CHAPTER VIII

SEWAGE PUMPING STATIONS

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Published: 01/01 Revised:

Page No.

ANNE ARUNDEL COUNTY DESIGN MANUAL

CHAPTER VIII

SEWAGE PUMPING STATIONS

I. GENERAL

A. Introduction

This Chapter of the Manual outlines the design of sewage pumping stations to meet the service needs of users and the operational responsibilities of the Department. The sewage pumping station design standards include: criteria, guidelines, drawings and technical specifications. The Reference Drawings for Wet/Dry Well and Submersible Pumping Stations as referred to herein are available from the County as a separate publication. This Chapter includes the criteria and guidelines for designing sewage-pumping stations within the limits of applicability for these design standards.

The design standards generally apply to sewage pumping stations up to 3.0 million gallons per day (MGD) capacity. Sewage pumping stations of 3.0 MGD pumping capacity and below shall be designed as a package pumping station of either the submersible or the wet well/dry well type as discussed in Section II. Paragraph G., later in this document. Design of larger sewage pumping stations with greater than 3.0 MGD capacity shall be considered on case-by-case basis, with special requirements as determined by the Department of Public Works.

The design professional shall check with the Department to determine the applicability of these design standards to planned sewage pumping stations. It is the responsibility of the design professional to integrate all applicable criteria and guidelines for sewage pumping stations incorporated into the Anne Arundel County Sewerage System. The Anne Arundel County Sewerage System consists of House and Building Connections, Collecting Sewers, Intercepting Sewers, Sewage Pumping Stations, Force Mains and Wastewater Treatment Plants. This Chapter discusses the sewage pumping stations.

To the extent practical, sewage pumping station designs shall conform to the guidelines given herein. The guidelines shall be applied to design conditions in a careful and thoughtful fashion. Significant deviations from the guidelines must be brought to the attention of the Department. All deviations should be justified to the Department, in writing, from an engineering evaluation standpoint and include consideration of life cycle costs and ease of maintenance.

All standards and regulations shall conform to the latest publication.

B. Ordinances and Authority

The material presented in this Chapter is in accordance with the authority and responsibility delegated by ordinance, resolution, an executive or administrative order to the various County agencies named herein.

C. Abbreviations

Whenever in this chapter or other chapters, the following abbreviations are used, they will stand for:

BOCA	Building Officials Conference of America
COMAR	Code of Maryland
DHHS	Department of Health and Human Services
DPW	Department of Public Works
EPACT	The Energy Policy Act of 1992
GPM	Gallons per Minute
HIS	Hydraulic Institute Standards
HP	Horsepower
HVAC	Heating, Ventilation and Air Conditioning
IEEE	Institute of Electrical and Electronic Engineers
KW	Kilowatt
LPI	Lightning Protection Institute
MCC	Motor Control Center
MDE	Maryland Department of the Environment
MGD	Million Gallons per Day
NEC	National Electric Code
NFPA	National Fire Protection Association
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PACE	Department of Planning and Code Enforcement
PVC	Polyvinyl Chloride
SRC	State Road Commission
TVSS	Transient Voltage Surge Suppressors
UL	Underwriters' Laboratory

II. DESIGN CRITERIA

A. Applicable Regulations

Sewage pumping stations must satisfy the regulations of agencies having jurisdiction. Sewage pumping stations shall conform to the Design Guidelines for Sewerage Facilities, 1978 edition or latest addenda as published by the Maryland Department of Health and Mental Hygiene, now the Maryland Department of the Environment (MDE). The design professional shall also ensure that the sewage pumping station

conforms to Design Guidelines for Wastewater Pumping Stations for the Protection of Shellfish Waters and Swimming Waters, effective June 1, 1996, published by MDE Anne Arundel County Department of Planning and Code Enforcement (PACE) land use regulations shall be considered in the selection and development of sewage pumping station sites. Buildings shall comply with BOCA requirements and permitting requirements of the Anne Arundel County Department of Planning and Code Enforcement. Other regulations governing facilities and construction shall be adhered to, including regulations published by the Occupational Safety and Health Administration, the National Fire Protection Association, National Electric Code, Anne Arundel County Plumbing Code, and others as applicable.

B. Pre-Design Meeting

Prior to commencing any design work on a Capital Project, a pre-design meeting shall be held as provided in Chapter I, General Instructions. For Developer Projects, a pre-sketch meeting may be held at the request of the developer. These meetings will discuss, at a minimum, the following design parameters pertinent to this Chapter, in addition to items, which pertain to any other Chapter, which will govern the design of the project:

- Odor Control Measures for Air Release Values near Populated Areas
- Blowoffs
- Type of Sewage Pumping Station
- Type of Bubbler System
- Flowmeters
- Pump Material
- Pressure Gauges
- Dual Feed Power Supply
- Security Systems
- Remote Terminal Unit

C. Schematic Design Report

For the Design Professionals guidance, below are listed major elements constituting the Schematic Design Phase of a Sewer Pumping Station Design Project:

1. Schematic Design Phase

The Schematic Design Phase shall include the verification of the facility plan or any preliminary reports supplied by the County.

It will also include the description of design criteria to be utilized, preliminary flow computations, design calculations, calculated system curves, surge protection analysis/recommendation, identification of right-of-way requirements, number of property owners involved, listing of permit requirements, and cost estimate based

on unit costs for major elements of work. In addition, the following design criteria shall be developed:

- Site Development
- Structural Design
- Architectural Design
- Hydraulic Analysis
- Mechanical Design
- Electrical Design
- Instrumentation and Process Control
- Corrosion Control (If necessary)
- Odor Control (If necessary)
- Noise Control (If necessary)

All information and data developed during the Schematic Design Phase shall be presented to the DPW in the Schematic Design Report.

D. Flow

Sewage pumping stations must satisfy the design flowrate. The design flow for the sewage pumping stations shall consider existing and projected peak flowrates and sewage composition.

1. Planning Period

Sewage pumping station discharge flowrates shall, at minimum, accommodate a 20-year planning horizon. In circumstances where the status of a planned pumping station is interim, the planning period for establishing flowrate may be shorter with the Department's approval. For all pumping stations, consideration shall be given to future upgrading flexibility necessary to accommodate flows beyond the normal planning horizon. This is especially important for larger (more than 400 GPM) sewage pumping stations.

2. Existing and Projected Flowrates

Sewage pumping stations shall be designed to pump the flow for existing and future users. In developed areas, population shall be determined by house count and non-domestic user inventory with allowances made for remaining undeveloped tributary areas. Population densities and per capita flows shall be as established by Facility Plans or in their absence, in agreement with the Water & Sewer Master Plan or instruction of the Department. Institutional, commercial and industrial flows shall be determined by a study of the establishment. PACE shall be consulted for future domestic and non-domestic land use and population densities. A "SWAMP" analysis should be requested from PACE to establish flows in existing service areas. Flowrate computations shall follow guidance given in the Water and Sewer Master Plan, Appendix A, as well as Part A,

Appendix D of the Anne Arundel County Design Guidance for Wastewater and Waterworks Facilities. If applicable, Guidelines for Design and Operation of Recreational Vessel Wastewater Facilities by MDE - Water Management Administration shall be incorporated in the design flow rate. A tabulation of the design flow shall appear on the Drawings (See Reference Drawings for Wet/Dry Well and Submersible Pumping Stations, Dwg. PS-M1-4).

3. Composition

Sewage composition can vary widely depending upon the proportion of design flow generated by non-domestic users. Non-domestic user sewage composition shall be investigated. In the absence of existing non-domestic user information for planning purposes, reference is made to the Pretreatment Ordinance. Adequate consideration and necessary provisions shall be taken to ensure that sewage pumping station equipment and materials are suitable for the anticipated composition of sewage. Consultation with the Department is required in the event that the sewage composition affects standard material and equipment requirements.

E. Hydraulics/Pumps

Sewage pumping stations must satisfy the hydraulic conditions of the system. A complete analysis of each sewage pumping station is required. An investigation and analysis of the sewage pumping station force main system to consider features of configuration, operation and potential impacts on existing force mains, gravity sewers and pumping stations when the new pumping station is added to the system shall be conducted. Sewage pumping stations shall be designed to operate at the appropriate discharge head and flowrate.

