

2021

Town of Culpeper & Culpeper County Water & Sewer Utility Standards Manual



TOWN OF CULPEPER & CULPEPER COUNTY

**WATER AND SEWER
UTILITY STANDARDS
MANUAL**

This document, Town of Culpeper and Culpeper County Water and Sewer Utility Standards Manual (USM) represents the joint policies and standards required to design and construct extensions to water mains, sanitary sewers and minor sewage pumping stations to be owned and operated by the Town of Culpeper or Culpeper County.

APPROVED: _____

DATE: _____

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TOWN OF CULPEPER & CULPEPER COUNTY
WATER AND SEWER UTILITY STANDARDS MANUAL

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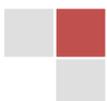
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WATER AND SEWER UTILITY STANDARDS MANUAL

GENERAL CONDITIONS

100.01 Purpose and Authorization:

This Document, the Town of Culpeper and Culpeper County Water and Sewer Utility Standards Manual (USM) represents the joint policies and standards required to design and construct extensions to water mains, sanitary sewers and minor sewage pumping stations to be owned and operated by the Town of Culpeper or Culpeper County.

As a policy and standards document, these design and construction standards are supplementary to the most current regulations of the Virginia Department of Health, Office of Drinking Water *Waterworks Regulations* and the Virginia Department of Environmental Quality, Sewage Collection and Treatment Regulations (SCAT), and it is not intended to supersede these regulations. Where conflicts exist, the more stringent requirement shall apply. Nothing herein shall be deemed to waive or modify other requirements of existing regulations and law. Conflicts are encouraged to be brought to the attention of the Town of Culpeper Director of Public Services and/or the Culpeper County Director of Environmental Services.

In addition, for the applicable permitting requirements, refer to the codified ordinances of the Town of Culpeper Code and the Culpeper County, Code of Ordinances.

This manual is not intended to address all situations encountered in the design and construction of water and sewer facilities. It is understood that exceptions, may be warranted depending upon the nature of the engineering application.

The Utility Standards Manual's policies and standards have been adopted by the Town of Culpeper Town Council and the Culpeper County Board of Supervisors. Modifications to the manual are subject to the approval of the Council and the Board. Proposed modifications shall be reviewed by the Town of Culpeper Director of Public Services and the Culpeper County Director of Environmental Services, prior to submission to the Town Council and the Board of Supervisors for final approval.

Necessary revisions/amendments occur frequently and shall take effect as approved by the Town and County Directors. In general, plans submitted and accepted for review shall be reviewed to comply with the standards existing at the time of submittal. Construction methods and materials used on the project shall comply with the standards in effect at the time of the issuance of Town of Culpeper Construction Permit and/or the issuance of the Culpeper County Construction Permit. Supplemental design requirements may be imposed by the Town and/or County Directors when warranted by unique situations.



100.02 Definitions and Abbreviations:

The following definitions are used throughout the text:

Town Council -	The Town Council for the Town of Culpeper
Board of Supervisors -	The Board of Supervisors of Culpeper County
Town -	Town of Culpeper
County -	Culpeper County
Director(s) -	The Town of Culpeper Director of Public Services and Culpeper County Director of Environmental Services

In order to remain concise and enhance readability, the following abbreviations are used throughout this manual:

ADF -	Average Daily Flow
ANSI -	American National Standards Institute
ASCE -	American Society of Civil Engineers
ASTM -	American Society for Testing and Materials
AWWA -	American Water Works Association
CI -	Cast iron
DEQ -	Virginia Department of Environmental Quality
DIP -	Ductile iron pipe
DIPRA -	Ductile Iron Pipe Research Association
du -	dwelling unit
EPA -	United States Environmental Protection Agency
FAR -	Floor to Area Ratio
fps -	feet per section
gph -	gallons per hour
gpm -	gallons per minute
HP -	Horse Power
ISO -	Insurance Services Office
I.D. -	Internal Diameter
Ku -	K = Rankine's Ratios of Lateral Pressure to Vertical Pressure u = The Coefficient of Internal Friction of Backfill Material
KSI -	Kips per square inch
MADC -	Milliamperes Direct Current
MGD -	Million Gallons per Day
MJ -	Mechanical joint
ppm -	parts per million
psi -	pounds per square inch
PVC -	Polyvinyl Chloride
RPA -	Resource Protection Area
SCADA -	Supervisory Control and Data Acquisition



SCFH -	Standard Cubic feet per hour
SDR -	Standard dimension ratio
v -	velocity
VDH -	Virginia Department of Health
VDOT -	Virginia Department of Transportation
VUSBC -	Virginia Uniform Statewide Building Code
% -	Percent

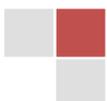
100.03 Projects - General:

Be reminded that, in all cases, the applicable requirements of the Virginia Department of Health Office of Drinking Water *Waterworks Regulations* and the Department of Environmental Quality, Sewage Collection and Treatment Regulations, Town of Culpeper Code, Culpeper County Code where applicable, must be met. Projects proposing water systems serving fifteen (15) or more water connections or where fire flow is required, or projects proposing sanitary sewer systems serving populations of four hundred (400) or more must submit plans and specifications to VDH and/or DEQ for review and approval.

For projects located within Town and County limits, and provided public water is within 300 feet of a principle structure, the owner of all houses, buildings, or properties used for human occupancy, employment, recreation or other purposes, situated within the Town or County of Culpeper and abutting on any street, alley, or right-of way in which there is now located or may be located in the future a public water main of the Town or County, is hereby required at his expense to install suitable water facilities therein, and to connect such facilities directly to the proper public water main when it involves new construction, failed well, or by requirement of the health department.

For projects located in Culpeper County, outside of Town limits, major water distribution systems shall be designed in accordance with the densities and intensities reflected in the Culpeper County Water and Sewer Master Plan and the Culpeper County Comprehensive Plan. New development located in the development area, as designated by the Culpeper County Water and Sewer Master Plan, shall connect to a public water system, when available. New developments located in the rural area, may connect to a Community Water System, connect to a public water system or may be served by private wells, as requested by the applicant for the project. The approximate location and character of the proposed water facilities shall correspond with the County Master Water and Sewer Plan Systems Map.

For projects located within Town or County limits and provided public sanitary sewer is within 300 feet of a principle structure, the owner of all houses, buildings, or properties used for human occupancy, employment, recreation or other purposes, situated within the Town or County of Culpeper and abutting on any street, alley, or right-of-way in which there is now located or may in the future be located a public sanitary sewer or combined sewer of the Town or County of Culpeper, is hereby required at his expense to install suitable toilet facilities therein, and to connect such facilities directly to the proper public sanitary sewer main when it involves new construction, failed septic system, or by requirement of the health department.



For projects located in Culpeper County, outside of Town limits, sewer systems shall be designed in accordance with the densities and intensities reflected in the Culpeper County Master Water and Sewer Plan. New development located in one or more of the Service Areas in the development area, as reflected by the Master Water and Sewer Plan, shall connect to a public sewer system, when available. New developments located in the rural area shall be served by a Community Wastewater System. The approximate location and character of proposed public sewer facilities shall correspond with the Existing and Proposed Sewer System Map, as amended. Sewer systems shall be designed for the estimated future population from all contributing points in the development area under consideration. The estimated future population shall be based on the adopted County Master Water and Sewer Master Plan Systems Map.

100.04 Public Water:

Where Town or County of Culpeper public water is available, such service shall be extended, at property owner expense, to each lot within a subdivision. The Town or County of Culpeper water supply is considered available if a water line of adequate size (or at which point a water line has been proposed to be constructed within a period of 12 months of the initial date of application for recordation of the subdivider's plat) is located within 300 feet from the proposed subdivision provided adequate treatment and storage capacity exists to supply the volume of water required by the proposed subdivision.

100.05 Public Sanitary Sewer Facilities:

Where Town or County of Culpeper public sanitary sewer facilities are available, such service shall be extended, at the property owner expense, to each lot within a subdivision. The Town or County of Culpeper sanitary sewer facilities are considered available if a sewer line of adequate size (or at which point a sewer line has been proposed to be constructed within a period of 12 months of the initial date of application for recordation of the subdivider's plat) is located within 300 feet from the proposed subdivision, provided adequate treatment capacity exists to treat the volume of wastewater to be discharged by the proposed subdivision.

100.06 Private Water and Sanitary Sewers:

Nothing in this manual shall prevent the installation of privately owned water or sewerage facilities or both in areas where public water or sewerage facilities or both are not available; provided that such installations shall meet all State requirements, Town of Culpeper Code or Culpeper County Code applicable to such installation. Specifications of all private water or sewerage systems serving more than 1 dwelling unit shall be as those standards established for public water or sewer systems. Where a public or combined sewer is not available under the provisions of this document, the building sewer shall be connected to a private sewage disposal system complying with the Town of Culpeper Code or Culpeper County Code. The type, capacities, location and layout of a private sewage disposal system shall meet all State requirements. No septic tank or cesspool shall be permitted to discharge to any natural outlet.



100.07 Local Review Authority:

Under the provisions established by the Virginia Department of Health (VDH) and the Virginia Department of Environmental Quality (DEQ) the Town of Culpeper and Culpeper County will apply for Local Review Authorities (LRAs) respectively. When this LRAs are granted, construction plans providing for extensions to water and sewer systems, and consistent with the master plan, may be reviewed solely or jointly as warranted by the Town and/or County. (Notification will be given when these LRAs have been approved.) Accordingly, after approval, it is anticipated that project plans do not require a construction permit from the Health Department provided that water main extensions are no greater than 12-inch diameter mains and sanitary sewer mains are no greater than 12-inch diameter pipe. All project plans containing pump stations, grinder pumps, force mains, or lines larger than stated above must be submitted to VDH or DEQ for review and approval. It is the Engineer's responsibility to insure that the required plans and supporting information are submitted to the appropriate State agency.

100.08 Review Process:

Until the LRAs are approved, all applications will require review by VDH or DEQ and shall be submitted through the Town and/or County that will in turn transmit copies of the project plans to the appropriate State agency thus acting as the "Applicant". Once LRAs have been approved and in situations where review by VDH or DEQ is required, modifications to project plans required by the Town and County shall be incorporated in final submissions to them. In this manner, the plans reviewed by the Town and County and VDH or DEQ will be the same document.

Approved project plans shall be submitted to the Town and County before construction of utilities will be approved. No water or sanitary sewer lines shall be connected to the Town water or sanitary sewer system without first being approved by the Town or County.

100.09 Information Required on Project Plans:

Project plans shall provide plan and profile views of all proposed water and sanitary sewer lines for the project. Water and sanitary sewer profiles shall be separate drawings. The location, type and size of all valves, fittings, manholes, frames and covers, laterals and other appurtenances shall be detailed on both the plan and profile views. Additionally, the plans shall specifically identify new pipe size, class and material, as well as valves, fittings and appurtenances on profile views. Show bearings and angles of deflection on plan views for sewers. Show existing utility crossings on plan and profile views. To insure that adequate crossing can be accomplished, the Town and County may require test holes to be dug on existing utility lines and test hole information shall be shown on plan and profile views.



100.10 Variances:

Variations are defined as approval of specific engineering design practices when deemed to be exceptional and reasonable by the Town and County Directors and that are unrelated to the *Virginia Waterworks Regulations*. Requests for variations are to be included in the cover letter, or letter of transmittal, accompanying the application. Variations shall be fully described and justified by the Engineer. Approval of variations will be facilitated under the current review process. However, VDH-ODW approval may also be required.

Variations cannot be requested for policies and standards of a general nature which are commonly shared by all, but shall be of a non-recurring and exceptional nature (Example: Use of a factor less than 0.013 to reflect the recommendations of a manufacturer cannot be authorized by a variance since such use of 0.013 is shared by all. Rather, such a change shall be facilitated by modification of the standards themselves). However, in a situation involving unusual existing topography, a variance for minimum cover that is supported by technical documentation, may be granted by the Town and County Directors in order to alleviate a specific condition. In all cases, the decision of the Town and County Directors shall be final.

100.11 Easements:

Water and sewer utilities which will become the property of the Town and County, and which do not lie wholly within a public right-of-way, shall require easements dedicated to the Town and County, and as follows:

- Minimum easement widths shall be 15-feet for water mains and 20-feet for sanitary sewers. The minimum easement width for a sanitary sewer force main shall be 15-feet. For sanitary sewer trenches greater than 10-feet deep, 5-feet additional width shall be required for each 5-feet of additional depth. Increased easement widths may be required when determined by the Town and/or County Directors.
- Easements dedicated to water and sewer utilities will preclude construction of permanent structures and fences within the easement.
- Easements will be provided to allow adjacent properties access to water and sanitary sewer lines and to allow the extension of water and sewer lines.
- In cases deemed necessary by the Town and/or County Directors, and in order to assure routine and emergency maintenance, access (ingress/egress) easements shall be provided.
- The owner/developer shall be responsible for maintaining the easement until the project is accepted by the Town and/or County. Maintenance shall include cutting



vegetation, removing trees, and grading sufficient to allow maintenance vehicles to traverse the easement.

100.12 References:

In order to properly utilize this manual, the project manager, engineer or user in general should have certain publications readily available, as they are referenced throughout this document. A listing of the most commonly utilized publications is as follows:

1. American Water Works Association (AWWA), Latest Editions;
2. American National Standards Institute (ANSI), Latest Editions;
3. American Society for Testing and Materials (ASTM), Latest Editions;
4. Department of Environmental Quality: State Water Control Board “Sewage Collection and Treatment Regulations,” Latest Edition;
5. Commonwealth of Virginia; State Department of Health “*Waterworks Regulations,*” Latest Edition.
6. Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs
7. Federal Manual for Identifying and Delineating Jurisdictional Wetlands
8. Guide for Determination of Required Fire Flow, Insurance Services Office, 160 Water Street, New York, NY 10038
9. Grading Schedule for Municipal Fire Protection, Insurance Services Office, 160 Water Street, New York, NY 10038
10. NFPA Standards, National Fire Protection Association
11. Soils Map of Culpeper County, Department of Agriculture, Soil Conservation Service
12. The Building Official's Code Administrators, “The BOCA Basic Building Code,” latest edition
13. The Culpeper County Comprehensive Plan



14. The Culpeper County Water and Sewer Master Plan
15. The Federal Safe Drinking Water Act (SDWA) and the National Primary and Secondary Drinking Water Standards
16. The Federal Water Pollution Control Act (Clean Water Act)
17. Virginia Erosion and Sediment Control Handbook
18. Virginia Uniform Statewide Building Code

100.13 Corrections of Deficiencies Noted During the Inspection Process:

Water and sanitary sewer lines, structures, facilities or appurtenances thereto not meeting the requirements of these standards shall be replaced or repaired in a manner approved by the Town and County. Defective materials, pipe or fittings shall be completely removed and replaced with new materials in a manner approved by the Town and County. Evidence of excessive leakage, or unsatisfactory alignment, or poor workmanship shall be justification for the Town and County to require complete removal of the substandard materials and its reconstruction in accordance with the approved plans and specifications and the standards of the current USM. .

100.14 As-Built Plans and Bond Release:

The project engineer will prepare the water and sanitary sewer as-built plan for projects. As part of the process, the contractor/developer/project engineer must request a bond release inspection from the Town in order to obtain the release of the performance bond for the project. The Town's bond release inspection is entirely separate from the County's inspection process, and the contractor/developer/project engineer must request a bond release inspection directly from the Town Engineer. All requests for bond release inspections shall include: the County Plan Name, the County Plan Number, and the name and address of the contact person to whom the list of deficiencies, or punch list, will be sent. Utilities and roads can be a separate release. Partial releases in certain instances may also be granted.

Once a valid request for a bond release inspection has been received by the Town or County a bond release inspection will be performed of the public water and sanitary sewer facilities within 30 days. A punch list, noted during this inspection shall be sent to the contact person listed in the inspection request. It is the contractor/developer/project engineer's responsibility to correct these deficiencies and schedule a re-inspection with the Field Inspector. Once the Field Inspector signs off on the project, the Town or County will provide a letter stating that the Town or County does not object to the release of the performance bond for the project. At this point, the Town or County assumes ownership and maintenance responsibilities for the public water and sanitary sewer facilities within the project.



WATER DISTRIBUTION SYSTEMS

110 GENERAL REQUIREMENTS

110.01 General:

The requirements of this USM shall be satisfied for all systems to be incorporated into the Town or County's inventory. Such systems shall include construction within a public right-of-way or private property where a dedicated easement exists, or will be provided. Specific variances to these standards shall be requested, in writing, and approved in accordance with this manual.

All standards referenced in this section shall refer to the latest edition of the referenced standard at the time of final approval. The authority for amendment to water standards shall vest with the Town and/or County. It shall be the responsibility of the developer, project manager or project engineer to familiarize themselves with all applicable specifications relating to utilities design and construction.

New development located in the development area in Culpeper County and not located in or integrated into the Town of Culpeper, as designated by the Culpeper County Water and Sewer Master Plan, shall connect to a public water system, when available. New developments located in the rural area, not covered by a Culpeper County Service Area, may connect to a community water system, connect to a public water system or may be served by private wells, as requested by the Applicant if public water service is not available. The approximate location and character of the proposed water facilities shall correspond with the Culpeper County Master Water and Sewer Plan Systems Map.

- Easements:
 - To provide for maximum utilization of public water systems, appropriate easements shall be required to adjacent properties for access to, or extension of, said utilities. Such easements shall be dedicated to the Town of Culpeper or Culpeper County depending on the location of the project.
- Private Water Service Connections:
 - All water service connections from the meter to the building, except when within a dedicated easement, are regulated by the Virginia Uniform Statewide Building Code and are to be privately maintained.
- Water Supply Interconnections:
 - There shall be no physical connections between a drinking water supply and a sanitary or storm sewer, or appurtenance thereof. All facilities furnished with a public drinking water supply will have no physical connection with private wells or other private water supply system, or any other source of contamination.



- Fire Safety Systems:

- Fire Safety systems shall be designed and constructed in accordance with this manual and ISO and NFPA guidelines.

