1.4 GRAVITY SANITARY SEWERS

1.4.01 General Requirements

A. Sanitary sewers shall be designed solely for the collection and transport of sanitary waste flows. Under no circumstances shall any sanitary sewer system be designed to accept flows from storm drains, roof drains, floor drains, foundation drains, surface drains, or subsurface drains.

B. Sanitary sewers shall be designed to serve the entire sewer shed. This necessitates consideration of property beyond the development or subdivision in question. The sewer shall be properly sized and at an appropriate location to permit future extensions. Elevation of the sewer system must be designed such that future extensions can serve the entire area which naturally drains towards the system.

1.4.02 Technical Design

A. System Layout

1. The layout and design of sewage collection and conveyance systems shall conform to the parameters set forth in these Standards and the approved Engineering Report.

2. A System Layout Plan shall be prepared for projects involving the construction of sewer lines, sewage pumping stations, and/or sewage force mains. The System Layout Plan shall delineate sewer shed area boundaries and clearly defines the areas pertinent to interim and ultimate development of the area proposed to be served.

   a. The System Layout Plan shall show existing utilities, indicating those impacted by the proposed project.

   b. Existing and proposed ground elevations shall be shown on the System Layout Plan at contour intervals not exceeding 2 feet unless otherwise approved by the Director.

   c. Proposed utilities necessary to serve adjacent properties, connections to existing utilities, and associated easements shall be shown.

   d. The scale shall be no smaller than 1” = 500’ or as specifically approved otherwise.

e. The System Layout Plan shall show the entirety of the drainage area(s) involved, the location(s) of existing and proposed line(s) in the system, and points of entry of flows, including any flows being received from other areas.

f. The System Layout Plan shall be keyed to the Sanitary Sewer Design Table (Form F-04) for the project. Computations and maps shall be submitted to DPU for review and must be approved prior to final plans approval.

3. All sanitary sewers must be accessible for operations and maintenance:

   a. Sanitary sewer branch lines and mains shall be located in legally established road rights-of-way wherever possible.

   b. Where public sewers cannot be located in established rights of way, the sewer shall be installed in existing or proposed permanent utility easements that are legally established for such purpose.

   c. Sewers shall be located outside of jurisdictional wetland areas whenever possible.

   d. Stormwater Management (SWM) and BMP facilities shall not encroach on the sanitary sewer, nor shall sanitary sewer be routed through any easement for such facilities.

4. Gravity sanitary sewer lines in two lane subdivision streets shall be run near the center of one travel lane with water lines located near the center of the other lane. Layout shall be in substantial conformance with the Department's *Water and Sewer Geometry Standard*. Gravity sewer lines in easements shall be located along the centerline of the easement unless the easement is to be shared with a water line. Exceptions must be approved in writing by the Director and will be permitted only when it has been established that it is not practical to adhere to the standard locations.

5. All sewers shall be designed and constructed on continuous grades between manholes.

6. For sewer depths up to 12 feet, sewer mains and manholes shall be located a minimum of 15 feet horizontally from any part of a building, structure, or foundation. Where the depth of sewer is greater than 12 feet, the sewer mains and manholes shall be located a minimum of 20 feet from any part of a building, structure, or foundation, or a distance equal to the depth of the excavation,

whichever is greater. In no event shall a sewer line be located so that future excavation of the line will jeopardize or damage an adjacent building, structure, or foundation.

7. Easement widths for sewer lines greater than 10 feet deep shall be twice the depth of the line, rounded up to the nearest five feet.

B. System Design

1. The overall design shall be in accordance with the provisions of the approved Engineering Report.

2. Design carrying capacities of branch, main, trunk, and interceptor sewers shall be based upon the total drainage area served by the line or lines in question. The design flow shall be based on acreage density, using the Goochland County Land Use Map or approved zoning whichever allows higher densities.

3. The design shall provide calculations of present and ultimate flows and demonstrate that capacity is provided in existing and proposed facilities. For existing facilities, the Engineer shall provide an analysis of the downstream system to the extent determined by the Department to determine the adequacy of the system for existing and future flows.

4. Equivalent flow from motels, schools, hospitals, etc. shall be based upon that of the Virginia Department of Environmental Quality (DEQ) *Sewage Collection and Treatment Regulations (SCAT)*.

5. In the absence of information on densities or equivalent flows, the Engineer shall supply sufficient information, substantiated by sound engineering judgment to verify the design. This information must be approved by the Department.

