

## 2. Design Standards

### 2.1 Construction Drawings

The construction drawings shall contain all information necessary to construct the utilities shown. The information shall be presented in a clear and legible manner, at a horizontal scale of 1" = 50' or larger for plan views on curb and gutter sections or 1" = 50' on ditch section Projects with a vertical scale of 1" = 5' or larger for profile views. Graphic scales shall be provided for each view.

The vertical datum for surveys shall be noted on the plans. The vertical datum shall be Mean Sea Level (USC & GS Datum). The horizontal datum shall be the Virginia Coordinate System (VCS) of 1983. The bearings shall be referenced to VCS 83 grid north. The foot definition used for conversion of the coordinates is the "US Survey Foot" or 1 foot = 1200/3937 meters.

The construction drawings shall show a survey base line with at least two control points and at least two vertical benchmarks, temporary or permanent, per sheet, all to first order accuracy at the mapping scale and to the nearest 1/100 feet.

The proposed utilities shall be labeled in plan and profile as to size and material. Each fitting, service line, valve, manhole, vault, or connection to existing utilities or other feature shall be labeled and stationed to the nearest foot in plan or profile. Drop manholes must be clearly labeled. For sewer systems, pipe slopes shall be shown to the nearest 1/100 of a percent and finished floor elevations, manhole rims, manhole inverts, and pipe inverts to the nearest 1/100 feet. The plan and profile views for utilities will be shown on the same drawing sheet unless otherwise expressly approved in writing by the County.

Each lot shall show the elevation of the rim of the upstream manhole of the sewer section to which the sewer lateral for the lot is connected. This elevation will be used to determine the need for backwater devices based on the flood rim elevation of potential plumbing fixtures.

The plans shall identify and show the vertical and horizontal location of all existing and proposed facilities or appurtenances that may be encountered, in conflict, or require protection during installation, repair, or future extension of the proposed water or sewer facilities. Such facilities, whether buried or above ground, may include but not be limited to facilities for water, sanitary sewerage, storm water, drainage, telecommunications, CATV, data, electrical, traffic control, gas, or steam. Where there is a possibility of conflict with existing facilities, the Department reserves the right to require that the Engineer secure accurate information on the horizontal and vertical location of such utilities through subsurface exploration and to include such information on the plans. The plans shall show the existing and the proposed rights-of-way and easements for those areas in which water and sanitary sewerage facilities are proposed.

A Key Sheet shall be provided for all multiple page plan sets. The Key Sheet, at a minimum, shall show:

- A. Sheet numbers of the plan and profile along the streets,

- B. Lot numbers and property lines,
- C. Sewer lines, laterals, and manholes,
- D. Water mains including Tees, valves, and fire hydrants, and
- E. A complete Sanitary Sewer Data Table, which may be shown on the main Key Sheet or in part on each plan and profile sheet.

The Engineer shall submit a copy of the Utilities checklist, included with the County's Site Plan Application, with a certification that the plans contain all applicable items on the checklist. The Utilities checklist does not cover all items required to complete the scope or work, but contains items that are routinely improperly submitted as well as items Department has selected to highlight for the convenience of the Applicant. The use of the checklist does not indicate that the Applicant is in compliance with all of the standards and requirements shown in this Manual. The Applicant is responsible for complete compliance with all standards and requirements. The Applicant is always responsible for full compliance with this DSM and the requirements of all regulating agencies.

Upon acceptance of the site plan by the Planning Department, the Applicant shall provide one (1) hard copy, full size set of the site plan to the Department.

## 2.2 Water System

### 2.2.1 Water Main Location

Water mains to be installed in streets that will become VDOT maintained rights-of-way shall be installed in accordance with the requirements of the most current versions of all pertinent VDOT standards, specifications, and regulations.

VDOT may allow, on a case by case basis, construction of water lines parallel to the right of way to be located under the pavement. This approval shall be based, in part, upon the density of the development and the practicality of placing water lines outside of the pavement area. The waterline shall be constructed in the centerline of the outermost lane. Waterlines shall not be constructed in the vehicle wheel path unless VDOT gives written approval of an alternate location. All measurements are from the centerline of the pipe. All water service taps and lines shall be constructed to the edge of the right-of-way during initial construction to eliminate the need for open cuts to make service connections. Water meter barrels shall be placed one foot behind the right of way line.

Water mains may also be installed in the easements parallel to the existing right-of-way. Where the water mains are to be installed in roads expected to be widened in the future, they shall be located in the easements unless the future road cross section is known and the location of water main and appurtenances are designed to avoid future relocation. The water mains and their appurtenances shall be designed so that they will not need to be lowered and so that excessive fill depths will not be created when the road is widened or driveways are installed.

The water mains installed in roads not planned for expansion will be installed in the existing right-of-way if possible.

The location of water mains along major roadways (roads four lanes or greater in width) shall be determined by the County on a case-by-case basis. The water mains shall be located on both sides of the major roadways and provided with appropriate interconnection points between the parallel water mains so that service connections need not cross the major road.

The Engineer shall consider the location of existing and proposed sanitary sewer, storm drainage systems, and all other underground structures and utilities that could affect the location and types of material for the water main. The selected location should avoid conflicts and facilitate future maintenance. Water mains shall be located at elevations above sanitary and storm sewers when possible. Water mains shall not be located under retaining walls.

Where there is a possibility of major conflicts with existing utilities or other structures, the Department may require that the Engineer obtain accurate information on the horizontal and vertical location of such utilities through subsurface exploration and reflect this information on the plans.

In a parallel installation, water mains shall be located at least ten feet (10') horizontally from any sanitary sewer lines and/or manholes and whenever possible. The distance shall be measured edge to edge between the structures and/or pipes. Reference [Section 2.3.1](#)

In a crossing installation, water mains crossing sanitary sewer mains shall be laid to provide a separation of at least eighteen inches (18") between the bottom of the water main and the top of the sewer whenever possible. Reference [Section 2.3.1](#)

The water mains shall be located at least ten feet (10') horizontally from any sewer septic tank and drain field.

All water lines crossings of railroads, major roadways, and other major structures shall be contained in a casing pipe. The design of the railroad crossings shall comply with the requirements of [The American Railway Engineering and Maintenance-of-Way Association](#), "Part 5 – Pipelines" (latest revision). The Applicant shall be responsible for obtaining the required railway permits or agreements for the County, paying any fees, and posting any required construction bonds and occupation fees for the railway crossing prior to beginning construction on any part of the Project. The Applicant shall provide to the Department copies of all permits or agreements prior to the issuance of a Construction Permit for the Project.