110.02 Hydraulic Analysis Parameters and Reporting:

A hydraulic analysis report shall be included with all project plans submitted for review and approval. The analysis shall state assumptions made about the existing system. Calculations will show available flows at the proposed hydrants and node pressures throughout the proposed system. Water lines shall be interconnected as directed by the Town and County to enhance the reliability, water quality, and operation of the water system.

The hydraulic analysis report shall be prepared using KYPIPE Hydraulic Software as developed by the University of Kentucky, WaterCAD or other acceptable computer program with the approval of the Town and County. The completed analysis with flow calculations shall be submitted to the Town or County for approval.

Water systems shall be so designed to adequately supply the projected peak day flow within the subdivision or site under consideration and maintain a pressure of not less than 30 psi at all points of delivery. Additionally, the water system will be designed to provide the fire flows specified in this manual and in conformance with ISO and NFPA guidelines, with a residual pressure of not less than 20 psi at any point in the distribution system. Fire flow calculations must be included with all project plans submitted for review and approval.

The pipe friction factor, "C", will be equal to 120 for pipes 12-inches in diameter and larger. "C" will equal 100 for pipes smaller than 12-inches in diameter. Since a conservative "C" factor is used, losses from valves and other fittings need not be considered.

The line velocity shall not exceed 10 feet per second under any flow condition. The velocity restriction does not apply to hydrant leads or to the pipe where the simulated pump is applied. The Town and County reserve the right to waive velocity restrictions in other areas if deemed appropriate to improve water quality.

The project engineer shall size all pipes to meet the fire flow, pressure and velocity requirements, but shall size the pipe no larger than needed in dead-end runs or closed loop systems that will not be extended in the future.

The submittal shall provide computations for maximum day demands and maximum day with fire flow applied simultaneously.

Flow calculations shall state assumptions made about the existing system, calculations to show available flows at the proposed hydrants and node pressures throughout the proposed system. If a project will be developed in sections or phases, the fire flow calculations will indicate the



available fire flows during each section or phase of the project. For small sites that propose no major water line extensions, an evaluation of the existing available fire flows may be substituted for the fire flow calculation. Again, water lines shall be interconnected wherever feasible to enhance the reliability and operation of the water system.

The available water storage system shall have adequate capacity to sustain required fire flows in conformance with ISO and NFPA guidelines. Documentation showing conformance with these guidelines shall be part of the complete design submittal.

Additionally, if irrigation is provided, irrigation demands shall be submitted by the project engineer based on the characteristics of the systems to be installed. Any proposed development project planning to utilize landscape irrigation or offering landscape irrigation systems as an optional feature for residential development shall demonstrate to the Town and/or County that the proposed landscape irrigation systems will have no detrimental effect on the water distribution and transmission systems and service pressure to the community.

110.03 Public Water Service Connections:

The water meter box and accessories therein necessary for meter installation shall be furnished and installed by the contractor/developer or owner and according to specifications contained herein. The Town and County shall provide and install standard water meters. Any increase in meter size or additional meters shall be at the expense of the contractor/developer or owner. The Town and County shall have the option to provide and install any and all size water meters, or in lieu thereof, establish a list of approved water meter types and manufacturers to be incorporated in the development or building. Each water meter is the property of the Town or County and at all times subject to its control and inspection. In residential areas, the water meter shall be installed one foot behind the sidewalk outside of the right-of-way. When curbs and sidewalks are not required, water meter boxes shall be set outside of the right-of-way at the property line. The water meter and service line size and location shall be shown on commercial and industrial site plans. Sizing of service lines and water meters will be based on the fixture loading imposed by the building and in accordance with AWWA No. M22, Sizing Water Service Lines and Meters. The Town and County shall have final approval authority of all line and meter sizes. Water meters shall not be located in sidewalks, driveways, travel ways or parking spaces. Water meters shall be protected from vehicular traffic by curbs, bollards or other means approved by the Town and County. Meters shall be located so as to be accessible to Town and County personnel at all times. Where any meter is located on any private property, building or premises, the Town or County shall have the right to enter the same at all reasonable hours for the purpose of examining, repairing, replacing or removing such meter or to obtain meter readings. Meter lids shall be located out of normal pedestrian walkways. All water meter settings shall be in conformance with the details and specifications in this manual. The cost for the service connection shall be set by the Town or County as applicable.

Residential fire suppression systems for single-family homes, duplexes and townhouses shall be approved by the Town and County as well as the Fire Marshal's Office. The preferred design configuration consists of the water supply for fire suppression flowing through the customer's



domestic service line and meter. Other configurations will be considered when adequate flows or pressures cannot be provided through the domestic supply. The required domestic service size and water meter size shall be shown on the project plans. The domestic service size and water meter size shall be consistent throughout the project. Calculations verifying the sizes of the domestic service and water meter shall be provided to the Town and County. The size of the water meter specified shall be able to accurately measure any anticipated low flow rates.

110.04 Private Water Service Connections:

Private water service connections from the meter to the building are regulated by VUSBC and will be maintained by the property owner. Water services and plumbing shall conform to the Uniform Statewide Building Code. Where the pressure at the service tap exceeds 80 psi, the provisions of the USBC shall apply.

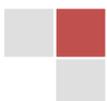
110.05 Large Meter Installations:

For 1-inch, 1.5-inch and 2-inch water meter installations, the Town and County shall retain the option of specifying the use of appropriately sized vaults in lieu of meter crocks. Water meters larger than 2-inches shall be installed with a bypass in order to isolate the meter for repairs. Plans for the installation of larger meters shall be submitted for approval. Water meters 3-inches or larger shall be stored at Town or County warehouses, as applicable, until ready for installation. The contractor/developer responsible for installing the meter shall make arrangements to pick the meter up from the warehouse. Water meters 3-inches and larger shall have provisions for in-place testing. All meters are paid for by the contractor/developer.

110.06 Water-Only Accounts:

In incidents where water used at a site will not be discharged into the sanitary sewer, a water-only account may be established with the Town. The County does not allow water only accounts for irrigation, swimming pools etc. due to limited groundwater supplies. Water-only accounts will not be charged fees for sewer use. Typical examples of water-only accounts are those solely for irrigation systems and public/commercial swimming pools. Each water-only account will be served by independent connection to the public water main with a separate domestic service line and meter. No "subtraction" meters will be allowed. The location and size of the domestic service line and meter serving the water-only account shall be shown on the project plans. Water-only accounts will comply with all applicable state and local cross connection ordinances. Cross connection prevention devices shall be located downstream of the water meter.

The size of the water meter for an irrigation system will be based on the peak flow rate needed to operate the system. The project engineer will provide the Town and County with the necessary information to determine the meter size. The developer must acquire all of the necessary approvals and permits from Culpeper County prior to the installation of an irrigation system. The location of the irrigation meter shall be shown on the project plans.



A water-only account may be established for a swimming pool only when the pool drain and the filter backwash discharge line discharge into a storm drainage system. The location of the pool drain, filter backwash discharge line, and pool meter shall be shown on the project plans.

110.07 Valve Boxes:

During the initial installation by the contractor/developer and prior to acceptance by the Town and County, valve boxes shall only be adjusted by sliding the casting up or down. No risers shall be permitted. Valve boxes located in sod or other off-street areas shall be set and adjusted such that the covers shall be exposed and flush with the immediate surface. Valve boxes shall be set and adjusted such that covers shall be exposed and flush with the street surface. If street surfaces are renewed or replaced by the contractor/developer or owner after the water system has been installed and placed in service by the Town or County, but while such streets are still the obligation of the contractor/developer or owner, the valve boxes therein shall be readjusted to proper location relative to the new street surfacing by the contractor/developer or owner.

110.08 Cross Connections:

In order for water service to be established, appropriate backflow prevention devices shall be provided in compliance with the adopted cross connection and backflow ordinances of the Town and County, and in accordance with the *Waterworks Regulations*.

120 DESIGN PARAMETERS

120.01 General Planning and Design

Commonwealth of Virginia Waterworks:

The design of water supply systems shall be governed by the Commonwealth of Virginia's *Waterworks Regulations*, the requirements of this manual and Town and County Code. The Town and County are using this Utility Standards Manual (USM) to apply for state and local review authority for water mains up to 12-inches in diameter from the Virginia Department of Health (VDH). Therefore, the Applicant is cautioned that until such time as the Town and County have approval authority, plans, and specifications for all projects must be submitted to VDH for approval. Notification will be given when the Town and County are granted this approval authority. Accordingly, the *Waterworks Regulations* shall be augmented by this USM, unless such augmentation is specifically waived by the Town and/or County, depending on where the project is located.

Water Lines in Public Rights-of-way:

Water lines shall be allowed within the right-of-way of any roadway, except within limited access right-of-way unless, as determined by Virginia Department of Transportation (VDOT), there are compelling design or safety issues which would demand consideration of an alternate



location. In instances that require special consideration, applicants are encouraged to seek Town and County concurrence of the waterline design concept prior to or during the preliminary plan process. It is also strongly recommended that the applicant review with the Culpeper VDOT Residency, the placement of any proposed water and sewer lines under VDOT pavement.

Water lines will not be allowed under the pavement of divided roadways with four or more lanes, except under the following conditions and with the approval of the Town and County:

- When a roadway has more lanes than required for the projected traffic, such as when a divided roadway is used for aesthetic purposes.
- In a subdivision, commercial, and industrial areas with adjacent development with direct access to a roadway and where sufficient road network exists such that noncircuitous alternate access is available within the development.
- The extension of existing water lines already located under existing pavement.
- The continuation of water lines under undivided roadways through widened intersections, only through the intersection, to a divided section.
- When the location of other items such as storm sewer, signs, landscaping, mature trees, or other utilities are such that sound engineering judgment would indicate the placement of water lines under the roadway pavement is appropriate.

When water lines are permitted under pavement, they should be located 5 feet from the outside edge of pavement or 7 feet from the face of curb.

Water lines greater than 24-inches in diameter, while permitted in most instances to cross any roadway, except a "limited access" right-of-way, shall not be permitted under the pavement parallel with the roadway alignment, due to the necessity for structures, vaults, etc.

VDOT should be contacted at the preliminary plan stage to determine the acceptability of locating water lines under the pavement and/or within the right-of-way of proposed roadways, especially if, from preliminary review, it appears these guidelines will be difficult or impossible to meet.

Nothing within these guidelines is intended to preclude VDOT from working with the local governments and utility owners to address situations requiring special consideration and is not intended to preempt local government guidelines that may be more restrictive.

- **Site Plan Development Submitted:**
All site development plans proposing a water system shall be submitted to the Director(s) as applicable, who shall coordinate the review and approval of all elements of the plan in accordance with this manual.



- **Site Development Plan Elements:**
The following information shall be provided on the site development plans: The size and location of all proposed water lines, valves, fittings, air relief valves, meters, discharge lines, blow-off chambers, and other appurtenances. On industrial and commercial developments; also show the water meter and service line size and location.

120.02 Line Sizes:

The minimum size of water line shall be as follows:

- In residential districts, 8-inches; 6-inch diameter pipe may be used at the discretion of the Director(s) when it completes a good gridiron and loops do not exceed 600 feet in length.
- In commercial and industrial areas, 12-inches; 8-inch pipe may be used at the discretion of the Director(s) and only when it completes a good gridiron and does not exceed 600 feet in length.
- Detailed design calculations may be submitted to substantiate line sizes other than those specified above. In any case, the minimum line size acceptable shall be 4-inches and shall not be used without the approval of the Director(s).
- Fire hydrants shall not be installed on lines less than 6-inches in diameter.
- 10-inch and 14-inch water lines are nonstandard sizes and shall not be used without the permission of the Director(s).

120.03 Depth of Cover:

All pipe shall be laid to a minimum depth of 36-inches from finished grade to the top of the pipe. Water pipe shall not be laid at excessive depths. Water lines will not be laid at depths greater than 8-feet without the permission of the Director(s). Water lines shall not be installed within the zone of influence of the foundation of a building or other structure.

120.04 Valve Locations:

Valves shall be installed at the intersection of water lines. The valving of the water system will be designed so as to allow segments of the system to be isolated for repairs and maintenance while leaving the rest of the system in service. Unless authorized otherwise, four valves will be used at crosses and three valves at tees. A valve shall also be installed at least every 1,000 feet on all lines. A valve will be provided approximately 2 pipe sections from the end of all water lines that will be extended in the future to provide a point to test against when the line is extended.



120.05 Separation of Water Mains and Sanitary Sewers:

The VDH *Waterworks Regulations* and DEQ standards for the separation of water mains and sanitary sewers shall be complied with.

The following factors shall be considered in providing adequate separation:

- Materials and types of joints for water and sewer lines
- Soil conditions
- Service branch connections into the water line and sewer lines
- Compensating variations in the horizontal and vertical separations
- Offsetting of pipes around manholes

Parallel Installation:

- Normal conditions - No water pipes shall pass through, or come in contact with, any part of a sewer manhole. Water lines shall be laid at least 10 feet horizontally from a sewer manhole and other utilities whenever possible; the distance shall be measured edge-to-edge.
- Unusual conditions, sanitary sewers - When local conditions prevent a horizontal separation of 10 feet, the water line may be laid up to 7.5 feet from the sanitary sewer or sewer manhole provided:
 - The bottom (invert) of the water main is at least 18 inches above the top (crown) of the sewer.
 - Where this vertical separation cannot be obtained, the sewer is constructed of AWWA approved water pipe, pressure tested in place to 50 psi without leakage prior to backfilling. The sewer manhole is of watertight construction and tested in place.
- Unusual conditions, other utilities - When local conditions prevent a horizontal separation of 10 feet, the water line may be laid up to 7.5 feet from utility lines other than sanitary sewers with the permission of the Director(s). Under no circumstances, including state right-of-way, shall the utilities be installed closer than the minimum separation required by section 20VAC5-309-140. Excavator's Responsibilities to Avoid Damage, Dislocating or Disturbances of Utility Lines in the Code of Virginia.



Crossing:

- Normal conditions - Water lines crossing above sewers shall be laid to provide a separation of at least 18-inches between the bottom of the water line and the top of the sewer.
- Unusual conditions - When local conditions prevent a vertical separation described above, the following construction shall be used:
 - Sewers passing over or under water lines shall be constructed of AWWA approved water pipe, pressure tested in place without leakage prior to backfilling.
 - Water lines passing under sewers shall, in addition, be protected by providing:
 - ◆ A vertical separation of at least 18-inches between the bottom of the sewer and the top of the water line,
 - ◆ Adequate structural support for the sewers to prevent excessive deflection of the joints and the setting on and breaking of the water line, and
 - ◆ The length of the water line be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewer.
- Maintain a minimum of 12 inches between water lines and utility lines other than sanitary sewers. Whenever possible, water lines should cross over the other utility lines. The cover over the water line may be reduced to 3 feet at a utility crossing to maintain the waterline over the other utility. Where water lines cross gas lines, water lines will be encased in polyethylene across the entire width of the gas line easement. Polyethylene encasement will also be used where corrosive soils or other corrosive environments are encountered. Polyethylene encasement will be as specified in ANSI/AWWA C105.

120.06 Blow-offs:

Provide a means for a blow-off at dead-end lines. Blow-offs will be sized to provide a flow velocity of 3 fps or greater. On lines 6-inches in diameter or larger, fire hydrants will be used for a blow-off unless otherwise directed by the Town and County. Blow-off assemblies or valve boxes shall not be placed in unpaved or gravel areas of rights-of-way.



120.07 Air Release:

Air release valves or hydrants shall be placed at high points in the system to provide for the release of trapped air.

Transmission mains shall be provided with blow-off valves or fire hydrants at strategic low points in the line and air release systems at high points. Blow-offs will be sized to provide a flow velocity of 3 fps or greater. On lines 6-inches in diameter or larger, fire hydrants will be used for a blow-off unless otherwise directed by the Town and County.

120.08 Termination of Water Mains:

Where a water main is terminated, the minimum length of pipeline between the isolation valve and end of the line shall be two pipe lengths, or as directed by the Town and County.

No water main shall terminate under a concrete gutter.

120.09 Valve, Air Release, Meter, Blow-off Chambers and Sample Stations:

Air and sediment accumulations may be removed through a standard fire hydrant. Compressed air and pumping may be used to dewater mains through hydrants. Chambers or pits containing valves, blow-offs, meters, or other such appurtenances to a distribution system shall not be connected directly to any storm drain or sanitary sewer, nor shall blow-offs or air release valves be connected directly 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 underground.

The open end of an automatic air release pipe shall be enclosed in the underground vault or chamber as shown and provided with a screened, downward-facing elbow. A ball valve with handle shall be attached so that it can be closed from outside the manhole and the manhole shall be vented for air release. Indicate the size of the air release line required on the project plans.

Distribution system sampling stations shall be provided for the water system being reviewed per the Town and County specifications.

120.10 Fire Hydrant Locations:

In general, fire hydrants shall be located as follows:

- At street intersections and at intermediate locations no greater than 500 feet of hose length from the structure to be protected and no greater than 1,000 feet from the nearest hydrant measured along the water main. All distance measurements are to be



taken along the center line of accessible streets, travel ways, or other unobstructed path used by the fire department.

- In areas with curb and gutter, the center of the fire hydrant shall be not less than 18 inches nor more than 36 inches away from the face of the curb. Under no circumstances will any part of a fire hydrant conflict with or overhang any sidewalk, trail, or vehicular travelway. On roads with ditches, fire hydrants will be located behind the ditch. In parking areas where the proposed site improvements do not provide adequate protection of fire hydrants from vehicular traffic, bollards or other protective measures will be provided.
- No plantings or erection of other obstructions shall be made within 4 feet of any fire hydrant.
- When installed in parking areas, they shall be protected by barriers that will prevent physical damage by vehicles. Clear access shall be provided to the front of and 15 feet to either side of the fire hydrant.

The location of all new and existing hydrants that are to serve the property shall be shown on the project plan.

When considering placement of fire hydrants, the engineer should avoid areas that are subject to high groundwater, flooding, contaminant and pollutants, and surface groundwater ponding. If there are no alternative locations to avoid these hazards, then the engineer must take steps to protect the water system from potential backflow and contaminants entering through the hydrant.

