for force mains shall be prepared in accordance with Section 1.6 - "Drawing Organization and Format."
- B. Drawings and specifications shall be of such quality and contain sufficient details so that no misunderstanding may reasonably arise as to the extent of the work to be performed, the materials to be used, the equipment to be installed, or the quality of the workmanship. Manufacturers of major items of equipment shall be specifically approved. No deviation from the approved manufacturers will be permitted.
- C. Drawings for pumping stations shall include a site plan drawn to a scale of not less than 1 inch equals 20 feet and shall contain existing and proposed contours on a 2 foot contour interval. The boundaries of the site shall be clearly shown on the site plan and shall be permanently monumented in the field prior to completion of construction.
- D. Plans for SCADA and electrical shall be provided.
- E. Drawings for pumping stations shall be drawn on a scale of not less than 1/4" equals 1'-0". Drawings required to clarify construction details shall be drawn on an appropriately larger scale.
- F. Drawings for force mains shall show stationing, pipe size, bearings, direction of flow, deflection angles and curve data.
- G. Profiles for force mains shall show the ground line, force main profile, underground utility lines and structures that might affect force main depth. It shall also show areas where additional depth will be required, any required vertical curve data and locations of all relief valves and appurtenances. All crossings of existing and proposed water mains shall be shown to clearly indicate vertical clearance between utilities.

- H. Details shall be shown for all blocking, pipe restraints, and for relief valves.
- I. Plans shall show the location of erosion control devices. These devices shall be in conformance with the Virginia Erosion and Sediment Control Handbook and Chapter 7 of these Standards.