### 2.2.2 Depth of Water Mains

For water and service lines up to twelve inches (12") in diameter, the depth from the finished grade to the top of the pipe must be greater than or equal to forty-two inches (42") and not exceed seventy-two inches (72"). For water lines twelve inches (12") and greater in diameter, the depth from finished grade to the top of the pipe must be greater than or equal to forty-eight inches (48") and not exceed seventy-two inches (72").

All water mains shall be constructed to a depth that will provide protection against freezing and thawing and loads imposed during roadway construction or repair to ensure adequate cover over valves and other appurtenances. The new installations of water mains adjacent to roadways shall have a minimum of forty-two inches (42") of cover from the existing or proposed edge of pavement. Greater depths shall be required where the potential for street grades to be lowered in the future exists. Clearance shall be provided for enlargement of undersized drainage structures.

Water main maximum and minimum depths shall be maintained regardless of earthwork subsequent to installation of the mains. Any earthwork occurring over an existing water main shall be required to maintain the water main at a maximum depth of seventy-two inches (72") below the finished grade and a minimum depth of forty-two inches (42") below the finished grade. Where the depth of a water main will exceed seventy-two inches (72"), the water main shall be raised; where the depth of cover is less than forty-two inches (42"), the water main shall be lowered.

### 2.2.3 Surface Water Crossings

Surface water crossings, both over and under water, present special problems and shall be discussed with the Director before the Applicant submits plans for consideration. Surface water crossings will only be approved when no other alternative exists.

The water mains to be constructed on piers or attached to bridges or any other non-buried structure will be permitted only when it can be demonstrated to the Director's satisfaction that no other practical alternative exists. The Engineer shall submit a design for the piers, pier foundation, attachments, hangers, and pipe that will demonstrate the structural integrity of the proposed system. Aboveground water pipes shall be adequately supported, protected from damage by freezing, and accessible for repair or replacement.

#### 2.2.3.1 Above Water Crossing

The pipe for above water crossing shall meet the following:

- A. Adequately supported (plans will include details of the piers and supports);
- B. Protected from damage due to freezing;
- C. Accessible for repair and replacement;
- D. Above the 100-year flood level

#### 2.2.3.2 Under Water Crossing

Under water crossing shall meet the following:

- A. The pipe shall be special construction, having flexible watertight joints;
- B. Valves shall be provided at both ends of the water crossing so that the section can be isolated for tests or repair; the valves shall be easily accessible and not subject to flooding;

- C. Sample taps shall be provided at each end of the crossing and at a reasonable distance from each side of the crossing and not subject to leaks.
- D. Permanent taps shall be made for testing and locating leaks.

## 2.2.4 Water Main Appurtenances

### 2.2.4.1 General

All valve boxes, air relief valves, fire hydrants, service lines, vaults, and other appurtenances shall be constructed in accordance with this DSM.

Chambers or pits containing valves, blowoffs, meters, or other such appurtenances to a distribution system shall not be connected directly to any storm drain or sanitary sewer, nor shall blowoffs or air relief valves be connected to any sewer.

Chambers or pits shall be drained to the surface of the ground where they are not subject to flooding by surface water or to absorption pits located above the seasonal groundwater table elevation. Sump pumps may be used where other means are not practicable.

### 2.2.4.2 Hydrants

Unless otherwise stipulated by the County Fire Marshall, the Director, or “Article 2 – Fire Regulations” of the Spotsylvania County Design Standards Manual, hydrants shall be located at street corners, in mid-block at lot side-lines, at low and high points along water mains, and at the ends of water mains. The maximum spacing between hydrants shall be 800 feet along water mains. The Department and the County Fire Marshall shall approve the exact location of fire hydrants.

Easements must be provided where there is less than five feet (5') of clearance from a hydrant to the property line. The edge of the easement is to be ten feet (10') from the fire hydrant.

Access to the fire hydrants must be unobstructed by guardrails, landscaping, or other obstacles. No obstructions will be erected within four feet (4') of fire hydrants or within ten feet (10") of fire department connections.

The four and a half inch (4 ½") “steamer” nozzle shall face the street or other travel way as approved by the Fire Marshall.

### 2.2.4.3 Valves

Valves shall be located at a maximum of 800 foot intervals and along pipe runs on the larger diameter pipe and at all changes in pipe diameter. Valves shall also be provided at all pipeline intersections so as to provide shut off for repairs of limited sections without interruption of service to large areas or to facilitate testing. A minimum of two valves shall be provided at tees, except hydrant tees and tapping sleeves. Hydrant tees require a valve on the hydrant branch only. Tapping sleeves must be specifically approved and require a valve on the tapped branch only. Crosses require three valves. The Department may require additional valves.

To facilitate repair, the distance along the pipe between valves and fittings shall be at least twelve inches (12") plus twice the laying length of a compact solid sleeve of matching diameter, but no greater than ten feet. All valves are to be restrained to fittings by approved methods. Where any main enters private property (for example, to provide for private fire service) a valve shall be installed at the property line. This valve shall not be considered as one of the two required at the Tee.

At the terminus of a water main that is proposed to be extended in the future, a valve shall be installed. The valve shall be properly restrained and shall have at least one full joint of pipe installed beyond the end-of-line valve. A hydrant may be installed at the end of the line; however, the hydrant branch valve shall not serve as the end-of line valve.

#### 2.2.4.4 Tapping Sleeves

Tapping sleeves are encouraged for new-branched connections to existing water mains to prevent system shutdowns.

#### 2.2.4.5 Specialties

Water mains shall be provided with air release valves, hydrants, and water quality-monitoring stations at suitable locations to allow testing, disinfecting, and flushing of the main. Standard fire hydrants shall be installed on all dead-end mains for flushing purposes. Sample stations will be installed to meet the requirements of VDH.

#### 2.2.4.6 Apparatus and Procedures for Flushing, Draining, and Air Release

A fire hydrant shall be provided at each low point (lowest local elevation of the water main, including consideration of hydrant spacing minimums) on mains twelve inches (12") and larger to facilitate flushing and draining. On lines smaller than twelve inches (12"), fire hydrants shall be located at low points whenever possible, to facilitate flushing and draining. Air release valves shall be placed at high points (highest local elevation of the water main, including consideration of the location of valves and hydrants) to minimize air buildup in the main and to allow air in or out during draining and refilling. Hydrants may be placed in lieu of air release valves at the discretion of the Department.

