

**DESIGN AND CONSTRUCTION STANDARDS
FOR
SANITARY SEWER FACILITIES**

SECTION 200.00 APPLICABILITY

- A. If public sewer is located within 300 feet of the proposed dwelling/dwellings, the owner is required to extend the public sewer and connect onto the public system.
- B. If public sewer is not available, the owner is required to acquire necessary Health Department approval prior to a building permit being issued by Montgomery County.
- C. Sanitary sewers shall be designed to serve all lots, including lateral connections between the trunk sewer and the property line being served.
- D. Plan approval of any outside jurisdiction involved shall be obtained by the developer prior to plan approval by the PSA.
- E. The Virginia Department of Environmental Quality (DEQ) approval is required for projects involving any non-single family home sewer pump station discharging into a gravity collector or interceptor sewer line. Virginia Sewage Collection and Treatment (SCAT) Regulations are to be used in conjunction with PSA standards with the more stringent of the two having precedence. SCAT Regulations can be found at <http://www.deq.virginia.gov/wastewater/regulations.html>.
- F. A preconstruction conference shall be held on all sewer projects by Montgomery County Public Service Authority (PSA) at least one day prior to any construction work being performed. The contractor's superintendent/foreman shall also attend this meeting. If superintendent/foreman cannot attend, then the developer or contractor's representative shall submit a letter to the PSA that the superintendent/foreman has been informed of items discussed at this meeting.

SECTION 200.01 GENERAL

- A. Type of Sewers
 - 1. The PSA Sewage System is designed to provide conveyance with total containment. New sewers, extensions, or replacements, not designed to provide total containment for the design period shall not be permitted.
 - 2. Under no circumstances shall storm water, surface water, ground water, roof runoff, subsurface drainage or untreated industrial process water be discharged into any public sanitary sewer system.

B. Compliance with Design Criteria

The criteria established herein are minimum requirements for design and review under the Montgomery County Subdivision and Land Development Ordinance. This criteria is required in order for the County to comply with the Virginia National Pollutant Discharge Elimination System Permit authorizing the discharge of pollutants, under prescribed conditions, to State waters pursuant to the Virginia Department of Environmental Quality Regulations.

SECTION 200.02 DESIGN CRITERIA

- A. All sanitary sewer designs shall comply with the approved Montgomery County Comprehensive Water and Wastewater Study, and Commonwealth of Virginia Sewer Regulations as applicable.

All sanitary sewer designs shall be prepared and properly certified by a professional engineer licensed in the State of Virginia.

- B. The adequacy of the existing sanitary sewer system receiving flows from the proposed project shall be determined at the preliminary stage to preclude unnecessary revisions to construction plans.

The designer shall provide calculations for the sanitary sewer system (on-site and off-site for both existing and proposed conditions as required) to the points of connection to the PSA sanitary sewer system when requested.

- C. Tributary Population

Sewerage facilities shall be designed for the estimated ultimate tributary population. Consideration shall be given to domestic, commercial, institutional, and industrial wastes in determining the capacity of the system. The design shall be based on approved estimates of anticipated populations and flows for a period of 50 years hence, or the entire watershed shall be assumed to be completely developed according to the Comprehensive Plan and/or sewer master plan, whichever provides the greater sewerage flow, unless the PSA Director approves otherwise.

- D. Sewage Flow

1. Determining the average design flow shall be the first step in the sizing of sanitary sewerage systems. Actual design quantities may be substituted for the average design flows, provided supporting data is furnished to and approved by the PSA Director.
2. Sewers shall be designed to carry a peak flow when full as determined by applying the appropriate peak flow factor to the average design flow.

3. Ventilation of gravity sewer systems shall be provided where continuous watertight sections greater than 1,000 feet in length occur.