C. Capacity Design

1. Branch and main sewers shall be designed to carry the ultimate tributary population with a 50-year projection as an upper limit.

2. Proper allowances for peak flow shall be included. Designer shall consult the County Master Plan for future flow projections.

3. Peak flow shall be calculated using the following formulas:

$$Q_P = 3.511 Q_A^{0.8121}$$

For $Q_A \leq 0.0125$ MGD, $Q_P = 8.0Q_A$

For $Q_A \geq 6.0$ MGD, $Q_P = 2.5Q_A$

Where: Q_A = Average Flow (MGD)

Q_P = Peak Flow

4. Trunks and interceptors shall be designed on the same basis as branch and main lines, except in cases where capacities of the system(s) or parts thereof can be readily increased by future relief, allowing for shorter capacity design life of initial lines.

5. The hydraulic design computations for all gravity sewer lines shall be shown on a Sanitary Sewer Design Table similar to that included in these Standards as Form F-04. The Sanitary Sewer Design Table shall be included on the Plans.

6. Computations shall be accompanied by a System Layout Plan as defined in 1.4.02.A.

D. Hydraulic Design

1. Minimum grades for gravity sanitary sewers shall not be less than those required to produce a velocity of approximately two (2.00) feet per second when the pipe is flowing full or half full. Pipe sizes shall not be arbitrarily increased in order to take advantage of a flatter grade.

2. The minimum size pipe to be used in a gravity sewer collection system shall be 8 inches.

3. The absolute minimum allowable slopes for gravity sewer lines are as follows:

Sewer Size (Inches)	Minimum Slope in Feet/100 Feet
8	0.40
10	0.28
12	0.22
14	0.17
15	0.15
16	0.14
18	0.12
21	0.10
24	0.08
27	0.07

30	0.06
36 (and larger)	0.05

4. As determined by DPU, design slopes greater than the minimum may be required.

5. Uniformity of design slope shall take priority over individual manhole depths.

6. Computations for velocity of flows shall be based on the Manning formula, where "n" equals 0.013.

7. Velocities in each pipe shall be computed, and shown in the Sanitary Sewer Design Table, for the following flow conditions:

   a. Pipe Capacity.

   b. Average Daily Flow.

   c. Peak Flow.

8. In no case shall the velocity in a pipe be less than 1.3 feet per second at peak design flow. Improvements to velocity shall be achieved by increasing the slope of the pipe, not by decreasing pipe diameter.

9. The sizes of pipe shall continually increase as contributing tributary areas increase. Any deviation from this standard must be approved by the Director in writing.

10. Miscellaneous head losses at manholes shall be accounted for by providing a minimum 0.10-foot drop between the influent invert and effluent invert. At the discretion of the Director, computation of manhole head losses may be required when unique design conditions exist.

11. Where there is an increase in pipe size at a manhole, pipe inverts shall be set so that the crowns of the influent and effluent pipes are at the same elevation.

12. Where velocities greater than 15 feet per second are expected, special provisions shall be made to protect against internal erosion by high velocity. The pipe shall conform to appropriate ASTM or AWWA specifications which provide protection against internal erosion.

E. Structural Design and Materials

1. Structural requirements must be considered in the design of all sewers and appurtenances.

2. The proper strengths shall be determined and indicated for sewer pipe materials being specified. Strength shall be based upon pipe size, proposed depth, width of trench, bedding conditions, existing ground conditions, etc. This is a matter of detail design not subject to simple generalizations. Refer to the Standard Details for bedding requirements.

3. In deep cuts, it is generally preferable to change pipe strengths to obtain proper design rather than vary bedding conditions. In such cases, pipe strength or class shall be shown on plans with stations to indicate the location.

4. No change in pipe strength or material shall be made between manholes without written approval from the Director.

5. Gravity systems receiving pumped flows shall be protected against sulfide attack for a minimum distance of 1,200 feet downstream from the point of pumped flow entry. This shall be accomplished by the use of acid-resistant pipe and manholes. The Department shall approve the materials and design for the conditions at each individual location. The receiving manhole and manholes within 1,200 linear feet downstream shall be internally coated with an approved sulfide resistant lining or coating.

6. Where odor may be a problem, chemical addition or other odor control method approved by the Director may be required at the pump station or the receiving manhole.

7. Ductile iron pipe or C900, DR14 PVC pipe shall be used where sewers enter or cross streams, estuaries, lakes or reservoirs, or cross jurisdictional wetland areas. The carrier pipe within any bore or tunnel crossing shall be ductile iron.

