

1. DESIGN STANDARDS AND PROCEDURES

1.1 General

These design standards have been prepared to assist engineers preparing plans for water and sanitary sewer projects in Hanover County, Virginia. These standards are for use by experienced design professionals. Variations will be permitted based solely on sound engineering practice and will be reviewed and approved by the Department of Public Utilities on an individual basis. Such variations must be requested in writing along with sufficient documentation supporting the request.

Designs shall be in accordance with the Latest Edition of the Waterworks Regulations and Sewage Collection and Treatment Regulations (SCAT), Virginia Department of Health, Commonwealth of Virginia and any other local, State or Federal agencies having jurisdiction. The engineer shall also comply with the requirements of the Code of Hanover County as it pertains to water and sanitary sewer systems. It is the responsibility of the engineer to inform developers of the contents as set forth in the applicable local ordinances as it relates to the project under review and consideration by the Department of Public Utilities.

1.1.1 Preliminary Matters

It is recommended that for most projects, but particularly complex projects and projects which may require special considerations, the engineer arrange a meeting with the Department of Public Utilities to discuss the approach to be taken to supply water and sanitary sewer service.

It is recommended that the engineer confer with the Virginia Department of Transportation or the Town of Ashland, as appropriate, prior to preparing plans for a water main or sewer line extension in any public right-of-way so that location issues may be resolved prior to preparation and submittal of the plans.

1.1.2 Master Plan

Prior to the approval of any portion of a phased development, subdivision or site plan, the developer, or his agent, shall submit an overall master plan of proposed water and/or wastewater systems for the entire development for review and approval by the Department of Public Utilities. The master plan shall be amended and submitted for review and approval as construction plans for future phases are submitted for approval if future development is not in accordance with the approved master plan.

1.1.3 Construction Drawings

Prior to construction of public water and/or sanitary sewer facilities, construction drawings for the proposed facilities must be submitted for review and approved by the Department of Public Utilities. The construction drawings must be in a form acceptable to the Department of Public Utilities.

Construction drawings are typically submitted to the Hanover County Planning

Department, the Town of Ashland Planning Department, or the Hanover County Department of Public Works which forward the plans to the Department of Public Utilities. If plans are submitted directly to the Department of Public Utilities, four sets of plans will be required for the Department's use. Normally other agencies require the correct number of plan sets so that the Department of Public Utilities can have four sets for its use. The Department of Public Utilities will contact a developer or engineer if additional plan sets are required.

All water and sanitary sewer systems must be located and sized properly to serve entire service areas as determined by the Department of Public Utilities.

It should be noted that where it is determined that water or sanitary sewer lines are necessary to serve adjoining properties or properties beyond the subdivision or development in question, the developer will be required to design and construct his system, properly sized and at an appropriate location, to permit future extensions to be made at the limits of the subdivision or development in question. If a subdivision or development is divided into logical phases, the water and sanitary sewer improvements to serve adjoining properties may be phased along with the subdivision or development. All improvements within or adjacent to a phase must be constructed as each phase is developed.

The sanitary sewer system normally will terminate, at or within one lot from the adjacent and/or upstream properties to be served by the system in the future. The termination point shall be approved by the Department. Normally sanitary sewers will be constructed to the limits of construction within a development so that future extensions to adjoining properties will not disrupt improvements. Elevations of the sanitary sewer system must be designed such that future extensions are taken into consideration to allow service to all the area which naturally drains towards the system. Utility easements to adjoining properties to allow for the extension of the public sewer system shall be provided.

The water system must be designed and constructed through the development to facilitate future extensions. Typically, this will include the construction of water mains along the full extent of any public road frontage of a subdivision or development unless such a water main is already present. The termination point shall be approved by the Department. If a water main is required outside of and not parallel to a right-of-way, the water main will be constructed to the limits of construction within the development so that future extensions to adjoining properties will not disrupt any improvements. Utility easements shall be provided to allow adjoining properties to connect to the public water system as appropriate.

Construction drawings shall contain the information necessary to construct the utilities shown. The information shall be presented in a clear and legible manner. Drawings shall meet the requirements of the Department of Public Utilities as outlined in the appropriate checklist contained in these standards.

The engineer shall coordinate the location of all proposed water and/or sanitary sewer lines within all existing and proposed road rights-of-way with regard to existing and

proposed roads, and drainage structures. In addition, coordination shall be made with other appropriate utility companies and agencies with regard to their existing easements, rights-of-way and facilities.

Where the possibility of conflicts with existing utilities exist, the Department of Public Utilities reserves the right to require that the engineer secure accurate information on the horizontal and vertical location of such utilities through subsurface exploration prior to approving the plans.

The plans will be reviewed and a review letter will be prepared. After revisions are made, the engineer must resubmit the plans for review. Plans will be approved when all comments of the Department of Public Utilities, and the comments of other departments and/or agencies have been addressed by the engineer.

Vertical datum for surveys shall be noted on the plans. Vertical datum shall be National Geodetic Vertical Datum of 1929 (NGVD 29).

1.1.4 Utility Service Agreement, Fees, Bonds, and Construction Permit

The developer must enter into an Utility Service Agreement with Hanover County before a Utility Construction Permit will be issued. All plan review and inspection fees must be paid, and performance bonds or surety posted before a utility construction permit will be issued. Work on utilities may not begin until a Utility Construction Permit is issued by the Department of Public Utilities.

1.1.5 Contractor Requirements and Inspection

All utility work must be performed by a Class A licensed contractor deemed acceptable to the Department of Public Utilities. The Department of Public Utilities may allow service laterals to be installed by a licensed plumber. All utility construction shall be subject to inspection, testing and approval by the Department of Public Utilities.

1.1.6 Contacting Property Owners

Prior to performing any survey or design work on private property, the engineer or surveyor shall notify the landowner and obtain the landowners permission for all work. In addition, the Department of Public Utilities may require that letters be sent to landowners with existing easements on their property prior to any work being completed in the easement. Notification shall be made in the form of a letter to be sent to the property owner. If requested copies of these letters shall be provided to the Department of Public Utilities.

1.2 Sanitary Sewers

1.2.1 Location

Whenever possible, sanitary sewers shall be constructed within street rights-of-way. All sanitary sewers located in existing or proposed streets shall be constructed along the center of the street or center of the travel lane except when this space has been previously used by another utility or when the width of the street justifies two lines. Exceptions to this specified location will be allowed only when it has been definitively shown that it is

not practicable to adhere to the standard location. All sanitary sewers shall be laid on a straight line and grade between manholes.