The Engineer shall use the following guidelines with regard to location of flush points and air release valves during the design of water main extensions.

Access to flush points by the Department personnel shall be provided.

Design must include appropriate erosion control, construction phase flushing procedures and environmental impact consideration for both construction and long-term operation of the facility. The County may require certain controls (such as rip rap in the discharge area or others) at the time water main is installed.

Water flushing devices shall not be directly connected to sanitary or storm sewer infrastructure.

The following are to be considered the minimum requirements for the construction phase flushing:

- A. Flushing operations require advance approval of the Department, which may specify day, date, and time of day for flushing.
  - a. Flush points are to be located near local drainage facilities (natural or man-made)
- B. The number of flushing points shall be minimized and strategically placed to allow for proper flushing to be performed.
- C. Chlorine residual exceeding three (3) parts per million shall be neutralized before discharge. Contractors must provide equipment for neutralizing chlorinated water flushed from mains to a maximum of three (3) parts per million during construction prior to discharging the water.

## 2.2.5 Fire Department Connections

“Article 2 – Fire Control Regulations” of the Spotsylvania County Design Standards Manual governs Fire Department connections.

## 2.2.6 Structural Design

### 2.2.6.1 Special Structures

Structures shall be built as shown in the standard details. Structures other than those shown in the standard details shall be considered special structures. Special structures require specific approval by the Department and must be specifically identified by the Engineer at the time of plan submittal.

### 2.2.6.2 Pipe

#### 2.2.6.2.1 ZINC COATED DUCTILE IRON PIPE

All Ductile Iron Pipe shall be zinc coated meeting the requirements of AWWA C151 and wrapped with V-Bio Enhanced Polywrap meeting C105/A21.5. Ductile iron pipe installations that meet category 1 according to the DIPRA Design Decision Model as referenced in [Section 2.2.6.3](#) may be exempted from this requirement, upon approval of the Director.”

Pipe shall be asphaltic coated outside and cement lined with double thickness and seal coated in accordance with AWWA C104. Unless otherwise indicated, the design thickness of the pipe shall be not less than the minimum shown in AWWA C150. Pipe shall be furnished in lengths of eighteen (18) to twenty (20) feet and shall include all jointing materials. Installation shall be in accordance with AWWA C600.

All water mains twelve inches (12") and greater in diameter or under paved areas shall be constructed of zinc coated ductile iron pipe unless otherwise approved by the Director.

#### 2.2.6.2.2 POLY VINYL CHLORIDE (PVC) PIPE

Polyvinyl Chloride pipe (PVC) four inches (4") through eight inches (8") shall be a minimum of Pressure Class 200 (SDR 14) PVC. Water mains with "push-on" type joints shall meet all requirements of AWWA C900. Installation of water mains and services shall be in accordance with AWWA C605.

PVC shall only be used for water mains that are less than twelve inches (12") in diameter.

PVC waterline shall not be used under paved areas. All ductile iron fittings on PVC lines shall be encased with V-Bio Polywrap unless the soil has been tested according to [Section 2.2.6.3](#).

#### 2.2.6.3 Corrosion

The Ductile Iron Pipe Research Association (DIPRA) Design Decision Model shall be used to determine the corrosivity of all soil conditions. **All ductile iron pipe shall be zinc coated and encased in V-Bio Polywrap** for conditions that are determined to be in categories 2 – 5 in the DIPRA Design Decision Model. It is the responsibility of the Engineer to show that zinc coating and V-Bio Polywrap are not needed based on a soil corrosivity analysis. If the corrosivity is determined to be category 1 according to the DIPRA Design Decision Model, then zinc coating and V-Bio Polywrap encasement can be waived upon the approval by the Director. Soil bores should be taken at a maximum of 1,000 linear feet along the proposed pipeline alignment for the purpose of performing corrosion analysis testing.

#### 2.2.6.4 Thrust Restraint

Mechanical joint restraint for zinc coated ductile iron pipe shall be incorporated into the design of the follower gland. The restraining mechanism shall consist of individually actuated wedges that increase their resistance to pull-out as pressure or external forces increase. The device shall be capable of full mechanical joint deflection during assembly and the flexibility of the joint shall be maintained after burial.

Thrust protection is to be shown on plans in the standard details profile. The profile shall include pipe joints, fittings, and appurtenances. When profile views are not available restraint lengths shall be included on the plan view or table. Thrust blocks are prohibited except where pipe restraint cannot be achieved using restrained pipe joints, fittings, and appurtenances. Use of Thrust blocks shall be approved by the Director.

The restraint system shall be compatible with PVC when connecting to existing PVC pipe.

- A. Design parameters for calculation of thrust restraint lengths shall be as follows:
- B. Soil designation is cohesive granular
- C. Minimum depth of cover is 3.5 feet
- D. Use type 3 laying conditions
- E. Working Pressure (100 PSI) + Surge Allowance (120 PSI) = Design Pressure (220PSI)



- F. Safety factor is 1.5
- G. The Engineer shall increase the above lengths for working pressures greater than 100 PSI
- H. The Engineer shall individually evaluate all combined bends and indicate the required lengths on the profile view
- I. In-line valves shall be treated as dead ends

## 2.2.7 Hydraulic Design for Water Mains

### 2.2.7.1 General

Design Basis: Water distribution systems shall be designed to provide adequate flow and pressure for domestic demands, irrigation demands and fire flows based on sound hydraulic analysis. The Waterworks Regulations stipulate a minimum 20-psi system pressure policy to insure proper supply. This minimum pressure shall be taken into consideration and the design shall be based upon:

- a. Maximum flow velocity at peak hour (excluding fire flow) of 5 feet per second.
- b. Hazen-Williams “C” Value of 120 for new pipe.
- A. Pipe sizing is based on velocity requirements, maintaining system residual pressure of twenty (20) psi during maximum day demand or required fire flow, whichever may result in larger pipe with a minimum size pipe diameter of six inches (6”).
- B. The required fire flow shall be calculated as set forth in “Article 2 – Fire Regulations” of the Spotsylvania County Design Standards Manual. The Engineer shall contact the Department to schedule a fire flow test. The Department shall be present during any test but will not provide equipment or manpower for a test. The County is not responsible for the results of any test or for any design made on the basis of any test. The County does not imply or warrant that conditions occurring during a test are necessarily representative of the system’s ability to provide water under all or even normal conditions.
  - a. Water mains not sized to carry fire flows shall not have fire hydrants connected to them.
- C. The available system pressure and potentially available flows at the connection points of the proposed water system to the County’s existing system may be provided by the Department on receipt of basic information from the Applicant for the proposed development, including but not limited to items below.
  - a. Number, size, and type of connections in the development;
  - b. Required Fire Flow, including any requirements for sprinkler or other specific fire protection systems;
  - c. Average day demand, maximum day demand, and peak hour demand;

- d. Operating hours for any large-demand customers (greater than 5,000 gallons per day);
- e. Numbers, sizes, and demands of irrigation systems within the proposed development.