E. Location of Sewers and Manholes

1. In general, sewer lines and manholes shall be located within legally established public streets or right-of-way wherever possible. If sewers cannot be located in right-of-way or public streets, then access easements to all manholes, sewer line and laterals shall be provided.
 - a. Manholes should be located along the centerline of streets when possible but always beyond the spread of stormwater gutter flow.
 - b. Sanitary sewer pipe and manholes shall not be located within the paved portion of privately owned and maintained streets or common driveways without the prior written approval of the PSA Director. This provision does not preclude the crossing of these driveways at generally 90 degrees with a sanitary sewer pipe.
 - c. The horizontal and vertical separation between sewers and waterlines shall be in accordance with the requirements of PSA Design and Construction Standards for Water facilities.
 - d. Sanitary sewers shall be designed such that they do not create skewed crossings with other utilities with an acute angle of less than 45 degrees, 90 degrees is preferred. Where skewed crossings are unavoidable due to existing utilities and involves any pipe larger than 24 inches in diameter, the crossing must be specifically designed and construction details provided.
 - e. A table of bearings and distances shall be provided on all construction drawings for sanitary sewer construction, in order to accurately locate the utility. The table of bearings and distances is not required on early submissions, but is required prior to final plan approval. The engineer or surveyor will supply cut-sheets for the installation of all sewer systems.
 - f. Plan and profile of the sanitary sewer system is required.
 - g. The deflection angle from the inflow pipe to the outflow pipe at any junction shall not be less than 90 degrees unless a drop connection is provided.
 - h. A table of lateral elevations at cleanout invert and minimum building sewer elevations shall be included in plans. Building sewer elevation shall be a minimum of two feet above cleanout invert elevation.
 - i. Long sewer service laterals shall not be allowed in lieu of sewer

main extensions, where a sewer main extension would serve other customers or areas. Where allowed, the sewer cleanout shall be installed at the right-of-way or easement line perpendicular to and at the shortest point from the public sewer main. Private sewer service laterals shall not be located within the public right-of-way or easement parallel to the sewer main. The property owner shall be responsible to obtain private easement(s) for any crossing of private property.

2. Proposed sanitary sewers to be publicly maintained shall not be located within the plane of influence of the building footing and in no case closer than one-half the required easement width from an existing or proposed building.
3. Manholes for access to sewer lines shall be provided at:
 - a. At all intersections of differing size sewers that are 27 inches in diameter or smaller.
 - b. At all points of change in alignment.
 - c. At all points of change in grade.
 - d. At the terminal end of the sanitary sewer line.
 - e. At intervals not exceeding 400 feet on all sewers 15 inches in diameter or less and not exceeding 600 feet on all sewers larger than 15 inches in diameter.
 - f. A sampling manhole will be required for all non-residential users. The sampling manhole may be used in lieu of the required cleanout at the property/easement line.
4. When it is necessary, due to steep slopes, increased velocity or invert elevation differences equal to or greater than 24 inches, a drop connection shall be employed. The maximum difference in elevation between the influent and effluent pipe inverts within the manhole itself shall be six inches. The minimum diameter manhole for use with an inside drop connection shall be five feet. Only one inside drop shall be installed per five-foot diameter manhole. Two inside drop connections may be made in a six-foot diameter manhole. These provisions apply for both sewer main and lateral connections. Refer to Detail Drawings.
5. Outside drop manhole connections are acceptable for use in Montgomery County. Refer to Detail Drawings.

6. Manholes for sewers up to 15 inches in diameter shall not be less than four feet inside diameter. Manholes over fifteen feet (15') in total depth (lowest invert to top of cover) shall be five-foot in diameter. Manholes over 20 feet in depth shall have safety slabs installed every 10 feet. Manholes for sewers up to 36 inches shall have an inside diameter of not less than five feet. If hydraulic characteristics do not permit use of a four-foot inside diameter manhole, then a five-foot diameter manhole or special manhole detail must be provided.
7. When designing new sewers to tie into existing sewers, the connection shall be made by one of the following methods:
 - a. Connection to an existing manhole. Connection to the existing manhole must be configured so that the invert of the new tie-in is not established lower than the existing bench. Existing manhole shall be cored through the manhole base (bench) on adequate slope and 0.2' higher than the existing invert at the point of intersection. The pipe connection shall be made using a manufactured flexible manhole boot.
 - b. New in-line manhole. The new manhole shall be set after removal of the existing pipe and installation of proper bedding material. Refer to Detail Drawings. The invert of the base section shall match the slope of the removed pipe. Outlet pipe shall be connected to the manhole boot. Inlet connection shall be made with a 6-foot pipe stub connected to the manhole boot and to the existing pipe by a Fernco coupling or approved equal as per Detail Drawings. This method will require pumping of existing flows during installation. Testing shall be by the vacuum test method.
 - c. Straddle manhole. Straddle manholes may be used for installations not suitable to the above two methods and approved on an individual basis by the PSA Director. Refer to Detail Drawings. Special care shall be taken to make the manhole watertight and to protect the integrity of the existing pipe. Outside of existing pipe shall be thoroughly cleaned and waterstops installed prior to placing of concrete. All concrete for invert shaping, bench, and base shall be of a single pour. Risers and other sections shall not be installed for a minimum of 24 hours after placing concrete. All existing concrete that comes in contact with new concrete shall be etched and have a bonding agent applied. A PSA inspector must be present during installation of all straddle manholes. Testing shall be by the vacuum test method.
8. All new sanitary sewer manholes shall be precast concrete in accordance with ASTM-C478 consisting of precast concentric riser reinforced sections, an eccentric conical or flat top section, and a base section conforming with the typical manhole as shown in Detail Drawings. Field installation of manhole flow trough (invert) using concrete will not be allowed.