1.2.2 Horizontal Separation from Water Mains

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

Minimum horizontal separation shall meet or exceed ten feet (10') whenever possible. The designer should consider alternate alignments and/or locations for water mains and sanitary sewer lines if required to provide the required horizontal separation. If it is not possible to obtain the specified horizontal separation based on specific local conditions then, in accordance with SCAT regulations, a sanitary sewer may be closer to a water main provided that:

1. The bottom of the water main is at least 18" above the top of the sewer.
2. Where the water main cannot be located at least 18" above the top of the sewer, the sewer shall be constructed of AWWA approved water pipe and shall be pressure tested to assure watertightness prior to backfilling. The test pressure shall be 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 2 hours.
3. Sanitary sewer manholes, located within 10 feet of water mains shall be of watertight construction and be tested in place by vacuum testing.

1.2.3 Vertical Separation from Water Mains

In a crossing installation, sanitary sewers crossing water mains shall be laid to provide a separation of at least 18" between the bottom of the water main and the top of the sanitary sewer whenever possible. Minimum vertical separation shall be provided whenever possible. The designer should consider alternate alignments and/or locations for water mains, sewer lines, and storm sewers if required to provide the required vertical separation between sanitary sewers and water mains. If it is not possible to obtain the specified vertical separation based on specific local conditions then, in accordance with the SCAT regulations, the following criteria must be met:

1. Sewers passing over or under water mains shall be constructed of AWWA approved water pipe and shall be pressure tested to assure watertightness prior to backfilling. The test pressure shall be 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 2 hours.
2. In addition, water mains passing under sanitary sewers shall be protected by providing:

- A. A vertical separation of at least 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 sanitary sewer.

1.2.4 Vertical Separation Other Utilities

Normally where storm sewers or other utilities pass over or under sanitary sewers, a minimum of 18” of separation should be maintain. The County may allow the separation to be less than 18” but no less than 6” on a case by case basis. Ductile iron pipe (Class 52 minimum) must be utilized for the sanitary sewer when the separation is less than 12”.

1.2.5 Horizontal Separation Other Utilities

Where the sanitary sewer is installed parallel to a storm sewer, there shall normally be minimum of 5 feet of horizontal separation, measured edge to edge, between them. Under unusual conditions, this requirement may be reduced by the County. If a sanitary sewer is located more than 5 feet below the bottom of a parallel storm sewer, the Department of Public Utilities may require that the distance between the two pipes be increased.

1.2.6 Bores and Tunneling

Carrier pipes within bores or tunnels for sanitary sewer installation shall generally be ductile iron (Class 52 minimum) sewer pipe with restrained joints.

1.2.7 Crossings of Railroads, Major Roadways and Other Major Structures

All sanitary sewer line crossings of railroads, major roadways, and other major structures shall be contained in a casing pipe or tunnel pipe. Design of railroad crossings shall comply with the requirements of American Railway engineering Association Specifications, Part 5 - Pipelines (latest revision). The developer shall be responsible for obtaining required railway permits and/or agreements for the County, paying any fees, and posting any required construction bonds for the railway crossing prior to beginning construction on any part of the project. A copy of the permit and/or agreement shall be provided to the Department of Public Utilities prior to a Utility Construction Permit being issued for the project.

1.2.8 Sanitary Sewers Near Force Main Discharge Points

Where a sanitary 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 whenever possible. If 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 coating resistant to corrosion by hydrogen sulfide. The special coating shall be approved by the Department of Public Utilities. If, in the County’s or engineer’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.

1.2.9 Sanitary Sewers Crossing Streams, Lakes, or Drainages

The tops of all sanitary sewers entering or crossing streams shall be a sufficient depth below the natural bottom of the streambed to protect the sanitary sewer line. Typically, sanitary sewers crossing streams shall have a minimum of three feet (3') of cover from the natural stream bottom. Less cover will be considered if no other option is available and the proposed sanitary sewer is ductile iron pipe, encased in concrete or otherwise protected, and the sanitary sewer will not interfere with future improvements to the stream channel. The sanitary sewer trench within the stream bed shall be protected from erosion by the use of rip-rap, concrete, gabion mats, or other appropriate measures. The developer shall be responsible for obtaining all required environmental permits for stream crossings and related construction activities. All conditions of any environmental permit must be acceptable to the Department of Public Utilities. It is the Developer's responsibility to obtain the Department of Public Utilities approval of any conditions prior to accepting any environmental permit.

Sanitary sewers located under paved channels, concrete channels, rip-rap lined channels, or other lined channels shall be located at least 2 feet below the bottom of the channel lining.

Sanitary 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 sanitary sewers will remain watertight and free from change in alignment or grade due to anticipated hydraulic and physical loads, and erosion.

Sanitary sewers will normally not be allowed to be constructed under lakes, estuaries, or storm water facilities. When constructed adjacent to such features, the sanitary sewer shall be located far enough away from the water surface that the sewer can be excavated without entering the water body for maintenance purposes.

1.2.10 Sewers within Floodplains

All sanitary sewer pipe within a 100-year floodplain, where cover is less than 4.0 feet or where size is greater than 12", shall be checked for floatation assuming the pipe is empty. Non-float pipe shall be utilized if appropriate. Other anti-floatation methods or devices will be considered on an individual basis.

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

Sanitary sewers shall be designed to remain fully operational during the 100-year flood. Sanitary 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. Sanitary

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 and meandering. 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 sanitary sewer while maintaining the minimum cover requirements for stream crossings outlined earlier.

1.2.11 Sewers Constructed in Fill

Sanitary sewers constructed in fill shall be of ductile iron sewer pipe (Class 52 minimum) with manholes founded on original ground unless a licensed geotechnical engineer furnishes a written certification that the fill has been sufficiently compacted so that settlement of the sanitary sewer and/or manhole will not occur.

1.2.12 Steep Slopes

In cases where sanitary sewers are to be constructed on steep grades and velocities greater than 15 feet per second are indicated, only solid-walled PVC pipe or other abrasion resistant material shall be used.

Whenever possible sanitary sewers shall not be laid at a slope greater than 20 percent. If no other alternative exists, sewers may be laid at grades greater than 20 percent with the prior approval of the Department of Public Utilities. Sanitary sewers laid on a slope of 20 percent or greater shall be anchored securely with concrete anchors or other approved means. Suggested minimum anchorage is as follows but shall be determined by the engineer:

1. Not over 36 feet center to center on grades 20 percent to 35 percent.
2. Not over 24 feet center to center on grades 35 percent to 50 percent.
3. Not over 16 feet center to center on grades 50 percent and over.