The pressures and flow capabilities provided by the County are not guaranteed values but are representative values under specific conditions selected by the Department for the evaluation of water system extensions at the time of the evaluation. Actual pressure and flow capability may be subject to significant change over time and in actual usage. The Engineer must evaluate any pressure and flow data the County may have provided to determine if that data is correct.

Hydraulic Report: The Engineer shall submit the information and calculations on fire flows and domestic water demands for the Project. The Engineer shall provide a detailed analysis for evaluation by the Department to ensure that the specifications of this section have been followed. The Engineer shall provide this information with all water plans submitted for review.

### 2.2.7.2 Demand Criteria

Until site-specific information has been established, the following criteria shall be used in estimating average daily demands at the discretion of the Department:

<u>Land Use</u>	<u>Gallons per Day per Acre</u>	<u>Equivalent Persons per Acre</u>
Residential - Less than 2 dwellings/acre	500	5
Residential - Less than 4 dwellings/acre	1,200	12
Residential - Less than 8 dwellings/acre	2,500	25
Residential - Low	500	5
Residential - Medium	1,000	10
Residential - High	2,500	25
Agricultural	1,000	10
Commercial - Retail	2,000	20
Commercial - Office	1,500	15
Industrial - Light	2,000	20
Industrial - Medium	3,500	35
Industrial - Heavy	3,500	35

Where site-specific determinations can be made, average day demands shall be determined by using the following design information:

<u>Facility to be Served</u>	<u>Design Units</u>	<u>Flow gpd</u>
Dwellings	per person	100
Elementary School	per person	10
High School	per person	16
Motel and Hotels	per room	130
Manufactured Home Community	per home	300
Restaurants	per seat	50
Service Stations	per vehicle serviced	10
Factories	per person per 8 hour shift	25
Shopping Centers	per 1,000 sq. ft.	250
Hospitals	per bed	300
Nursing Homes	per bed	200
Homes for the Aged	per bed	100
Medical Center	per 1,000 sq. ft.	500
Laundromats	per washing machine	500
Theaters	per seat	5
Bowling Alleys	per lane	75
Office Buildings	per 1,000 sq. ft.	200

Flows for other uses may be determined by using demands approved by the Department.

Maximum daily demands and peak hourly demands for new development will be governed by specific determinations if operating factors are known (for example, in the case of production facilities). If specific determinations cannot be made, the following formula from VDH shall be used for residential demand of less than 1000 dwellings:

$$Q = 11.4 * N^{0.544}$$

Where Q = maximum day demand in gallons per minute

N = number of dwellings (less than 1,000)

In other cases, the following demand multipliers may be used at the discretion of the Department.

Maximum Daily Demand = 1.8 times Average Daily Demand

Peak Hourly Demand = 2.7 times Average Daily Demand

### 2.2.7.3 Fire Flow Calculations

The method of calculating the fire flow requirements shall be at the discretion of the Applicant. The fire flow requirements shall be provided by the Applicant to the Department with all non-residential site plans. This data is for informational purposes only. By approving a site plan, the County does not warrant that its system will necessarily provide any calculated flow. It is the Applicant's responsibility to complete any testing and come to its own conclusions about the ability and reliability of the County's system to provide adequate fire flow. See "Article 2 Fire Department Connections", Spotsylvania County Design Standards Manual.

### 2.2.7.4 Dead-End Mains

Dead-end water mains shall be eliminated by looping whenever feasible. Dead-end water mains shall be a minimum of six inches (6") in diameter if there is no more than one (1) fire hydrant at the end for flushing and a water demand where design flow and residual pressures can be maintained. Approved joint restraint systems are to be used as required to provide adequate restraint.

Where valves are placed for future water main extensions, valves are to be restrained to the fitting. A minimum of one joint of pipe, restrained to the valve, shall be installed past the valve except where calculations or local conditions indicate more pipes are required to provide adequate restraint. The live side of the valve shall be restrained to the appropriate length for the size, pressure, and local conditions of the main.

### 2.2.7.5 Multiple Supply Points

A minimum of two connections to the water system may be required by the Department to meet water quality standards and fire flow demands.

### 2.2.7.6 Meters

The Applicant is required to provide service lines and meters to all lots serviceable from the proposed construction. Services and meters shall be sized and locations designed in accordance with the worksheet presented in [Appendix A](#) of this DSM. Minimum service size shall be three-quarter inch (3/4") pipe with five-eighths inch (5/8") meter. Services shall be shown and detailed on the plans for both residential and commercial developments. County standard meter sizing forms (in [Appendix A](#)) shall be submitted with all non-residential site plans. If an irrigation meter is used, it will connect separately to the primary supply main so that the domestic use meter does not meter the flow.

### 2.2.7.7 Pressure Reducing Valves

When the service connection system pressure will be greater than eighty (80) psi, pressure-reducing valves to be operated and maintained by each customer shall be installed on the customer's service line or interior plumbing in accordance with the plumbing code. The pressure reducing valve shall be owned, operated, and maintained by the owner of the property and shall be inspected by the County's Building Inspector.

### 2.2.8 Cross-Connection Control Program

The County conducts a cross-connection control program. In accordance with this program and the requirements of the Virginia Waterworks Regulations, no direct connection of any type to the potable water system to any sewer, storm or drain system is permitted. In addition, no connection to the potable water system to any unapproved source, for example, a private well, is permitted.