9. Sewers adjacent to or crossing streams, estuaries, lakes and reservoirs shall be designed, constructed and protected in accordance with requirements of the Virginia Department of Environmental Quality Sewerage Regulations, except that:
 - a. The connection of sanitary sewer lines shall be made only at manholes. The type of material shall be the same from manhole to manhole. Connections to existing manholes shall be made under direct supervision of Montgomery County PSA personnel.
 - b. Sewer lines crossing streams shall be Class 52 Ductile Iron pipe, HDPE SDR-9, C900-DR 14 PVC or equivalent and concrete encased. Reference Detail Drawings. Pipe shall be provided with a minimum of one foot of cover over the concrete encasement where the stream is located in rock and three feet minimum cover where the stream is located in other materials. The cover requirements may be lessened with the approval of the PSA Director in an area that will not interfere with future improvements to the channel bottom.
 - c. Sewer lines shall not be located within stormwater management impoundment areas unless there is no alternative. The PSA Director may approve sewer lines within a stormwater management impoundment area only if such sewer lines are designed and constructed to site specific conditions that will protect the sewer line for a period of 100 years. If allowed, sewers shall be configured so that repairs can be made without dewatering the impoundment.
 - d. Inverted siphon (sag pipes) shall be approved on an individual basis by the PSA Director. Inverted siphons shall not be less than two (2) barrels, with a minimum pipe size of six inches (6) and shall be provided with necessary appurtenances for convenient flushing and maintenance; the manholes shall be designed to facilitate cleaning; and, in general, sufficient head shall be provided and pipe sizes selected to secure velocities of at least 3.0 feet per second for average flows. The inlet and outlet details shall be arranged so that normal flow is diverted to one (1) barrel so that either barrel may be removed for service or cleaning.
 - e. Aerial sewer crossings shall be approved on an individual basis by the PSA Director. Pipe shall be restraint joint ductile iron on concrete piers with specifically designed pipe supports/anchors. Aerial sewers shall be protected against water borne debris if crossing a stream, ditch, gully, etc. Exit/entrance points of pipe shall be protected against erosion by grouted riprap or concrete section.
10. Sewer located in areas of unstable soil conditions or other special

circumstances may need to be encased in concrete, relocated or re-designed as required by the PSA Director.

F. Sanitary Sewer Lateral Cleanouts

1. Sanitary sewer cleanouts will be:
 - a. Located at the property line or sanitary sewer easement line contiguous to the property. Refer to Detail Drawings.
 - b. A traffic bearing type cleanout box is required if located in pavement areas. Refer to Detail Drawings.
 - c. Minimum slope for service lateral shall be 2.08 percent (1/4": 1'). Maximum slope of service lateral shall be 45 degrees within public easements or right-of-ways.
 - d. The offset angle of the lateral to run of the sewer main shall not exceed 45 degrees.

G. Minimum Sewer Size

No public sanitary sewer main shall be less than eight inches in diameter except for sewer force mains.

H. Hydraulic Criteria

The design and determination of sewer size shall be based on the following conditions.

