

1.5 WASTEWATER PUMP STATIONS AND FORCE MAINS

1.5.01 General Requirements

- A. This section provides the minimum requirements for design of wastewater pump stations and force mains intended for ownership by Goochland County.
- B. Sewage pumping stations and force mains are to be provided solely for the conveyance of sanitary wastewater. Under no circumstances shall flow from any storm drain, roof drain, foundation drain, floor drain, surface drain, subsurface drain or any other form of storm drainage be allowed to flow to, or pass through, the proposed facilities.
- C. The design of sewage pumping stations and force mains is a complex engineering process and is not subject to blanket requirements. For this reason, the specific requirements for each proposed pump station will be handled on a case-by-case basis.
- D. Prior to starting design of any wastewater pump station intended for ownership by Goochland County, the person or entity proposing to design and construct the station (the Developer) must submit detailed documentation of the need for a pump station to the Department for review. Written approval from the Director is required for any privately constructed pump station.
- E. Following approval of a sewage pump station by the Director, the Developer shall submit a detailed Preliminary Engineering Report (PER) for the station to the Department for review. This report shall fully comply with all requirements for an Engineering Report contained in Section 6.1.05. It shall evaluate the proposed sanitary sewer service area, the overall effect of the proposed station on downstream County facilities, and shall justify the proposed station peaking factor. The PER shall provide preliminary hydraulic and mechanical design for the pump station, including preliminary pump specifications, and shall be sealed and signed by a Professional Engineer registered in Virginia.
- F. The design must conform to the minimum standards set forth in the Virginia Department of Environmental Quality *Sewage Collection and Treatment (SCAT) Regulations* for a Reliability Class 1 sewage pumping station. County requirements for specific equipment and submittals will be detailed during preliminary engineering review.
- G. The Developer shall prepare an Operations and Maintenance (O&M) Manual for the station. The O&M Manual shall be prepared in accordance with the Virginia Department of Environmental Quality *SCAT Regulations* and approved by the State (if required) and County before the County will accept the station for operation and maintenance. The manual shall contain complete operating

information for all equipment, a complete set of approved shop drawings and a copy of the record plans for the station. The record plans shall be updated to include all plan revisions and field changes made during bidding and construction. One complete hard (paper) copy of the O&M Manual with a reproducible set of record drawings and one complete electronic (PDF) copy of the O&M Manual and record plans shall be submitted to the County prior to Final Acceptance. Refer to Record Drawing requirements in Section 4.7.

- H. Plats for the property occupied by the pump station and force main shall be prepared and submitted to the Department. The pump station property must be transferred to the County, and all applicable utility easements for the station and the force main must be recorded prior to Final Acceptance of the pump station by the County.
- I. All federal, state, and local permits and approvals must be obtained prior to approval of plans and specification by the County.

1.5.02 Technical Design

A. System Layout

1. The sizing and configuration of the pumping station 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.
2. 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.
3. For sewage pumping stations with an ultimate firm rated capacity of 1.0 MGD or less, the Department will consider design and construction of permanent pumping stations using wet-well(s) and submersible pumps in accordance with Standard Detail PS-1. For stations with a capacity greater than 1.0 MGD, only a wet well/dry well configuration will be accepted.
4. Submersible pump stations shall use centrifugal, non-clog submersible pumps capable of handling 3" spherical solids, with 3-phase motors unless otherwise approved in writing by the Department. Submersible pumps shall be designed specifically for pumping sewage.
5. Each pump motor shall be rated for inverter duty and controlled by a

variable frequency drive (VFD).

6. Wet-well(s) for submersible pump stations shall be a minimum 6-feet in diameter.
7. A magnetic-type flow meter shall be installed in the discharge piping and analog wet well level indication instrumentation shall be installed to record wet well level and control pump operation.
8. An ample, all-weather road, including surface treatment, storm drainage and parking, shall be provided for easy access to the pumping station.
9. The architecture of the pumping station shall be consistent with the zoning and general appearance of the surrounding area.
10. Buildings shall be precast concrete as manufactured by Smith-Midland or approved equal. The minimum interior dimensions for the building shall be 10 feet x 12 feet. A larger building may be needed depending upon the layout, size and space requirements of equipment in the building.
11. Site grading, seeding or sod, and trees or shrubs shall be provided to present a finished appearance as approved by the County department having jurisdiction.
12. Approved fencing with gates shall be provided to properly protect the facility. Unless otherwise approved, an eight-foot chain link fence with three (3) rows of barbed wire shall be installed around the operational area with at least one 20-foot sliding gate or as otherwise approved by DPU.
13. The Design Engineer shall determine the availability of electric service to the proposed pump station site and coordinate with the power company to provide service to the pump station. The Design Engineer shall evaluate the need for a primary service extension and advise the Department if an extension is necessary. The standard power service for a sewage pump station to be owned by Goochland County is 480 Volt, 3-Phase. Provision of service which does not meet this requirement must be approved in writing by the Director.
14. All pump stations shall be Reliability Class 1 in accordance with the Virginia Department of Environmental Quality *SCAT Regulations* and shall comply with the requirements thereof.
15. Each pumping station shall have a permanently installed emergency

generator and automatic transfer switch sized to power the entire station. The transfer switch shall be installed inside the pump station building. The fuel storage tank shall be sized to operate the entire station with all pumps running for 48 hours continuous operation. Generator shall be mounted outside in a sound-attenuated weatherproof enclosure. Sound attenuation shall be 68 to 70 dB(A) at 23 feet under full load.