1. Pump/System Curve

System curve characteristics shall be determined by the Hazen-Williams formula for piping head loss. The pump/system curve shall be shown on the drawings (See Reference Drawings for Wet/Dry Well and Submersible Pumping Stations, Dwg. PS-M1-1). Pump/system curves shall be shown for both new and aged force main conditions, as well as for multiple pump operation in stations having three or more pumps. Hazen-Williams "C" factors used in evaluating pump and system curves shall be selected using good engineering judgement and in accordance with the standards of the Hydraulic Institute. As a guideline, "C" factors for the following types of pipe are listed in Table VIII-1 below:

TABLE VIII-1 HAZEN-WILLIAMS "C" FACTORS

Type of Pipe	Size	"C" Factor
Ductile/Cast Iron:*		
New	All	130
5 years old	All, up to 24"	120
	24" and over	115
10 years old	4"	105
	12"	110
	30" and over	85
40 years old	4"	65
	16"	80
Welded Steel	All	Same as for ductile/cast iron 5 years and older
Concrete*	Large sizes, good workmanship, steel forms	140
	Centrifugally spun	135
PVC++	All	150
HDPE	All	155

* Use of ductile/cast iron and concrete pipe is no longer permitted

++ Use of PVC pipe is subject to approval by the DPW

2. Water Hammer

   The potential impact of water hammer shall be evaluated. If the combined effects of static head and water hammer do not exceed the weakest piping system component working pressure, no special provisions need to be included to control water hammer. Where the maximum water hammer pressure exceeds the weakest piping system component working pressure, strengthen those elements affected, reevaluate pipe size and velocities, or select an appropriate device to control water hammer as prescribed by the Allievi method. Wherever possible, spring type, oil-cushioned elbow hydraulic surge relief valves are the preferred choice by the Department. No pressure vessel/surge tank type devices will be acceptable. The decision to strengthen piping system components instead of utilizing a water hammer control device or different pipe size shall be based upon life cycle cost economic comparison.

   In the evaluation of water hammer conditions, it will be necessary to include the impacts of the appropriately provided air release and air vacuum valves along the force main as required in Chapter 7.

3. System Hydraulics/Pump Selection

   Provide proper wet pit design and suction line design per Hydraulic Institute Standards to avoid vortexing cavitation related vibration problems. The design

professional shall perform a net positive suction head available (NPSHA) analysis and include this information in the pump specification. The NPSHA shall be calculated for the expected design flows and shall exceed the pump manufacturer's requirements by an added margin of safety of not less than 2 feet.

Avoid applications where pumps must operate in an adverse area of their performance curve. Examples would be pumps operating at very low flows and high heads, near shutoff heads, of "runout" conditions. These conditions can result in excessive hydraulic loading or cavitation damage to impellers, casings and shafts, rapid bearing and mechanical seal wear, and high vibration.

F. Siting

Sewage pumping stations must satisfy the site characteristics. Sewage pumping station site selection is dependent on a number of factors. Topography, access, availability of power supply, floodplain, wetlands, land use, aesthetic concerns, overflow potential and impact to the environment shall collectively be considered in the process of site selection.

1. Topography

Sewers tributary to sewage pumping stations commonly dominate site selection. Adjacent drainage areas potentially served by the sewage pumping station must also be considered. Sewage pumping station site selection shall also be compatible with suitable site access, and soil capability with respect to land grading in conjunction with site development.

2. Access

All sewage pumping stations shall be sited to permit access by all-weather surface roads capable of accommodating a large tanker truck.

3. Floodplain

Sewage pumping stations shall be sited to remain operational and permit access during a 100-year return frequency flood. Pumping station top slab elevation shall be set a minimum of one foot above the 100-year floodplain elevation.

4. Wetlands

Avoid direct impacts wherever possible and minimize impacts to wetland buffer areas. Buffer areas include the first 100 feet beyond tidal wetlands, or 25 feet beyond non-tidal wetlands.

5. Land Use

   Sewage pumping station sites should be selected to occupy vacant land. In new subdivisions the sewage pumping station site shall occupy an area at least equivalent in size to the minimum allowable lot size. In existing subdivisions site size shall meet the minimum allowable lot size if possible. Pumping station sites acquired "fee simple" is preferable to those where permanent easements are obtained. Pump station sites wherever possible must conform to land use regulations such as building restriction lines and setbacks in relation to neighboring properties. Variances may be required where restrictions cannot be met. Special exceptions may be required if the pumping station is not a conforming use under Anne Arundel County Zoning Regulations. Pump station siting shall consider the Critical Areas Requirements for those installations where bayfront or wetlands proximity necessitates, and shall consider requirements to meet MDE shellfish requirements for emergency holding capacity.

6. Aesthetics

   Natural screening and remoteness of the site should be a primary element of site selection wherever possible. Where pump stations are sited in proximity to developed areas, predominant wind direction for potential odor dispersion and building aspects such as generator exhaust and ventilation fan noises shall be considered. Similarly, building setbacks shall be considered to provide minimal impact to neighboring properties.

7. Overflow

   Sewage overflow at sewage pumping stations is not permitted. Sewage pumping station sites shall be selected to permit site development, which will preclude on-site overflows.

8. Ownership

   It is the County's intent to not allow pump stations to be designed and built for private ownership. In the rare and extenuating circumstances where private ownership must be considered, the pump station and all appurtenances shall be in strict compliance with the County Standards. Pump station site shall be separately subdivided lots to be deeded to the Department. Lot size shall be large enough to allow for minimal environmental impacts to wooded buffers, steep slopes, wetlands, etc., while maintaining sufficient land area for the following necessary features:

   - Pumping station wetwell and drywell, if any
   - Pump-around vault

- Control/generator building
- Truck access with turnaround area
- Odor control systems
- Stormwater management facilities
- Emergency holding capacity per MDE shellfish protection requirements.

G. Selection

The type of sewage pumping station required by the Department will be governed by station capacity in terms of flowrate and horsepower. Sewage pumping stations will be either custom built-in-place wet well/dry well type or engineered package wet well / dry well type, or engineered package submersible type subject to the limitations set forth.

Reference Drawings for Wet/Dry Well and Submersible Pumping Stations are available as separate documents from the County DPW. These reference drawings provide the design professional with the minimum notes, details and drawing layouts which the DPW requires on design drawings for sewage pumping stations.

1. Custom Built-In-Place Wet Well/Dry Well Sewage Pumping Station

   This type of sewage pumping station will be designed for installations with design flows above 3.0 MGD. Custom built-in-place stations shall be engineered to meet the requirements of these guidelines, as well as any supplemental guidelines imposed by the Department on a case-by-case basis.

2. Package Sewage Pumping Station

   This type of sewage pumping station will be utilized for design flows of 3.0 MGD and less. Depending upon flowrate and motor horsepower, the packaged pump stations will be wet well/dry well configuration or submersible configuration. Packaged sewage pumping stations shall be engineered to meet the requirements of these guidelines.

   a. Submersible: Submersible sewage pumps with guide rail and pump discharge elbow assemblies installed in the wet well shall be used for small sewage pumping stations. Submersible type sewage pumping stations shall be used at locations where design flow does not exceed 400 GPM and motor horsepower is 20 or less. If either motor horsepower or design flow limitations for submersible type sewage pumping stations are exceeded, a dry well/wet well configuration shall be used.

b. Dry Well/Wet Well: .Dry Well/Wet Well sewage pumping stations shall be used where flows are in excess of 400 GPM or where a submersible station would require a motor greater than 20 HP. Dry Well/Wet Well sewage pumping stations shall use dry pit submersible type pumps and motors.

3. Other Configurations

In special circumstances due to extraordinary sewage composition, rehabilitation of an existing installation or other reasons, the Department shall be consulted to determine the acceptability of other configurations before sewage pumping station design commences.

H. Site Improvements

Sewage pump stations must be developed with the necessary improvements to ensure adequate and reasonable access, security, drainage and maintainability.