120.11 Surface Water Crossings:

Water lines crossing surface waters, both above and below the watercourse, present special problems, and should be discussed with the Town and County before final plans are prepared. The design engineer shall be responsible for obtaining all required State and Federal permits to install a surface water crossing.

Crossing of surface waters above the watercourse shall only be made when other methods are impractical.

When crossings are permitted, they shall be as close to a right angle to the stream as possible. No more area shall be disturbed than is necessary to provide for the construction of the water line at that location.

- Above Water Crossings – the pipe above water crossings shall be:
 - adequately supported (plans will include details of the piers and supports);



- protected from damage from freezing;
 - accessible for repair or replacement;
 - above the 100 year flood level;
 - constructed of mechanically restrained joint pipe; and
 - valved on each side of the crossing.
- Under Water Crossings – the pipe crossing under a water body shall be:
 - of special construction, having flexible watertight joints;
 - valved 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; and
 - sample taps shall be installed at each end of the crossing and at a reasonable distance from each side of the crossing. Sample taps shall be located outside of the 100 year flood plain.

120.12 Dedicated Fire Lines:

All water lines serving a fire suppression system in a building shall be shown on the project plans. Combined domestic and fire services shall not be allowed. All fire lines shall be owned and maintained by the property owner. A detector check assembly shall be located on the fire line at the point it connects to the public water system. The minimum size fire line shall be a 6-inch I.D., ductile iron line.

130 DESIGN STANDARDS - PIPE AND FITTINGS

130.01 Water Pipe Fittings and Accessories:

All pipe for water main construction shall be ductile iron pressure pipe of the "push-on" or "mechanical" joint variety, conforming to ANSI A21.51 (AWWA C151). Minimum class shall be Class 52 for all pipe 12-inches or less in diameter and a minimum of Class 51 for all pipe greater than 12-inches in diameter.

- Ductile Iron Standard Mechanical Joint Pipe:



Ductile iron standard mechanical joint water pipe shall conform to ANSI A21.51 and shall be double lined with cement mortar and have a protective exterior coating. The linings and protective coatings equal to "Enameline" with tar coating on the exterior will be considered as a satisfactory lining and coating for the water pipe; however, any substitution in pipe lining and/or coating from the ANSI A21.4 shall be specifically approved by the Director(s). Joints and gaskets of standard mechanical joint pipe shall conform to ANSI A21.11.

High strength ductile iron tee head bolts, hex nuts, ductile iron glands, and rubber gaskets shall be as furnished by the pipe manufacturer. Steel accessories are not acceptable.

- Ductile Iron Pipe - "Push-On" Joint:

"Push-on" or "slip" joint pipe shall conform to the requirements for mechanical joint in regard to strength, class, protective coating and lining.

- Pipe Fittings:

Fittings for ductile iron pipe shall be in accordance with ANSI A21.10 or A21.53 (AWWA C110 or C153), with a minimum pressure rating of 250 psi for fittings larger than 12-inches and pressure rating of 350 psi for fittings 12-inches and smaller. All pipe fittings shall be restrained with Megalugs or other restraining system approved by the Town and County. All fittings shall be cement mortar lined in accordance with ANSI 21.4 (AWWA C104).

- Water Service Lines:

All water service pipe less than 3-inches in diameter from main connections to the meter box assembly shall be seamless, annealed, "K" type copper made in conformance with ASTM B88. HDPE CTS made in conformance with ASTM D2737, Municipex made in conformance with ASTM D3350 or equal may be used but must have dual tracer wires installed. All connections shall use flared type fittings for sizes up to 1-inch and compression for sizes greater than 1-inch). The minimum size service connection shall be "K" type copper, 0.75-inch, I.D. Corporation stops shall be Ford F-600, Mueller or an acceptable equal substitute approved by the Town and County. Water services 3-inches in diameter and larger shall be Class 350 Ductile Iron Pipe between the main and the meter box. No joints shall be allowed in the copper service line between the main and the meter.

- Meter Boxes and Appurtenances:



- Meter boxes shall be one piece construction of concrete or rigid fiberglass (not Orangeberg).
- Meter yokes shall be constructed of cast iron, with two angle valves. Meter yokes shall be Ford No. 500 Series, or approved equal.
- Meter box covers shall be cast iron, (or other acceptable material as necessary to facilitate automatic meter reading system), 4 inches in depth and shall include a "worm" type lock. Meter box covers shall be designed to accommodate automatic meter reading applications used by the Authority. Covers for 18-inch meter boxes shall be Ford No.A32-REC-NPR-T, or approved equal.

130.02 Casings and Tunnels:

Pipe lines which must be bored or tunneled under a roadway, or other natural obstruction, shall be installed in a steel casing or tunnel. Pipe in casings and tunnels shall be constructed of a minimum of Class 350 ductile iron pipe, wall thickness minimum of 0.25-inches, with restrained joints. For railroad crossings, the minimum casing wall thickness shall be 0.375-inches. Prefabricated stainless steel pipe supports with non-conductive skids or another acceptable support system will be provided to support the pipe. Pressure treated timber skids shall not be permitted. Install casings and tunnels on a slope so that they will drain. Casings must conform to the details provided in this manual. Complete design information for a utility tunnel must be provided in the project plans.

130.03 Gate Valves:

Gate valves shall be of superior quality cast iron body with double disc parallel seat with full bronze mount. All gate valves shall be factory tested, withstand a working pressure of at least 150 psi and shall be in strict conformance with AWWA C500 and upon request the manufacturer shall furnish certified copies of test reports. The 2-inch square AWWA operating nut shall turn to the left (counterclockwise) to open the valve. The valves shall be so arranged to fit into pipelines having standardized "push-on" or mechanical joints. Gate valves shall be Mueller No. A2380-20, or approved equal and shall be installed as shown in the details.

Resilient seat wedge valves may be used for valves 12-inches and smaller. Gate valves smaller than 3-inches shall be bronze, solid wedge, rising stem, at least 200 psi working pressure, with Jenkins 49-U threaded ends. Resilient seat wedge valves shall conform to AWWA C-509 and shall be approved by the Town and County.

Valve ends shall be mechanical joint (MJ) for underground service and flanged joints for meter vaults and above ground service in accordance with AWWA C111. The valve body shall be fusion bonded epoxy coated in accordance with AWWA C550.



130.04 Check Valves:

The check valves shall operate in the direction denoted in the plan.

The check valve shall Mueller or approved equal, meet the requirements of AWWA C508 for iron bodied, bronze mounted, swing check valve. The valve shall be rated at a minimum of 150 psi non-shock working pressure.

130.05 Butterfly Valves:

Rubber seated butterfly valves conforming to AWWA C504 shall be used for water mains larger than 12-inches in diameter, unless directed otherwise.

Bodies of all valves shall be cast iron construction of ASTM A126, Class B, or ASTM A48, Class 40, and shall be as manufactured by Mueller or Kennedy or an approved substitute.

Underground valves shall be provided with operators with noncorrosive type of construction for input shaft, seals, bushings and bolting. Operators shall be totally enclosed and permanently lubricated for direct burial of the valves and frequent submergence in water up to 20 feet of head. The operators shall open the valve on a counterclockwise rotation of the operator wrench.

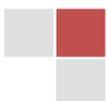
Valve ends shall be mechanical joint in accordance with AWWA C111. The valve body will be fusion bonded epoxy coated in accordance with AWWA C550.

130.06 Valve Boxes:

Valve boxes, base extensions, head and cover shall be of cast iron. Valve boxes shall be of the Mueller sliding type or Buffalo Type-4905 manufactured by Bingham Taylor Corporation, with 5.25-inch shaft and round head marked "Water". The shaft diameter shall not be less than 5-inches. The valve boxes shall have a minimum range of extension to fit 2-inch to 12-inch valves inclusive, placed on mains at depths of 3 to 5 feet of cover in order that the top cover of the valve box is set to finished grade.

Valve boxes shall be a Mueller Company 10364, or approved equal. Valve boxes shall be centered over the valve screw and set plumb.

All valves in which the operating nut is greater than 5 feet below the normal ground or road surface shall be provided with extension stems to bring the operating nut to within 5 feet of the finished grade. The extension stem shall be provided with a 2-inch square operating nut on top and a coupling to connect the extension to the operating nut of the valve. Extension shall be keyed to the valve stem with a stainless steel pin. A stem guide shall be provided to keep the valve stem extensions concentric with the valve box. Extension stems shall be of the same diameter as the valve stem unless otherwise specified.



130.07 Fire Hydrants:

Hydrants shall be traffic model either Mueller Super Centurion A-423, Kennedy Guardian K81A, American Darling B62-B-5 or acceptable substitute approved by the Town and County. Hydrants shall be post type, dry-barrel, compression type with main valve openings not less than 5.25-inches in diameter, double O-ring seals and safety flange, and shall conform to AWWA C502 requirements. Hydrants shall have a cast iron body with full bronze trim and shall withstand a hydrostatic test pressure of at least 150 psi. Hydrants shall have a minimum 6-inch connection base for setting with a minimum of 36-inch cover on connection pipe. Hydrants shall be equipped with hose connections as follows:

Two each 2.5-inch, N.S.T. hose connections

One each 4.5-inch, N.S.T. pumper connection

Hydrants shall conform to National Standard and be operated by a 1.5-inch pentagon shaped operating nut, opening counterclockwise. The direction of opening shall be clearly marked by an arrow case on the outside of the hydrant. Hydrants shall be connected to the main with a 6-inch ductile iron pipe and shall be controlled by an independent 6-inch gate valve. The 6-inch gate valve shall be located as near to the service main as practical. Where the 6-inch hydrant service line is longer than 50 feet, a second 6-inch gate valve shall be located not less than 1 foot and no more than 6 feet from the hydrant. The gate valve shall be rodded to the tee and the hydrant shall be rodded to the valve with anchor blocks placed at opposing ends and sized on a case by case basis. The 4.5-inch connection shall face the street, travel lane, service drive, or normal vehicular travelway, whichever applies.

Hydrants connection caps shall be fitted with connection chains. Also, hydrants shall be equipped with safety flange, breakaway top type and stem. Hydrant barrels shall be ordered from the supplier and delivered to the field, painted safety red (Rust-Oleum Fire Hydrant Enamel #43827 or acceptable substitute). Upon installation, hydrants bonnets and caps shall be painted according to AWWA and NFPA 291:

Class	Flow	Color of Bonnets & Caps
AA	1,500 gpm or greater	Blue
A	1,000 gpm or greater	Green
B	500 to 1,000 gpm	Orange
C	Less than 500 gpm	Red

130.08 Flush-Type Hydrants:

Flush-type hydrants shall be GIL Industries, Inc. 2-inch post flush hydrant or equal as approved by the Town and County.

Hydrants shall be connected to the main with a 3-inch ductile iron pipe branch tee and shall be controlled by an independent 3-inch gate valve. The 3-inch gate valve shall be located as near to the service main as practical. The 3-inch gate valve shall be fitted with a 3-inch by 2-inch reducer for the 2-inch hydrant service line. Where the 2-inch hydrant service line is longer than



50 feet, a second 3-inch gate valve shall be located not less than 1 foot and no more than 6 feet from the hydrant. The gate valve shall be rodded to the tee and the hydrant shall be rodded to the valve. The 2-inch connection shall face the street, travel lane, service drive, or normal vehicular travelway, whichever applies.

130.09 Automatic Flushing Devices:

Automatic flushing devices shall be Kupferle #9400-A Automatic 1" Flushing Device or equal as approved by the Town or County.

Automatic flushing device shall have a 1 inch brass inlet, leading vertically into a 1 inch automatic solenoid valve. The automatic solenoid valve shall have a 150 psi rating. Each unit shall be furnished with a stand-alone valve controller. The valve controller will not require a second hand held device for programming. It must have a minimum of 12 possible flushing cycles per day with up to 6 hour of flush per cycle and shall be submersible to 12 feet, operate with a 9 volt battery (compartment holds 2 batteries) and must have a rein-sealed electrical components. The solenoid shall have no loose parts when removed from the valve. Each unit shall have a single valve, all brass sampling point. Removal of the 1 inch solenoid valve shall be possible via an O-ring connector located under the valve after removal of stainless steel access plate. Under ground parts shall be housed in a PVC enclosure and each unit shall be self draining, non-freezing. All above ground components shall be contained in a UV resistant locking dome cover, as manufactured by Kupferle Foundry Company, Model 9400-A or approved equal.

130.10 Air Release Valves:

Air release valves shall be the universal type, orifice diameter of 0.25-inches, with a working pressure from 0 to 150 psi, stainless steel float, and resilient seat. Valves shall be type "AV" with 2-inch diameter screwed connection as manufactured by APCO (Model 145C), Crispin Multiplex Manufacturing or equal. Manual air release assemblies may be permitted on a case-by-case basis as approved by the Town and County.

Air release valve vaults shall be a standard precast concrete manhole. The valve vault atmospheric drain shall be a 4-inch cast iron pipe discharging into a one cubic yard dry well or discharging to free atmosphere. The outlet of the 4-inch pipe shall be screened.

130.11 Tapping Valves and Sleeves:

Tapping sleeves shall be mechanical joint type, with an iron body, and a brass test plug suitable for installation on the existing pipe, in accordance with AWWA C110. Tapping sleeve shall be Mueller Model H-615, or approved substitute.

Tapping valves shall be mechanical joint type with O-ring seals and non-rising stem. Inlet end shall have a Class 125 flange for attending sleeve. Tapping valves shall be manufactured in accordance with AWWA C500, and shall be Mueller Model 11-667, or approved substitute.



130.12 Inserting Valves:

Inserting valves shall be parallel seat and double disc design, conforming to the requirements of AWWA C500. Valves shall be designed for a working pressure of 200 psi, with specifically designed mechanical joint ends. Valves shall be Mueller Model H-842, or approved substitute.

130.13 Sample Stations:

Sample Stations shall be Water Plus Corp. 301-D-NL or equal as approved by the Town or County.

The water sampling station shall consist of a main shut-off ball valve, a spigot and throttling valve and a built-in evacuation tube. The unit shall be constructed with a brass and/or stainless steel water way. The below grade water way portion of the station shall be encased in a non-corrosive housing. The above grade portion of the station shall be enclosed within a lockable polyethylene housing.

The main shut-off valve shall be ball valve type with brass body and a stainless steel ball. This valve shall be one-quarter turn operation and shall be of a maintenance free design. The throttling spigot shall consist of a ball valve of the same design and a stainless steel spigot. The throttling valve shall be placed inline, above grade, at a distance from the spigot end which facilitates a steady flow of water containing no aeration.

The evacuation tube shall allow all water to be removed from the unit by means of a portable, hand-held pump. This tube shall allow all water to be removed from the station after each use to minimize bacteria growth and provide freeze protection.

All piping in the unit shall be constructed of brass or stainless steel or a combination of these materials. All waterway materials shall be non-corrosive. The buried portion of the water way shall be completely enclosed in a noncorrosive, non-conductive outer housing.

The above grade portion of the unit shall be enclosed in a polyethylene enclosure. The enclosure shall have a removable top which, when removed, provides complete access to the throttling valve, spigot, main shut-off valve and evacuation tube. The removable top shall be lockable by means of a tamper proof lock. The enclosure shall be manufactured with ultraviolet inhibitors for maximum life expectancy in outdoor installations.

The unit shall be Model 301D as manufactured by Water Plus Corporation or approved equal.

140 WATER LINE CONSTRUCTION

140.01 General:

The construction of all public water supply systems shall conform to the Virginia *Waterworks Regulations*, and plans and specifications approved by the Town and/or County.



The materials listed in this Utilities Standards Manual (USM), are for general information. Engineers and contractors working in the Town or County shall contact the respective authority to determine what materials are acceptable for each specific project.

- **Storing of Materials:**
Materials to include all pipe, fittings, and other appurtenances stored onsite or in the contractor/developer's storage yard shall be protected from intrusions by foreign materials, animals, insects, soil, and water at all times. End caps will be installed by the manufacture and will be left in place until the pipe is installed in the trench. End caps will be made of closed-cell polypropylene and will fit snugly on both ends of the pipe. The contractor/developer may use a flexible bag covering or shrink-wrap as a means of protection providing they have written approval from the Director.
- **Handling of Materials:**
To avoid shock or damage, load and unload pipe, fittings, valves, hydrants and accessories by lifting with hoists or skidding. Under no circumstances shall such material be dropped. Handle pipe such that the coating and lining shall not be damaged. The Town and County have the authority to reject any or all materials found damaged.
- **Line and Grade Stakes:**
Prior to the construction of an approved water main, the engineer shall place adequate line and grade stakes which identify the main, fittings, valves, hydrants, and water meter that are located within 1 foot of the property line or other appurtenances to insure the system can be constructed in accordance with the approved plans.
- **Cut Sheets:**
 - The engineer shall prepare legible cut sheets at 100 foot stations. Cut sheets will contain all data pertinent to the construction of the water main, the station and length of service connections, and all fittings including hydrants, tees, and bends.
 - Five (5) sets of cut sheets, certified by a Professional Engineer or surveyor shall be submitted to the Town and County for review and approval. The Engineer or surveyor who certifies the cut sheets shall also provide the following statement on all sets: "The professional seal and signature appearing on this document certifies that information shown conforms to the approved plan and/or actual field conditions." If a deviation from the approved plans in the horizontal location or grade of any main, structure or appurtenance is necessary; a revision to the approved plans showing the proposed deviation must be submitted to the Town and County for review and approval before the changes are constructed.



140.02 Blasting:

Blasting, where required shall be done with great care and in accordance with all applicable Federal, State and local laws, ordinances, and regulations. The contractor/developer shall be responsible for obtaining all required permits and bonds prior to blasting. Permits must be on site and available for review upon request by the Town and County. Any damages to foundations, structures, facilities, pipelines, utility conduits or any other damages attributed to the use of explosives shall be corrected at the contractor/developer's expense. The contractor/developer shall provide the owners of adjacent buildings, structures and properties, in writing, a description of the blasting and seismic operations, prior to blasting.