Backflow prevention devices are required where, in the opinion of the Department, the customer's use of water may present a potential for backflow or contamination. Backflow prevention may also be required where otherwise defined under the Uniform Statewide Building Code, the Cross Connection and Backflow Prevention Program, or the Virginia Department of Health Waterworks Regulations.

### 2.2.9 Water Pumping Stations

Water pumping stations are special Projects and specific Project standards and plans will be prepared by the Engineer and submitted to the County for review and approval. Water pumping stations will only be allowed when specifically approved by the Department.

The design requirements for a water pump station shall be determined through discussions with the Department prior to submitting the design to the County. After the design criteria has been determined, the Engineer shall prepare a preliminary engineering report, which shall address all issues requested by the Department and meet all the requirements of the VDH, for approval of both of these entities.

### 2.2.10 Automated Water Meter Infrastructure

The County utilizes an Automated Meter Infrastructure System. Provisions will need to be made to provide a location to mount the infrastructure and provide a location for 110V electrical service. Viable locations for mounting the infrastructure can be but are not limited to; community centers, light poles, pump stations.

## 2.3 Sanitary Sewerage

### 2.3.1 Sanitary Sewer Location

Sanitary sewer mains should be installed in easements outside of existing VDOT maintained rights-of-way. Sanitary sewer mains to be installed in streets that will become VDOT maintained rights-of-way must be done so in accordance with the requirements of the most current versions of all pertinent VDOT standards, specifications, and regulations. Where approved by VDOT, on a case by case basis, construction of sanitary sewer lines parallel to the right of way may be permitted to be located in the roadway. This approval shall be based, in part, upon the density of the development and the practicality of placing the sanitary sewer lines outside of the pavement area. The sewer line shall be constructed in the centerline of the outermost lane,

except when this space has been previously used by another utility or when the width of the street justifies two lines. Sewer lines shall not be constructed in the vehicle wheelpath. The determination of the number of lines shall be made by the Department during the plan review process. All sanitary sewers shall be laid on a straight line and straight grade between manholes. All sewer laterals shall be constructed to the edge of the right-of-way during initial construction to eliminate the need for open cuts to make service connections.

In a parallel installation, sanitary sewer lines or manholes shall be located at least 10 feet horizontally from any water main whenever possible. The distance shall be measured edge to edge between the structures or pipes.

In accordance with the VDH requirements, when local conditions prevent a horizontal separation of ten feet (10'), a sanitary sewer may be closer to a water main provided that:

- A. The bottom of the water main is at least eighteen inches (18") above the top of the sewer.
- B. Where the water main cannot be located at least eighteen inches (18") above the top of the sewer, the sewer shall be constructed of AWWA approved water pipe and shall be pressure tested to assure water tightness prior to backfilling. For gravity mains, the test pressure shall be five (5) psi, or a pressure greater than the pressure exerted by a column of water equal to the depth of the deepest section of the sewer being tested, whichever is greater. The test pressure shall be held for a minimum of two (2) hours. For force mains, the test pressure shall be the working pressure of the mains plus an allowance of fifty percent (50%) for surge. The test shall be conducted in accordance with the pressure test procedure for water mains.
- C. Sanitary sewer manholes located within ten feet (10') of water mains shall be of watertight construction and be tested in place by vacuum testing.

In a crossing installation, sanitary sewers crossing water mains shall be laid to provide a separation of at least eighteen inches (18") between the bottom of the water main and the top of the sewer whenever possible.

When conditions prevent a vertical separation of eighteen inches (18"), the following shall be used:

- A. Sewers passing over or under water mains shall be constructed of AWWA approved water pipe and shall be pressure tested to assure water tightness prior to backfilling. The test pressure shall be five (5) psi, or a pressure greater than the pressure exerted by a column of water equal to the depth of the deepest section of the sewer being tested, whichever is greater. The test pressure shall be held for a minimum of two (2) hours.
- B. In addition, water mains passing under sanitary sewers shall be protected by providing:
  - a. A vertical separation of at least eighteen inches (18") between the bottom of the sewer and the top of the water mains.

- b. Adequate structural support for the sewers to prevent excessive deflection of the joints and settling on and breaking of the water mains.
- c. A full section of water pipe centered at the point of crossing so that the joints will be equidistant and as far as possible from the sewer.

Where the sanitary sewer is installed parallel to a storm sewer, there shall normally be minimum of five feet (5') of horizontal separation, measured edge to edge, between them. Under unusual conditions, the County may reduce this requirement.

The carrier pipes within bores for sanitary sewer installation shall be restrained mechanical joint zinc coated ductile iron sewer pipe, H2 sewer safe Protecto 401 epoxy or approved equal.

Where a sewer pipe is located within 2,000 feet downstream of the discharge end of a force main, the pipe shall be constructed of PVC materials. If zinc coated ductile iron pipe is required within 2,000 feet of the discharge end of a force main because of lack of cover, lack of separation, or any other reason, the pipe shall have a special interior lining resistant to corrosion by hydrogen sulfide. The special coating shall be approved by the Department. If in the County's judgment, corrosion by hydrogen sulfide will continue to be a problem for more than 2,000 feet, corrosion resistant materials shall continue to be used for an appropriate distance from the discharge end of the force main. The Applicant shall determine, in consultation with the pipe manufacturer, additional areas of pipe, which may require special interior lining. Conditions requiring special interior lining may include but are not limited to areas of warm temperatures, low operating velocities, high turbulence, partially full flows, and/or long retention times.

All sanitary sewer line crossings of railroads, major roadways, and other major structures shall be contained in a casing pipe. The design of railroad crossings shall comply with the requirements of American Railway Engineering Association Specifications, "Part 5 – Pipelines" (latest revision). The Applicant shall be responsible for obtaining required railway permits or agreements for the County, paying any fees, and posting any required construction bonds and occupation fees for the railway crossing prior to beginning construction on any part of the Project. The Applicant shall provide to the Department a copy of the permit or agreement before the County will issue a Construction Permit for the Project.

Zinc coated Ductile iron sewer pipe (Protecto 401 coated) with V-Bio polywrap, protecting the sewer main from point loading shall be used for sanitary sewers when crossing storm sewers or other rigid underground conduits with less than eighteen inches (18") of vertical separation.