Details of anchorage must be shown on the construction plans before the plans will be approved by the Department of Public Utilities.

1.2.13 Utility Easements

Sanitary sewers not located in public right-of-ways shall be located in utility easements. Easements shall be wide enough to provide sufficient space for both installation and maintenance and shall have a minimum width of 20 feet. The Department of Public Utilities may require wider easements for sewers greater than 24" in diameter and/or greater than 12 feet in depth.

1.2.14 Depth Of Sanitary Sewer Lines

All PVC sanitary sewers within existing or proposed streets or areas subject to traffic shall be designed to provide a minimum cover of 6 feet over the pipe. Where less than six feet (6') of cover is provided in areas subject to traffic, the sewer shall be constructed of ductile iron sewer pipe (Class 52 minimum). Sanitary sewers in areas subject to traffic shall have no less than four feet (4') of cover unless otherwise approved by the County.

Greater depths shall be provided to serve low properties, where street grades may be lowered in the future, where there is a possibility of further extension of the sanitary sewer line to serve adjoining areas, to maintain separation from water mains, to maintain separation between sanitary sewer services and water mains, or where clearance must be provided for other utilities. Adequate clearance shall be provided for the future enlargement of undersized drainage structures. Sanitary sewers and sanitary sewer services shall generally be located at least 18” below water mains unless it can be demonstrated that no other practical alternative exists.

All sanitary sewer lines in easements not subject to traffic shall be provided with a minimum of four feet (4’) of cover unless otherwise approved by the Department of Public Utilities. The Department of Public Utilities may approve sewers with as little as two feet (2’) of cover, provided no other practical alternative exists, the sewer is constructed of ductile iron sewer pipe (Class 52 minimum), and a concrete cap, pavement, gabions, geotextile fabric and/or other appropriate stabilization measures are utilized to protect the sanitary sewer.

When sewer lines have more than fifteen feet (15’) of cover, the engineer shall verify that the type of pipe material proposed, particularly PVC pipe, is appropriate for the intended installation based on the soils, loading, and bedding conditions. If appropriate, the engineer shall provide special details showing how the pipe is to be bedded. The Department of Public Utilities may require written verification that such an analysis have been completed but the engineer is responsible for the design irregardless of whether the Department of Public Utilities requests such an analysis and irregardless of the depth of the sewer.

1.2.15 Sanitary Sewer Manholes

1.2.15.1 General

Manholes shall be constructed in accordance with Hanover County’s standards and details.

Manholes shall be located at the end of each line, at all changes in pipe size, at all changes in grade and at sewer junctions. Maximum spacing between manholes on straight runs shall be 400 feet for sewers 15” or less in size and 500 feet for sewers 18” and larger unless otherwise approved by the Department of Public Utilities.

Manholes in residential neighborhoods shall not be installed near the middle of front or rear yards. Manholes in residential yards shall be located near or at the side property lines. This limits the possibility of the manhole being in conflict with future improvements of the homeowner.

The angle between any incoming and outgoing pipe in a manhole shall typically not be less than 90 degrees. Under special circumstances, the County may approve and an angle of not less than 85 degrees.

1.2.15.2 Manholes Subject to Flooding

Manholes subject to flooding shall have watertight manhole covers. All manhole rims shall be one-half foot (1/2') above the 100 year flood elevation, except where the rim would be more than four feet (4') above the existing grade in which case watertight covers shall be used and the manhole top set at a height of 18" above final ground elevation.

1.2.15.3 Vandal-Proof Frames and Covers

Vandal-proof manhole frame and covers shall be used for manholes located in easements unless watertight covers are required. Unless otherwise approved by the Department of Public Utilities, rims of manholes in unmaintained easements (easements located in areas not normally maintained by the property owner) shall be placed at least 18" above final ground elevation.

1.2.15.4 Drop Manholes

Drop manholes are to be avoided whenever possible. Their use may be approved by the Department on a case by case basis when required to avoid excessive depth on a connecting sewer (greater than 12 feet). Drop manholes shall only be used when the invert elevation of the incoming sewer line exceeds the invert elevation of the outgoing sewer line by 2 feet or more. Exterior drop connections shall be utilized whenever possible.

1.2.15.5 Sewer Venting

Standard and vandal proof manhole frame and covers provide adequate venting for most sanitary sewers. When water tight manhole frames and covers are utilized on sanitary sewers, unvented sections of sanitary sewer shall not exceed 1,000 feet in length. If water tight frames and covers must be utilized on runs of sanitary sewer longer than 1,000 feet in length, air vents must be provided at manholes at increments spaced no more than 1,000 feet apart.

1.2.15.6 Sanitary Sewer Manholes Near Force Main Discharge Points

If a manhole is located within 2,000 feet of the discharge end of a force main, the manhole shall have an interior coating or concrete admixture resistant to corrosion by hydrogen sulfide. Coatings and admixtures utilized shall be approved by the Department of Public Utilities. If, in the County's or engineer'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.

1.2.16 Sanitary Sewer Service Connections

1.2.16.1 General

Service connections shall be provided in accordance with the County ordinances, specifications and details. The sewer service connection is the pipe that runs from the sewer main to the edge of the easement, property line, or right-of-way, as appropriate for

the particular installation. The sewer service connection to this point is owned and maintained by the Department of Public Utilities. Beyond this point, on private property, the sewer service is privately owned and maintained and is not subject to these requirements but is subject to the requirements of the Building Official. The Building Official should be contacted to determine these requirements.

Plugged service connections are to be provided to the easement, property line or right-of-way, as appropriate, for all lots and parcels within new developments unless otherwise approved by the Department of Public Utilities.

The minimum diameter pipe to be used for a service connection is 6". Normally the minimum grade for service connections shall be 2.08 percent (1/4" per foot). Under unusual conditions, the Department may approve a minimum slope of 1.04% (1/8" per foot) for a lateral. A cleanout is to be provided on all service connections at the easement, property line or right-of-way by the plumber when the service is extended. The County will own and maintain the sewer service from the main sewer line to the easement, property line, right-of-way, or clean-out as applicable. The remainder of the sewer service, including the cleanout, is the property owner's responsibility to own, operate, and maintain. The County shall have the right to utilize the clean-out for inspections and maintenance of its lines.

Direct service connections to sewers 18" in diameter and larger are not allowed. Service connections to sewers 18" in diameter and larger must be made at manholes. In certain cases, it may be appropriate to construct a parallel 8" sewer line to provide local service in an area. In such cases, additional easement shall be provided to allow for the construction and maintenance of the parallel 8" sewer line.