When explosives are used, work shall be executed by persons who are properly licensed to use explosives. Each blast shall be covered with rubber tire or steel mats. Blasting is not permitted within 24 feet of utilities, facilities or structures. Blasting closer than 24 feet must be pre-approved by the Town and County providing the project engineer can demonstrate that the safety or soundness of existing facilities are not in any manner endangered. Blasting shall not occur within 300 feet of any radio transmitter or radio frequency emission equipment. The magazine keeper shall maintain accurate records and inventory for all explosives, detonators and equipment from time of delivery, until used or removed from the site. The contractor/developer shall provide the required security for the site.

140.03 Excavation, Bedding and Backfill:

The work site shall be conservatively cleared of all vegetation, shrubs, trees and objectionable material which may interfere with construction. Vegetation, shrubs and trees which do not interfere with construction shall be protected from damage.

All excavated material shall be stockpiled in a manner that will not endanger the work and will prevent obstruction of driveways, gutters, and natural water sources. Hydrants, under pressure, valve pit covers, valve boxes or other utility controls shall be left unobstructed and accessible at all times. Topsoil shall be stockpiled separately to guarantee its placement at the top of the backfill trench.

Excavate trenches such that pipe can be laid to the alignment and depth required. Do not leave trenches open for more than 500 feet in advance of the completed pipe laying operation. The width of the trench shall be ample to permit the pipe to be placed, backfilled and thoroughly compacted in accordance with the requirements of these specifications. Trenches shall be of such extra widths as required to permit the convenient placing of timber supports, sheeting and bracing and handling of special fittings or appurtenances. Sheeting and shoring shall be furnished in accordance with the provisions of OSHA.

Excavate trenches to the depth required so as to provide a uniform and continuous bearing and support for the pipe on solid and undisturbed ground at every point between bell holes, except that it will be permissible to disturb and otherwise damage the finished surface over a maximum length of 18-inches near the middle of each length of pipe by the withdrawal of pipe slings or



other lifting tackle. Backfill the bottom of the trench, excavated below the specified grade, with approved bedding materials and thoroughly compact. The finished subgrade shall be prepared accurately.

Where excavation is made in rock, boulders, or other unsuitable materials, the subgrade shall be made by backfilling with a minimum 6 inches of #57 aggregate which shall be thoroughly compacted.

Provide bell holes at each joint to permit the jointing to be made properly.

Remove ledge rocks, boulders, and large stones to provide a clearance of at least 6-inches below and on each side of all pipe, valve and fittings for pipe up to 24-inches in diameter. A larger clearance may be required for pipes larger than 24-inches in diameter. The specified minimum clearances are the minimum clear distances which will be permitted between any part of the pipe and appurtenances being laid and any part, projection or joint of such rock or stone.

No pipe shall be laid in water or when, in the opinion of the Directors, trench conditions are unsuitable.

Place backfill in two, 1 foot layers over the pipe and thoroughly tamp to 85 percent compaction. The remainder of the backfill shall be placed in 2 foot layers tamped to 85 percent compaction. Backfill material shall be free of perishable material, frozen clods, sticky masses of clay and other unsuitable matter. Rock pieces larger than 2 inches shall not be used in the backfill within the 2 feet directly above the pipe.

Any work within existing or proposed Rights-of-Way shall meet all requirements of the Town, County and the VDOT.

140.04 Installation of Pipes, Valves, Fittings and Hydrants:

When installing pipe in the trench, proper implements, tools, and facilities satisfactory to the Directors and as recommended by the material manufacturer shall be provided and used by the contractor for the safe and convenient prosecution of the work. Carefully lower pipes, valves, and fittings, hydrants and accessories into the trench, piece by piece, by means of a derrick, ropes, slings or other suitable tools or equipment and in such a manner as to prevent damage to the water main material as well as protective coatings and linings. Do not drop or dump water main materials into the trench. Inspect pipe, fittings, valves, hydrants and other appurtenances for defects, damage immediately before installation while suspended above grade. Defective materials shall be marked and held for inspection by the Town and/or County, who may prescribe corrective repairs or reject materials. Installation of materials shall be in accordance with AWWA C600.

Remove lumps, blisters and excess coal tar coatings from the ends of each pipe, and wire brush and wipe clean the outside of the spigot and the inside of the bell. Spigots shall be dry and free from oil and greases, dirt, sand, grit or any other foreign material before pipe is laid.



Every precaution shall be taken to prevent foreign material, including non potable water from entering the pipe while it is being placed in the line, thus the trench shall be dewatered prior to pipe installation. If the pipe-laying crew cannot put the pipe into the trench and in place without preventing the entry of foreign material, a heavy, tightly woven canvas bag of suitable size shall be placed over each end and left there until the connection is to be made to the adjacent pipe. During laying operations, do not place debris, tools, clothing, or other materials in the pipe. At the end of each day place a watertight plug in the end of each pipe opening.

After placing a length of pipe in the trench; the spigot end shall be centered in the open bell of the pipeline and the pipe pushed home so that the face of the spigot is in close contact with the shoulder of the bell. Prior to joining pipe sections, mark spigot end insertion depth around pipe with a visible marking to provide confirmation that joint is thoroughly seated in bell. Lay ductile iron pipe with the bells facing the direction of the laying.

The cutting of pipe for inserting valves, fittings, or closure pieces shall be done by machine in a neat and workmanlike manner without damage to the pipe or the cement lining and so as to leave a smooth end at right angles to the axis of the pipe.

When machine cutting is not available for cutting pipe 24-inches in diameter or larger, the electric-arc cutting method will be permitted using a carbon or steel rod. The flame cutting of pipe by means of oxyacetylene torch shall not be allowed.

After cutting the pipe by any method, bevel the outside cut-end of the pipe approximately 0.25 of an inch back at an angle of about 30 degrees with the center line of the pipe. Remove any sharp edges or burrs that could damage the gasket.

Whenever it is necessary to deflect pipe from a straight line, either in the vertical or horizontal plane, to avoid obstructions or plumb stems, or where long-radius curves are permitted, the amount of deflection allowed shall not exceed that required, for satisfactory joining of the pipes, as specified by the manufacturer.

Restrain all tees, bends, plugs, caps and fire hydrants against movement by restraining joints. Restraining glands are preferred and shall be Megalugs as manufactured by EBAA Iron or other restraining glands acceptable to and approved by the Town and County. Concrete reaction blocking may be used on a limited basis in place of restraining glands or manufacturer's restrained joint pipe as approved by the Town and County. All concrete blocking will rest against undisturbed soil. All concrete blocking will be in accordance with the details in this manual.

In making connections of ductile iron pipe using the standard mechanical joint, place the gland followed by the rubber gasket over the plain end of the pipe, which shall be carefully inserted and aligned into the socket end of the pipeline. The gasket shall then be pushed into position so that is evenly seated in the socket. The gland shall then be moved into position against the face of the gasket, bolts inserted and made finger tight. Tighten the bolts by using a ratchet wrench



not less than 14 inches in length. All other requirements outlined previously concerning bedding, alignment, and cleaning of the pipe before making the joint, shall be followed.

Valve boxes shall be provided for all buried valves. The valve box shall not transmit shock or stress to the valve and shall be plumb and centered over the operating nut of the valve, with the box cover flush with the finished grade. Proper drainage around the valve box shall be provided.

All dead ends on new mains shall be provided with a fire hydrant or flushing hydrant. Temporary dead-end mains shall be provided with a 2-inch blow off valve.

Fire hydrant location, position and drainage shall be in accordance with AWWA C600. Prior to installation, all hydrants shall be inspected for direction of opening, nozzle threading, operating-nut and cap-nut dimensions, tightness of pressure-containing bolting, cleanliness of inlet elbow, handling damage and other defects. Defective hydrants shall be held for inspection by the Town and/or County, who may prescribe corrective actions or reject materials.

Placement of the hydrant shall be so that the bottom of the 4.5-inch nozzle shall be 18 inches above the elevation of the edge of the shoulder on streets without curb and gutter and 18 inches above the elevation of the curb on streets with curb and gutter. The 2.5-inch hose connections shall have a minimum of 4 feet clearance on all sides. Each hydrant shall be connected to the main with a 6-inch branch controlled by an independent 6-inch valve. Upon installation, hydrant bonnets and caps shall be painted according to AWWA and NFPA 291.

140.05 Pressure and Leakage Testing:

All newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure of not less than 150 psi above.

All high points in the portion of the system under test shall be vented and air shall be expelled from the system prior to beginning the test. After all the air has been expelled, the corporation cocks shall be closed and test pressure applied. At the conclusion of the test, the corporation cocks shall remain closed and left in place.

Fittings and hydrants shall be properly braced or blocked before applying pressure. Where concrete thrust blocks are used, they shall have attained their final set prior to testing.

Pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Town and/or County. After the valved portion of the system under the test has reached the required pressure as stated herein, the pressure shall be maintained for at least two hours and not vary by more than 5 psi for the duration of the test. Pressure readings at the test gauge shall be corrected to account for the difference in elevation between the test gauge and the critical points of the portion of the line being tested. At the conclusion of the pressure test, the volume of makeup water required to refill the pipeline shall be determined by measurement with a displacement meter or by pumping from a vessel of known volume.



All exposed pipe, joints, fittings, valves and hydrants at which leakage occurs shall be reworked to insure tightness. If the measured amount of leakage exceeds the values for the appropriate size as found in AWWA Specification C600-17, Hydrostatic Testing, the pipeline shall be repaired and retested until leakage is within the limit set. Methods of repair prior to retesting will be done with the Town and/or County approval and inspection and at the contractor's expense. No visible leaks will be allowed.

Allowable leakage shall be determined using the following calculation:

Testing allowance shall be defined as the maximum quantity of makeup water that can be added into a pipeline undergoing hydrostatic pressure testing, or any valved section thereof, to maintain pressure within ± 5 psi (34.5 kPa) of the specified test pressure (after the pipeline has been filled with water and the air has been expelled*). The testing allowance is exceeded if the quantity of makeup water is greater than that determined by the following formula(s):

In inch-pound units; (Eq 1)

$$L = \frac{SD\sqrt{P}}{148,000}$$

Where:

L = testing allowance (makeup water) (gph)

S = length of pipe tested (ft)

D = nominal diameter of the pipe (in.)

P = average test pressure during the hydrostatic test (psi [gauge])

In metric units; (Eq 2)

$$L_m = \frac{SD\sqrt{P}}{794,797}$$

Where:

L_m = testing allowance (makeup water) (L/hr)

S = length of pipe tested (m)

D = nominal diameter of the pipe (mm)

P = average test pressure during the hydrostatic test (kPa)

These formulas are based on a testing allowance of 10.49 gpd/mi/ in. (0.971 L/d/km/mm) of nominal diameter at a pressure of 150 psi (1,034 kPa). When testing against closed metal-seated valves, an additional testing allowance per closed valve of 0.0078 gal/hr/in. (1.2 mL/hr/mm) of nominal valve size shall be allowed. When hydrants are in the test section, the test shall be made against the main valve in the hydrant.

140.06 Wet Taps:

All wet tap installations require a Town and/or County representative to be present at the time of the tap. The tap shall require the approval of the Town and County. Sleeve and valve assemblies shall be properly tested for 10 minutes before the actual tap is made.



Wet taps shall employ a ductile iron mechanical joint sleeve, or other fitting specifically designed for this purpose as approved by the Director(s).

140.07 Disinfection of Water Mains:

After testing and before final inspection of the completed systems, flush new water mains and chlorinate in accordance with AWWA Specification C651. All valves, hydrants and appurtenances shall be operated during this time. Flushing shall be accomplished at a flow velocity of not less than 3 feet per second.

The disinfection solution shall remain in the new piping for no less than 24 hours, after which time a minimum chlorine residual of 25 ppm throughout the line shall be required.

Following chlorination, the new piping shall be thoroughly flushed and refilled with potable water. The heavily chlorinated water shall be flushed from the new main until the chlorine residual is no higher than that generally prevailing in the existing system. The water in the new main shall be proven comparable in quality by testing. The environment to which the heavily chlorinated water is to be discharged shall be inspected and if there is any question that the chlorinated water may cause damage to the environment, then a reducing agent shall be applied to the water that is to be wasted to thoroughly neutralize the chlorine residual that is remaining. When necessary, federal, state and local regulatory agencies shall be contacted to determine special provisions for the disposal of the heavily chlorinated water. If finished water from an existing public water supply is introduced into the new water main, the contractor shall tightly close the gate valve separating the new main from the existing main immediately after introduction of water, to ensure that heavily chlorinated water cannot enter the existing potable system.

The *Virginia Water Regulations* require at least two consecutive satisfactory bacteriological samples taken 16 hours apart, analyzed at a laboratory certified for bacteriological analysis, from the new water main/distribution system before the system can be placed into service. If the results of these samples indicate contamination, the disinfection procedure must be repeated. These samples shall be collected at regular intervals, not exceeding 1200 feet, throughout the length of the new water main.

150 ON-SITE PRIVATE WELLS

150.01 Applicability:

Private wells are allowed in developments located in the rural area, as designated by the Culpeper County Master Water and Sewer Plan. Private wells are also allowed on individual lots in the development area, where a public water system is not available. The use of private wells shall be governed by ordinance and, if permitted, must be approved by the Culpeper County Health Department. The minimum area for any such use shall be 1 acre or more as required by the Culpeper County Health Department. No person shall install or maintain any connection



whereby water from an auxiliary system may enter the Town and/or County water system(s) unless the auxiliary water system and the method of connection and use of such system shall have been approved by the Town and/or County. State Regulations: Private wells shall be designed and tested in accordance with the Commonwealth of Virginia's *Waterworks Regulations* and Private Wells Regulations.

150.02 Review and Approval:

Information pertaining to private wells shall be submitted as part of the site/subdivision plans and in accordance with this manual. The review and approval of this information shall be performed by the Culpeper County Health Department.

160 FIRE SAFETY SYSTEMS

Fire Safety systems shall be designed and constructed in accordance with this manual and ISO and NFPA guidelines.

160.01 General Policy and Requirements:

Water Supply Systems:

- Water supply systems shall be provided in accordance with this manual.

Fire Protection Lines:

- All fire protection lines shall be privately owned and maintained and provided with approved backflow prevention.
- All fire protection lines shall have an approved detector check and vault installed within the Town or County utility easement.

Fire Flow Calculations:

- Fire flow calculations shall be included with the site development plans.
- Deviations from the minimum fire flow requirements of this manual shall require a conditional fire flow waiver with the site development plan application. The waiver shall address current fire flow available and provide a system analysis to determine measures for bringing deficiencies up to minimum standards.
- Public Works, after coordination with the Fire Marshal's Office, shall approve additional fire protection measures proposed for every building not covered by adequate fire flows, prior to the approval of the site development plans. Any waivers will be coordinated with the Town and County as applicable.



- Fire protection lines will be reviewed for general conformance only, to include location and materials of construction. Sizing of the fire protection line shall be the responsibility of the design engineer and shall be in accordance with the requirements of the sprinkler manufacturer.

160.02 Submission Requirements:

Plan Elements in General: The site development plans shall include the following:

- Emergency access.
- Existing and approved fire hydrants.
- Fire protection lines.
- Water storage systems, where applicable.
- Rural water supplies, where applicable.

Fire Hydrants in General:

- Fire hydrants shall be connected to a water main with a 6-inch ductile cast iron pipe, and shall be controlled by an independent 6-inch gate valve. The gate valve shall be located as near to the service main as practical.
- Where the hydrant service line is longer than 50 feet, a second 6-inch gate valve shall be located not more than 6 feet from the hydrant.
- All hydrant barrels shall be painted safety red (Rust-Oleum Fire Hydrant Enamel #43827 or acceptable substitute). Upon installation, hydrants bonnets and caps shall be painted according to AWWA and NFPA 291.
- The 4.5-inch pumper connection on the hydrant shall face the street, travel lane, or service drive.
- The bottom of the 4.5-inch nozzle shall be 18 inches above the elevation of the edge of the shoulder on streets without curb and gutter and 18 inches above the elevation of the curb on streets with curb and gutter.
- The 2.5-inch hose connection shall have a minimum of 4 feet of clearance on all sides.



Fire Hydrants Location in Relation to Streets and Parking Lots:

- Fire hydrants shall be located along the right-of-way at street intersections and at intermediate locations where necessary, as determined by the Fire Marshal's Office in cooperation with the Town and County. All distance measurements are to be made along the water main between the two hydrants. In no case shall the distance between fire hydrants be greater than 1,000 feet.
- In areas with curb and gutter, the center of the fire hydrant shall be located from the face of the curb no less than 18 inches or more than 36 inches. Any part of a fire hydrant shall not conflict with or overhang a sidewalk, trail, or vehicular travelway.
- On roads with ditches, fire hydrants shall be located behind the ditch.
- Traffic bollards or other protective measures shall be provided in areas such as parking lots, where the proposed site improvements will not provide adequate protection of the fire hydrant from vehicles.
- When installed in parking areas, clear access shall be provided to the front of the hydrant (that portion with the large pumper connection at the center), and 15 feet to each side. This clear access area shall be marked as fire lane.
- Plantings or other obstructions shall be kept clear of fire hydrants for a minimum of 4.5 feet around the hydrant.

Fire Hydrants Location in Relation to Buildings:

- Fire hydrants shall be located to serve remote areas of buildings. Those hydrants used to meet fire flow requirements shall be located within 500 feet of the building to be protected.
- Fire hydrants shall be required along the perimeter of the building. The remote distance shall be measured to the most remote distance the hydrant will serve. Fire hydrants shall be a minimum of 50 feet away from all buildings, except single-family dwellings.

Fire Hydrants location in Relation to Sprinklers/Standpipes:

- Fire hydrants shall be located within 100 feet of any fire department sprinkler connection or standpipe where those systems are required in buildings.

Fire Hydrants location in Relation to Pipestem Lots:

- A fire hydrant may be required, as determined by the Fire Marshal, to be placed within 500 feet of all pipestem lots.

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Fire Protection Lines:

- Fire protection lines shall be a separate connection to the water main unless otherwise directed by the Town and County.
- Fire protection lines shall have a valve at its connection to the main.
- Plans for fire protection lines and a permit application shall be submitted for review and approval by the Town and County, as applicable, prior to installation.