The tops of sewers crossing streams shall have a minimum of three feet (3') of cover from the natural stream bottom. The County will consider permitting less cover if the proposed sewer crossing is contained in a steel casing pipe with a zinc coated ductile iron carrier pipe used and the sewer will not interfere with future improvements to the stream channel. The sewer trench within the stream bed shall be protected from erosion by the use of rip-rap, gabion mats, or other appropriate measures to include specific bedding design for the stream crossing. See the Stream Crossing Standard Detail for the typical crossing design. The Applicant shall be responsible for obtaining all required environmental permits for stream crossings and construction activities.

Use of concrete in a stream bed is discouraged due to the disruption to natural movement of the streambed.

Sewer pipe with less than four feet (4') of cover installed within a 100-year flood plain shall be checked for flotation. Flotation calculations shall assume the pipe is empty. Non-float pipe shall be utilized if appropriate. Other anti-flotation methods or devices will be considered on an individual basis.

Clay dams shall be utilized in the trench where the possibility exists that ground water will follow the sewer trench and cause damage to property or undermine the pipe bedding.

Sewer lines located under paved channels or concrete channels shall be located at least two feet (2') below the bottom of the channel pavement.

Sanitary sewers constructed in fill shall be of zinc coated ductile iron sewer pipe with V-Bio wrap with manholes founded on original ground, either through a specifically designed foundation transferring the load to original ground or by placing the base slab on original ground, unless a licensed geotechnical engineer furnishes a written certification that the fill has been sufficiently compacted so that settlement of the sewer or manhole will not occur.

Sanitary sewers shall be designed to remain fully operational during a twenty-five (25) year flood event. Sewers and their appurtenances located along streams shall be protected against the normal range of high and low water conditions, including the 100-year flood. Sewers located along streams shall be located outside of the streambed and sufficiently removed from the stream channel to provide for future possible channel widening or meandering. Sanitary sewers crossing streams, estuaries, lakes, or reservoirs shall be constructed of watertight pipe. The pipe and joints shall be tested in place and shall exhibit zero infiltration. Sewers laid on piers across ravines or streams shall be allowed only when it can be demonstrated that no other practical alternative exists. Construction methods and materials of construction shall be such that sewers will remain watertight and free from change in alignment or grade due to anticipated hydraulic and physical loads and erosion.

In cases where sanitary sewers are to be constructed on steep grades and velocities greater than fifteen feet (15') per second are predicted, solid-walled PVC pipe shall be used.

Sanitary sewers shall not be laid at a slope greater than twenty percent (20%). Sanitary sewers laid on a slope of eighteen percent (18%) or greater shall be anchored securely with concrete anchors or other approved means. The Engineer shall determine the method of anchorage. The details of anchorage shall be shown on the construction plans before the plans will be approved by the Department.

### 2.3.2 Depth of Sanitary Sewer Lines

All sewer lines shall be designed to provide a minimum cover of four feet (4') over the pipe unless otherwise approved by the Department. The maximum depths of sewers shall be twenty feet (20') unless otherwise approved by the Department. Sewers located adjacent to streams and swales shall be located deep enough so that adjoining areas on the opposite side of the stream



or swale can be served by the sewer while maintaining the minimum cover requirements for stream crossings as outlined in [Section 2.3.1](#).

### 2.3.3 Sanitary Sewer Manholes

Manholes shall be constructed in accordance with this DSM. See [Section 3.3.2.2](#) for construction specifications.

On a given Project all manholes shall be of the same construction and all cleanouts shall be of the same construction.

Manholes shall be located at the end of each line, at all changes in pipe size, at all changes in grade or direction, at all changes in material, and at sewer junctions. Maximum spacing between manholes on straight runs shall be 500 feet for sewers fifteen inches (15") or less in size and 600 feet for sewers eighteen inches (18") and larger in size.

"Cut-in" manholes, in lieu of Doghouse manholes, over existing sewer mains shall be constructed in accordance with standard detail S-26 (manhole base and two ductile iron sleeves).

Manholes shall have manhole inserts installed in accordance with the Standard Details.

Steps shall not be installed in sanitary sewer manholes unless approved by the Department.

Five-foot (5') diameter manholes shall be used when the depth of the manhole is sixteen feet (16') or greater.

If a manhole is located within 2,000 feet downstream of the discharge end of a force main, the manhole shall have an interior coating or liner resistant to corrosion by hydrogen sulfide. The Department shall approve coatings and liners utilized. If, in the County's judgment, corrosion by hydrogen sulfide will continue to be a problem for more than 2,000 feet, corrosion resistant materials shall continue to be used for an appropriate distance from the discharge end of the force main.

Unvented sections of sewer shall not exceed 1,000 feet in length.

The deflection of horizontal flow direction from any incoming pipe to any outgoing pipe in a manhole shall not exceed ninety degrees (90°).

Drop manholes shall be used when the invert elevation of the incoming sewer line exceeds the invert elevation of the outgoing sewer line by two feet (2') or more. One (1) internal drop is allowed per four-foot (4') diameter manhole. If two or more drops are necessary, the manhole diameter must be increased to five feet (5').

Manholes subject to flooding shall have watertight manhole covers.

Bolt Down manhole lids shall be used for manholes located in Offsite easements. In areas subject to flooding, bolt down watertight manhole covers are required. The rims of manholes in off-site easements shall be placed at least eighteen inches (18") above final ground elevation and shall be marked with fiberglass manhole markers visible four feet (4') above the ground. The rims of manholes located in maintained easements shall be placed flush with the final grade. The four-

foot (4') marker requirement may be waived at the discretion of the Department.

Monitoring manholes shall be provided on the service lines for all facilities producing non-domestic wastewater governed by the County "Sewage Use Ordinance and Pretreatment Ordinance". Monitoring manholes are owned by the property owner and shall be easily accessible. The County shall have the right of access to monitoring manholes at all times.

### 2.3.4 Sewer Service Connections

Service connections shall be provided in accordance with this DSM, County ordinances, specifications, and details. During site infrastructure construction the sewer lateral shall be constructed to the right-of-way line, property line or edge of easement with the end plugged. A two by four (2x4) marker shall denote the end of the lateral per the Lateral Service Connection detail.

During building construction, the building lateral shall be connected to the existing lateral stub with a wye and a cleanout installed to the surface. The cleanout top, per the Standard Detail S-10-A, shall be installed to grade by the site contractor prior to CCTV of the sanitary sewer lateral by the County and setting of the water meter.