16. Generator enclosures with belly tanks shall have a deck around the generator to access all components of the generator. Deck height shall be at the height of the top of the belly tank. Deck shall not interfere with panel removal or maintenance of the diesel engine or generator. Deck shall be built of pressure treated wood with stairs up to the deck and shall be designed by a structural engineer.
17. The Design Engineer shall consider the need for protection of the pumping station, force main, and receiving manholes against hydrogen sulfide attack and odor, and shall provide the proper equipment if such protection is found necessary.
18. All motors, motor control and other electrical equipment shall be housed in a building. Adequate provisions shall be incorporated for the proper ventilation, drainage and flood protection in order to ensure maximum reliability, electrical and personnel safety. The building and/or control cabinets shall have HVAC as required for temperature and humidity control.
19. Pump Control and SCADA Telemetry shall be through a Programmable Logic Controller as specified by the Department. Telemetry shall be to the SCADA Control Center with equipment provided by HSQ or High Tide for compatibility with existing hardware and software.
20. All pumping station wet wells shall be considered explosion hazards. All electrical equipment installed therein shall be explosion proof approved for NEMA 7, Class I, Group D, in accordance with Article 500 of the National Electrical Code (NFPA NO. 70). Intrinsically safe controls shall be specified in accordance with National Electric Code (NEC) requirements.
21. For submersible pump stations, local disconnects for each pump motor and a wet well junction box for level controls shall be provided adjacent to the wet well. No junction boxes shall be installed inside the wet well. Conduits between wet well and junction box shall have gas seals or a

means of venting gases.

22. Adequate provision for differential settlement between wet well and valve vault shall be incorporated by means of flexible pipe joints consisting of a minimum of at least two restrained mechanical joint bell connections or restrained couplings.
23. In all sewage pumping stations over 1.0 MGD an adequate headworks structure, a wet well and a dry well shall be provided. The following items shall also be provided: a control building with employee access via stairs, channel grinders for solids, bar rack for large solids, and a davit hoist for removing screenings from headwork. A maintenance platform shall be provided in each wet well.
24. All handrails, ladders, and grating shall be aluminum.
25. All pumping stations shall be of sufficient size and contain adequate clearances to provide ample room for maintenance and equipment replacement. In wet well/dry well stations a bridge crane shall be provided for removing pumps.
26. The facility shall be connected to a public water supply. An RPZ type backflow preventer shall be installed on the water service. Where a public water supply is not available, a water supply well shall be installed.
27. Force main locations shall conform to Section 1.1. 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 release valves wherever feasible. Every effort shall be expended to maintain the force main below the hydraulic gradient. When this is not possible, all high points shall have a combination air/vacuum release valve installed. Where a release valve is required, an automatic valve shall be provided and installed inside a standard manhole with adequate means of drainage. Adequate access to the manhole must be provided.
28. Every effort shall be made to maintain a full force main under operating conditions. The Design Engineer shall identify and design provisions for any flow away conditions.
29. Isolation valves (plug or resilient seat gate) shall be provided on both sides of all road, rail, and creek crossings, at maximum intervals of 2,000 feet,

and at connection points to other force mains.

30. Sizing of force main shall be such that velocity shall be a minimum of 2.5 feet per second for self-scouring velocity. Maximum velocity shall be 6 feet per second unless otherwise allowed by the Director.
31. Force mains shall be 4 inches in diameter or larger.
32. All force mains shall be cement-lined ductile iron pipe or DIPS DR-9 HDPE pipe. Where Hydrogen sulfide could be present ductile iron pipe shall be epoxy lined.
33. The Design Engineer shall consider ground conditions in the case of metallic conduits and provide suitable cathodic protection and polyethylene bagging where necessary.
34. The potential for sulfide and odor generation must be fully evaluated based on the characteristics and properties of odor causing compounds and the principals of control. The appropriate odor and/or sulfide control system shall be provided.

B. Capacity Design

1. Capacity design for the pumping station and force main shall be based on Section 1.1 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.
2. Pump selection and force main sizing shall be based on a hydraulic analysis of the required flows, pipeline velocities and receiving gravity sewer capacities.
3. Pumping into a common force main (manifold condition) shall be avoided if possible. When the use of a common force main is permitted, the overall operational characteristics of, and interactions between/among all connected pumps and force mains shall be analyzed as a system. Any necessary upgrades to existing pump stations and/or force mains must be designed and constructed as part of the pump station project.
4. System curves shall be calculated and a chart and graph prepared showing static head and total dynamic head for both single and multiple pump operation. Pump performance curves for both single and multiple pump operation shall be plotted over the system curve to determine pump

operating points. 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 indicative of potential operating conditions. The system curves shall illustrate the effect of wet well level and potentially varying pipe roughness coefficients on the total dynamic head. Particular attention shall be given to the available versus required net positive suction head (NPSH).