Sprinkler/Standpipe Fire Department Connections:

- Fire department connections shall be located to be visible from a street. If a visible location from a street is not possible, alternate locations shall be approved by the Fire Marshal's Office. Such connections shall be located to provide immediate access to the fire department. Walls, fences, trees, shrubs, and other obstructions shall not prevent access.
- Fire department connections shall be arranged to allow the use of anyone water sprinkler connection to serve all the sprinklers within the building, and to allow the use of anyone standpipe connection to serve all the standpipes within the building.
- Fire department connections shall not be less than 18 inches and not more than 42 inches in elevation measured from ground level to the centerline of the inlets.
- In buildings classified as high rise by the building code, the fire department connections shall be located a minimum of 50 feet from the building. The location of this yard connection shall be approved by the Town and County, as appropriate and the Fire Marshal's Office.

Water Systems and Fire Flow Requirements:

- Water systems shall be designed to provide fire flows, plus the domestic demand required by the Town and County. A residual pressure of not less than 20 pounds per square inch (psi) at the required fire flow to at least one point within 500 feet of each building proposed to be served shall be provided.
 - New development shall provide adequate fire flow as required by the Town and County. Where the size and the scope of the development may exceed design standards, additional flow shall be provided in accordance with Insurance Services Office (ISO) requirements.
 - The minimum size water line used for fire protection to properties zoned single family residential shall be 6 inches in size. The minimum size water line used for fire
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protection to properties zoned multifamily residential, commercial or industrial shall be 8 inches in size.

- Fire flow requirements may be met in single-family residential and two-family developments with a single hydrant within 500 feet of a structure.
- In areas of multiuse development, the higher flow rates listed above shall be provided for each hydrant.
- Other residential, commercial, institutional, and industrial developments shall provide a fire flow of 1,500 gallons per minute.

Fire Flow Calculations:

- Fire flow calculations shall include assumptions about the existing system. The calculations shall indicate available flows at the proposed hydrants and the pressure throughout the proposed system.
- Fire flow calculations for projects to be developed in sections or phases shall indicate the available fire flows during each section or phase of the project.
- For small sites that propose no major waterline extensions, an evaluation of the existing fire flow available may be substituted for existing fire flow calculations.
- In the event that minimum fire flows cannot be achieved, the developer of a property shall design additional fire protection measures into every building not covered by adequate flows. Any deviation from the minimum fire flow requirements shall require a site development plan waiver application, for conditional fire flow requirements.
- Flow calculations shall be prepared using a computer program that is acceptable to the Town and County, such as KYPIPE Hydraulic Software as developed by the University of Kentucky or WATERCAD, Version 6.0 or latest published revision.
- Flow calculations shall utilize a pipe roughness factor, $c=120$ for pipes that are 12-inches in diameter and greater. For pipes smaller than 12-inches, roughness factor, $c=100$ shall be utilized. Since a conservative "c" factor is utilized in the calculations, no allowance is required for the losses in valves and other fittings.
- The line velocity shall not exceed 10 feet per second (fps) under any flow condition. Consideration shall be given to the line size used in areas where a domestic service line extends from a dead end line. In this instance, the line velocity may be permitted to exceed 10 fps to avoid stale water problems.



Water Storage Systems:

Water storage systems utilized to maintain fire flow shall have capacity to sustain the required flows and volumes in accordance with guidelines set forth by ISO and NFPA.

Rural Water Supplies (County Only):

- Suitable static water sources such as storm water management or BMP wet ponds in areas beyond the limits of public water services shall be accessible to fire department pumps. Access to static water sources may include dry suction hydrants and/or access lanes capable of supporting heavy fire apparatus under all weather conditions.
- The location and method of access shall be approved by the County and shall be constructed in accordance with this manual.

160.03 Construction Standards:

Rural Water Supply Access (County Only):

Access to a static rural water supply shall be constructed in accordance with design criteria, NFPA Standard 1231.

Acceptance Testing for Fire Protection Lines:

- Acceptance testing shall be required on all fire protection lines prior to concealment and use. Fire protection lines, except those serving single-family detached and two-family dwellings, shall be hydrostatically tested at not less than 200 pounds per square inch (psi) for 2 hours or at 50 psi in excess of the maximum static pressure when the maximum static pressure is in excess of 150 psi.
- Concealment of an underground fire protection line prior to acceptance testing may occur if a visual inspection of the system is conducted to verify that piping and anchorage is installed in an approved manner, and if the developer or contractor assumes responsibility for corrections to failures of the hydrostatic test.
- Flushing of a fire protection line shall occur prior to admittance of any water through the line and into the fire protection system. The minimum water flow required for line flushing or the hydrostatically calculated water demand rate of the system, whichever is greater.
- Hydrostatic testing of the fire protection line shall consist of testing the line from the valve at the water main up to, and including, the temporary flange/gate valve assembly.



Fire Protection Line Anchorage:

- Pipe anchorage shall be required on fire protection lines whenever they change direction. This includes bends, tees, and pipe ends. The pipe shall bear on a surface which is capable of resisting the loads imposed by moving water.
- Restraining systems shall comply with the standards in Section 130 of this manual.

Fire Detection Check Valves:

- Approved detection check valves shall be required on all fire service mains in buildings served by a "wet pipe" type sprinkler system.
- The detection check valve shall be equipped with a bypass meter assembly. An appropriately sized gate valve shall be installed on either side of the check valve.
- The vault housing the detector check valve should be adequately sized.
- Detection check valves shall not be required on exterior fire lines, unless otherwise directed by the Town and County.
- The Director(s) approved back flow preventer detector check valve and vault housing shall be required on all fire protection lines. Furnish detail drawings of both for prior approval.

160.04 Specifications:

Fire Hydrants:

- All fire hydrants shall be traffic model type, either Mueller Super Centurion A-423, Kennedy Guardian K81A, or approved equal.
- Fire hydrants shall be of the post type, dry-barrel, compression type with main valve openings not less than 5.25-inches in diameter, double O-ring seals and safety flange, and shall conform to AWWA C502 requirements. Hydrants shall have a cast iron body with full bronze trim and shall withstand a hydrostatic test pressure of 150 pounds per square inch (psi).
- Fire hydrants shall have a minimum 6-inch connection base for setting, with a minimum of 36 inches cover on connecting pipe.
- Fire hydrants shall be equipped with 3 hose connections. Two of the connections shall be 2.5-inch N.S.T., and the third connection shall be 4.5-inch N.S.T.



- Fire hydrants shall have a standard 1.5-inch pentagon shaped operating nut, opening counterclockwise. The direction of the opening shall be clearly marked by an arrow case on the outside of the hydrant.
- Fire hydrant connections to the water mains shall be 6-inch ductile cast iron pipe and shall be controlled by an independent 6-inch gate valve.
- Hydrants connection caps shall be fitted with connection chains.
- Hydrants shall be equipped with safety flange, breakaway top type and stem.
- Fire hydrant barrel paint shall be safety red, high performance acrylic Rust-Oleum Fire Hydrant Enamel #43827, or equal. Upon installation, hydrant bonnets and caps shall be painted according to AWWA and NFPA 291.

Sprinkler Standpipe Connections:

- All fire department connections shall be fitted with national standard threads.



SANITARY SEWER SYSTEMS

170 GENERAL REQUIREMENTS

170.01 General:

It shall be the responsibility of each developer, contractor and engineer to familiarize themselves with all applicable specifications relating to utilities design and construction. The applicable requirements of the Virginia Department of Health Office of Drinking Water *Waterworks Regulations* and the Department of Environmental Quality, Sewage Collection and Treatment Regulations, the Building Officials and Code Administrators International (BOCA), the Virginia Department of Transportation (VDOT), the American Water Works Association (AWWA), Town of Culpeper Code, Culpeper County Code and any other specifications where applicable, must be met. All standards referenced in this section shall refer to the latest revision or revised edition of the referenced material. The authority for discretionary provisions for sewer designs shall vest with the Director(s). Any references to acceptance and/or approval shall mean acceptance and/or approval by the Town and/or County.

For projects located within Town or County limits and provided public sanitary sewer is within 300 feet of a principle structure, the owner of all houses, buildings, or properties used for human occupancy, employment, recreation or other purposes, situated within the Town or County of Culpeper and abutting on any street, alley, or right-of-way in which there is now located or may in the future be located a public sanitary sewer or combined sewer of the Town or County of Culpeper, is hereby required at his expense to install suitable toilet facilities therein, and to connect such facilities directly to the proper public sanitary sewer main when it involves new construction, failed septic system, or by requirement of the health department.

For projects located in Culpeper County, outside of Town limits, sewer systems shall be designed in accordance with the densities and intensities reflected in the Culpeper County Master Water and Sewer Plan. New development located in one or more of the Service Areas in the development area, as reflected by the Master Water and Sewer Plan, shall connect to a public sewer system, when available. New developments located in the rural area shall be served by a Community Wastewater System. The approximate location and character of proposed public sewer facilities shall correspond with the Existing and Proposed Sewer System Map, as amended. Sewer systems shall be designed for the estimated future population from all contributing points in the development area under consideration. The estimated future population shall be based on the adopted County Master Water and Sewer Master Plan Systems Map.

Sewers shall be designed and constructed to achieve total containment. Sewers shall be designed for the ultimate tributary population with an upper limit consisting of the 50 year population growth projection, except when considering parts of the line that can be readily increased in capacity. Sewers shall remain fully operational during the 25 year flood wave action. Sewers and their appurtenances located along streams and rivers shall be protected against normal range of high and low water conditions, including the 100 year flood wave action.



To provide for maximum utilization of public sewer systems, appropriate easements shall be provided to adjacent properties for access to, or extension of, said utilities. Such easements shall be dedicated to the Town and County depending on the location of the project.

All sewers and service laterals located outside of state rights-of-way or public easements are regulated by the Virginia Uniform Statewide Building Code (VUSBC), and shall be privately maintained.

There shall be no physical connections between a drinking water supply and a sewer or appurtenance thereof.

170.02 Private Sewer Service:

Building sewer connections, or portions of building sewer connections outside the VDOT right-of-way or easement shall be privately owned, operated and maintained. Building sewer connections, or portions of building sewer connections within the VDOT right-of-way or easement in the County shall be owned and maintained by the County. Sewer laterals that are on private property will be inspected by the Building Official

All sewer service connections between the building and the public main in Town shall be owned and maintained by the property owner. The Town and County will provide lateral inspection services for acceptance by the Town and County as applicable.

170.03 Relationship to Waterworks Structures:

Public wells, other public water supply sources, structures, and sewers shall meet the requirements of the Virginia *Waterworks Regulations* with respect to minimum distances from water supply wells or potable water supply sources and structures. No sewer line shall pass within 50 feet of a potable water supply source or structure unless special construction and/or pipe materials are used to obtain adequate protection. The engineer shall identify and adequately address the protection of all potable water supply structures within 100 feet of the proposed project.

170.04 Location of Sewers in Relation to Streams, Estuaries, Lakes and Reservoirs:

For the location and installation of sewer lines in relation to streams, estuaries, lakes and reservoirs, refer to the State Water Control Board (SWCB), Sewage Collection and Treatment regulations.

Sewer lines crossing streams or standing bodies of water, both above and under water, present special problems and should be discussed with the Town and County before final plans are prepared. Sewers located along streams shall be located outside of the stream bed wherever possible and sufficiently removed therefrom to protect the natural stream channel. Reasons for requesting sewer lines to be located within stream beds shall be given in the site development



plan application. Sewers laid on piers across ravines or streams shall be allowed only when it can be demonstrated that no other practical alternative exists.

Sewers entering or crossing streams shall be of sufficient depth below the natural bottom of the streambed to protect the sewer line. In paved channels, the top of sewers shall be placed below the bottom of channel pavement. Sewers shall remain fully operational during a 25 year storm event. Sewers and their appurtenances located along streams shall be protected against the 100 year storm event. Sewers located along streams shall be located in conformance with this manual and the State Water control Board (SWCB), Sewage Collection and Treatment regulations.

170.05 Sewer-Only Accounts:

Under special circumstances, the Town and County will allow sewer-only accounts. Sewer-only accounts will not be charged water use fees, but the private wells supplying such accounts must be fitted with sewer meters. Meters will be read by the Town and/or County as applicable in order to establish quantities per billing cycle. The size and location of the sewer meter shall be shown on the project plans.

170.06 Grease Traps:

Private grease traps, volatile liquid separators, or other such devices may be required for restaurants and other facilities where, due to the nature of the operation, it is deemed necessary or required by the VUSBC or the Town and County. The owner of the facility served by a grease trap, volatile liquid separator or other such device, shall be responsible for its proper installation, operation and maintenance.

170.07 Inverted Siphons:

Inverted siphons shall not be allowed without the written approval of the Director(s) and only in cases where other alternatives make the use of inverted siphons in the best interest of the Town and County.

180 DESIGN PARAMETERS

180.01 Virginia Department of Environmental Quality, State Water Control Board, Sewage Collection and Treatment Regulations:

The design of sanitary sewer systems and sanitary sewer pump stations shall be governed by the DEQ, SWCB, Sewage Collection and Treatment Regulations and the requirements of this manual. The Town and County have applied to have local review authority for the design of wastewater systems using this manual as its application. Accordingly, after approval, it is anticipated that the Sewage Collection and Treatment Regulations shall be augmented by the USM, unless such augmentation is specifically waived by the Director(s), depending upon where the project is located.



Specific parameters of the proposed project's sewer system, e.g., lift stations and sewers larger than 12-inches in diameter, must be reviewed both locally and by the DEQ. The developer or the engineer must coordinate with the Director(s) to ensure that the appropriate agencies review the various portions of the sewer utility plan.

180.02 Submission Requirements:

All site development plans proposing a sewer system shall be submitted to the Director(s), as appropriate, who shall coordinate the review and approval of all elements of the plan in accordance with this manual.

All site development plans shall include horizontal and vertical views of all of the proposed sewer lines and appurtenances. The diameter, length, material, and slope of all proposed sanitary sewer lines shall be shown on the plan profiles. Sanitary sewer design calculations shall be submitted for all proposed sewer mains as part of the site development plans along with a sewer shed map. Deviations from the flow rates of Table 180-1 shall be included in the submission of the site development plan, with a description of the procedure used for the calculations, and must be approved by the Director(s), depending upon the location of the project. Also, if there is sewer crossing watercourses, design information and details shall be submitted for review.

180.03 Tributary Population:

Sewer systems shall be designed to carry the peak flows generated by the estimated future population from all contributing points under consideration. The estimated future population will be based on the adopted Town of Culpeper Comprehensive Plan and the Culpeper County Master Water and Sewer Plan for the watershed to be sewered. The estimated average daily flow will be computed using the unit flows from Table 180-1.

Consideration will be given to domestic, commercial, institutional, and industrial wastes plus groundwater infiltration in determining the necessary capacity of the sewer system. A design analysis and sewer shed map will be submitted with all project plans.

180.04 Sewer Systems in Relation to Waterworks Structures:

Sewer systems shall meet the requirements of the Virginia *Waterworks Regulations* as well as private well regulations with respect to minimum distances from water supply wells or water supply sources and structures. No sewer line shall pass within 50 feet of a water supply source or structure unless special construction and/or pipe materials are used to obtain adequate protection. The proposed design shall identify and adequately address the protection of all water supply structures within 100 feet of the proposed project.

180.05 Design Quantities:

New sewer systems will be designed to carry the estimated peak flow from the contributing watershed plus any flows pumped into the watershed from a lift station. The peak flow will be



computed by multiplying the average daily flow by the appropriate peaking factor from Figure 180-1. The unit flows from Table 180-1 will be assumed to cover infiltration. When deviations from the flow rates of Table 180-1 are proposed, a description of the procedure used for the sewer design shall be included with the submission of the site development plans. The use of any flows other than those listed in Table 180-1 must have the written permission of the Town and County.



FIGURE 180-1

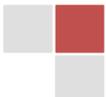
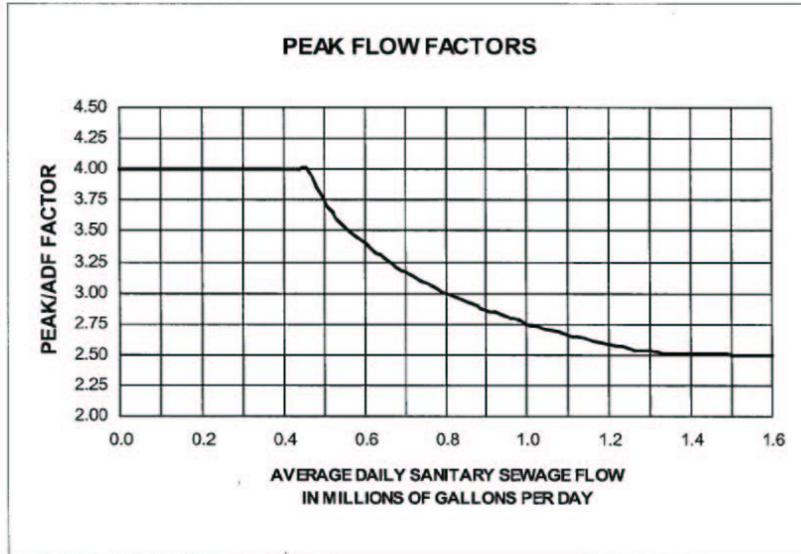


TABLE 180-1**AVERAGE DAILY WASTEWATER FLOWS
Unit Flows by land Use Category**

Land Use Category	Maximum Density (Unit/Ac)	Unit	Flow/Unit (gpd)
Residential:			
RMH	3.0	DU	300
R-4	12.0	DU	300
R-3	3.0 – 8.0	DU	300
R-2	1.7 (25,000 ft ² min.)	DU	350
R-1	1.1 (40,000 ft ² min.)	DU	350
RA, RR	0.3 (3 Ac. min.)	DU	350
A-1	0.2 (5 Ac. min)	DU	350
Office:			
OC	---	Acre*	2000
Industrial:			
M-2, HI	---	Acre	2000
M-1, LI	---	Acre	1500
Commercial:			
CC, VC, CS, SC	---	Acre	2000

* Note:

- (1) Acre refers to gross acreage
- (2) A-Agricultural; RA-Rural Area; RR-Rural Residential; RMH – Residential Mobile Home; CC-Convenience Center; VC-Village Center Commercial; CS-Commercial Services District; OC-Office District, SC-Shopping Center District; LI-Light Industry (Industrial Park); HI-Heavy Industry (Industrial District), M-Manufacturing.