Service connections shall have a maximum depth of twelve feet (12') at the connection to the main. The minimum diameter of pipe to be used for a service connection is 4 inches. The minimum grade for service connections shall be two and eight one-hundredths percent (2.08%) (1/4" per foot). Laterals shall be Schedule 26 or Schedule 40 PVC and all fittings shall be Schedule 26 or Schedule 40.

"Hung" Sewers (sewer pump in basement) in houses are encouraged to eliminate deep sewers. When the basement floor elevation is below the receiving sewer main, a back water device must be installed and will be inspected by a County building inspector. The Department is not responsible for identification of structures that require back water devices.

### 2.3.5 Sewer Structural Design

The minimum pipe size for all gravity sewer mains shall be eight inches (8") in diameter.

Structural requirements must be considered in the design of all sanitary sewers and appurtenances. This is a matter of detail design and is not subject to generalization. The following should be considered at a minimum:

- A. Special Structures: whenever possible sanitary sewer structures shall be built as shown in the standard details. Structures other than those shown in the standard details shall be considered special structures and shall be designed and detailed by a Professional Engineer licensed in the Commonwealth of Virginia.
- B. Flotation: Sewers shall be designed to resist flotation where such conditions may reasonably be expected to exist. See [Section 2.3.1](#)
- C. Manholes sixteen feet (16') or deeper shall be five feet (5') in diameter.

### 2.3.6 Hydraulic Design for Sanitary Sewers

The quantity of sewage for design purposes shall be determined by the requirements of the total drainage area, which is tributary to the section of sewer under consideration in its built-out condition, unless otherwise approved by the Department.

Until site specific information has been established, the average quantities of sewage shall be computed using the following values, which include a minimum infiltration allowance:

<u>Land Use</u>	<u>Gallons per Day per Acre</u>	<u>Equivalent Persons per Acre</u>
Residential - 1 to 2 dwellings/acre	500	5
Residential - 2 to 4 dwellings/acre	1,200	12
Residential - 4 to 8 dwellings/acre	2,500	25
Agricultural	500	5
Commercial - Retail	2,000	20
Commercial - Office	1,500	15
Industrial - Light	2,000	20
Industrial - Medium	3,500	35
Industrial - Heavy	3,500	35

Where site-specific determinations can be made, sewage flows may be determined by using the following specific design information:

<u>Facility to be Served</u>	<u>Design Units</u>	<u>Flow (gpd)</u>
Single Family Residential	3.5 people/unit	350
Three Bedroom Apartment	3.5 people/unit	350
Two Bedroom Apartment	3 people/unit	300
One Bedroom Apartment	2 people/unit	200
Three Bedroom Condo	4 people/unit	400
Two Bedroom Condo	3 people/unit	300
Elementary School	per person	10
High School	per person	16
Motel and Hotels	per room	130
Manufactured Home developments	per unit	300

Restaurants	per seat	50
Service Stations	per vehicle serviced	10
Factories	per person per 8 hour shift	25
Shopping Centers	per 1,000 sq. ft.	250
Hospitals	per bed	300
Nursing Homes	per bed	200
Homes for the Aged	per bed	100
Medical Center	per 1,000 sq. ft.	500
Laundromat	per washing machine	500
Theaters	per seat	5
Bowling Alleys	per lane	75
Office Buildings	per 1,000 sq. ft.	200

Flows for other uses may be determined by using flow information provided by the Applicant and approved by the Department.

Peak flows shall be utilized for design of sanitary sewers. Peak flows shall be determined in accordance with the Virginia SCAT Regulations and as follows:

For “Lateral” sewers, sewer pipes that do not receive flow from any other common sewer, and “sub-main” sewers, sewer pipes that receive flow from only lateral sewers, peak flows will be 4.0 times average flows.

For “Main” or “trunk” sewers, sewer pipes that receive flow from multiple sub-main sewers, peak flows shall be 3.5 times the average daily flow.

For “Interceptor” sewers, sewer pipes that receive flow from multiple main sewers, peak flows shall be 3.5 times the average daily flow.

- A. Sewers shall have a continuous slope, straight alignment, and uniform pipe size and material between manholes.
- B. At all junctions where a smaller diameter sewer discharges into a larger one and at all locations where the line increases in size, the invert of the larger sewer shall be set so that the energy gradients of the sewers at the junction are continuous through the manhole. This condition may be met by matching the crowns of the two pipes.
- C. Sewers shall be designed to be free flowing with the hydraulic grade line no higher than the crown of the sewer and with slopes sufficient to provide an average velocity, when flowing full, of not less than two feet per second. Computations of velocity of flow shall be based on a Manning coefficient of 0.013. Hydraulic Grade Lines shall be included on sanitary sewer line profiles.

- D. The following are minimum slopes in feet per hundred feet to be provided for sewer lines. Slopes greater than the minimum are desirable. Pipe size shall not be increased solely to reduce required slope unless approved by the Department.

Pipe Size	8"	10"	12"	15"	18"	21"	24"	27"	30"	36"
Slope (%)	0.40	0.28	0.22	0.15	0.12	0.10	0.08	0.067	0.058	0.046

- E. In cases where sewers are to be constructed on steep grades, the slope shall not exceed twenty percent (20%). Suitable drop manholes shall be provided to break the steep slopes and to limit slope to no more than 20% in the connecting sewer pipes between manholes.
- F. Miscellaneous head losses at manholes, curves, and junctions shall be estimated and allowed for as follows:
- a. In sewers twenty-four inches (24") and less in diameter, allow head loss equal to at least 0.10 feet at each manhole. The Department may allow this to be reduced to 0.05 feet under special circumstances.
  - b. At transitions and intersections of sewers larger than twenty-four inches (24") in diameter, allow  $0.50 V^2 / 2g$ , where "V" is the velocity in the downstream pipe assuming pipe full conditions (feet per second) and "g" is the gravitational constant of 32.2 feet per second squared.
- G. The pipe diameter should continually increase with the increase in tributary flow. Where steep ground slopes make possible the use of a reduced pipe size and substantial economy of construction costs is thereby indicated, the pipe size may be reduced, but hydraulic allowances shall be made to provide for head loss at entry, increased velocity and effect of velocity retardation at the lower end where the flow will be on flatter slopes. In no case shall pipe size be reduced more than one nominal size in diameter.
- H. The minimum pipe size for gravity sewers shall be 8 inches.
- I. Gravity sewer mains eight (8), ten (10), and twelve (12) inches in diameter shall be sized at fifty percent (50%) of full pipe flow. Pipes fourteen inches (14") and larger shall be sized at eighty-five percent (85%) of full pipe flow.