1. Sewers shall have a uniform slope and alignment between manholes.
2. At all manholes where a smaller diameter sewer discharges into a larger one, the invert of the larger sewer shall be lowered so that the energy gradients of sewers at junction are at the same level. Generally, this condition will be met by placing the 0.8 depth of flow or diameter in each sewer at the same elevation.
3. Sewer shall be designed to be free-flowing with the hydraulic grade below the crown and with hydraulic slopes sufficient to provide an average velocity of not less than 2.0 feet per second when running full to maintain cleansing flow. Computations of velocity of flow shall be based on a PVC pipe coefficient of roughness "n" in the Manning formula of $n = 0.015$.
4. In no case shall terminal lines with less than 20 residential connections have a slope of less than one percent unless approved by the PSA Director.

5. The maximum permissible velocity occurring with average flow shall be 10 feet per second (before applying peak flow factor).
6. Where due to steep grades, velocity exceeds 10 feet per second, and/or where drop manholes are impractical for reduction of velocity, the sewer shall be designed with an abrasion resistant material meeting ASTM or AWWA specifications approved by the PSA Director and shall be anchored where appropriate.
7. In general, the following are minimum slopes in feet per hundred feet to be provided for pipes flowing at full depth to one-half of full depth:

Sewer Size Minimum Slope in Feet per 100 Feet

8 Inch	0.40
10 Inch	0.28
12 Inch	0.22
14 Inch	0.17
15 Inch	0.15
16 Inch	0.14
18 Inch	0.12
21 Inch	0.10
24 Inch	0.08
27 Inch	0.067
30 Inch	0.058
36 Inch	0.046

8. Benches in terminal manholes shall be built at a slope of not less than one inch per foot.
9. Minimum Permissible Depth

All sewer mains and service laterals shall have a minimum cover of three feet (See Construction, Section 201.04 Pipe Installation for more information).

10. a. Maximum depth of sewers shall be 18 feet unless approved in writing by the PSA Director.
 - b. In general, the maximum allowable depths to inverts of various types and sizes of pipe is dependent on different types of bedding, earth loading and live loading. Pipes with less than minimum cover and pipe with cover greater than 18 feet require pipe strength calculations to be submitted with the design. The maximum depth for all types of pipe shall be in accordance with manufacturer's specifications and recommendations for Standard Pipe Laying

Conditions - Type 3 Trench.

11. Slope Anchorage

Concrete anchors shall be placed on sanitary sewer lines with grades of 20 percent or greater. Minimum anchorage shall be provided such that anchors are not located over 36 feet center to center on grades from 20 to 35 percent. The maximum grade for sanitary sewers shall be 35 percent with anchorage unless otherwise approved in writing by the PSA Director. Refer to Detail Drawings.

12. In general, the pipe diameter of sewers shall increase continually with increase in tributary flow. Where steep slopes would permit the use of reduced pipe size and construction cost savings can be derived, the pipe size may be reduced one size at a manhole; however, appropriate hydraulic allowances shall be made for head loss of entry, increased velocity, and the effect of velocity retardation at the lower end where the flow will be on a flatter slope. Prior written approval of the PSA Director is required for reduction in line sizes.

I. Sanitary Sewer Force Mains

1. The minimum size for force mains shall be four inches except when using grinder pumps.
2. At pumping capacity, a minimum velocity of two feet per second shall be maintained.
3. Automatic air/vacuum relief valves shall be placed at the necessary high points in the force main to release trapped air and mitigate vacuum conditions.
4. Maximum velocity shall be eight feet per second.
5. All force mains shall connect to a cleanout with a drop stack connection at the right-of-way or easement line. From there the flow shall be gravity into the public system. See Detail Drawings.
6. All pipe used for force mains shall be pressure type with pressure type joints. (PVC SDR 21, CL 200 minimal)
7. Anchorage shall be provided where deemed necessary by the PSA Director, refer to the Commonwealth of Virginia Sewerage Regulations for testing and anchorage guidelines of force main sewers.
8. Receiving gravity flow sewage system shall be analyzed for adequacy to handle peak force main discharges.

9. Locator wire shall be installed with all force main PVC and HDPE pipe. Refer to Detail Drawings. Minimum U.S. standard gauge 12 solid copper. PSA Director may require heavier gauge wire in depths of greater than 6'.
10. Public force mains for use with private individual sewer grinder pumps shall be acceptable. Design shall provide means to prevent excessive holding time and septic conditions. It shall be clearly noted on the deed or other title document that the sewer pump maintenance is the property owner's responsibility.