1. Access Road

All sewage pumping stations must provide complete vehicular access.

a. Duty and Section: Access roads should be designed to accommodate all types of vehicles at low speeds from passenger automobiles up to large tanker trucks. An all weather surface with cross section design adequate to support the vehicular loads anticipated should be designed for local soil conditions. Access roads shall be a minimum 12-foot wide single lane with 2 percent cross slope to provide surface drainage. Two foot wide shoulders on each side of the road surface shall be included with a cross slope of 6 percent (See Reference Drawings for Wet/Dry Well and Submersible Pumping Stations, Dwg PS-C1-3). Swales, pilot ditches and culverts as necessary shall be provided to ensure adequate storm drainage for a 10-year return frequency rainfall event. Grading and slope stabilization in conjunction with access road design shall be compatible with local soil conditions.

b. Geometry: Horizontal access road geometry shall permit vehicular movement such that vehicle tires can remain on road and shoulders at all curves. Turning flares shall be provided at the intersection with traveled roads. Vertical access road geometry shall provide smooth grade transitions and adequate site angles at intersections with traveled roads. Access road grades should be limited to 8 percent, but in no case may exceed 12 percent. Access roads shall satisfy all horizontal and vertical geometry requirements for vehicles in size up to large unit trucks.

c. Security: Access roads longer than 75 feet in length shall include a padlocked entrance chain between pipe bollards across the access road. The chain and pipe bollards shall be set back a minimum of 5 feet from the right-of-way line.

Consideration may be given to access road entrance chain and pipe bollards for access roads less than 75 feet in length.

2. Sewage Pumping Stations

All sewage pumping station sites shall be improved with paved surfaces, security fences, site lighting and screening. Certain locations and attendant conditions may require other improvements, which may consist of storm drainage systems or more extensive security provisions.

a. Perimeter Fence: All sewage pumping stations must have a minimum 7 foot high chain link fence surrounding the parking area, building, wet well, dry well and vaults. In areas particularly subject to vandalism higher fences and electronic security systems should be considered on a case by case basis. Full width sliding fence gates, up to fourteen feet wide, with padlocked astrigal shall be located to suit entry and exit of the pump station site. All exposed fencing materials shall be black vinyl coated. A two foot wide, 6 inches thick, reinforced concrete mowing strip shall be cast beneath the perimeter fence (except across gate openings) with expansion joints spaced a maximum of 10 feet apart, and 1 foot each side of all posts (See Reference Drawings for Wet/Dry Well and Submersible Pumping Stations, Dwg. PS-C1-5).

b. Paving and Other Surfaces: Sufficient bituminous paved surfaces, within the sewage pumping station perimeter fence, shall be provided to enable the maneuvering and turning of vehicles in size up to unit trucks. The paving section composition shall consist of band SF surface course, an underlying band BF and a CR-6 crushed stone base course, all of a composite thickness necessary to support all anticipated wheel loads in consideration of local soil conditions (See Reference Drawings for Wet/Dry Well and Submersible Pumping Stations, Dwg. PS-C1-1). The remaining surfaces inside the perimeter fence not occupied by structures shall be covered with a compacted course of washed SRC-2A stone of thickness equal to bituminous concrete site paving and underlain by a CR-6 crushed stone base course of thickness equivalent to the paved surface base course placed on a geotextile fabric. A 1/4-inch x 6" epoxy or bituminous-coated steel edge strip shall be installed adjacent to paved areas to provide a protective edge for the paving..

c. Grading: Sewage pumping station grades for paved areas shall prevent local ponding, provide positive drainage away from structures and generally be limited to no greater than 4 percent slopes. Stone surfaces around paved areas shall provide proper site drainage at slopes 10 percent or less. Land grading outside of the sewage pump station perimeter fence shall not exceed 3 to 1 slopes; 4 to 1 slope maximums are desirable. Lesser slopes wherever possible are preferred. Site grading design shall be compatible with slope stability for soils encountered. Slope stabilization shall be appropriate for the degree of

slope and soil conditions. The use of retaining walls on or adjacent to the sewage pumping station site shall be avoided.

d. Landscaping: All sewage station sites shall be screened as appropriate for surrounding development. Landscaping materials should be aesthetically pleasing and require minimal maintenance (watering, fertilizing, trimming, etc.).

e. Lighting: Exterior lights shall be wall-mounted on the pump station building, high pressure sodium type controlled by an on-off switch.

3. Structures

All structures shall be protected from 100-year return frequency floods. Structure foundation design shall be based upon geotechnical evaluation of underlying bearing stratum. The design professional shall include the geotechnical report and soil boring report in the project specifications.

a. Building: Sewage pumping station electrical, control and standby power systems are to be housed in an at-grade brick and block building with wooden roof trusses and shingles. The building shall be sized to afford reasonable access to and removal of all components housed within. Details of construction shall follow the architectural, structural, mechanical and electrical standard design (See Reference Drawings for Wet/Dry Well and Submersible Pumping Stations). All buildings shall be designed to comply with the BOCA 1993 National Energy Conservation Code.

The control room shall be heated with an electric unit heater to automatically maintain a minimum temperature of 55º F during the winter. The unit heater will be controlled by a thermostat rated for a maximum temperature setting of not greater than 75º F. The control room shall be ventilated to eliminate heat build up during the summer. An exhaust fan shall be provided and controlled by a thermostat. All motor operated dampers/louvers shall be of heavy-duty aluminum design and of airtight energy efficient construction.

b. Pumping Station: Sewage pumping equipment will be located in a below grade concrete structure of the type indicated for the capacity planned. The pumping station concrete structure(s) shall extend at least 12 inches above finished grade (See Reference Drawings for Wet/Dry Well and Submersible Pumping Stations). Bituminous concrete paving shall surround the pumping station structure(s) and be continuous to the mowing strip. In areas where stone is used, a 1/4" X 6" epoxy or bituminous-coated steel edge strip will be used where the stone ends and paving begins to provide a crisp edge.

c. Vaults: Precast concrete vaults for emergency station bypass pumping connections and valves shall have an interior epoxy paint finish and an

exterior elastomeric membrane waterproofing in accordance with the Reference Pumping Station Specifications. Valve vaults for submersible sewage pumping stations shall be segmented and contain emergency connection couplings and valves in one compartment and all pump discharge check valves, isolation valves, gauges and flushing connection control valve in a separate compartment (See Reference Drawings for Wet/Dry Well and Submersible Pumping Stations). Sewage pumping station vaults shall extend 12 inches above grade and shall have hatches and ladders with spring-loaded extension poles to access valves and emergency connection couplings. Vault dewatering will be accomplished with the use of a cast iron mud valve and drain line discharging into the wet well. The mud valve shall have extended operating stem for easy operation from above grade through the open hatch. Vaults normally will be surrounded with bituminous concrete paving.

I. Sewage Pumping Station Features

Sewage pumping station structures, equipment systems, piping, controls and accessory systems must be engineered according to these guidelines to form a cohesive design integrating the intended service and operational characteristics stipulated. To fulfill the intent of these guidelines, the design professional must exercise judgment to use the special knowledge relating to project site characteristics and conditions of service (head, flow, force main, etc.) particular to the sewage pumping station design under development.

1. Wet well

Wet wells shall be considered a hazardous environment, classified as NEC Class I, Division I for explosive gases. Wet wells shall be designed and constructed to be as hazard free as possible, and corrosion-resistant materials shall be used throughout. All materials and equipment used in wet wells shall meet NEC Class I, Division I standards, with the exception of control floats. Conduit between the junction box and control building shall be sealed at the junction box with explosion-proof seal. Conduit carrying float cables between the junction box and wet well shall contain removable seal for ease in removal and replacement of control floats.

a. Structure: Sewage pumping station wet wells shall be constructed of reinforced concrete. Package sewage pump station wet wells shall have precast base slabs and riser sections, and cast-in-place top slabs. Custom built-in-place sewage pump station wet wells shall be compartmented and constructed entirely of cast-in-place reinforced concrete. The structural design of cast-in-place concrete is the responsibility of the design professional. Wet wells shall have an interior epoxy paint finish and exterior elastomeric membrane waterproofing in accordance with the Technical Specifications. Wet wells shall be adequately designed to prevent flotation. Wet well size and depth shall be as required to accommodate the influent sewer, pump suction

submergence as recommended by Hydraulic Institute Standards or in the case of submersible pumps complete pump submergence. The required working volume and preferred intervals between sewer and control elevations shall be determined as follows:

1) Working Volume (in Gal.) = $\frac{TQ}{4}$ =

   T = minimum time between motor starts or 7 minutes whichever is greater; for pumps 30 horsepower (HP) and larger, minimum cycle time shall be 12 minutes