8. The maximum allowable slope for a gravity sewer line is 20%.

9. Clay or concrete dams shall be utilized where the possibility exists that ground or surface water will follow the sewer trench, causing damage, or undermining of pipe bedding.

10. A minimum 30-foot wide public utility easement shall be provided where sanitary sewer lines are installed between buildings.

11. Ductile iron pipe (DIP) or C900, DR14 PVC pipe shall be used in other areas where, in the opinion of the Department, the sanitary sewer is not easily accessible for maintenance.

12. All manholes, service connections and other appurtenances shall be designed in accordance with these Standards and all applicable Standard Details.

F. Manholes

1. Manholes shall be installed at the end of each line at all changes in grade, size, or alignment, and at all sewer line intersections.

2. When manholes are located in paved areas accessible to vehicular traffic, they shall be spaced at distances no greater than 300 feet for sewer sizes up to 15 inch and 400 feet for sewer sizes 16 inch through 30 inch. When located in inaccessible areas, spacing of manholes on sewer lines 30 inch and less, shall not exceed 300 feet.

3. Spacing of up to 400 feet may be permitted in sewers larger than 30 inches at the discretion of the Director.

4. Watertight manhole frames and covers shall be used on all manholes not located in paved streets.

5. At the upstream manhole in a cul-de-sac, the maximum number of sewer connections allowed into the manhole is 3.

6. Manholes shall not have stub-out sections of sewer pipe, nor shall they have bricked-up or partially scored openings for future sewers. Connection to manholes shall be made in accordance with standards and specification in effect at the time the sewer is extended.

7. A minimum slope of 1% shall be used for any sanitary line flowing from a terminal manhole (e.g., the upstream manhole in a cul-de-sac) from which no future extension is contemplated.

8. Manholes over 18 feet deep shall have a polyethylene or epoxy lining specifically designed to resist hydrogen sulfide corrosion. Depth is measured from manhole top to lowest invert in the manhole.

9. Manholes more than 18 feet deep shall be minimum 60 inches diameter. Manholes more than 24 feet deep shall be minimum 72 inches diameter.

G. Sewer Appurtenances

1. Sewer connections serving more than one building shall be made by construction of a manhole on the County sewer and an appropriately sized sewer line terminating in another manhole at the uppermost building connection. Such construction shall be in accordance with County Standards.

2. Sewer lines shall be protected from flood by raising manhole tops a minimum 12 inches above the FEMA 100-year flood plain elevation and by the use of watertight frames and covers. Where watertight frames and covers are used, unventilated length of sewer cannot exceed 1000 feet. Manhole covers shall be no more than 30 inches above ground level.

3. Grease traps are required for all restaurants, bakeries and other facilities involved in preparation of food that has the potential to discharge oil and/or grease to the sanitary sewer system. It is the discharger's responsibility to install and properly maintain grease traps and other such pretreatment systems necessary to ensure that concentrations of oil and grease discharged to the sanitary sewer system do not exceed the limits included in the latest version of Section 14-125 of the County Code. Grease traps shall be inspected annually by the County, and shall comply with the requirements of the County Plumbing Code

4. Oil/Water separators shall be required on all facilities where oil can infiltrate the sewer system. Oil/water separators shall be shown on the plans. Separators shall comply with requirements of the County Plumbing Code. A schematic of the oil/water separator shall be shown on the plans.

5. A monitoring manhole shall be required on all new construction or renovations or modifications to existing facilities, where the discharge originating in the new, renovated, or modified facility is, or may have the potential to be, non-domestic in nature. All waste from such a facility shall flow through a monitoring manhole, which shall be part of the public sewer system. Any facility with an Oil/Water separator or grease trap shall discharge to a monitoring manhole.

6. For multi-use buildings such as shopping centers, the public sewer must be sufficient distance from the building to allow installation of a monitoring manhole as well as oil/water separators and/or grease traps on each sewer lateral.

7. For individually metered facilities, a sewer lateral is required for each meter. Enough space to accommodate installation of the monitoring manhole shall be provided.

8. If the facility is master metered, a monitoring plan is required for the entire facility. A monitoring manhole shall be provided.

9. The minimum inside diameter of a monitoring manhole shall be sixty inches.

10. In easements not subject to regular mowing or landscape maintenance, manhole covers shall be 18-24 inches above final grade. Where required by the Department, flat top manholes shall be provided.