5. Consideration must be given to a design that produces minimum power requirements to accomplish the functions required. If requested, supporting data shall be furnished to the County.

C. Structural Design

1. In addition to conventional design procedures, there are several specific areas that must be considered.
 - a. The effect of hydraulic thrust must be countered by the use of thrust blocking, pipe anchorage, mechanical joint restraints or other suitable means to prevent movement of pumping equipment and pipelines.
 - b. 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, bedding methods, and operational pressures. 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.
 - c. Surge analysis may be required at the discretion of the Director and surge relief valves installed at the pump station.
 - d. All pipe joints at the pump station within the fenced in area, and at the discretion of the County Engineer, shall be restrained.

1.5.03 Drawings

A. Drawing Requirements

1. Drawings for pumping stations and plan and profiles for force mains shall be prepared in accordance with Section 1.2 and the requirements of this Section.

2. Drawings shall include:
 - a. Complete pump information with manufacture's name, model numbers, serial numbers, horsepower, voltage, phase, calculation summary sheet, pump curve, impellor size with specifics of any proposed impellor trimming, and all other pertinent pump information.
 - b. Provisions for anti-floatation as required based on the buoyancy calculations for wet well, valve vault, and manholes.
3. 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 components and equipment shall be specifically approved. No deviation from the approved manufacturers will be permitted.
4. A Theory of Operation shall be provided on the plans describing pump cycling for both normal and high flow conditions, alarms, and operating pressures. The Theory of Operation shall include a detailed list of initial settings for pumps on/off, high/low level alarms and other relevant operational information.
5. Drawings shall include mechanical details, architectural details, structural details, electrical one-line diagrams, instrumentation and controls plans (P&ID drawings, panel board schedules, points list, etc.), flow diagrams, and all other pertinent information.
6. Drawings for pumping stations shall include a site layout and grading plan which shows all relevant geometric information as well as, existing and proposed grading using a 1-foot contour interval. A sufficient number of spot-elevations shall be included to demonstrate positive surface drainage away from all structures as well as the routing of storm water off the site. The boundaries of the site shall be clearly shown on the plan. Permanent monumentation shall be installed at the corners of the parcel prior to completion of construction. Site and grading plan(s) shall be drawn to a scale of not less than 1-inch equals 20 feet.
7. Architectural drawings for buildings and structures shall be drawn on a scale of not less than ¼ inch equals to 1 foot. Drawings required to clarify construction details shall be drawn on an appropriately larger scale.

8. Drawings for force mains shall show stationing, pipe size, bearings, direction of flow, deflection angles and curve data.
9. Profiles for force mains shall show the ground line, force main profile, existing and proposed underground utility lines and existing and proposed 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 isolation valves, combination air/vacuum valves, fittings, utility crossings and all other appurtenances. All crossings of existing and proposed water mains shall be shown and shall clearly indicate vertical clearance between utilities.
10. Details shall be shown for all blocking, pipe restraints, buried valves and combination air/vacuum valves.
11. A complete erosion and sediment control plan shall be prepared for the project and included in the plan set. The design shall be in conformance with the *Virginia Erosion and Sedimentation Control Handbook* and shall be subject to review by the County's Environmental Division.

1.5.04 Miscellaneous Components

- A. In addition to the design requirements in this Section, all wastewater pump station and force main designs shall include the following:
 1. All junction boxes shall have finger proof terminal strips equal to Allen Bradley 1492-J series.
 2. Pump control and level indication shall be by an ultrasonic level sensor with a narrow transmitting cone or an approved pressure transducer. The sensor shall be located in the wet well so that it is accessible for maintenance and does not interfere with pump removal. The transmitter shall be located in the pump control panel with a readout on the cabinet front. Set points shall be field adjustable.
 3. In addition to the ultrasonic level control the pumps control shall have a high-level alarm float and a low-level alarm float. The low-level alarm float shall be wired directly through the pump starter holding coils to stop the pumps and provide an alarm indication. The high-level alarm float shall be wired directly through the pump starter holding coils to start the pumps and provide an alarm indication.
 4. Aluminum or stainless steel access hatches shall be cast into the wet well

and valve vault tops with reinforced doors able to withstand a uniform live load of 300 lb. psf. Additional door load capacity shall be provided in areas subject to vehicular traffic or other significant loads, as determined by the Department. Doors shall close flush with the frame. Hatches shall be of sufficient size to allow convenient access and adequate clearance for equipment removal. All access hatches shall come equipped with a locking system and hold open arm. Protective grating shall be provided in areas requiring additional fall protection. Grating shall be hinged with positive latch to maintain upright position with provisions for a padlock and safety orange powder-coated finish. The load rating of the grating shall be equal to or greater than the load rating of the door.

5. Tracer wire and test stations shall be provided as indicated in Section 5.2.
6. Permanent monumentation shall be installed at the corners of the pump station parcel prior to completion of construction.

END OF SECTION 1.5