   Q = ultimate design discharge rate of one pump in operation in GPM

   Working Volume = lead pump on - lead pump off

2) Minimum inside width - 8 feet (considerations shall include retention time & pipe/pump configuration & access)

3) Minimum elevation difference between influent sewer and high water alarm - 18 inches

4) Minimum elevation difference between control elevations - 6 inches

5) Emergency storage per Design Guidelines for Wastewater Pumping Stations for the Protection of Shellfish Waters and Swimming Waters, published by MDE.

b. Access: Package pump station wet well access shall be through a top slab opening with aluminum hatch cover and frame. The top slab access hatch shall be 36 by 36 inches minimum size and as large as necessary to allow removal of equipment from the wet well. Permanent aluminum safety railings shall be provided around the access hatch in accordance with OSHA regulations. An aluminum ladder with extendable spring-loaded aluminum safety poles at the top shall be provided to permit safe entry. Rungs shall be square with serrated top surfaces. Structures 20 feet in height or more shall be equipped with removable intermediate landings as required to obtain less than 20-foot intervals. The ladder landing on the wet well floor shall be flat. Custom built-in-place wet well personnel access shall be stairs, minimum of 36 inches wide. Provisions should be made for wet well access openings large enough for equipment removal.

c. Wet Well Work Platform: Package pump station wet wells shall have an intermediate platform completely covering the wet well. The work platform shall be constructed of aluminum grating sections and grating supports of structural aluminum shapes fastened to the wall. Custom built-in-place pump

station wet wells shall have an aluminum perimeter platform with handrail over the wet well and screening channel. Seven feet minimum of headroom over work platforms is desirable. Care shall be taken to locate removable grating sections consistent with equipment placement and removal requirements. All fixed grating shall be bolted down as detailed. All fasteners are to be stainless steel.

d. Debris Removal: All sewage pumping stations will have bar racks for debris removal. Package sewage pumping stations will have manually cleaned static bar racks attached to the wet well wall and work platform (See Reference Drawings for Wet/Dry Well and Submersible Pumping Stations). Static bar racks shall be of welded aluminum and stainless steel construction. Custom built-in-place sewage pump stations shall have a special debris-screening channel and bypass channel upstream of the segmented wet well. Aluminum stop gate guides shall be cast into the channel walls for insertion of flow isolating aluminum stop gates. Maximum clear opening between bars shall be 1¼ inches for all bar racks. Bar rack headloss shall not cause any reduction in influent sewer flow velocity. Bottom of bar racks shall be located 12 inches below the invert of the influent sewer pipe.

e. Invert Slope: Wet wells shall have sloping sides to form a hopper at the bottom of the wet well. Package sewage pumping stations shall have grout fill slopes of 1 horizontal to 1.75 vertical (See Reference Drawings for Wet/Dry Well and Submersible Pumping Stations, Dwg. PS-M1-6). Custom built-in-place sewage pumping station-wet wells shall have side slopes of 1 horizontal to 1 vertical if possible. The flat portion of the wet well floor shall be sufficient in area to accommodate equipment mounting, ladder landings and recommended pump suction hydraulic conditions as outlined by Hydraulic Institute standards.

f. Bubbler and Floats: Wet well liquid levels are controlled by a bubbler system with back up float switches. These systems within the wet well shall be located to minimize the turbulent influences of flow into the wet well on the control of liquid level. Bubbler tube piping and float staffs shall be readily removable from the wet well work platform. Bubbler systems shall be manual purging. At the Department's discretion, a Gorman-Rupp differential pressure level control system may be used in lieu of the standard bubbler system.

g. Odor Control: Odor control method selection for pumping stations is to be based upon the decision tree in Appendix A. It should be assumed that a pump station with a greater than two-hour upstream force main detention time will produce both H2S and NMOC levels greater than 5 ppm. See Reference Drawings for Wet/Dry Well and Submersible Pumping Stations and the Special Provisions Design Standards for Sewage Pumping Stations for design requirements. For grinder pump systems with more than 15 units discharging

to a collection system, the effects of H2S on the downstream infrastructure shall be addressed by the design professional. Analyses shall be submitted to the DPW for approval.

h. Lighting: Wet wells shall be provided with wall-mounted explosion proof incandescent light fixtures with guard and globe. One fixture shall be installed near the top of the wet well and another three feet above the grating. An explosion-proof switch shall be installed to operate the lights.

i. Ventilation: Wet wells shall be provided with a separate ventilating system and shall be sized to provide a minimum of 30 complete air changes per hour. In addition to manual control, time clock operation of fans shall be provided to allow a minimum of 2 complete air changes per hour. Ventilation shall be accomplished by the introduction of fresh air into the wet well under positive pressure. If the fan is installed outdoors, the fan assembly and housing shall be of corrosion-resistant and weatherproof construction. The entrance hatch to the wet well shall be provided with a limit switch to energize the fan whenever the hatch is open. The fan shall be direct drive.

j. Dewatering: Package sewage pumping station shall be designed with pump around vaults and flushing valves. Custom built-in-place sewage pumping station wet wells shall have individual valved drains to a common station drain sump. Designer shall incorporate provisions for the periodic dewatering of the wet well for the abatement of grit accumulation in the wet well which will be determined by the individual pumping station's size and sewage composition.

k. The design professional shall evaluate the likelihood of grease accumulation in the wet well based on the station size and sewage composition. Design should include measures for preventing grease accumulation, such as air infusion systems, if grease problems are anticipated. If grease accumulation is not anticipated, then typical maintenance measures, such as providing for easy washdown of the wet well, will be sufficient.

2. Dry Wells

Below grade dry wells shall be designed to provide suitable environments for operating and maintaining pumping equipment and piping systems and shall incorporate the use of corrosion resistant materials throughout. Configuration of dry well components shall promote safe access and adequate space for equipment and valve maintenance. Proper design shall minimize hazards for maintenance personnel.

a. Structure: Sewage pumping station dry wells shall be constructed of reinforced concrete. Package sewage pump station dry wells shall have segmented precast concrete base, riser, access tube and top slab sections as

necessary on a cast-in-place structural concrete base slab foundation (See Reference Drawings for Wet/Dry Well and Submersible Pumping Stations). Custom built-in-place sewage pump station dry wells shall be constructed integral with the wet well and above grade building structures. The structural design of all cast-in-place concrete is the responsibility of the design professional. Dry wells shall be adequately designed to prevent flotation. Dry well exteriors shall be waterproofed with elastomeric membrane as specified in the Technical Specifications. Dry well interiors shall have a smooth, easy to clean special coating finish as specified in the Technical Specifications. Dry well depth and size shall be adequate to provide proper wet well suction and spaces for maintenance and removal of all equipment.

b. Access: Package pump station dry well access shall be through a top slab opening with aluminum hatch cover and frame. The top slab access hatch and precast access tube riser shall be of sufficient size to permit the removal of an assembled sewage pump or any other station component, if larger. Minimum hatch size shall be 36 by 36 inches. Permanent aluminum safety railings shall be provided around the access hatch in accordance with OSHA regulations. An aluminum ladder with extendable spring-loaded safety poles at the top shall be provided to permit safe precast concrete dry well entry. Rungs shall be square with serrated surfaces. Structures 20 feet or more in height shall be equipped with removable intermediate landings as required to obtain less than 20-foot intervals. The ladder landing area shall be sufficiently clear to permit easy ladder use and equipment removal. Custom built-in-place dry well personnel access shall be ladders equipped with fall protection systems, minimum 16 inches wide. Additional grating, plate or concrete covered access openings shall be provided directly above each pump.

c. Lighting: Precast concrete dry wells shall have wall-mounted vapor-proof incandescent lights. Cast-in-place concrete dry wells shall have lighting system specifically designed to provide illumination best suited for the dry well layout which may include suspended, wall, or ceiling mounted; energy efficient fluorescent, or other types of fixtures. Dry well lighting shall be at levels adequate for routine service inspections and maintenance activities. Portable supplemental lighting will be utilized for unusual or non-routine maintenance activities.

d. Ventilation: Dry wells shall be provided with a separate ventilating system and shall be sized to provide 10 air changes per hour. In addition to manual control, time clock operation of the ventilating fans shall be provided. Ventilation shall be accomplished by the introduction of fresh air into the dry well under positive pressure. Precast dry well ventilating fans shall be continuously energized whenever the access hatch is open. Fans shall be direct drive.

e. Heating: Thermostatically controlled electric unit heaters shall be provided to maintain a minimum temperature of 55 degrees in custom-built dry wells.

f. Humidity Control: Precast dry wells shall have small wall mounted dehumidifier units piped to drain in the dry well sump. Custom-built pump station dry well dehumidifiers shall be considered on a case-by-case basis.

g. Sump Pump: Precast dry wells shall have a simplex sump pump with minimum discharge capability as specified in the Technical Specifications. Cast-in-place concrete dry wells shall have a simplex float-controlled submersible sump pump located in a common station drain sump. The sump pump shall have capacity to handle anticipated maximum station drain system flow from seepage and infiltration, and shall discharge into the wet well. All dry wells shall be provided with a float switch emergency alarm system to protect the dry well from flooding in the event of sump pump failure. Each sump pump shall have dual check valves installed on the discharge piping to protect the dry well from siphoning from the wet well.