J. Sewage Pump Stations

1. Private sewage pump stations (i.e., those stations not accepted into the PSA sewer inventory and privately maintained) may be approved by the PSA Director under the following conditions.
 - a. Private sewer pump stations shall meet the construction requirements of the applicable building codes and may only accept flows from private sewer systems limited to:
 - a1. Building laterals
 - a2. Collector laterals
 - a3. Private sewer systems entirely on a single lot of record
 - b. Only sewer grinder pumps shall be acceptable.
2. Public sewage pump stations shall be required whenever the pump station accepts flow from more than one lot of record or as required to be reviewed under the Virginia Sewage Regulations. Public sewage pump stations must conform to the following:
 - a. All public pump stations shall be designed using submersible pumps.
 - b. The design criteria and equipment specifications must meet the requirements of the PSA and the Virginia Department of Environmental Quality (DEQ).
 - c. The design calculations for the sewage pump station and force main shall be submitted for review. This design shall address:
 - c1. Design flows from the subdivision and ultimate sewershed
 - c2. Force main TDH and velocities
 - c3. Pump curve
 - c4. Wetwell size

- c5. Holding times in wetwell and force main relative to septicity
 - c6. Piping configuration
 - c7. Specifications including electrical
 - c8. Operating conditions and setting of pump station between initial and ultimate flows.
- d. Minimum of 2 hours of storage at average flow must be provided above high-level alarm set point to allow time to respond to a pump station failure.
 - e. The entire facility, to include the building lot on which the station is located, must be dedicated at no cost to the PSA. Minimum lot size shall be 100 feet by 100 feet.
 - f. All materials must be new and unused.
 - g. All pump stations shall be designed with two pumps and be controlled by submersible level transducers. Pump controllers shall include provisions for automatic alternation plus backup control of pumps.
 - h. Pumps shall be selected for maximum operating efficiency. The pump operating design point (system curve intersect) shall be between 60 to 120 percent of the gallon per minute (GPM) flowrate (Q) of the pump rate (GPM) at the point of maximum operating efficiency (n) on the manufacturer's pump curve.
 - i. On-site generators shall be provided for all pump stations. Generators shall be natural gas (if available) or propane and sized to provide adequate service to start and operate both pumps.
 - j. Due to the excessive operation and maintenance costs of public sewer pump stations, these stations will only be accepted under a waiver request. Each request must identify all alternatives to the pump station including the cost to provide gravity sewer service to the property. The cost for off-site gravity sewer extension must exceed the cost of the pump station by a factor of three (3). The inability to obtain off-site public easements for a gravity sewer extension will not in itself be justification to install a pump station.
 - k. A spare (not installed) pump shall be provided with each pump station.
- K. Public sewage pumping stations shall at a minimum be designed to meet the following criteria:
- 1. All public sewage pump stations shall have an all-weather access road with a

minimum width of 15 feet.

2. Public sewage pumping stations shall be protected using standard security fence unless otherwise approved by the PSA Director. Refer to Detail Drawings.
3. Pumping stations shall have an alarm system with light and battery backup. The alarm system shall monitor power failure, high wet well level, and low level alarm. An automatic dialing mechanism is also required.
4. Potable water shall be provided to pump station unless otherwise approved by PSA Director. Potable water systems shall be properly protected against backflow by an approved device.
5. Gate valves and check valves shall be installed on force main outside of pump station in square concrete vaults with “Bilco” hatch or approved equal. Gate and check valves shall not be installed in a vertical position.
6. Submersible pumps shall have provisions for pumps to slide freely on guide rails to allow for easy removal and installation. Guide rail bracing shall be provided at the midpoint of each ten-foot length of guide rails.
7. Wet well platforms may be required for submersible systems 10 feet deep or greater.
8. Stations shall not utilize long stem valves.
9. Operations and maintenance manuals and shop drawings shall be submitted for all electrical and mechanical equipment including complete manufacturer's parts lists and wiring diagrams.
10. Electrical Requirements:
 - a. Three-phase power should be provided for all sewage pump stations. All pumps shall be three-phase where three-phase power is available. Pumps 5 horsepower and above shall be 3 phase. Variable Frequency Drives (VFD) shall be provided for all pumps 5 horsepower and greater where three phase power is not available. Where 3 phase is available, all pumps shall be 3 phase. Three-phase power shall be considered available and provided if the supply is within 2,000 feet for overhead service or 1,500 feet for underground service of the sewage pump station.
 - b. Three phase pumps shall have phase protection on individual phases. Three phase pumps shall have an individual poly-phase starter.
 - c. All pumps shall be controlled by starters and have individual HOA switches with test and run lights.