Sanitary sewer design calculations and a sewer shed map will be submitted for all proposed sewer mains as part of the project plans.

180.06 Hydraulic Design Criteria:

Sewers shall have a uniform slope and straight alignment between manholes. Sewers will be designed to be free flowing with a hydraulic grade below the crown of the pipe. All sewers will be designed with slopes sufficient to provide a velocity during peak flow conditions of not less

than 2 feet per second (fps). Capacity and velocity computations for gravity sewers will be done using the Manning formula as follows:

$$v = 1.49/n R^{2/3} S^{1/2}$$

$$Q = 646,300 (1.49/n A R^{2/3} S^{1/2})$$

Where: V = Velocity (fps)
 n = Roughness coefficient
 R = Hydraulic radius
 S = Slope (feet per foot)
 A = Cross-sectional area (square ft.)
 Q = Flow rate (gpd)

A roughness coefficient (n) of 0.013 will be used for all pipe materials. All sewers will be designed so that the actual depth of flow in the pipe during peak flow conditions will not exceed 80 percent of the pipe's nominal inside diameter. Due to low flows, upper or terminal sewer runs shall have a minimum slope of 0.80 percent unless there is a distinct possibility of the sewer being extended in the near future. Sewers shall be designed such that the maximum velocity is 10 fps. Where velocities must exceed 10 fps, the sewer shall be constructed of ductile iron pipe conforming to this manual. Where smaller sewers discharge into larger sewers, the 0.80 flow line of the pipes shall be matched. The minimum size sewer main shall be 8 inches in diameter. The diameter, length, and slope of all proposed sanitary sewer runs will be shown on the profile views of the sewer on the project plans.

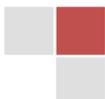
Table 180-2 shows the minimum slopes in feet per hundred feet.

Table 180-2	
MINIMUM SLOPES	
Sewer Diameter in Inches	Minimum Slope
8	0.47
12	0.26
15	0.18
18	0.14
21	0.113
24	0.088
30	0.062
36	0.048
42	0.040
*	-

* Note: For sewers larger than 42-inches in diameter, the minimum slope will be computed by the formula –

$$S = V^2/[1.49R^{2/3}/n]^2 \quad (V = 2 \text{ fps})$$

Hydraulic losses at manholes will be accounted for by providing minimum of 0.2 foot difference between the invert in and the invert out for sewer lines up to 12-inches in diameter.



At intersections and transitions of sewers larger than 12-inches in diameter, the hydraulic losses shall be computed separately and the hydraulic analysis submitted to the Town and County for approval.

180.07 Separation of Water Mains and Sanitary Sewers:

General - The following factors shall be considered in providing adequate separation:

- Compliance with VDH and DEQ requirements.
- Materials and types of joints for water and sewer lines.
- Soil conditions.
- Service branch connections into the water line and sewer lines.
- State variations in the horizontal and vertical separations.
- Offsetting of pipes around manholes.

Parallel Installation:

- Normal conditions - Sewer lines shall be laid at least 10 feet horizontally from other utilities whenever possible, the distance shall be measured edge-to-edge.
- Unusual conditions - When local conditions prevent a horizontal separation of 10 feet, the sanitary sewer line may be laid up to 7.5 feet from water lines provided that:
 - The bottom (invert) of the water main shall be at least 18 inches above the top (crown) of the sewer.
 - Where this vertical separation cannot be obtained, the sewer shall be constructed of AWWA approved water pipe, pressure tested in place to 50 psi without leakage prior to backfilling.
 - The sewer manhole shall be of watertight construction and tested in place.
- Unusual conditions - When local conditions prevent a horizontal separation of 10 feet, the sanitary sewer line may be laid up to 7.5 feet from utility lines other than water lines with the permission of the Director(s).

Crossing:

- Normal conditions - Sanitary sewer lines crossing below water lines shall be laid to provide a separation of at least 18 inches between the bottom of the water line and the top of the sewer whenever possible.
- Unusual conditions - When local conditions prevent a vertical separation described above, the following construction shall be used:

Water & Sewer Utility Standards Manual



- Sewers passing over or under water lines shall be constructed of the materials described in 130.01 and meet AWWA standards.
- Water lines passing under sewers shall, in addition, be protected by providing:
 - ◆ A vertical separation of at least 18 inches between the bottom of the sewer and the top of the water line.
 - ◆ Adequate structural support for the sewers to prevent excessive deflection of the joints and the setting on and damage to the water line. The project engineer shall evaluate each crossing on a case-by-case basis.
 - ◆ The length of the water line be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewer.
- A minimum of 12 inches will be maintained between sanitary sewer lines and utility lines other than water lines.

Sewer Manholes:

- No water pipes shall pass through or come in contact with any part of a sewer manhole.

180.08 Sewer Pipelines:

In general, sewers shall be placed along the centerline of the street or travel way. On curved streets, the sewer main shall not vary more than 10 feet on either side of the centerline, except at street intersections. Manholes will not be located in areas where water backs up in the street during a storm, such as the spread area in front of storm drainage inlets. In state road right-of-ways the location of all sewers and manholes must meet VDOT's criteria. On primary and other high volume roads, VDOT may not allow sewers or manholes to be located in the pavement. At the initial stage of design it is strongly recommended that the applicant renew with the Culpeper VDOT Residency the placement of any proposed water and sewer lines under VDOT pavement.

All other utility lines shall be a minimum horizontal distance of 10 feet, measured edge to edge, from all sewer lines and manholes whenever possible. When unusual conditions make it impossible to provide a 10 foot horizontal separation, the required horizontal separation may be reduced to as low as 7.5 feet at the discretion of the Town and County, provided that a minimum vertical separation of 18 inches can be maintained. Sanitary sewers shall be designed to run below the water system. All water lines will cross above sanitary sewers with a minimum vertical separation of 18 inches. The Town and County may require the sanitary sewer to be constructed of ductile iron pipe when the minimum separation is provided. At all utility



crossings, except for water, a minimum vertical separation of 12 inches will be maintained between the utility line and the sanitary sewer.

All crossings of streams, estuaries, lakes and reservoirs shall be constructed of Class 350 ductile iron pipe. The pipe shall exhibit no infiltration, and shall be designed, constructed and protected against anticipated hydraulic and physical, longitudinal, vertical and horizontal loads and erosion and impact. Sewers laid on piers across ravines or streams shall be allowed only when it can be demonstrated that no other practical alternative exists. Such sewers on piers will be constructed of Class 350 ductile iron pipe with mechanically restrained joints. Design information and details of the aerial crossings and piers will be included in the project plans. The design engineer shall be responsible for obtaining all required State and Federal permits (such as the Virginia Marine Resources Commission Permit) to install a surface water crossing. All aerial crossings will be designed in conformance with DIPRA recommendations. At stream crossings, the top of the sewer will be a minimum of 1 foot below the stream channel when the stream bed is rock, and 3 feet when the stream bed is an unconsolidated material. When the sanitary sewer runs parallel to a stream, the invert of the sewer will be a minimum of 3 feet below the invert of the stream channel to insure that adequate crossings can be made. The invert of the stream channel will be shown on the sanitary sewer profile.

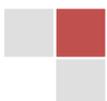
When sanitary sewer lines cross gas transmission lines the sanitary sewer will be constructed of Class 350, ductile iron pipe or the sewer line will be installed in a steel casing running the width of the gas line easement. If the sanitary sewer is constructed of ductile iron pipe, the line will be polyethylene encased in accordance with ANSI/AWWA C105. If the gas transmission main is constructed of steel pipe, the distance to the nearest anode bed will be shown on the project plans. Test pits will be dug on the gas transmission main at the proposed crossings. The test pit information will be shown on the project plans.

180.09 Manholes:

Manholes shall be constructed of precast circular manhole block, or precast concrete with cast iron frames and covers as shown on construction plans. Precast manholes shall conform to ASTM C478. All reinforcing steel shall conform to ASTM A615. Joints shall be sealed with flexible butyl resin sealant conforming to Federal Specifications SS-S-210A and AASHTO M-198. Manholes shall be provided with galvanized iron, rubber-coated steps as shown on construction plans.

The minimum inside diameter for a manhole shall be 4-feet. A larger inside diameter may be required depending on the pipe diameter and the type of connector used. The inside diameter of the manhole shall be noted on the project plans whenever the lines connecting to the manhole are greater than 12-inches in diameter. Pipes larger than 24-inches in diameter shall have specially designed manhole structures.

Manholes shall be provided at all junctions with other sewers, at all points in change in alignment, grade, or pipe size and at the terminal point of the main. All sewer lines 8-inches or



larger shall terminate with a manhole. The maximum distance between manholes shall be 400 feet.

At all collector system manholes, the difference between the influent and effluent inverts shall not be more than 12 inches. Where this difference occurs, a smooth transition between the pipes, equal in height to 0.80 of the diameter of the pipe, shall be provided. No connections shall be made where the difference in the invert elevations is between 12 and 30 inches. Where the difference in invert elevations is greater than 30 inches, drop connections conforming to the details in this manual will be used. For interceptor sewers larger than 18-inches, the difference in invert elevations may be up to 24 inches.

Manhole frames and covers shall be in accordance with the requirements shown on the plans. They shall conform to the current version of ASTM A283. The words, "Sanitary Sewer" shall be cast in the cover so as to be plainly visible. Manholes shall extend above the known level of flooding or, if this is not possible or practical, watertight manhole frames and covers shall be installed. All manholes that do not have watertight frames and covers, will be provided with a watertight manhole insert. All manholes will have a manhole chimney seal between the manhole casting, adjusting rings, and cone section to prevent inflow and infiltration into the manhole throughout a 20 year design life. On watertight gravity sewer lines manhole vents conforming to the details shown in this manual will be provided at least every 1,000 feet. Manhole tops located in open areas out of yards, roads, travel ways, and parking areas will be set a minimum of 2 feet above the surrounding finished grade unless otherwise directed by the Director(s). Under no circumstances will manholes be located in sidewalks or other pedestrian travel ways or in parking spaces.

Manhole connections shall be made to sewer lines utilizing rubber gaskets cast integrally into the pipe opening of the manhole at the time of manufacture. Rubber gasket seals shall be manufactured in accordance with Rubber Joint Specifications ASTM C4333 and shall meet performance and test requirements of ASTM C425.

Dog house manholes may be allowed over existing sewer lines. The dog house manhole shall be set on a minimum of 8-inch solid concrete block with a minimum 8-inch of 3000 psi concrete base. The manhole shall be tested prior to existing sewer line being cut out.

Manholes within 1,000 feet or the first 3 manholes downstream (whichever is the greater number of manholes) of discharge points for sanitary sewer force mains shall have interior linings to prevent corrosion. New manholes shall have protective linings applied that are approved by the Town and County. When force mains are tied into existing manholes, the interior of downstream manholes within 1,000 feet or the first 3 manholes downstream (whichever is the greater number of manholes) of the discharge shall be thoroughly cleaned and protected from corrosion by the application of a lining system approved by the Town and County. The proposed lining system will be shown on the project plans.

Manholes constructed on fill will have a false bottom extending to undisturbed ground or another approved means of preventing settlement of the manhole.



All manholes in a project will have a unique alphanumeric identifier on the project plans.

180.10 Manhole Water Tightness:

Watertight manhole frames and covers shall be provided for all manholes located outside of paved areas in areas where the frames are at or below the 25-year flood level. Watertight systems shall be vented at least every 1,000 feet.

180.11 Service Connections:

Service connections installed from the main to the property line or right-of-way shall have a minimum 4-inch inside diameter. A 4-inch sewer cleanout shall be installed just inside the property line for all anticipated service connections at the time of construction of the sewer main. The cleanout will not be located in a sidewalk, driveway or entrance. No building service connection to the public sanitary sewer will be allowed to tie into the vertical cleanout riser at the property line allowing a vertical drop to exist in the line. All clean-outs shall have a brass cap. All service connections must be connected by means of a manhole connection or a pre-manufactured tee or wye, or with an approved saddle type connection approved by the Director(s). Service connections to terminal manholes shall not exceed three in number. Service connections to in-line manholes must obtain prior approval of the Town and County. A sanitary sewer lateral table will be included in the project plans. The table will include the invert of the lateral at the main, the finished floor elevations of the proposed buildings, and the size, length, and slope of the laterals.

The lowest floor elevation of any structure to be served by gravity shall be a minimum of 4 feet above the invert elevation of its sewer service connection at the sewer main. For existing structures, connection to the public sewer with plumbing fixtures located on a floor of the structure that is not 4 feet or more above the sewer main as specified above shall not be allowed unless a written waiver is obtained from the Town and County or a pumping operation is utilized.

Sewer laterals shall not be tied directly into a trunk sewer unless specifically approved by the Director(s).

180.12 Pipeline Depth of Cover:

All sewers with a depth of cover of 18 feet or greater will be constructed of ductile iron pipe. The class of pipe used will be in accordance with Table 180-3. All sewers constructed on fill will be constructed of at least Class 350 ductile iron pipe.



TABLE 180-3

MAXIMUM DEPTH OF COVER* TYPE "4" LAYING CONDITION Cement-lined D.I.P.				CLASS I GRAVEL BEDDING PVC**
Pipe	Class 350	Class 300	Class 250	SDR-35
8	34	--	--	18
10	28	--	--	18
12	28	--	--	18
14	27	26	23	--
15	--	--	--	18
16	24	26	24	--
18	28	26	23	18
20	28	26	23	--
21	--	--	--	18
24	28	26	23	18
27	--	--	--	18
30	28	25	23	--
33	--	--	--	--
36	28	25	23	--
42	28	25	23	--
48	28	25	23	--
54	28	25	23	--
60	28	25	23	--

* All depth shown in feet

** For depths in excess of 18 feet, engineer shall provide design data.

No sewer shall be installed at depths greater than 20 feet without the written permission of the Town and County.

Normally, sewers constructed in a street or travel way will have a minimum of 5 feet of cover. Sewer lines may be installed with between 3.5 feet and 5 feet of cover, provided that the sewer is constructed of Class 350 ductile iron pipe.

Sewer constructed in open areas will have a minimum cover of 3.5 feet. Sewer lines may be installed with between 2 feet and 3.5 feet of cover provided that the sewer is constructed of Class 350 ductile iron pipe. Any time the depth of cover is less than two pipe diameter for a significant distance, calculations will be provided showing that buoyant forces will not cause floatation of the line.



180.13 Pipeline Slope:

Sewer lines at a slope of 20 percent or greater will require the approval of the Director(s) and if approved will be anchored securely as described in this manual. Structural and installation details of the anchors will be included in the project plans. The anchors will be spaced on the sewer one as shown on Table 190.1. All sewers with slopes greater than 14 percent will be constructed of ductile iron pipe.

190 DESIGN STANDARDS - SANITARY SEWERS

190.01 Pipe Materials for Sanitary Sewers:

- Structural Requirements:
 - The structural design of sewers shall conform with the methods given in the ASCE Manual Number 37 for the design and construction of sanitary and storm sewers. In the use of this manual, the backfill weight shall equal 130 pounds per cubic foot and K_u shall be 0.130. The live load for sewers subject to traffic loading shall be determined from a minimum wheel load equivalent to an H-20 loading (16,000 pound wheel load). An allowance of 50 percent of the design wheel load shall be added for impact. A minimum wheel load of 10,000 pounds per wheel shall be applied to all other sewers not subject to traffic load. Ultimate strengths of rigid pipe shall be measured in terms of ultimate three-edge bearing strength divided by a safety factor of 1.5. The allowable load shall be the working strength times a 2.5 load factor for concrete cradle or arch bedding and times a 1.9 load factor in Class B gravel bedding condition.
- Bedding:
 - Pipes up to and including 18-inches in diameter, except ductile iron, shall be bedded in compacted granular material placed on cradle or arch bedding. Pipe shall be placed on compacted granular bedding having a minimum thickness of one-fourth (0.25) of the pipe's outside diameter (4 inches minimum), and the granular bedding shall extend to a depth of 4 inches over the crown of the pipe, completely wrapping the pipe barrel. The granular material shall be gap-graded, crushed stone meeting the requirements of gradation 57, 67, or 78. Ductile iron pipe shall have a minimum of 4 inches of granular bedding. Bedding for pipe larger than 18-inches shall be designed on an individual basis and approved by the Director(s).

Sewers to be constructed on fill shall require that the finished grade be completed to the pipe invert prior to pipeline bedding preparation. Thereafter the fill material for the full trench width shall be excavated and replaced entirely with VDOT aggregate 21-A.



- Pipe Material Selection:

- The pipe materials listed hereunder have been generally approved for use in the Town and County. However, the acceptability of specific pipe materials for use shall be determined by the Town and County on an individual basis at the time of review of final project plans. This will necessitate that prospective developers/builders or their engineers contact the Town and County directly to ascertain its specific pipe material requirements. The type or types of pipe allowable for use on any specific project shall be shown on the approved project plans.

- ◆ Ductile-Iron Pipe: Conform to "Ductile-Iron Pipe Centrifugally Cast in Metal Molds or Sand-Lined Molds, For Water or Other Liquids," ANSI A21.51 (AWWA C151), Thickness Class 350, unless a higher pipe class is needed as determined by the Town and County. Use Class 350 pipe in exposed pipe installations, at stream crossings and for excessive cover where other pipe materials may be subject to crushing. Supply with "push-on" joints conforming to ANSI A21.11 (AWWA C-111). If required for special aerial pipelines, use mechanical joint systems. Conform fittings to ASTM A-21.1 0, using ductile iron with mechanical or push-on joints. Provide interior coating for pipe and fittings conforming to one of the following:

Apply minimum 0.281-inch thick lining consisting of sand and high alumina cement. Conform to AWWA C-104, except for cement used. Protect exterior spigot ends (6-inch maximum) and spigot face with 16-mil epoxy coating. Protect interior faces of bell, including gasket cavity, and all interior surfaces of fittings with like thickness of epoxy coating.