3. Pumping and Piping System

All sewage pumping stations shall have multiple pumping units. Sewage pumping stations shall be capable of delivering the design flowrate with the largest pumping unit out of service. Sewage pumping station design shall permit individual pump maintenance while maintaining the station in operation. Suction and discharge piping must be supported rigidly at or near the pump connections. Supports shall be designed and placed to avoid vibration.

a. Piping: The minimum size for sewage piping (except surge relief valve discharge piping) shall be 4 inches. Pump suction piping velocity should be within the range of 2½ to 5 feet per second. Pump discharge piping shall be sized to provide velocities in the range of 2½ to 10 feet per second. Pump suction pipes shall be flared, have free and smooth unobstructed bellmouth openings in the wet well, and shall be designed with a gradual slope from the opening upward to the pump, in accordance with Hydraulic Institute Standard. Individual suction pipes are required for each pump. Flooded pump suction is required under all normal conditions of operation. Pump suction piping design and installation shall not permit the accumulation of air in the suction piping or induce excessive turbulence in the pump suction area. Long radius suction piping bends shall be used whenever possible, and eccentric reducers are to be used with flat side up to prevent formation of air pockets. Package sewage pumping stations shall have adequate piping and fittings to permit station bypass pumping with portable above-grade pumps. All sewage pumps shall be provided with casing drains with ball valve shut-offs installed either on the pump suction elbow or on the suction line between the pump and suction isolation valve. Take-off nipples shall be Schedule 80 stainless steel.

Pipe nipples must not be installed in a tapped hole in piping. Use either a welded-on "thread-o-let" connection or service saddle.

b. Valves: Each sewage pump shall have isolation valves to permit the removal or maintenance of the pumps without affecting the operation of remaining pumps. Isolation valves shall be non-lubricated plug valves. Plug valves shall be 100% port opening; 4 to 6 inch plug valves shall be quarter turn to open. Large plug valves shall have geared operators with handwheels. Plug valves shall be positioned so that when closed, the valve body is isolated from the actively flowing portion of the piping system. Plug valves if installed horizontally shall be positioned so that when the valve is opened, the valve plug shall be at the top of the body. See Section 15210, Part 2.09 for plug valve specifications. Each pump shall have a swing check valve to prevent backflow through inoperative pumps. In accordance with the criteria for water hammer control, check valves shall be of the type and strength required to eliminate water hammer damage.

c. Bypass Arrangement: As mentioned in Paragraph 3. a. above, sewage pumping stations shall have additional pipe, valves, fittings and couplings as necessary to permit bypassing of the station pumping units from a vault separately from the pumping station. This vault should be provided with a gravity drain discharging into the wet well. A mud valve shall be provided in the bottom of the vault to close the drain line. This system shall also permit the recirculation of pump discharge back into the wet well for the purpose of scouring solids from the wet well and pumping them into the force main. The emergency pump-around piping connections shall be housed in a buried precast concrete vault with aluminum access hatch and be easily accessible from grade. Quick-disconnect stainless steel cam-lock couplings shall be provided for connecting portable pumps to pump-around piping. A 6-inch by 4-inch coupling adapter shall also be provided with the station. Submersible sewage pumping stations must have an on-site manhole upstream of the wet well to serve as an emergency wet well for portable pump use. Care should be taken to locate this manhole out of traffic areas.

d. Flowmetering: Dedicated pump discharge flowmetering and chart recording devices shall be provided for all custom built-in-place stations and those package stations designated by the Department. Where dedicated flowmetering equipment is not provided, provisions shall be made for utilizing portable flow metering devices in the future. The design professional shall consult with the Department of Public Works to determine requirements for flowmeters prior to design. The Department utilizes magnetic flowmetering instruments, which normally require a location with limited influence of valves, bends and fittings. For the devices employed by the Department, five upstream and three downstream pipe diameters of straight pipe are usually sufficient. Additional length of straight piping is desirable. Meters shall be provided with valved bypass arrangement.

e. Pumping Units: Sewage pumps shall be 4-inch minimum size. All sewage pumps shall rotate clockwise as viewed from the motor end. Sewage pumps shall be centrifugal non-clog solids handling pumps capable of passing a 3-inch sphere, and meet all requirements of M.D.E. Pump motors shall operate on 460 volt, 3 phase, and 60 cycle electrical service and at a speed no higher than 1780 rpm. Pump motor horsepower shall be sufficient to prevent motor overload under all possible conditions. Sewage pumps and motors shall be suitable for continuous duty.

1) Wet Pit Submersible Sewage Pumps: Pump volute, impeller and motor housing shall be of cast iron construction. The pump volute casing and impeller shall be fitted with replaceable stainless steel wear rings to maintain sealing efficiency between the pump volute and impeller. At the Department's option, other special pump materials may be required for a particular application. The motor shaft shall be a single piece heat-treated high strength alloy steel or high strength stainless steel having a tapered end with keyway to receive the impeller. All nuts, bolts and screws shall be stainless steel. The motor shall be Class F insulated (minimum) and sealed from the pump by independent double mechanical seals. The upper and lower mechanical seal shall run in an oil chamber. The upper seal shall be a stationary tungsten-carbide seal with rotating carbon ring. The lower seal shall be one stationary and one positively driven rotating tungsten-carbide ring. All mating surfaces where watertight sealing is required shall be machined and fitted with a rubber O-ring. The machining of mating surfaces shall provide metal to metal bearing on sealing surfaces without crushing the O-ring.

2) Dry Well Sewage Pumps: Pumps shall be of the vertical builtogether or of the dry pit submersible design. The pump casing/volute, impeller, support base, suction elbow, seal housing/motor adapter and motor housing shall be of cast iron construction. The pump’s casing and impeller shall be fitted with replaceable hardened stainless steel wear rings to maintain sealing efficiency between the volute and the impeller. Impellers shall be able to pass a minimum 3-inch diameter solid. At the Department’s option, other pump materials may be required to suit a particular application.

Vertical builtogether pumps shall have the following additional features:

- One-piece backhead and motor adapter with impeller adjustment cap screws;

- Solid full diameter stainless steel shaft with no shaft sleeve or solid large diameter steel high strength alloy steel shaft with stainless steel shaft sleeve having a tapered end with keyway to receive the impeller;

- Double mechanical shaft seals cooled and lubricated by the pumped fluid through a cleanable seal filter assembly and provided with a mechanical seal vent with petcock;

- Premium Efficiency motors shall be specified (where commercially available) for all three-phase pump motors.

  Dry Pit submersible pumps shall meet the same general requirements as the wet pit submersible pumps in Paragraph e. (1) above, but in addition shall be specifically designed for continuous operation in air for application in a dry well. The motors for dry pit application shall be capable of 8 starts per hour minimum in air. They shall also be designed to function reliably in a continuous submerged condition should the dry well become flooded. Motors shall be cooling water jacket, submersible-rated air-over motor cooling fan or positively forced oil cooling.

f. Pump Removal: From time to time sewage pump removal is required for periodic maintenance or overhaul. Dedicated lifting devices for pump removal will be provided for custom built-in-place sewage pumping stations. A motorized trolley hoist positioned over pump access openings shall be furnished. Package sewage pumping stations need not have dedicated lifting devices. Pump removal will be accomplished by a truck mounted boom hoist positioned over access openings. A minimum three feet of clearance shall be designed between the top of the pumps and the ceiling of the dry well. Submersible sewage pumps shall feature stainless steel guide rails and automatic cast iron discharge connection elbow system permanently installed in the wet well. Package wet well/dry well sewage pumping stations shall be furnished with a sufficient number of lifting eyes in the dry well top slab which can be used to assist in safe positioning of the pumps under the dry well access tube for a direct lift.

g. Gauges: Pressure gauges where required by the Department shall be direct reading 4-½ inch dial with a ½-inch connection in accordance with Section SP-15210, Part 2.12. Gauge connection ports shall be included on all pump discharge mains and suction lines (dry well/wet well installation). The connection port shall include a coated service saddle or welded thread-o-let for tapping of the main, Type 316 stainless steel nipples, a stainless steel spring return ball valve to the closed position, and a ½-inch Swagelok "QF" series female NPT stem with protector cap (See Reference Drawings for Wet/Dry Well and Submersible Pumping Stations, Dwg. PS-M2-4).