- d. Starters shall be sized one size larger than horsepower required. Heaters shall be sized for actual current load.
- e. Leakage sensors for indication and protection of fluids in stator housing shall be installed.
- f. An hour run meter shall be provided for each pump motor.
- g. All control circuits shall be a maximum of 120 volts.
- h. Electrical service shall be provided with secondary surge arresters.
- i. All electrical wiring shall be copper, placed in conduit, and have markers at all wire terminations.
- j. Electrical panel shall have a minimum of 12 circuits.
- k. At least one 20 amp GFI circuit shall be provided.
- l. Dusk to dawn high-pressure sodium or approved equal light with the initial lamp rating of at least 5000 lumens shall be provided 10' above the ground at all outdoor electrical equipment.
- m. A non-automatic transfer switch shall be installed on load side of service disconnect. Switch shall be rated same as or higher than service disconnect.
- n. All wiring, electrical equipment and installation shall meet requirements of current National Electrical Code. All areas to be considered wet locations.
- o. Electrical junction boxes and other accessories shall be easily accessible.
- p. Pump motors shall be of "explosion proof" construction meeting National Electric Code (NEC) Article 500 Class 1 Division 1 Group D classification.

L. Public Easements

- 1. Sanitary sewer mains may be constructed on private property provided that the owner has duly recorded a public easement adequate for the proper installation, maintenance, operation or removal of the sewage facilities. The owner shall have recorded easements from all parties possessing or having legal interest in the property.
 - a. Public easement width shall be determined based on a one-to-one side

slope measured from outside edge of pipe extending from invert of the pipe at its lowest point below proposed grade between manholes and rounded up to nearest foot. See Detail Drawings.

- b. Minimum public easement width for sanitary sewers shall be 20 feet.
 - c. Increased/decreased public easement widths may be required by PSA Director for unusual situations or circumstances.
2. No privately owned permanent structure or landscaping other than shrubs shall be permitted within a public easement. Any damage to shrubs that are located within the easement that may be caused by the legal use of the easement by the PSA shall remain with the property owner.
 3. Where deemed necessary by PSA Director, and in order to ensure maximum utilization of public sanitary sewer systems, it will be required that appropriate public easements be provided to adjacent properties for access or extension of said public sewer system.
 4. Grade within existing public easements shall not be changed without written approval of the PSA Director.

SECTION 200.03 Repair Guidelines

- A. Prior approval of the PSA Director is required for repairing damaged concrete sanitary sewer pipe.
 1. Maximum repairable size hole above the spring line shall be three inches in diameter. It shall be repaired using a repair coupling. Coupling shall extend a minimum of six inches beyond the edge of damage. Only one repair coupling is allowed between new manholes.
 2. All other damage (i.e., cracks, holes in pipe line, or crushed pipe) shall be repaired by replacement of the damaged section. To repair this type of damage, vertical plane cuts shall be made a minimum of one foot beyond the extremity of the damaged section. A replacement section shall then be installed such that the joint gap at either end shall be no more than one-eighth of an inch. Replacement section will then be clamped. If damage is in joint at manhole, then the entire joint shall be replaced.
 3. All clamps shall be full circle and made of stainless steel and have a minimum width of 12 inches.
 4. All excavation shall be performed to afford proper protection to line while repair is made.
 5. Location of sanitary sewer pipe repairs will be made part of the as-built

records.

6. Location of each repair will be measured from the manhole on each side of repair.
 7. Type of repair situation will be noted.
 8. When pipe is required to be removed and replaced, the location of the repair clamps used will be noted on the as-built plans.
 9. PSA shall be notified 48 hours in advance of making repairs so an inspector can be scheduled. Corrections made without notification will not be accepted.
- B. PSA shall be responsible for informing owner/developer as to the approved method of repair.

SECTION 200.04 STRUCTURAL

A. General

Structural design of sewers shall conform to methods set forth in the ASCE Manual No. 37, for the Design and Construction of Sanitary and Storm Sewers, except as modified hereafter.

- END OF SECTION -