Where sewers run between lots, sewer services to the lots on either side shall be placed near either the front or rear building set back line, depending on at which set-back line the sewer is lower. In no case shall services be installed near the center of the building envelope unless a detailed house location plan is provided showing that the service will not be located immediately adjacent to the house.

Service connections to force mains shall not be allowed.

1.2.16.2 Depth of Sanitary Sewer Services

Sanitary sewer service connections will generally not be allowed to be made to sewer lines more than 20 feet deep, as measured from final grade above the sewer line to the invert of the sewer. Shallower, local sewer lines may be required to be installed by the Department of Public Utilities in areas where the main sewer line is more than 20 feet deep. The Department of Public Utilities may approve connections to sewers more than 20 feet deep on a case by case basis. Parallel, local sewer lines shall be located far enough away from the deeper main sewer line to allow for excavation of either line without disturbing the other.

Sewer laterals shall be no more than eight (8) feet deep at the edge of the easement or right-of-way unless otherwise specifically identified on the approved plans as being

deeper than eight (8) feet.

1.2.16.3 Grease Traps

Grease traps shall be provided on the private portion of the service connection for all facilities with the potential to deposit grease in the County's sewer system. Grease traps shall be installed on all service lines serving restaurants, food preparation establishments and other businesses or industries identified by the Department. The size of grease traps shall be indicated on the plans and is subject to approval by the Department and the Building Official. Monitoring manholes shall be provided down stream of all grease traps. Grease traps and monitoring manholes are privately owned and maintained.

1.2.16.4 Monitoring Manholes

Monitoring manholes shall be provided on the private portion of the service connection for all facilities discharging non-domestic wastewater to the public sewer system. These include industrial facilities, eating establishments, facilities with central kitchens such as nursing homes, facilities with a central laundry such as nursing homes, grocery stores, bakeries, automobile service stations, gasoline stations, hospitals, medical offices, dental offices, animal hospitals, veterinary clinics, cleaners, machine shops, photographic finishers, printing shops, laboratories, funeral homes, and other such facilities as determined by the Department of Public Utilities. Monitoring manholes are owned by the property owner and shall not be located in utility easements whenever possible. Monitoring manholes shall be easily accessible and the County shall be given the right of access to monitoring manholes at all times.

1.2.17 Sanitary Sewer Structural Design

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 general criteria should be considered by the design engineer at a minimum:

1. 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.
2. Pipe Foundation; In all cases the proper strength sewer pipe shall be specified for the proposed depth, width of trench and bedding condition. Soil conditions should be considered with samples being obtained where necessary to verify pipe selection and foundation design.
3. Flotation; Sewer shall be designed to resist flotation where such conditions may reasonably be expected to exist.

1.2.18 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 of Public Utilities.

Average quantities of sewage, including an infiltration allowance, shall be computed using the following:

<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 - 1 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 Water Use	1,000	10
Industrial-Medium Water Use	2,000	20
Industrial-Heavy Water Use	3,000	30

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

<u>Discharge Facility</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	4.0 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
Trailer Courts	per trailer	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 approved by the Department of Public Utilities.

Peak flows shall be utilized for design of sanitary sewers. Peak flows shall be determined as follows:

For average daily flows (Q_A) greater than 0 mgd and less than 0.50 mgd, peak flows (Q_P) will be 4.0 times the average daily flow. ($Q_P = 4.0 \times Q_A$)

For average daily flows greater than 0.50 mgd but less than 6.00 mgd, the peak flow in mgd, will be equal to $(4.136 - (0.273 \times Q_A)) \times Q_A$, where Q_A is in mgd.

For average daily flows greater than 6.0 mgd, peak flows shall be 2.5 times the average daily flow. ($Q_P = 2.5 \times Q_A$)

The engineer should ensure that the following design criteria are adhered to:

1. Sewers shall have a continuous slope, straight alignment and uniform pipe material between manholes. Pipe material may transition from DIP to PVC when drop connections are utilized one joint of pipe away from the drop connection.
2. 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 at the same level. Generally, this condition will be met matching the crowns of the two pipes. If this is not possible, the 0.8 depth of flow in each sewer should be placed at the same elevation.
3. Sewers shall be designed to be free flowing with the hydraulic grade below the crown of the sewer and with hydraulic 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 value of

“n” = 0.013 as used in Manning’s formula for velocity of flow unless otherwise approved by the Department of Public Utilities.

4. The following are minimum slopes in feet per hundred feet to be provided for sewer lines. Slopes greater than minimum are desirable. Sewers shall be placed at 1% slope or greater whenever possible. Slopes less than this should be utilized only when required to serve upstream areas. Pipe size shall not be increased solely to reduce required slope unless approved by the Department of Public Utilities.

Pipe Size	8”	10”	12”	15”	18”	21”	24”	27”	30”	36”
Slope (%)	.40	.28	.22	.15	.12	.10	.08	.067	.058	.046

A minimum slope of 0.52% shall be maintained for terminal 8” lines not to be extended.

Minimum pipe size for all sewers between manholes shall be 8”.

5. In cases where sewers are to be constructed on steep grades for which high velocities are anticipated, the maximum permissible velocity at average flow (before applying peak flow factor) should not exceed 15 feet per second. Suitable drop manholes shall be provided to break the steep slopes and to limit velocities to not more than 15 feet per second in the connecting sewer pipes between manholes.

Where drop manholes are impracticable for reduction of high velocity, the sewer shall be of solid wall PVC pipe or other abrasion resistant material.

6. Miscellaneous head losses at manholes, curves and junctions shall be estimated and allowed for as follows:
 - a. In sewers 24” and less in diameter, allow head loss equal to at least 0.10 feet at each manhole. The Hanover Department of Public Utilities may allow this to be reduced to 0.05 feet under special circumstances.
 - b. At transitions and intersections of sewers larger than 24” in diameter, allow $0.50 \frac{V^2}{2g}$, where “V” is the velocity in the pipe assuming pipe full conditions.
7. In general, the pipe diameter should be continually increasing 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.

If requested, hydraulic computations shall be submitted to the Department of Public Utilities for approval. Information submitted shall include, at a minimum, sewage flow generation calculations, sewer service shed drawings including tributary areas, average and peak sewage flow for each pipe, average and peak capacity of each pipe, top and invert information for manholes, and, if requested, an analysis of downstream capacity of existing improvements.

The Department of Public Utilities may require a project to include off-site improvements to the County's existing sewer system if such improvements are required to meet the needs of the project.