Apply minimum 40 mils (dry film thickness) Ceramic Epoxy Lining to pipe and fitting interiors. Protect gasket area and spigot ends (6 inch maximum) with 6 mils nominal, 10 mils maximum Protecto Joint Compound. Apply all materials according to manufacturers' specifications. The ceramic epoxy must be a high build multi-component Amine cured Novalac Epoxy Lining, Protecto 401 or approved substitute. Test every section of pipe and every fitting for pinholes with a nondestructive 2,500 volt test.

- ◆ PolyVinyl Chloride (PVC): PVC sewer pipe shall be manufactured in accordance with ASTM designation 3034 (SDR 35). Gravity sewer pipe shall be unplasticized polyvinyl chloride with integral rubber ring wall bell and spigot joints furnished in 12.5 feet and 20 feet nominal lengths. Installation of PVC gravity sewer pipe and fittings shall be in accordance with ASTM designation 2321 and manufacturer's recommendations. PVC



sewer pipe shall be stored in accordance with manufacturer's recommendations on flat, even surfaces and shall remain racked on the pallets as delivered to the job site until such time as the trench is ready for the placement of the pipe; i.e., PVC pipe shall not be strung out on the job site. Pipe stored for more than one year prior to installation shall be covered with an opaque covering to prevent damage by the sun.

- ◆ There will be no change in pipe material from manhole to manhole unless approved by the Director(s).

190.02 Manholes:

Manhole sections shall be precast and manufactured in accordance with ASTM C478 for most installations. Composite polymer concrete manholes manufactured in accordance with ASTM C478 and ASTM C857 shall be installed downstream of a force main as directed by the Town and County.

Each section shall have lifting lugs or keyways for the purpose of handling and setting. Joints shall be of the a-ring rubber gasket type or other jointing system approved by the Town and County. The joint design shall meet the requirements of ASTM C443. Gaskets shall meet the requirements of ASTM C361. When assembled the joint shall be uniform and watertight.

Steps for manholes shall be made of fiberglass, cast iron or steel and shall have a plastic coating.

All manholes with standard frames and covers shall be equipped with watertight manhole inserts.

Castings shall be of best quality, tough, gray iron, free from cold shuts, blow holes, and other imperfections and shall meet the requirements of ASTM A48, Class 30. The castings shall be sound, true to form and thickness, cleaned by sandblasting and neatly finished. The bearing surfaces shall be machine ground and finished to insure satisfactory seating and anti-rocking. Covers shall receive one coat of black asphaltum paint at the factory.

Standard covers shall be furnished with two pick holes. Watertight covers shall be used in easements and remote locations. Watertight frames and covers shall be anchored to the manhole.

190.03 Casings and Tunnels:

Pipe lines which must be bored or tunneled under a roadway, or other natural obstruction, shall be installed in a steel casing or tunnel. Pipe in casings and tunnels shall be constructed of a minimum of Class 350 ductile iron pipe with restrained joints. Prefabricated stainless steel pipe supports with non conductive skids or another acceptable support system will be provided to support the pipe. Pressure treated timber skids shall not be permitted. Install casings and tunnels on a slope so that they will drain. Casings will conform to the details provided in this manual. Provide complete design information for a utility tunnel in the project plans.



Where crossings are to be installed beneath a roadway, all operations and materials shall conform to the requirements of VDOT governing such crossings and the contractor shall obtain approval of all materials and methods to be employed before such work is started. A copy of such permission shall be filed with the Town and County prior to starting the work. The contractor will also be required to furnish a release from the proper authorities before final acceptance of the work by the Town and County. The contractor shall bear any expenses required by VDOT for inspection, permits, insurance, etc.

190.04 Anchors:

Sewer lines approved for slopes of 20 percent or greater shall be anchored securely with concrete anchors or other approved method. Structural and installation details of anchors shall be included in the project plans. Space anchors as shown on Table 190-1. Sewers with slopes greater than 14 percent will be constructed of ductile iron pipe.

TABLE 190-1

ANCHOR SPACING	
Percent Slope	Anchor Spacing (center to center)
20-35	36-ft.
35 – 50	24-ft.
Over 50	16-ft.

190.05 Sewer Service Connections:

The following standards shall apply to sewer service connections that are located within dedicated rights-of-way and easements. These service connections will be constructed of hub and spigot cast iron pipe (extra heavy conforming to ASTM A74), PVC sewer pipe conforming to ASTM 3034 (SDR 35) or schedule 40 PVC pipe conforming to ASTM 1785. Sewer service connections with a depth of cover of 18 feet or greater will be constructed of Class 350, ductile iron pipe to the property line. PVC SDR 35 joints shall be made with integral rubber ring wall with bonded-in-bell elastomeric seal. The schedule 40 PVC joints shall be made with a solvent weld bell and spigot joint using PVC pipe glue as supplied by the manufacturer. No solvent weld joints will be permitted within the state road right-of-way. No-hub pipe shall not be permitted.

190.06 Private Building Sewer Connections:

All building sewer connections outside of the state road right-of-way are regulated by the VUSBC.



200 DESIGN STANDARDS - LIFT STATIONS

200.01 General:

Consideration for allowing the construction of new sanitary sewer lift stations to serve new development shall only be made by the Town and County after all other options to serve the development by gravity sanitary sewer mains have been exhausted by the developer to the Town and County's satisfaction, and only possible option for such service is through the construction of a sanitary sewer lift station.

Sanitary sewer lift stations will be designed in conformance with the Commonwealth of Virginia Sewage Collection and Treatment Regulations. The developer shall submit plans and specifications for the lift station to the Town and County and shall be responsible for any modifications to the plans and specifications as required by the Town and the County. The developer shall obtain a Certificate to Construct (CTC) from Town and County prior to any construction activities. A copy of the CTC shall be provided to the Town and/or County as applicable. During construction, the Town and/or County shall conduct inspections of the project to ensure compliance with the approved plans and specifications. Upon completion of construction, the developer shall be responsible for scheduling the final inspection of the project with the Town and County. Upon approval from Town and County to operate the lift station, a Certificate to Operate (CTO) issued by the Town and County in the name of the Town of Culpeper or Culpeper County as appropriate. In addition, five copies of the Operations and Maintenance Manual approved by the Town and /or County, shall be provided, and certified pump curves. Also, a certificate of substantial completion with the approved plans and specifications, must be issued by the Town and/or County as applicable.

Upon issuance of the CTO, the developer shall deed the lift station and the property on which it is located over to the Town or County as applicable. Such deed shall include all necessary ingress/egress easements and shall be at no cost to the Town or County. At such time the deed is properly recorded, the Town or County will accept the lift station and will be responsible for its operation.

There shall be no cost to the Town or County with regard to design, construction, permitting or any other expenses related to the delivery of the fully constructed and operational lift station. The developer shall solely bare such costs up to and including deeding of the lift station (with necessary easements) to the Town or County.

200.02 Lift Stations:

Lift station sites shall be accessible by vehicle at all times. An all weather paved access road shall be provided for ingress and egress before conveyance to the Town or County and shall be a minimum of 15 feet in width. The minimum road section will consist of a compacted subgrade, 6 inches of compacted VDOT 21A stone, and 2 inches of compacted VDOT SM-2A bituminous concrete. The grade on the road will not exceed 10 percent.



Lift stations will be located above the level of the 100 year flood/wave action. The minimum lot size shall be 100 feet by 100 feet. The pumping station lot will be fenced and visually screened/landscaped. Lift station sites are to be fenced by a 6 foot high chain link fence, topped with 3 strands of barbed wire. The fenced area of the site shall be at least 70 feet by seventy 70 feet and shall be located in the center of the entire site. The fence shall have a double swing 16 foot wide gate that is lockable. Visual screening shall be provided between the fence and property line. Such screening shall consist of 1 row of evergreen trees planted 10 feet on center, and shall be a minimum distance of 10 feet from the fence. Such screening shall have a 1 year warranty by the developer.

Lift stations shall be of Smith and Loveless design unless approved by the Directors. The lift station will be designed for the peak flow from the drainage area. The peak flow for a lift station will be a minimum of 2.5 times the average daily flow unless otherwise directed by the Town or County. Pump curves, flow calculations and a drainage area map will be included in the project plans for lift stations. All lift stations will have at least two pumps. For stations with two pumps, each pump must be able to pump the design peak flow with the other pump out of service. For lift stations with more than two pumps, with any pump out of service, the remaining pumps must be able to pump the design peak flow. During the review process, the Town or County shall receive three copies of all project plans, specifications and engineering reports for the proposed lift station. The project plans will include all of the structural, electrical and mechanical design information and details necessary to construct the station. There are three types of sewage lift stations:

- **Temporary Lift Station:** A temporary lift station will be used to serve a single subdivision or commercial site. The station will be abandoned when gravity sewers reach the station. Temporary stations shall meet all of the design and construction criteria specified in this manual.
- **Interim Lift Station:** An interim lift station shall be designed to serve the portion of the sewer shed upstream of the station site. The station will be abandoned when the permanent lift station and associated interceptor sewers are constructed. Interim stations are subject to a special review process by the Town and County.
- **Permanent Lift Stations:** Permanent lift stations shall be designed and sited to serve the entire sewer shed service area. A permanent station may not be initially constructed with capacity for the entire sewer shed, but the major structures in the facility will be designed to accommodate the ultimate capacity of the station. Permanent stations are subject to a special review process by the Town and County.

The lift station wet well shall be either cast-in-place concrete or pre-cast concrete, and shall meet or exceed the minimum requirements of the Town and County. Access to the wet well shall be provided by a 30 inch by 30 inch aluminum hatch that is lockable. A stainless steel bar shall be provided inside the wet well for float switch control mounting. This bar shall be mounted to the inside top of the wet well using stainless steel hardware. The interior floor of the wet well shall



be sloped at an adequate grade to ensure all solids can be pumped from the wet well. The wet well shall include a ductile iron screened vent pipe.

The lift station building shall be either frame construction, with a full brick exterior and a pitched roof, or an aggregate pre-manufactured building approved by the Town and County. The Town and County shall determine the minimum acceptable dimensions of the building upon submittal of the draft plans and specifications. The floor of the building shall be concrete. The building shall have double swing metal doors with a minimum opening of 6 feet. The doors shall be located so as to be in line with the gated opening in the fence. The doors shall have a commercial grade lockset and shall be keyed as required by the Town or County. Six lockset keys shall be provided. The lift station building shall be located on the site in such a way as to be partially over the wet well, thereby providing suction line access to the wet well through the floor of the station. The floor penetrations to the wet well shall be sealed so as not to allow any gases from the wet well to enter the lift station building.

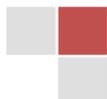
Ventilation of the lift station building shall be provided by the installation of an exhaust fan. The exhaust fan shall be wall-mounted and located on the opposite wall from a through-wall louvered intake. The exhaust fan shall be controlled by a switch that activates the exhaust fan upon opening of the exterior building door, as well as a wall switch that overrides the door switch when extended occupancy of the lift station building by personnel is required.

All electrical installation shall comply with all national, state and local building codes. The developer shall contract with the electric utility provider for service, and shall be responsible for any fees associated with providing power to the lift station. Upon the issuance of an occupancy permit, and conveyance by deed, the electric service shall be placed in the name of either the Town of Culpeper or Culpeper County as applicable. The developer shall obtain and install the appropriate meter base for the lift station. A minimum of 2 GFIC duplex outlets shall be provided inside the lift station building. All wiring from the main service panel to its termination point shall be in conduit. Separate heavy-duty 600 volt disconnect switches shall be provided to each pump motor.

A 600 volt manual transfer switch of adequate amperage rating shall be provided. The transfer switch shall have a manual throw switch handle capable of being locked in either the normal or standby power position, shall be mounted on the interior wall of the lift station building, and shall be rated NEMA 3R. A conduit shall be installed from the manual transfer switch to the outside of the building. An Appleton receptacle (#AJA20034200) shall be connected to the conduit at the outside of the building, and shall be housed in a NEMA 3R enclosure.

The lift station building shall be electrically heated so as to maintain a minimum temperature of 68 degrees F in the winter. The heater shall be controlled with an adjustable thermostat.

Interior lighting shall be provided through 2 ceiling-mounted LED light fixtures.



Exterior lighting shall be provided as follows:

- One LED light fixture mounted on the wall adjacent to one side of the exterior door. This fixture shall be controlled by a photocell.
- One LED light mounted on the exterior wall on which the Appleton receptacle is mounted. This fixture shall be controlled by a switch located inside the lift station building.
- One LED light on the exterior wall that faces the wet well. This fixture shall be controlled by a switch located inside the lift station building.

The lift station shall be new, manufactured by Smith & Loveless, Inc., and shall be the standard wet well mounted suction lift pump station (2 pumps). The lift station shall be constructed in one complete factory-built assembly.

200.03 Design Criteria:

All sewage lift stations will be designed in accordance with the following criteria:

- **Lift Stations and Pumping Units:** The manufacturer of the lift station shall guarantee for one year from the date of acceptance of the operational lift station that the structure and all equipment will be free from defects in design, material and workmanship. The manufacturer shall be solely responsible for the guarantee of the lift station and all components. In the event a component fails to perform as specified or is proven defective in service during the guarantee period, the manufacturer shall provide a replacement without cost to the Town or County.
 - **Protection Against Clogging:** All lift stations will have a vertical screen at the influent end of the station. The vertical screen will be sized for the estimated peak flow into the station. The vertical screen will be designed so as to be easily removable from the flow channel without disturbing any piping connections. Vertical screens shall be designed for continuous operation and will automatically restart after power failures. The screen shall also be equipped with a bypass mechanical bar screen and flow diverter so that the vertical screen can be taken out of service for repair and maintenance. The clear openings on the bar screen will not exceed 2.5 inches in any dimension.
 - **Pump Openings:** All pump openings and passages shall be large enough to permit the passage of a sphere 3 inches in diameter and any trash or stringy material which can pass through a 4-inch house collection system. All pumps will have cleanout ports.
- **Lighting:** Adequate LED lighting will be provided throughout the station. All lighting fixtures shall be rated for the environment in which they will be installed. All lighting located in a wet well shall be explosion proof, corrosion resistant and shall be



mounted with stainless steel hardware. All lighting located in a wet well shall be serviceable from the catwalk. All lighting located in a dry well shall be vapor proof, corrosion resistant, and shall be mounted with stainless steel hardware. All exterior photoelectric switches shall be intrinsic.

- Ventilation: Ventilation shall be provided for all lift stations during all periods when the station is manned. Where the pumps are below ground, mechanical ventilation is required and shall be arranged so as to independently ventilate all of the wells and/or vaults at the station. No damper shall be used on the exhaust or fresh air ducts, and there will not be any fine screens or other obstructions in the ducts that may cause clogging. The switches for the operation of the ventilation equipment shall be well marked and located above grade near the entrance hatches. The lighting and ventilation switches on all wet wells shall be interlocking. If three phase service is available the exhaust fans motors shall be three phase motors. Time clock switches will be provided to allow a programmed run time of the exhaust fans. There will be no interconnection between the ventilation systems in the wet well and dry well.
 - Wet Wells: Ventilation may be either continuous or intermittent. Ventilation, if continuous, shall provide at least 12 complete air changes per hour; if intermittent, at least 30 complete air changes per hour. All wet well electrical equipment and devices shall be explosion proof. Wet well ventilation fans and ducts shall be constructed of either stainless steel or fiberglass.
 - Dry Wells: Ventilation may be either continuous or intermittent. Ventilation, if continuous, shall provide at least 6 complete air changes per hour; if intermittent, at least 30 complete air changes per hour.
- Water Supply: Wherever possible, a 3/4 inch public water service line supplied by a 5/8 inch meter will be extended to the lift station for wash down and cleanup operations. A non-freeze yard hydrant will be installed at the station.
- Structures: Access hatches will be located in the station so as to facilitate the removal of the pumps, motors and other equipment in the station without disrupting the operation of the facility. All hatches will be aluminum with stainless steel hardware. All hatches will have locking hasps and automatic hold-open arms. A fixed or portable hoist suitable for removing the pumps, and other equipment will be provided at the station. If a portable hoist is provided, wall sockets will be installed at the pump well. The valve vault, and flow meter vault will have floor drains. The floor drain will have a "P" trap and will discharge into the wet well. The floor drain shall be installed with a check valve or flapper valve to prevent sewage from entering the structures if the wet well floods.
 - Wet Wells: The wet wells at major lift stations (1.0 mgd or larger) will be divided into two interconnected sections to facilitate repairs and cleaning. The



effective capacity of the wet well will be such that one pump will run continuously at least 5 minutes of every 30 minute period at the minimum flow. The wet well fillets shall have a minimum slope of one-to-one to the hopper bottom. The hopper bottom shall be no larger than necessary for the proper installation and function of the inlet.

- All wet wells shall have a lining system to prevent corrosion. The wet well size and control settings shall be designed to avoid heat buildup in the pump motor due to frequent starting and to avoid septic conditions due to excessive detention times. A visual gauge of the wet well level shall be provided.
- Generator and Control Building: The requirement for housing the stand by generator shall be reviewed and required by the Director(s) on a case-by-case basis. If required, the generator and control building for interim and permanent lift stations will be designed. The building shall be sized to accommodate all of the proposed equipment and to provide adequate space for personnel to operate and repair the equipment in the building with the access doors closed. A thermostatically controlled heater and exhaust fan sized for the building will be provided in the generator and control building. The exhaust fans shall be adequately sized to cool the heat generating equipment located in the building. The thermostats controlling all HVAC equipment shall be located in an easily accessible area. The fuel storage tank for the emergency generator shall be within the secure perimeter of the site and have the volume to contain sufficient fuel for 72 hours of continuous operation. Access to the fuel lines shall be locked. Prefabricated buildings shall be an "Easi-Set Building" as manufactured by the Smith-Midland Corporation or an acceptable substitute approved by the Town and County.
- Reliability: All lift stations will be reliability Class I. Electric power shall be provided to the station by distribution lines and by an emergency generator. Both power sources shall be sufficient to operate the pumps, critical lighting and ventilation systems during peak flow conditions.