The hydraulic computations shall be submitted to the Department for approval. The Engineer shall submit with all sewer plans information and calculations on sewer flow demands, sewer shed drawings including tributary areas, sewer capacities for the Project, and, if requested, an analysis of downstream capacity of existing improvements.

### 2.3.7 Sewage Pump Stations and Force Mains

The Water/Sewer Master Plan identifies regional sanitary sewage and water pumping stations. Pumping stations not identified in the Water/Sewer Master Plan will not be considered unless such pump stations meet interim utility planning objectives and approved by the Department.

The pump station design shall be in accordance with the approved preliminary engineering report. At a minimum, the following information shall be provided in the construction plans:

- A. Structural design and calculations, including steel reinforcement drawings where applicable, for the facility,
- B. Hydraulic design for the equipment selected, including scaled drawings,
- C. Electrical and mechanical drawings and specifications for the equipment selected,
- D. All mechanical and electrical equipment which could be damaged or inactivated by contact with or submergence in water shall be physically located above the 100-year flood or otherwise protected against the 100-year flood damage. All stations shall be designed to remain fully operational during the 25-year flood.
- E. Project specifications,
- F. Pump and system head curves,
- G. The average and peak station inflows shall be determined. Appropriate industry standard engineering methods, as indicated in [Section 2.3.6](#) of this DSM and subject to approval by the Department, may be used in calculating the average sewage flows. The peak flow shall be determined as indicated in [Section 2.3.6](#) and shall not be less than 3.5 times the average flow.
- H. The effective capacity of the wet well should be such that one pump will have a cycle time of no less than ten (10) minutes and there will be no more six (6) pump starts per pump in one hour, unless approved by the Department. Pump cycle time includes both the pump down time and influent fill time.
- I. Site Plan.

The construction plans shall be approved by the Department and the DEQ.

All pump stations shall have a backup operation system installed. The Director shall determine the best application on a case by case situation.

At least one of the following systems shall be installed at all pump station sites:

- A. A permanent diesel engine driven direct drive critically silence pump set. The pump set shall be self-priming. The pump set shall have permanent piping to the station and wet well and all appurtenances shall be insulated to protect against freezing. The pump set shall be designed to handle the maximum capacity of the station.
- B. A permanent diesel engine driven direct drive power pack generator and automatic

transfer switch that will handle the starting and operating load of all equipment needed for sustained operation as per the SCAT regulations.

SCADA systems shall be required with all new pump stations. The SCADA will be consistent with the most current type being utilized for existing pump stations, and must be acceptable to the Department.

Sanitary sewage force mains shall be zinc coated ductile iron pipe with V-Bio wrap, with a corrosion resistant 401 ceramic epoxy coating or approved equivalent, PVC, AWWA C-900, pipe, or other pipe approved by the Department. Force mains are to be designed with a minimum flow velocity of 2.0 feet per second and a maximum flow velocity of 8.0 feet per second. A Hazen-Williams "C" value of 120 shall be used for design. Minimum force main size shall be four inches (4") in diameter. A constant grade shall be used where feasible. Valves and air releases will be provided where directed by the Department. Minimum cover on force mains shall be 3.5 feet.

Design parameters for calculation of thrust restraint lengths shall be as follows:

- A. Soil designation is cohesive granular
- B. Minimum depth of cover is 3.5 feet
- C. Use type 3 laying conditions
- D. Design pressure is 100 PSI working pressure plus 120 PSI surge allowance
- E. Safety factor is 1.5
- F. The Engineer shall increase the above lengths for working pressures greater than 100 PSI
- G. The Engineer shall individually evaluate all combined bends and indicate the required lengths on the profile view

Manholes receiving the discharge from force mains shall be designed in accordance with this DSM. In addition, special acid-resistant manholes and sanitary sewer pipe shall be provided downstream of the discharge point for a minimum of 2,000 feet. On existing systems, non-acid resistant sanitary pipes and manholes shall receive an approved PVC liner or other acid resistant liner approved by the Department.

### 2.3.8 Grease Interceptors

All non-domestic facilities dealing with grease shall, at the Owner's expense and as required by the Department:

- A. Provide a set of plans for review and approval by the Department and the County Department of Code Compliance.
- B. Provide an adequately sized grease interceptor.
- C. Locate the interceptor in a manner that provides ready and easy accessibility for inspection and cleaning.

- D. Maintain grease interceptors in continuous proper operating condition. The Owner shall be responsible for all repairs, replacements, maintenance costs, or any other fees.
- E. Unless otherwise specified by the Department, service the grease interceptor at a minimum of every six (6) months.

Sizing Requirements:

The recommended minimum size for an exterior grease interceptor is 1,000 gallons. The generator may supply sizing information for a smaller unit, but under no circumstances shall an exterior grease interceptor have a capacity of less than 500 gallons.

Design Considerations:

- A. Except for grease traps, each grease interceptor shall be located outside of a building or structure at least ten feet from any sink or dishwasher to allow proper cooling of wastewater, in an area accessible for service, and so installed and connected that it shall be at all times easily accessible for inspection, cleaning and the removal of intercepted waste. The inlet flow control inspection ports, the interceptor inspection ports, and the effluent monitoring ports shall be in area where vehicles do not temporarily block access. It shall be a violation of the requirement of accessibility if ladders are required to reach or bulky equipment or stored materials must be removed in order to access or inspect any of the components of the grease interceptor. The location of all inspection and motoring ports shall be included on the building plans and must meet the approval of the Department.
- B. The grease interceptor shall be constructed of impervious materials capable of withstanding abrupt and extreme changes in temperature. It shall be of substantial construction and shall meet all applicable loading criteria for locations subject to vehicular traffic loads. The structure shall be made watertight through bituminous coatings, joint gaskets, and pipe connection gaskets or seals.
- C. The grease interceptor shall be properly vented to allow flow through the unit without creating potential odor problems.
- D. Inspection ports shall be installed prior to the influent flow control device and for each compartment of the unit.
- E. An effluent monitoring port shall be provided for ease of sampling the discharge from the interceptor. The monitoring port shall be, within the confines of the property boundary, as close as possible to the connection with the POTW, but prior to its combining with any other waste stream. It shall be unlawful for any generator to divert sewage around a monitoring port to the POTW.