1.2.19 Sewage Pump Stations And Force Mains

Public sewage pump stations will only be allowed when approved by the Department of Public Utilities. Sewage pump stations will be used when it has been determined by the Department of Public Utilities that a pump station is the only practical way to provide sanitary service based upon a finding that:

1. It is economically impractical to extend a gravity sewer and the use of a pump station will not adversely affect the County's ability to serve the area with a gravity sewer at a future time; and
2. The proposed design and plan for the pump station and connecting lines do not adversely affect the current financial status of the County utility system or the future ability of the County to install a gravity sewer; and
3. The proposed design of the pump station permits replacement of the pump station with a gravity sewer without significant capital outlay at a future time; and
4. The pump station will not overload the existing sewage facilities and will not otherwise negatively affect the County's ability to efficiently manage the sewer system.

The design requirements for a sewage pumping facility shall be determined through discussions with the Department of Public Utilities **PRIOR TO INITIATING THE DESIGN**. A peaking factor of 2.5 shall be utilized in the design of all sewage pump stations. After the design criteria have been determined, the engineer shall prepare a preliminary engineering report for approval by the Department of Public Utilities and the Virginia Department of Environmental Quality. The preliminary engineering report shall address all issues requested by the Department of Public Utilities and meet the

requirements of the Virginia Department of Environmental Quality.

The pump station design shall be in accordance with the approved preliminary engineering report and all requirements of the Virginia Department of Environmental Quality. At a minimum, the following information shall be provided in the construction plans:

1. Structural design and calculations, including reinforcing drawings where applicable, for the facility.
2. Hydraulic design for the equipment selected, including scaled drawings.
3. Electrical and mechanical drawings and specifications for the equipment selected.
4. Project specifications.
5. Pump and system head curves.
6. Site Plan.

The construction plans shall be approved by the Department of Public Utilities and the Virginia Department of Environmental Quality.

Sanitary sewage force mains shall be ductile iron water pipe (Class 52 minimum), with a corrosion resistant coating, PVC AWWA C-900 pipe, PVC AWWA C-909, or other pipe approved by the Department of Public Utilities. 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 4" in diameter. A constant grade shall be used where feasible. Valves and air releases will be provided at appropriate locations. Minimum cover on force mains shall be 3.5 feet.

Manholes receiving the discharge from force mains shall be designed in accordance with the County's standard details. 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, existing manholes and sewer pipes shall receive a liner and/or coating approved by the Department of Public Utilities.

1.3 Water Mains

1.3.1 Water Main Location

Generally, water mains are to be installed along public or private streets, or travel aisles so they can be easily accessed. In subdivisions, water mains will be permitted in easements only when there is no other feasible alternative and approval is obtained from the Department of Public Utilities.

The engineer shall consider the location of existing and proposed sanitary sewer and

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 above sanitary and storm sewers whenever possible.

Where the possibility of major conflicts with existing utilities and/or other structures exist, the Department of Public Utilities 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.

1.3.1.1 Utility Easements

Easements shall be wide enough to provide sufficient space for both installation and maintenance of the water main. The minimum utility easement width for any water main shall be 20 feet unless an easement is located adjacent to a right-of-way in which case the easement shall be wide enough to provide 10' of easement beyond the water main.

Easement widths may be increased by the Department of Public Utilities for water mains larger than 16" in size or with more than ten feet (10') of cover.

1.3.1.2 Where Required

Typically, water mains will be required to be constructed along the full street frontage, both internal and perimeter, of any project or development. Water service and fire protection must be provided to each individual lot in a subdivision. This includes both streets being constructed as part of the project and existing streets which abut a project. Water mains may not be required to be constructed along the full frontage of existing streets if the following conditions exist:

1. A water main along the street frontage is not required to serve the project or the overall needs of the County's water system as determined by the Department of Public Utilities.
2. A water main, of the appropriate size to meet the overall needs of the County's system, already exists along the street frontage.
- 3.. Information on the size and/or location of a water main is not available to allow the Department of Public Utilities to provide adequate direction for the installation of a water main. If this is the case, the Department of Public Utilities may require that an utility easement be dedicated adjacent to the right-of-way to allow the future extension of a water main by others should it become necessary.
4. A project has been broken into multiple phases and the Department of Public Utilities has approved the phasing plan for the construction of water mains along the project's existing street frontage. In this case, water mains may be constructed with the approved phase of a project at the appropriate time.

5. The project is located on a large parcel of land where building and parking lot construction, not including private access roads to buildings and parking lots, is not proposed within 400 feet of the existing street frontage. Improvements, which would interfere with future water main extensions are not proposed in the vicinity of an existing street, and the project is not required by proffer of special condition to construct street improvements. Although full existing street water main improvements may not be required if these conditions are met, the Department of Public Utilities may require that an appropriately sized water main stub-out, with appropriate appurtenances and utility easements, be provided to the existing street to allow the logical development of the County's water system. The Department of Public Utilities may also require that utility easements be dedicated along the street frontage and the water mains be terminated out beyond any entrance.
6. Other special conditions that may exist and that are approved by the Director of Public Utilities on a case-by-case basis.

1.3.1.3 Subdivision Streets

In subdivision streets that have curb and gutter, water mains should generally be located five feet (5') in front of the face of curb (three feet (3') from the gutter pan) except in streets less than thirty feet (30') in width from face of curb to face of curb where the water main may be located behind the curb at least three feet (3') if there is also sewer located in the street. In subdivision streets without curb and gutter or along existing subdivision streets, water mains should be located three feet (3') to five feet (5') off of the edge of pavement or behind the ditch line if there is sufficient right-of-way to allow this. Future widening of the roadway shall be considered during the design of the water main.

1.3.1.4 Arterial and Collector Streets

In arterial and collector streets with curb and gutter, water mains should generally be located five feet (5') behind the curb. In arterial and collector streets without curb and gutter, water mains should generally be located five feet (5') behind the edge of pavement. Water mains adjacent to arterial and collector streets are allowed to be located under turn lanes. If, on an arterial or collector street, it is not possible or feasible to locate the water main behind the curb, the water main shall generally be located five feet (5') in front of the face of curb (three feet (3') from the gutter pan). In no case shall the water main be located closer than two feet (2') to the front of the gutter pan or less than three feet (3') behind the curb. Future widening of the roadway shall be considered during the design of the water main. Ductile iron pipe shall be utilized for water mains constructed adjacent to arterial and collector streets unless otherwise directed by the Department.

1.3.1.5 Four Lane or Greater Roadways

The location of water mains along major roadways (roads four lane or greater in width) shall be determined on a case-by-case basis. Generally, water mains shall be located on both sides of major roadways so that service connections need not cross the major road

with appropriate interconnection points between the parallel water mains.