4. Emergency Station Operation

   To ensure that utility power failures do not cause sewer system overflows, provisions to maintain sewage pump station operation with a standby power

supply shall be made. The design professional shall evaluate the following methods of dealing with utility power failures for the project;

a. On-Site Power Generation: Typically on packaged pumping stations a diesel engine driven emergency electric generator shall be provided. The unit shall be sized to allow both pumps to operate simultaneously plus auxiliary loads, and to start the second pump while the first pump is running with a maximum voltage dip of 20%. An automatic transfer switch shall be provided in the MCC to switch to emergency power on a power failure or a drop in any phase voltage to 70 percent of line voltage. An aboveground diesel oil tank shall be provided in the generator room for fuel storage. The fuel tank shall be the smallest available size to give a 24-hour fuel supply at full load for the generator size provided. A fuel spill containment curb shall be constructed around the fuel storage tank. The design shall include provisions for attenuation of noise from the generator.

b. Dual Feed Power Supply: At the Department's option, particularly on custom stations, dual feed power supply may be evaluated for the station if available from the power company. The evaluation should recognize that dual feeders result in two monthly bills to the County. Design professional is advised that to meet the EPA requirement of dual power feeders (two reliable sources), it is not necessary to originate supply lines from separate sub-stations if the following conditions can be met from one sub-station:

1) The sub-station must have two sources of supply.

2) The sub-station must have two separate transformers.

3) The supply lines from the sub-station to our facilities must be on separate pole lines or trenches.

5. Miscellaneous

a. Motor Control Center: Standard specifications for pumping station motor control centers (2 pumps - less than 100 hp) are provided in Section 16100 of the Special Provisions Design Standards for Sewage Pumping Stations. In addition, diagrams of the motor control center layout and standard two - pump operation electrical control circuits are provided on Dwg. PS-E2, E3 and E4 in the Reference Drawings for Wet/Dry Well and Submersible Pumping Stations, for sewage pumping stations less than 3 mgd. Standard motor control center layout for 2 or more pumps (100 hp or over) shall be provided with the following section of panels:

- Power company metering and main breakers

- Automatic transfer switch

- Circuit beakers and starters for unit heaters, portable pump, main sewage pumps, fans, compressors, etc., and fused switch for lighting transformer

- Flow recorder and pump controls

- Free standing electronic self-starters for constant speed main sewage pumps.

b. Water System: Where public water is available, a metered connection from the existing water system shall be made and water for the purposes of flushing and sewage pumping station washdown shall be provided. A 50-foot length of hose with spray nozzle, hose bib and interior backflow preventer shall be provided at a minimum. If there is no existing water supply system, a well and bladder-type hydropneumatic tank shall be installed at custom built-in-place stations, but the Department will determine the need for and location of well and equipment on package stations.

c. Convenience Receptacles: 120 volt, 1-phase receptacles shall be provided within the pump station buildings. One GFCI duplex outdoor weatherproof outlet shall be provided for portable tools, lights, etc.

d. Portable Generator Connection: Pump station buildings shall have a through wall 4-inch diameter pipe sleeve with capped ends to permit the passage of temporary power cables. Power from a portable generator can be delivered to the automatic transfer switch at the emergency generator connection lugs for stations so equipped, or at the station main breaker if emergency generator is not provided.

e. Coatings and Painting: In general, all exposed construction materials and equipment shall be field painted or have some other form of field-applied protective coating. Stainless steel, aluminum, PVC, and brick are excluded. Factory finished items do not require field painting if the factory finish conforms to the specified paint system and color. Painting unfinished materials shall be in accordance with the specification. Paint and other coatings shall be utilized as necessary to prevent corrosion, extend wear or promote easy to clean surfaces. Paint and coating systems used at sewage pumping stations must exhibit superior durability.

f. Testing: The installation of mechanical and electrical equipment in accordance with these design standards requires, upon completion and prior to final inspection, testing to insure the standards are met and to maintain quality control. Electrical testing procedures which apply to all electrical equipment, vibration testing procedures which apply to dry well/wet well installations, and load bank testing procedures which apply to all standby generators are included in the County's reference Special Provisions for Sewage Pumping Station Construction.

g. Final Inspection Checklist: Prior to sewage pumping station acceptance as a part of the Anne Arundel County Sewerage System, a thorough inspection and operational check of the station is required in the presence of a representative of the Department. A typical final inspection test procedure and checklist is enclosed in the County's reference Special Provisions for Sewage Pumping Station Construction. Each sewage pumping station design shall be submitted with an inspection test procedure and checklist tailored to the individual station.

h. Fall Protection: The design professional shall design and specify temporary and permanent fall protection for all floor and wall openings in the pumping station in accordance with the requirements of the latest edition of OSHA 29 CFR, Chapter XVII, Paragraph 1910.23. Fall protection includes, but is not limited to railings, toeboards, screens, covers, hatches, grills, slats and fences. Floor openings include, but are not limited to, ladderways, hatchways, trap doors, chute openings, pits and manholes. Wall openings include, but are not limited to chute openings, low windows, temporary openings and openings where there is a hazard of material falling through the opening. Open sided floors, platforms and runways used for equipment or machinery maintenance or vehicle loading or unloading shall likewise be protected in accordance with the same OSHA regulations.

J. Package Sewage Pumping Station Standards

As a part of these Design Standards, the Department offers a set of typical package sewage pumping station Drawings and Technical Specifications. The Drawings reflect a building sized to house a 100 KW generator, 275-gallon fuel tank and other electrical and control equipment. The Drawings are to be used by the design professional as an aid in developing a specific package sewage pumping station design. Building size, site layout, paving sections, piping routes, etc. shall be depicted by the design professional to suit the actual site and service conditions. The Technical Specifications are intended to be used in conjunction with the Standard Specifications and references thereto will be found in the Technical Specifications. The design professional is expected by the Department to utilize to the extent practical the Technical Specifications offered by the Department. The design professional shall make such additions, deletions and revisions to the Technical Specifications as are required to suit the project. In addition, the design professional shall prepare Division 1 - General Requirements and Supplementary General Provisions for the project.

K. Vibration and Alignment Standards

The pumping station design professional is directed to include vibration design alignment and installation requirements as indicated in Section 15990 of the special provisions, Reference Drawings for sewage pumping stations.

L. Corrosion Protection

See Chapter VII, Sanitary Sewers, Section II. Paragraph H. for corrosion protection guidelines.

M. Energy Conservation

To ensure that the sewage pumping station conforms to EPACT on energy conservation, premium - efficiency motors shall be provided for all nonsubmersible, three-phase motors, one horsepower or greater.

N. Minimum HVAC Requirements

Otherwise stated the previous sections, see Section 15600 for the minimum HVAC requirements.

O. Power Requirement

The electric service shall be 277/480-3ϕ-4W. The service shall be sized to allow all station fixtures, equipment and all pumps to operate together.

P. Minimum Architectural Standards

See Section II. Paragraph G. 3. and the Reference Drawings for Wet/Dry Well and Submersible Pumping Stations, for the standard architectural requirements at the sewage pumping station.

Q. Security Systems

Where required by the Department, the design professional shall include in his design, security systems at the sewage pumping stations. The security systems shall include intrusion, fire and environmental hazard systems at the site. Consult the Department for special requirements.

R. Compatibility with Surrounding Planned Development

See Section II. Paragraph E. for the sewage pumping station compatibility with the surrounding planned development.