11. Sewer laterals for non-residential connections shall be a minimum diameter of 6 inches. Connections shall typically be made at an angle of 90-degrees to the main. Six-inch sanitary laterals shall be installed at a minimum grade of 1/8 inch per 1 foot.

H. Depth of Sewers

1. Minimum design depth of cover over sewers shall be 5.5 feet in rights-of-way and 4.5 feet in easements; however, a greater depth may be required to account for future extension or possible future lowering of existing road grade or utilities. Where the minimum design depth requirement cannot be met, DIP or C-900, DR-14 PVC pipe shall be used. In no case may cover over a gravity sewer line be less than 3.5 feet (42 inches).

2. Except as otherwise permitted by the Department, all gravity sewers shall be designed with sufficient depth to provide service to the lowest finished floor elevation of the lowest building or structure to be served, allowing for future upgrades to service connections.

3. The Design Engineer shall certify that all proposed sites can be served by gravity with sewer service lateral connections installed at the applicable minimum slope, except where shown otherwise on the plans and approved by the Department. The depth of service

connections shall be in accordance with these Standards, the applicable Standard Details, and the applicable Plumbing Code.

4. Exceptions to the above requirements will be considered only if impractical to provide depths, in which case special approval must be secured in writing from the Department. In the special case of less than minimal cover, sewer service connections shall be ductile iron pipe of adequate thickness.

5. Sewer pipes with greater than 18 feet of cover shall be of ductile iron. Class of pipe shall be as recommended by the pipe manufacturer.

6. Sewer pipes with greater than 18 feet of cover shall have a polyethylene or epoxy lining specifically designed to resist hydrogen sulfide corrosion. Manufacturer's data shall be submitted prior to plan approval.

7. Sanitary sewers crossing under storm sewers shall maintain a minimum separation of 18 inches, outside edge to outside edge. Where this separation is not possible, the sewer line shall be Ductile Iron pipe. Concrete supports may be required for the storm sewer. A full length of pipe shall be installed with its center at the crossing.

8. Manholes more than 18 feet deep shall be minimum 60 inches in diameter. Manholes more than 24 feet deep shall me minimum 72 inches in diameter. Sewers and manholes more than 24 feet deep require special permission from the Director.

1.4.03 Drawings

A. In addition to requirements in Section 1.2 of these Standards, the Drawings shall also include:

1. Stationing, pipe size, material, bearings, direction of flow, deflection angles, slope, grade, and distance between centerlines of manholes.

2. All manholes shall be numbered, with drop manholes identified and top, influent invert and effluent invert elevations clearly shown.

3. The following information shall be included on the plans:

a. Lowest finished floor elevation for each existing structure to be served with public sewer.

b. Street address of each existing structure to be served with public sewer.

c. First floor elevation of each proposed structure to be served with gravity sewer, and elevation of lowest floor to be served.

d. Spot elevations showing proposed final grade at the corners of the buildable area on parcels/lots less than 1 acre in size.

e. The lowest finished floor elevation which can be served by gravity sewer for each parcel/lot.

f. All existing utilities, with elevations.

4. Each lot or parcel which requires a pump in order to receive public sewer service shall be identified on the plans.

5. Water mains shall be shown, and profiles shall indicate points where crossings occur, clearly indicating vertical clearance between utilities.

6. The location of erosion control devices shall be shown on the plans. These devices shall be in conformance with the Virginia Erosion and Sediment Control Handbook.

7. The Department's Standard Water and Sewer Utility Construction Notes (Form F-09). shall be included on the drawings.

8. A drop manhole shall be provided when the elevation difference between the invert in of the upstream sewer line and the invert out of the downstream sewer line in a gravity sewer manhole must be greater than or equal to 2.00 feet.

9. Straight alignments between manholes shall be provided for all sewers of all diameters, unless otherwise approved in writing by the Director.

10. A fifty-foot minimum separation distance between sewer lines and wells or other drinking water sources or as otherwise required by the Virginia Department of Health.

11. Watertight (AWWA) pipe with mechanical joints and zero infiltration shall be specified where sewer lines cross under streams or other bodies of water.

12. Sewer lines not to be owned by the County shall be clearly identified as “Private.”

13. All off-site easements with Instrument Number. Deed Book and Page Number may be used where Instrument Number is not available.

14. Northing and Easting coordinates for all manholes and cleanouts. Grease traps and oil/water separators shall be located by dimensioning from buildings and other landmarks.

END OF SECTION 1.4