1.3.1.6 Future Roadway Improvements

Future widening of roadways shall be considered during the design of any water main. Where water mains are to be installed in proposed or existing roads expected to be widened in the future, they shall be located in easements unless the future road cross section is known and location of water main is designed to avoid future relocation. Water mains shall be designed so that they will not need to be lowered when the road is widened or driveways are installed.

1.3.1.7 Depth Of Water Mains

Standard minimum cover shall be 42" and maximum cover shall be 10 feet unless otherwise approved. Water mains shall be constructed at minimum cover whenever possible. All water mains shall be constructed to a depth that will provide protection against freezing and thawing, and ensure adequate cover over valves and other appurtenances. New installations of water mains adjacent to roadways shall have a minimum of 42" of cover from existing/proposed edge of pavement. Greater depths shall be required where street grades will possibly be lowered in the future. Clearance shall be provided for enlargement of undersized drainage structures. Any earthwork which takes place over an existing water main shall be required to maintain the water main at a maximum depth of 10 feet below finished grade and minimum depth of 42" below finished grade. Where the depth of a water main will exceed 10 feet, the water main shall be raised. Where the depth of cover is less than 42", the water main shall be lowered.

1.3.2 Water Main Design

1.3.2.1 Changes in Alignment

Water mains shall be designed so that changes in alignment are made by deflecting successive lengths of pipe whenever possible. Joint deflection shall be limited to one-half of the pipe manufacturer's maximum allowable deflection. For PVC pipe, the deflection is made by curving the pipe, since there is no deflection capability in the joints. The bending radius shall be limited to one-half of the pipe manufacturer's recommended bending radius. Bending and joint deflection limits apply to vertical as well as horizontal curves. Bends with approved thrust blocks or approved joint restraint systems shall be used when deflecting the pipe is not practical.

1.3.2.2 Separation between Water and Sanitary Sewer Facilities

The engineer shall meet the requirements for separation between water and sanitary sewer facilities as stated in section 1.2, Sanitary Sewers, of these standards.

1.3.2.3 Vertical Separation Other Utilities

Normally where storm sewers or other utilities other than sanitary sewer pass over or under water mains, a minimum of 18" of separation should be maintain. The County may allow the separation to be reduced to one-half foot (0.50') on a case by case basis, however, ductile iron pipe must be utilized when the separation is less than one foot

(1.0’).

1.3.2.4 Bores and Tunneling

Water mains within bores or tunnels for shall be ductile iron pipe (minimum pressure class 350) with restrained joints.

1.3.2.5 Crossings of Railroads, Major Roadways and Other Major Structures

Water main crossings of railroads, major roadways, and other major structures shall be contained in a casing pipe. Design of railroad crossings shall comply with the requirements of American Railway engineering Association Specifications, Part 5 - Pipelines (latest revision). The engineer or developer shall be responsible for obtaining required railway permits and/or agreements for the County, paying any fees, and posting any required construction bonds for the railway crossing prior to beginning construction on any part of the project. A copy of the permit and or agreement shall be provided to the Department of Public Utilities prior to a Construction Permit being issued for the project.

Isolations valves may be required to be installed on either side of the crossing at the option of the Department of Public Utilities.

1.3.2.6 Water Mains Crossing Streams

Water mains entering or crossing streams, shall be ductile iron pipe. The tops of these mains shall be a sufficient depth below the natural bottom of the streambed to protect the pipe. In general, a minimum of 4 feet of suitable cover is required. The pipe and joints shall be designed, constructed, and protected against anticipated hydraulic and physical, longitudinal, vertical, horizontal loads, erosion and impact. Reasons for requesting less cover shall be given in writing to the County prior to plan submittal. The trench above the pipe in streams must be stabilized through the use of rip-rap, concrete, gabion mats, or other approved methods.

Subaqueous water main installations will be permitted only when it can be demonstrated that no other practical alternative exists. The pipe shall be of special construction having flexible watertight joints. Special attention shall be directed to foundation conditions and thrust restraint for the pipe.

For all subaqueous crossings, the design shall provide valves at both ends of the crossing so that the section can be isolated for tests and repairs. The valves shall be easily accessible and not subject to flooding.

1.3.2.7 Water Main Overhead Crossings

Water mains constructed on piers or hung from bridges will be permitted only when it can be demonstrated that no other practical alternative exists. The engineer shall submit a design for the piers, pier foundation and pipe that will demonstrate the structural integrity of the proposed system. Aboveground water pipes shall be adequately supported, protected from damage by freezing, accessible for repair or replacement, and be located above the 100-year flood elevation.

Isolation valves on either side of the crossing will be required.

1.3.2.8 Water Mains Constructed in Fill

Water mains constructed in fill shall be ductile iron pipe with restrained joints unless a licensed geotechnical engineer can furnish a certification that the fill has been compacted so that settlement of the main will not occur.

1.3.2.9 Structural Design of Water Mains

Structural requirements must be considered in the design of all water mains and appurtenances. This is a matter of detail design and is not subject to generalizations. The following criteria should be considered by the engineer:

1. Special Structures - Structures shall be built as shown in the standard details, however, structures other than those shown in the standard details shall be considered special structures and shall be designed and detailed by the design engineer and submitted for review and approval to the Department of Public Utilities prior to plan submittal or brought to the Department's attention at the time of plan submittal.
2. Pipe Foundation - In all cases, the proper strength water pipe shall be specified for the proposed depth, width of trench and bedding condition. Soil condition should be considered with samples being obtained where necessary to verify pipe selection and foundation design.
3. Thrust protection as shown on plans in the standard details shall consist of concrete thrust blocks against undisturbed earth and the use of approved restraint systems for ductile iron and PVC AWWA C-900 pipe as appropriate. Hydrant valves shall be installed with hydrant tees and the hydrant protected from thrust by the use of approved restraints and thrust blocks.
4. Where valves are placed for future water main extensions, valves are to be restrained to the fitting and 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 pipe is required to provide adequate restraint. Dead-end mains shall be provided with a flushing device or fire hydrant, whichever is practical. Approved joint restraint systems are to be used as required to provide adequate retention of the pipe and valve when thrust blocks cannot be used.

1.3.2.10 Hydraulic Design For Water Mains

Water distribution systems shall be designed to provide adequate flow and pressure for both domestic supply and fire flow based on sound hydraulic analysis. Design shall be based on a maximum flow velocity at peak flows (excluding fire flow) of 5 feet per second and a Hazen-Williams "C" Value of 120. Values of existing demand and supply pressures shall be coordinated with the Department of Public Utilities. If required, the

engineer shall contact the Department of Public Utilities to schedule a fire flow test. The Department of Public Utilities must be present during any test but will not provide equipment or manpower for a test. Hanover County is not responsible for the results of any test or for any design made on the basis of any test. Hanover 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.