S. Lightning and Surge Protection

1. The design professional shall provide lightning protection in accordance with the latest edition of the following publications:

   - NFPA 780: Lightning Protection Code
   - UL 96: Lightning Protection Components

- UL 96A: Installation Requirements for Lightning Protection Systems
- LPI-175: Lightning Protection Installation Standard
- LPI-177: Inspection guide for LPI Certified Systems

2. The design professional shall provide transient voltage surge suppressors (TVSS) on service, feeders, branch circuits and at utilization point. TVSS shall be applied in accordance with the following publications:

   - IEEE 142: Recommended Practice for Grounding of Industrial and Commercial Power Systems. 1991.
   - IEEE 241: Recommended Practice for Electric Power Systems in Commercial Buildings (the Gray Book). 1990
   - IEEE 242: Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (the Buff Book). 1986 (Reaffirmed 1991).
   - IEEE 1100: Recommended Practice for Powering and Grounding Sensitive Electronic Equipment. 1992
   - Underwriters Laboratories Inc. Electrical Institution Materials Directory. Northbrook, IL UL, 1995.
   - UL 1449: Transient Voltage Surge Suppressors. 1985.
   - National Fire Protection Association. The National Electrical Code 1996 Handbook.
   - IEEE C62.41-1991: Recommended Practice on Surge Voltage in Low-Voltage AC Power Circuits.

T. Confined Space Entry Warnings

The design professional shall be aware of the warnings and dangers of confined spaces when designing the sewage pumping station. The following are regulations and publications for the design professional to get familiar with the cautions and safety standards for confined spaces.

- COMAR 09.12.35, Maryland Occupational Safety and Health Standards for Confined Spaces.
- OSHA 29 CFR Part 1910, Permit Required Confined Spaces.

- NIOSH (DHHS) Publication No. 87-113, A Guide to Safety in Confined Spaces.

U. Remote Terminal Units

1. General

   Remote terminal units (RTU's) shall be specified for sanitary sewers and/or pumping stations when directed by the County. The County will provide the design professional with information on how the existing control master system screen displays are to be updated, what reports, if any, need to be updated by information received from the additional RTU's, current manufacturers and model numbers of equipment and existing software in use by the County. All equipment and software must be compatible with the County's existing SCADA system.

2. RF Path Study

   The design professional shall perform an RF path study as part of the project design effort. The RF path study is used to verify communications reliability between the proposed RTU location and the existing control master unit or the nearest radio communications hub. The County will furnish the design professional with any information, which it has acquired from its preliminary County-wide RF path studies, which may be applicable to the project.

3. Telemetry

   Where the RF path study indicates it is feasible, UHF and VHF radio will be used to transmit signals between the RTU's and the Water Supply Command Center. Where spread spectrum radio cannot be used, communications shall be via the use of leased telephone lines.

4. Screen Displays

   The design professional shall specify that it is the contractor's responsibility to provide screen displays to the existing man-machine interface (MMI) computers, which meet the County's requirements. The County will provide direction to the contractor regarding the graphics required for the screen displays.

5. Communications Protocols

   The RTU shall utilize the QEI system, which the contractor shall purchase from the County.

6. RTU Equipment

   RTU equipment currently approved by, and in use in the County is the QEI system. The design professional shall specify that the contractor will purchase the equipment required for the project from the County.

III. CONTRACT DRAWINGS AND DOCUMENTS

A. Reports

Reports shall be submitted as stipulated in Chapter I, General Instructions, which includes Life-Cycle Cost Analysis on appropriate projects.

B. Design Computations

Design Computations shall be submitted as stipulated in Chapter I, General Instructions.

C. Specification

Specifications shall be submitted as stipulated in Chapter I, General Instructions. Standard specification, training, and Operation and Maintenance manuals shall be considered in the development of the specifications.

1. Standard Specifications

   Specifications for the sewage pumping stations shall conform to the Anne Arundel County Standard Specifications and the Special Provisions Design Standards for Sewage Pumping Station.

2. Instruction of County's Personnel

   The design professional shall incorporate into the specifications the services of a manufacturer's representative to conduct group training of the County's designated personnel in the operation of each appropriate system. Manufacturer's representative must be a factory-trained employee of the manufacturer. Sales representatives will not be considered to be acceptable. Include instruction covering basic system theory, operating principals, and adjustments, routine maintenance and repair and "hands-on" operation. The number and duration of the group training sessions, as well as the specific systems for which training is required, shall be jointly determined by the design professional and County operations personnel.

3. Operation and Maintenance (O&M) Manuals

   The O&M manuals shall be prepared in accordance with the format and chapter outline shown in Appendix B.1 of the Special Provisions Design Standards.

4. Spare Parts

   The design professional shall incorporate into the specification section for all appropriate equipment that requires preventative maintenance; a year's supply of spare parts shall be supplied to the pumping station accordingly.