The engineer shall submit with all water plans, information and calculations on water demands for the project. If requested, the engineer shall provide a detailed analysis for evaluation by the Department of Public Utilities to ensure that the requirements of this section have been followed and that the proposed water system design meets these specifications and satisfies maximum day demands plus fire flow requirements or peak hour demands, whichever flow condition is more difficult to meet. The engineer shall provide this information with all water plans submitted for review when requested. Whether the detailed analysis is requested or not, the engineer is responsible for ensuring that the design as proposed meets the requirements of these standards and, if the design does not meet any part of these standards, bringing all deficiencies to the Department of Public Utilities attention.

The water distribution system and any extensions thereto shall be designed to supply the demands of all customers while maintaining the following minimum pressures at all points in the system:

20 psi for the greater of maximum day plus fire flow, or peak hour domestic demand.

The following criteria shall be used in estimating average daily demands:

<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 - 1 to 4 dwellings/acre	1,200	12
Residential- 4 to 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 Water Use	1,000	10
Industrial-Medium Water Use	2,000	20

Industrial-Heavy Water Use	3,000	30
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Where site specific determinations can be made, flows may be determined by using the following design information:

<u>Discharge Facility</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	4.0 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
Trailer Courts	per trailer	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 of Public Utilities.

To determine maximum daily demands and peak hourly demands the following multipliers shall be used:

Maximum Daily Demand (residential) = 1.8 times Average Daily Demand

Maximum Daily Demand (non-residential) = 1.3 times Average Daily Demand

Peak Hourly Demand = 2.7 times Average Daily Demand

1.3.2.11 Water Main Size and General Layout

Minimum pipe size shall be 8", except that dead-end water mains may be four (4) inches in diameter if there is not a fire hydrant on the line and six (6) inches in diameter if there is a single fire hydrant on the line and design flow and residual pressures can be maintained. Dead-ends shall be eliminated by looping whenever feasible. The Department of Public Utilities may require a project to increase the size of its water mains above the size required to meet the specific needs of the project in order to meet the overall needs of the County or improve system performance or reliability. Typically, the Department of Public Utilities will require a project to extend regional water mains through its interior and along its public street frontage in order to meet the overall needs of the County and improve system performance and reliability.

1.3.2.12 Commercial and Industrial Areas – Fire Requirements

Hydrants in commercial and industrial areas should generally be located at street corners and at entrances to facilities. Hydrants should generally be located on the right hand side of the road, before the turn, based on the route that would be taken by a truck dispatched from the nearest fire station. The exact location of fire hydrants shall be approved by the Department of Public Utilities. The maximum spacing between hydrants shall be 1,000 feet along water mains. The hose laying length to any outside wall of a structure shall be no more than 500 feet from a hydrant.

New water systems in commercial and industrial areas shall be designed to provide a minimum flow of 2,000 gallons per minute at a residual pressure of 20 psi unless otherwise approved by the Department of Public Utilities. If it is not possible to obtain a fire flow of 2,000 gallons per minute, reductions down to but not less than 500 gallons per minute will be considered on a case-by case basis. Reductions of fire flow below 1,000 gallons per minute will only be considered with the written concurrence of Hanover County Fire Marshall.

If a facility is to have an automatic fire suppression (sprinkler) system that requires a fire department connection, there shall be a dedicated fire hydrant within 100 feet of the fire department connection. This hydrant cannot be utilized for meeting the building coverage requirements outlined above.

1.3.2.13 Fire Department Connections

Fire sprinkler systems shall be equipped with an approved double detector check valve assembly with bypass meter in a vault located as close to the property line as possible. Installation of double detector check valve assembly at locations other than the property line must be approved by the Department of Public Utilities. The property owner will own and be responsible for the maintenance of the valves, meter, double check assembly

and vault. Valve vaults shall be located out of the main flow of traffic and parking lots or driveways whenever possible. Fire department connections shall be placed on the outlet side of the double detector check valve assembly and shall have a dedicated hydrant located within 100 feet of the connection.

1.3.2.14 Residential Areas – Fire Requirements

Hydrants in residential areas should generally be located at street corners or in mid-block at lot lines. Hydrants should generally be located on the right hand side of the road, before the turn, based on the route that would be taken by a truck dispatched from the nearest fire station. The exact location of fire hydrants shall be approved by the Department of Public Utilities. The maximum spacing between hydrants shall be 1,000 feet along water mains. The hose laying length to any residential lot shall be no more than 500 feet from at least one hydrant.

New water systems shall be designed to provide a minimum fire flow of 1,000 gallons per minute in residential areas (except apartments) with a residual pressure of 20 psi being maintained in the system unless otherwise approved by the Department of Public Utilities. Reductions of fire flow down to but not less than 500 gallons per minute will be considered on a case-by case basis by the County.

New water systems shall be designed to provide a minimum fire flow of 2,000 gallons per minute for apartments with a residual pressure of 20 psi being maintained in the system unless otherwise approved by the Department of Public Utilities. Reductions of fire flow for apartments down to but not less than 500 gallons per minute will be considered on a case-by case basis by the County. Reductions of fire flow below 1,000 gallons per minute will only be considered with the written concurrence of Hanover County Fire Marshall.

1.3.2.15 Supply Points

At least two supply points shall be provided for subdivisions containing more than 50 lots. Phased developments may develop up to 50 lots without a second supply point. At the time that more than 50 lots are approved, a second supply point must be provided unless the Department has approved a waiver from this requirement.

1.3.3 Non-Residential Water Services

Service lines shall, at a minimum, be one size larger than the water meter when initially installed to allow for future upsizing of the water meter without requiring replacement of the water service. Minimum service size shall be 3/4" pipe with 5/8" meter. Services shall be shown and detailed on the plans.

Non-residential water meters shall be sized in accordance with the Department's requirements found in these standards. The County's standard meter sizing forms shall be submitted with all site plans. If an irrigation meter is used, the main meter shall be sized assuming that both domestic and irrigation demands are occurring simultaneously. Irrigation meters are privately owned and maintained and must be located outside of any utility easement.

Pressure reducing valves shall be installed on the customer side of the meter by the builder or property owner when the service connection system pressure will be greater than 80 psi. 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.

Non-residential parcels may not share a service line. Master metering a non-residential parcel is preferred. Individual metering for facilities on one parcel of land is allowed only when individual tenants will be owning or renting space within a development.

1.3.4 Residential Water Services

Residential water meters shall be 5/8" in size. Individual residential service lines, 3/4" in size, shall be installed to each lot unless service lines are being run under an existing street, in which case two residential lots may share a 1" service line per detail MET-13.

Services shall be shown and detailed on the plans for both residential and commercial developments.

Pressure reducing valves shall be installed on the customer side of the meter by the builder or property owner when the service connection system pressure will be greater than 80 psi. 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.

1.3.5 Valves

Valves shall be located at not over 1,000 foot intervals and at all changes in pipe diameter. Valves shall also be provided at all pipe line intersections so as to provide shut off for repairs of limited sections without interruption of service to large areas and to facilitate testing. A minimum of two valves shall be provided at tees and three valves at crosses. However an additional valve may be required at the discretion of the Department of Public Utilities. Valves shall be located as close to the fitting as practical. All valves are to be restrained to fittings by approved methods.

1.3.6 Connecting to Existing Water Mains

When connecting to an existing water main, installing two main line valves and a tee with and isolation valve (for a total of three valves) as opposed to utilizing a tapping sleeve and valve is desirable when there are long distances between main line valves (greater than 1,000 feet) or even if the distance is less than 1,000 feet where it would be an advantage to add main line valves for better system control. Therefore, the engineer must contact the Department of Public Utilities prior to beginning design for each project to determine a method acceptable to the Department of Public Utilities for making any connection to the existing water system. If it is determined that main line valves and a tee must be cut-in, temporary line stop valves may also be required in order to maintain service to existing customers while the work is being completed. Under some circumstances, where only a limited number of customers will have their service disrupted, the Department may allow a water main to be taken out of service in order to cut-in the main line valves and tee. If this is done, the developer will be required to communicate with all existing customers and schedule the work to minimize disruptions to existing customers. The developer shall obtain the approval of the County's Inspector

prior to taking any water main out of service.

1.3.7 Water Main Appurtenances

Valve boxes, air relief valves, fire hydrants, service lines, vaults and other appurtenances shall be constructed in accordance with Hanover County standards and details.

Water mains shall be provided with appurtenances such as air release valves, blowoffs, and water quality monitoring stations at suitable locations to allow testing, disinfection and flushing of the main. Flushing hydrants shall be installed on all dead-end mains. The Department of Public Utilities may require the installation of an automatic or manual flushing device as it deems appropriate.

1.3.7.1 Blow-offs at Low Points

A fire hydrant or blowoff (minimum size blow-off shall be 4" for 12" mains, 6" for 16" mains, and 8" for 24" mains per WAT-4) shall be provided at low points on mains 12-inches and larger to facilitate flushing. On lines smaller than 12", fire hydrants shall be located at low points whenever possible to facilitate flushing. If it is not possible to place a hydrant at the low point, a flushing hydrant may be used on lines smaller than 12". In-line isolation valves shall be provided on either side of fire hydrants or blow-off on water mains located at low points.

1.3.7.2 Location of Flushing Hydrants, Air Releases, Blow-offs

The engineer should use the following guidelines with regard to location of flushing hydrants, air release valves, blowoffs, etc. during the design of water main extensions:

1. Access to flush points by the Department of Public Utilities personnel shall be provided. Flush points serve no purpose if access to the flush points cannot be obtained.
2. Emphasize (through appropriate notes) to Contractor to maintain good erosion control and flushing procedures. Erosion control and environmental impact consideration must be taken into account whenever a flush point is chosen, therefore, certain controls may be needed at the time water main is installed.
3. Engineer needs to advise Contractor to coordinate his work through the Inspectors and the Inspector coordinate with the Department of Public Utilities Operations section regarding when to flush (time of day and season, etc.).
4. Attempt to locate the flush points as near to the roadways or at a stream (keeping in mind adverse effects to downstream ponds, etc.).
5. Contractor is to perform flushing prior to acceptance of the new water main.

6. Minimize the number of blowoffs, and strategically place them so that proper flushing can be performed.
7. Minimizing number of air release valves, taking into consideration the depth that the water main is to be placed.
8. The chlorine in heavily chlorinated water flushed from mains shall be neutralized before discharge. Contractors must provide equipment for neutralizing heavily chlorinated water flushed from mains during construction prior to discharging the water.

1.3.8 Offsite Improvements

The Department of Public Utilities may require a project to include offsite improvements to the County's existing water system if such improvements are required to meet the needs of the project.

1.3.9 Private Central Fire Systems

Private central fire systems are privately owned and maintained water systems connected to the public water system that provide fire protection to two or more lots, or that serve one lot and have private fire hydrants located on them. Private central water systems can only be utilized for fire protection purposes and shall be designed and constructed in accordance with the requirements of the Fire Marshall and Building Inspector. Water in private central fire systems shall only be utilized for fire protection purposes. No other use is allowed. If private central fire fighting systems are utilized, they shall be provided with a fire water meter and a double check assembly per details FIR-5, FIR-6 and FIR-7. The fire water meter shall be purchased and installed by the Owner and then dedicated to the County. Fire water meters shall be in accordance with the requirements of the Department of Public Utilities. The fire water meter and its associated vault shall be constructed in a utility easement and shall be owned and maintained by the County. The double check valve assembly and its associated vault shall be installed immediately after the County owned meter and shall not be located within a utility easement. The double check valve assembly is privately owned and maintained. The vault for the double check valve assembly shall be provided with a gravity drain line or sump pump, whichever is appropriate for the specific field conditions.

1.3.10 Water Pump Stations

Water pump stations are a special project and specific project standards and plans will be prepared by the engineer and submitted to the County for review and approval. Water pump stations will only be allowed when approved by the Department of Public Utilities.

The design requirements for a water pump station shall be determined through discussions with the Department of Public Utilities **PRIOR TO INITIATING THE DESIGN**. After the design criteria have been determined, the engineer shall prepare a preliminary engineering report for approval by the Department of Public Utilities and the Virginia Department of Health. The preliminary engineering report shall address all issues requested by the Department of Public Utilities and meet the requirements of the Virginia Department of Health.

The pump station design shall be in accordance with the approved preliminary engineering report and all requirements of the Virginia Department of Health. At a minimum, the following information shall be provided in the construction plans:

1. Structural design and calculations, including reinforcing drawings where applicable, for the facility.
2. Hydraulic design for the equipment selected, including scaled drawings.
3. Electrical and mechanical drawings and specifications for the equipment selected.
4. Project specifications.
5. Pump and system head curves.

The construction plans shall be approved by the Department of Public Utilities and the Virginia Department of Health.