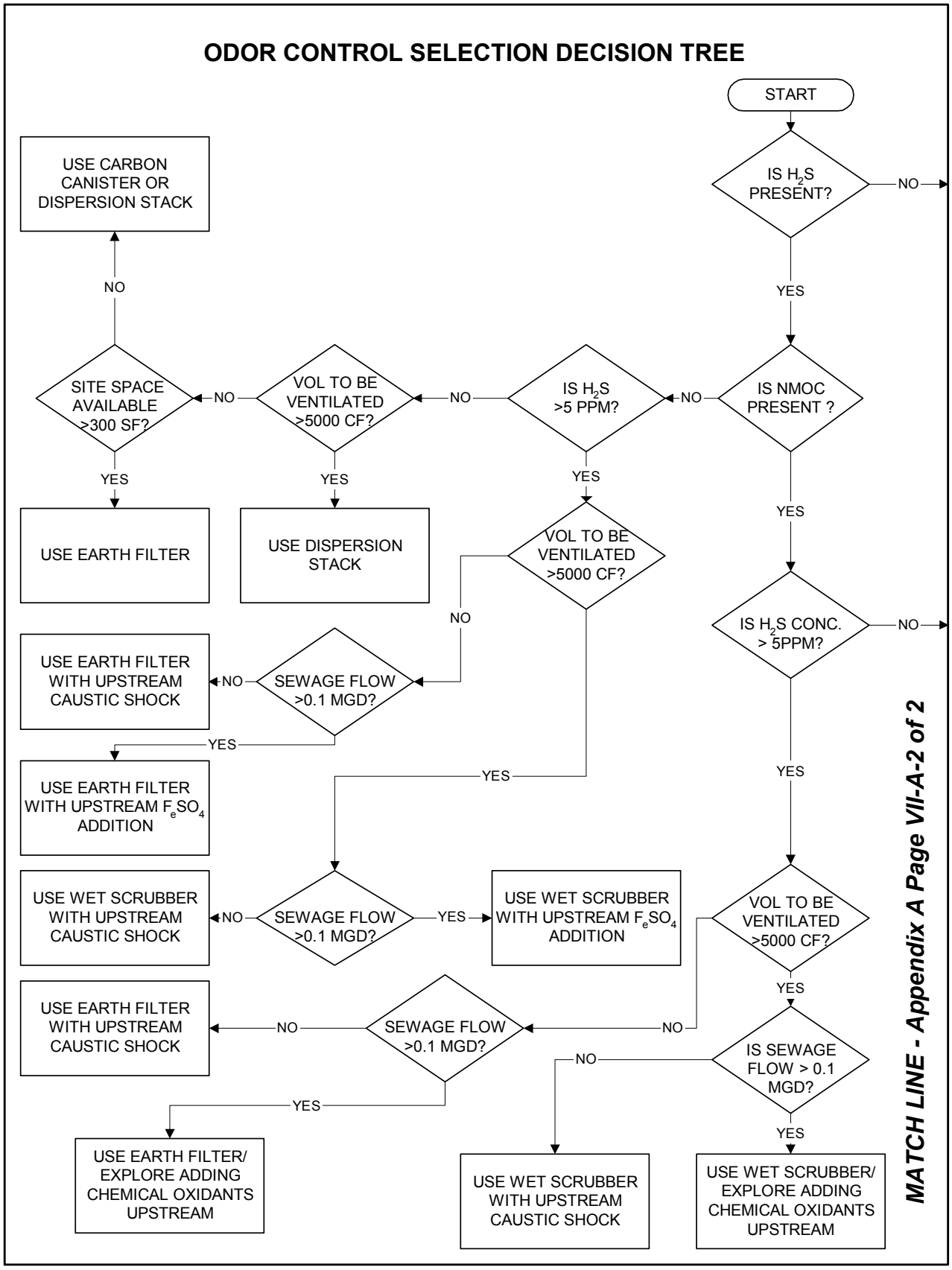
5. Start-Up Assistance

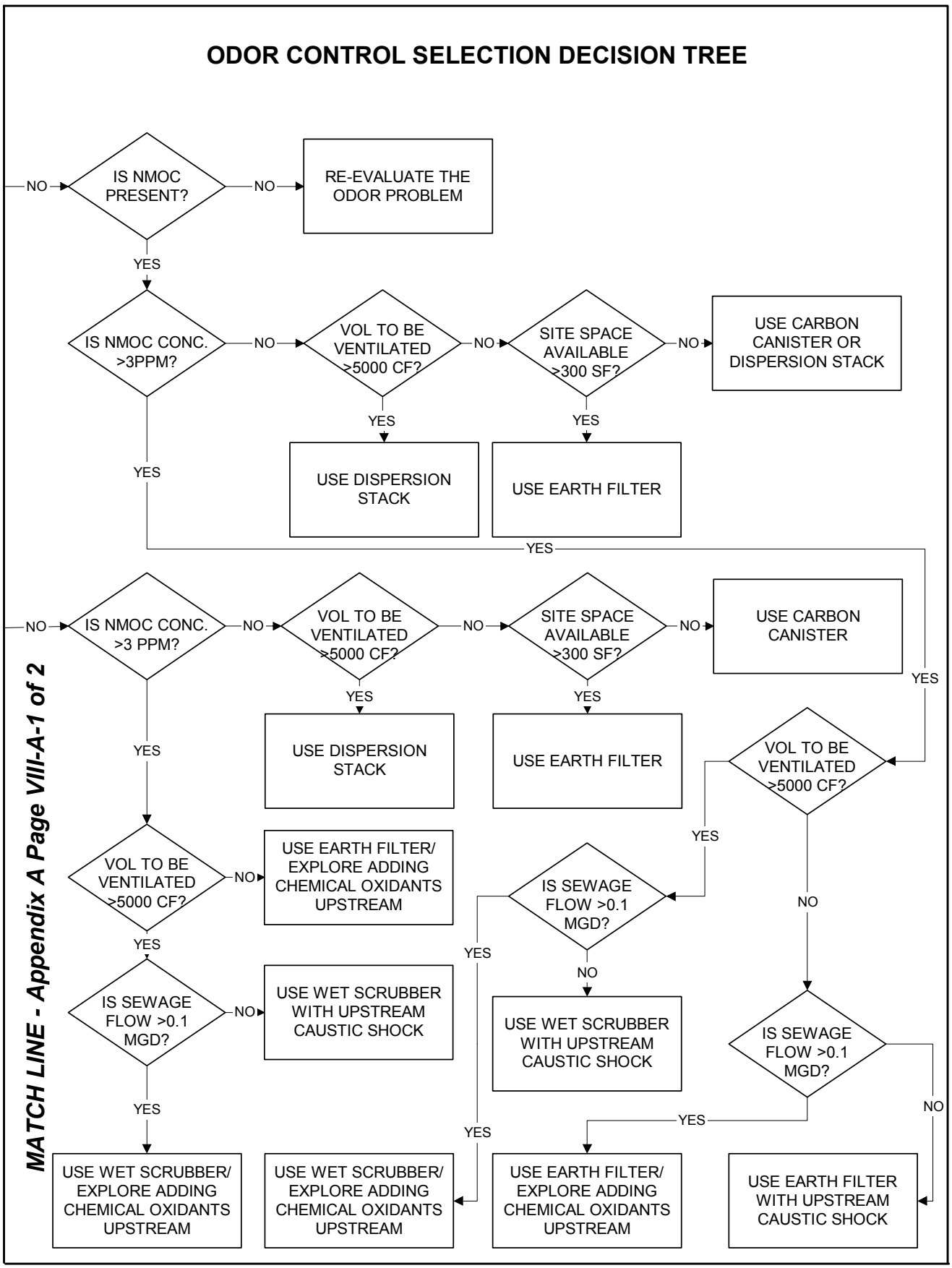
   The design professional shall incorporate into the specifications the services of a manufacturer's representative for a minimum of two (2) working days to assist the County's personnel during start-up of the system. The purpose of this assistance is to support in making final adjustment of settings on the instrument systems.

IV. APPENDIX

A. Odor Control Selection Decision Tree

B. Design Checklist


ODOR CONTROL SELECTION DECISION TREE
START
IS H_2S PRESENT?
NO
YES
IS NMOC PRESENT ?
NO
IS H_2S >5 PPM?
NO
YES
VOL TO BE VENTILATED >5000 CF?
NO
YES
SEWAGE FLOW >0.1 MGD?
NO
YES
USE EARTH FILTER WITH UPSTREAM CAUSTIC SHOCK
USE EARTH FILTER WITH UPSTREAM F_eSO_4 ADDITION
VOL TO BE VENTILATED >5000 CF?
NO
YES
USE DISPERSION STACK
SITE SPACE AVAILABLE >300 SF?
NO
YES
USE CARBON CANISTER OR DISPERSION STACK
USE EARTH FILTER
IS H_2S CONC. > 5PPM?
NO
YES
SEWAGE FLOW >0.1 MGD?
NO
YES
USE WET SCRUBBER WITH UPSTREAM CAUSTIC SHOCK
USE WET SCRUBBER WITH UPSTREAM F_eSO_4 ADDITION
VOL TO BE VENTILATED >5000 CF?
NO
YES
SEWAGE FLOW >0.1 MGD?
NO
YES
USE EARTH FILTER WITH UPSTREAM CAUSTIC SHOCK
USE EARTH FILTER/ EXPLORE ADDING CHEMICAL OXIDANTS UPSTREAM
IS SEWAGE FLOW > 0.1 MGD?
NO
YES
USE WET SCRUBBER WITH UPSTREAM CAUSTIC SHOCK
USE WET SCRUBBER/ EXPLORE ADDING CHEMICAL OXIDANTS UPSTREAM
MATCH LINE - Appendix A Page VII-A-2 of 2



Published: 01/01 **Revised:**

APPENDIX B

DESIGN CHECK LIST

The following checklist is provided to assist the design professional in designing the sewage pumping station. Compliance with the checklist, however, in no way is meant to relieve the design professional of responsibility for project design.

Project:_____

Date:_____

Checked By:_____

DESIGN CRITERIA

- _____ Design Flowrate Calculations
- _____ Hydraulic Analysis
  - _____ Pump / System Curve
  - _____ Water Hammer
  - _____ Air Release and Air / Vacuum Valves
  - _____ Blowoffs (if required)
- _____ Site Selection
  - _____ Topography
  - _____ Access
  - _____ Floodplain
  - _____ Wetlands
  - _____ Land Use
  - _____ Aesthetics
  - _____ Overflow
  - _____ Ownership
- _____ Type of Sewage Pumping Station Selected
- _____ Site Design

_____ Access Road (Security, Geometry, Duty and Section)

_____ Sewage Pumping Station Site

_____ Perimeter Fence

_____ Paving

_____ Grading

_____ Landscaping

_____ Lighting

_____ Structures

_____ Building

_____ Pumping Station

_____ Vaults

_____ Security Systems (if applicable)

_____ Pumping Station Design

_____ Wet well

_____ Structural

_____ Access

_____ Work Platform

_____ Bar Rack

_____ Wetwell Size and Configuration

_____ Bubbler System (float switches)

_____ Odor Control

_____ Lighting

_____ Ventilation

_____ Dewatering

_____ Drywell

- _____ Structural
- _____ Access
- _____ Lighting
- _____ Ventilation
- _____ Heating
- _____ Humidity Control
- _____ Sump Pump

_____ Pumping and Piping System

- _____ Piping
- _____ Valves
- _____ Bypass Arrangement
- _____ Flowmetering
- _____ Pumping Units
- _____ Pump Removal
- _____ Pressure Gauges

_____ Emergency Station Operation

_____ Water System

_____ Portable Generator Connection

_____ Receptacles

_____ Painting