The distribution lines and the generator shall have a means of being disconnected before the generator switch gear. The generator will automatically switch on-line in the event of a power failure. The generator switch gear will be fully automatic with the ability to sense a single phase power condition and switch to the generator power system with a minimum time delay. Both power sources shall be protected by fuses or breakers prior to the transfer switch. The transfer switch shall be capable of being operated manually.

- Lift Station Power System Design: The station's power supply shall be protected from lightning. A final stepdown transformer shall be provided on each electric feed line with adequate physical separation between them to prevent a common mode failure. Separate buses shall be provided for each power source. The electric transmission line and the emergency generator will remain separate and form separate distribution



substations up to the internal bus system transfer switch to preclude a common mode failure of both sources. Breaker settings or fuse ratings shall be coordinated to effect sequential tripping such that the breaker or fuse nearest the fault will clear the fault prior to activation of other breakers or fuses to the degree practical. All lighting transformers shall be pad mounted. The load distribution panel shall not be an internal part of the transformer.

- **Equipment Location:** All electrical switch gear, controls, and the emergency generator will be located in a building. Any equipment remotely located from the distribution panel shall have a lockable service disconnect on the line side. Adequate ventilation will be provided for the operation of the emergency generator. All louvers for the ventilation of the generator shall automatically open when the generator is operating and automatically close when the generator ceases operation. Fuel for the generator will be stored in a skid mounted tank. Skid mounted tanks shall be double-walled for leak containment and shall meet all DEQ and EPA regulations. The fuel tank will be sized to hold adequate fuel to run the generator for 72 hours. A fuel storage level indicator will be provided in the generator and control building. The generator will be equipped with a block coolant heater. The generator will be equipped with an alarm indicator to display the cause of a generator failure. The means for starting an emergency generator shall be completely independent of the normal electric power source. The starting system shall be sufficient to start the generator a minimum of three times without recharging. The starting system shall be alarmed and instrumented to indicate loss of readiness.

All motors and control enclosures will be adequately protected from moisture from the weather and water under pressure. Indoor motors will be of a splash resistant design.

All equipment shall be installed in accordance with the manufacturer's recommendations. When laying out the location of the equipment in the control and generator building the engineer will consider the necessary separation between devices to provide adequate ventilation, the location of door, hatches and panel covers to avoid conflicts between these items when they are opened and closed, and provisions for housekeeping pads to keep equipment off of the floor. Any equipment located outside of the generator and control building will be located in a moisture proof, NEMA 4x enclosure constructed of noncorrosive materials.

- **Equipment Type:**
 - The electrical equipment in the generator and control building, wet well, dry well and the valve vault will comply with the appropriate requirements of the National Electric Code. No aluminum bus bars, wire, connectors or lugs shall be allowed.



- Three phase motors and their starters will be protected from electric overload and short circuits on all three phases.
- All motors will have a low voltage protection device which will cause and maintain the interruption of power to the motor upon the reduction or failure of voltage.
- Temperature detectors shall be provided in the stators and bearings of larger motors 100 hp and larger to indicate overheating problems.
- All wires installed in underground conduits will have moisture resistant insulation as identified in the National Electric Code. All wiring installed in raceways shall be THHN stranded wire. Electrical cables shall be type SO with sunlight & ultraviolet protection. All 4 - 20 MADC signal cables shall have shielding properly terminated on one end of the cable run.
- Concrete, metals, control and operating equipment, and safety devices will be constructed of corrosion resistant materials.
- Electrical power devices or equipment used to convert single phase power to three-phase power will be dedicated to a single specific motor.
- All surface mounted electrical device boxes and small junction boxes subjected to moisture shall be Crouse Hinds cast device boxes constructed of noncorrosive materials. All boxes shall have mounting lugs. Drilling mounting holes in the back of the box shall be unacceptable. Gasketed covers with stainless steel screws be provided for all boxes. The covers will be from the same manufacturer as the boxes. All boxes will be mounted with stainless steel hardware. Moisture proof bell boxes are not acceptable.
- Any cable subjected to stress or strain shall be equipped with a stainless steel wire mesh strain relief fitting properly sized for the cable. All cables shall be routed and installed so as to be protected from stress, crush and abrasion hazards.
- Generators shall be manufactured by Kohler, Caterpillar or approved equal. The generator switch gear shall be provided by the same manufacturer as the generator. All electrical distribution equipment shall be manufactured by Cutler Hammer or approved equal. The motor starters shall be Citation Series. Electrical equipment shall be protected by a Solid State Advanced Control Phase Monitor, model RLM 911 (480 volt) or model RLM 611 (240 volt). Monitoring



device shall be provided to monitor over and under voltage and shut down generator if either condition occurs, prior to damaging equipment being provided power.

- All electrical enclosures located indoors, except in wet wells, and above grade shall be NEMA 4. All enclosures located below grade and outdoors shall be NEMA 4X. Electrical enclosures located in the wet well shall be explosion proof and corrosion resistant. All pulling devices and junction boxes in the wet well shall be PVC coated.
 - Wiring conduit shall be PVC conduit no smaller than 3/4 of an inch in diameter except for conduits located in the wet well. Conduits shall be sized to facilitate wiring for the ultimate design conditions. All conduit straps used in the wet well will be PVC coated. All other conduit straps shall be corrosion resistant. Fasteners used outdoors and below grade shall be stainless steel. Channels used to mount electrical equipment or conduits shall be aluminum or other material approved by the Town and County.
 - All foreign sources of electrical power entering a control cabinet or motor control cabinet shall be identified and a means of disconnecting the power shall be provided.
- Alarm Systems: All lift stations will be monitored by the Town and County's Supervisory Control and Data Acquisition (SCADA) systems. The SCADA systems will be installed by the Town and County. The cost of the SCADA system equipment and installation will be reimbursed to the Town and County by the developer. Dry, normally open contacts will be provided for all status and alarm circuits. This will include pump run/fail, generator run/fail, high wet well, AC power status, generator starting system loss of charge and pump overload. A description of SCADA status and alarm circuits is listed below. Both an audible and visual alarms will be provided at the lift station. A press-to-test circuit will be installed for all of the control and alarm panel indicator lights. High wet well, generator fail and power fail alarms shall function upon complete loss of power. All alarms shall clear after events return to normal (no latching alarms to SCADA).
 - Instructions and Equipment: One WORD and one PDF copy of the approved Operations and Maintenance Manual will be supplied to the Town and County prior to completion of the station. The Operations and Maintenance Manual will be reviewed and approved by the Department of Environmental Quality and the Town and County. The Operations and Maintenance Manual will contain a reduced set of the lift station plans, including as-built electrical and control schematics. All necessary tools and spare parts will be supplied with the station. In addition, copies of all equipment manuals and warranties will be provided.



- **Access and Security:** A 15 foot wide, paved access road within a 50 foot right-of-way will be provided to the lift station. The minimum road section will consist of a compacted subgrade, 6 inches of compacted VDOT 21A stone, and 2 inches of compacted VDOT SM-2A bituminous concrete. The grade on the road will not exceed 10 percent. Unrestricted ingress and egress will be granted to the Town and County from a public right-of-way to the lift station. On long access roads a locking gate will be provided at the entrance to the access road from the public right-of-way.

An unrestricted, all weather access road to the station will be maintained by the developer until the permanent access road is complete and accepted by the Town and County. The Town and County shall have access to the station at all times.

A 6 foot high, chain link security fence topped with 3 strands of barbed wire will be provided around the lift station lot. Access into the station will be through a double swing 16 foot wide, lockable gate. All door locks and padlocks in the station will be keyed to the Town and County's standard keys.

Adequate provisions will be made for parking and turning vehicles around at the station.

Visual screening shall be provided between the fence and the property line. Such screening shall consist of 1 row of evergreen trees planted 10 feet on center and shall be a minimum of 10 feet from the fence. Such screening shall have a 1 year warranty by the developer.

- **Spare Parts & Special Tools:** The Town and County shall be provided with sufficient spare parts for all major equipment. A specific spare parts list will be generated by the Town and County after the review of the equipment submittals for the lift station. Special tools may be required for a given station that uses special (non-standard) equipment. Special tools shall be specified during the review of the lift station plans by the Town and County.
- **Odor Control:** The engineer will evaluate the need for odor control measures for each lift station design on a case-by-case basis, subject to approval by the Director(s). The required odor control measures used at a station will be determined during the review of the plans for the station.
- **Sump Pumps:** In installations where sump pumps are required, the sump pumps shall have a minimum discharge rate of 40 gpm. Sump pumps shall be a Myers, Series WHRH pumps or an acceptable substitute approved by the Town and County.
- **Protective Coatings:** The project specifications will specify a paint or other protective coating for all corrodible materials not otherwise protected. The type, color and



thickness of the paint or other protective coating is subject to the approval of the Town and County.

200.04 Force Mains:

The minimum force main size will be 4-inches except for grinder pump systems. The flow velocity in the force main shall not be less than 2 fps nor more than 8 fps. Air release valves, conforming to the details shown in this manual, will be provided at the high points in the force main. Blow-off pits will be installed as directed by the Town and County at low points in the force main. Force mains will be adequately anchored within the lift station and throughout the line. The number of bends in the force main will be minimized. Restrained joints will be provided at all bends and other required locations. A resilient seat wedge valve shall be provided on the force main just outside of the flow meter vault.

The force main shall enter the receiving manhole at no more than 1 foot above the flow line of the manhole. The force main shall enter the receiving manhole with its centerline horizontal. The receiving manhole will have a lining system as specified in Section 180.09 of this Volume.

All force mains will be constructed of pressure type pipe with pressure type joints. All force mains will be constructed of ductile iron pipe unless otherwise approved by the Director(s). Class 52, ductile iron pipe will be used for force mains 12-inches in diameter and smaller. Force mains larger than 12-inches in diameter will be constructed of Class 51 ductile iron pipe. The interior coating of ductile iron pipes shall conform to the standards of this manual. All bends and fittings shall be pressure rated and will meet all applicable AWWA Standards. A No. 12 solid copper tracer wire or other locating system will be installed with all non-metallic force mains.

The force main will be tested at a minimum pressure of at least 50 percent above the design operating pressure for at least 30 minutes. Leakage will not exceed the criteria of AWWA Standard C-600.

Pipe bedding will conform to the standards of this manual or the pipe manufacturer's recommendations, whichever is more stringent.

210 SANITARY SEWER CONSTRUCTION

210.01 General:

Construction of sanitary sewers and appurtenances within the Town and County respective service areas shall be in accordance with plans and specifications approved by the Town and County. Prior to the construction of an approved sanitary sewer, the engineer shall place adequate line and grade stakes identifying the sewer, sanitary sewer cleanouts located at the property line and other appurtenances to insure the system can be constructed in accordance with the approved plans. The engineer shall then prepare legible cut sheets at 100 foot stations. Cut sheets will contain all data pertinent to the construction of the sewer main, the station and length of service connections, the location of all concrete encasements or cradles and the finished grade



of all manhole rims. Five sets of all cut sheets shall be submitted to the Town and County for review and approval.

If a deviation from the approved plans in the horizontal location or grade of any sewer, structure or appurtenance is necessary, a revision to the approved plans showing the proposed deviation must be submitted to the Town and County for review and approval before the changes are constructed.

210.02 Construction Standards:

Construction of sanitary sewers and appurtenances within the Town and County service areas shall conform to the Department of Environmental Quality, “Sewage Collection and Treatment Regulations”, and plans and specifications approved by the Town and/or County.

- **Handling of Materials:**
Load and unload pipe, fittings, valves, and accessories by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall such material be dropped. Handle pipe such that the coating and lining shall not be damaged. The Town and County have the authority to reject any and all materials found damaged.
- **Line and Grade Stakes:**
Prior to the construction of an approved sanitary sewer, the engineer shall place adequate line and grade stakes identifying the sewer main, sewer laterals, and other appurtenances to insure the system can be constructed in accordance with the approved plans.
- **Service Connections:**
Proposed service connections to in-line manholes must be approved by the company providing service.
- **Water Crossings:**
The water crossings shall be tested in place, and shall exhibit no infiltration or exfiltration. Pipes and joints shall be constructed so as to be protected against anticipated hydraulic and physical impact, longitudinal, vertical and horizontal loads and erosion impact. Construction methods and materials of construction shall be such that sewers shall remain watertight and free from change in alignment or grade.
- **Inspections:**
All sanitary sewers, including manholes, shall be inspected prior to acceptance testing, and any water leakage into the system sufficient to constitute any noticeable trickle or dribble shall be corrected and eliminated prior to undertaking the acceptance test.
- **Cut Sheets:**



- The engineer shall prepare legible cut sheets at 100-foot stations. Cut sheets will contain all data pertinent to the construction of the sewer main, the station and length of service connections, the location of all concrete encasements or cradles and the finished grade of all manhole rims.
- Five (5) sets of cut sheets, certified by a Professional Engineer or surveyor shall be submitted to the Town and County for review and approval. The engineer or surveyor who certifies the cut sheets shall also provide the following statement on all sets: “The professional seal and signature appearing on this document certifies that information shown conforms to the approved plan and/or actual field conditions.” If a deviation from the approved plans in the horizontal location or grade of any main, structure or appurtenance is necessary; a revision to the approved plans showing the proposed deviation must be submitted to the Town and County for review and approval before the changes are constructed.

210.03 Erosion and Sediment Control:

The Virginia Erosion and Sediment Control Handbook, this USM, and Code of the Town of Culpeper Chapter 7, land disturbing activities, shall be the accepted references in the preparation of grading plans and erosion and sediment control proposals and measures. The erosion and sediment control plan shall provide for two phase erosion and sediment measures. The first phase shall reflect the perimeter controls and any interior controls necessary to protect undisturbed land areas and shall reflect existing conditions including drainage divides. Existing drainage divides shall be the basis to determine the use of sediment traps versus sediment basins. The second phase shall reflect specific controls once the sewer pipes are installed.

Erosion and sediment control measure generalities:

- All applicable erosion and sediment control measures shall be installed prior to the beginning of construction.
- The contractor/developer shall provide all materials for required erosion and sediment control.
- No more than 500 feet of trench shall be open at any one time.
- Any disturbed area, not paved, sodded or built upon by November 15, is to be seeded on that date with oats, Abruzzi rye or equivalent and mulched with hay or straw.
- Synthetic filter fabric fencing shall be used for sediment control when the utility line or land disturbing activities are within 25 feet of a live creek or stream.
- No excavated material shall be placed in streambeds.



- The contractor/developer shall inspect all erosion and sediment control devices at the close of each work day and after each weather event. Make any necessary repairs or cleanup to maintain the effectiveness of the device immediately.
- The contractor/developer shall protect graded areas from the action of the elements. Settlement or other damage that occurs prior to acceptance of the work shall be repaired and grades satisfactorily reestablished.
- Upon completion of construction work and after spoil and debris have been removed, the contractor/developer shall re-grade any areas disturbed by operations.
- No disturbed area shall remain denuded for more than 30 calendar days after the completion of utility installation. Those areas which were used for access to or from the actual construction site may remain in a denuded form if erosion control is properly provided. There shall be no erosion runoff traversing across or out of the existing easement provided to the contractor/developer.
- All disturbed areas, not in the streets and not used for access to or from the continuing job, are to be permanently seeded and mulched within 15 days of reaching final grade between March 15 and October 15. Those areas which are used for access during construction shall be permanently seeded and mulched within 30 calendar days of completion of the job or within 15 days after the use of the access area is no longer required. When final grades are reached between October 16 and March 14, disturbed areas shall be temporarily mulched as outlined previously. Permanent seeding and mulching shall then occur during the proper season.

Mulching:

If permanent stabilization of a disturbed area cannot be completed for any reason, the contractor/developer shall apply mulch asphalt emulsion, jute matting or similar materials for temporary protection. Areas brought to final grade during an off-season shall be mulched immediately and overseeded during the proper season with permanent grass land legume species. The mulch shall be properly anchored to prevent dislodging.

Temporary Sediment Barriers:

- The contractor/developer shall provide silt fence barriers across or at the toe of slopes to intercept and detain sediment. The location of all silt fences shall be shown on the construction plans.
- The contractor/developer shall place securely tied down hay or straw bales, having a dry weight of not less than 50 pounds, in a single row, lengthwise in ditch lines as shown on the construction plans.



- The contractor/developer shall securely anchor bales in place using Number 3 steel reinforcing bars, steel pickets or 2-inch by 2-inch wooden stakes driven 1.5 feet into the ground and extending 4-inches above the bale. Wire ties running lengthwise between anchors to secure bales shall be used.

Removal:

The contractor/developer shall remove all temporary erosion and sediment control devices after the work has been completed and restore the site as required by the Town and County.

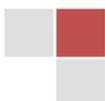
210.04 Excavation:

Excavation shall conform to the lines and grades shown on the approved project plans and cut sheets. The slope of the sides of the excavation shall be kept as nearly vertical as possible consistent with the types of materials encountered. Where required to maintain safe working conditions, trench walls will be sloped or benched. Maintain a clear area a sufficient distance back from the top edge of the excavation to avoid overloading which may cause slides, cave-ins or shifting of the pipe. The contractor shall provide sheeting, bracing and shoring necessary to perform the work, and protect existing structures and excavations in accordance with the Virginia OSHA Regulations. The width of the trench from the foundation to 12 inches above the pipe shall not exceed the maximum width as shown in Table 210-1.

**TABLE 210-1
MAXIMUM TRENCH WIDTH**

Nominal Pipe Diameter (in.)	8	10	12	14	15	16	18	20	21
Max Trench Width (in.)	42	42	42	42	42	42	44	44	48
Nominal Pipe Diameter (in.)	24	27	30	33	36	42	48	54	
Max Trench Width (in.)	51	55	60	63	69	78	87	96	

The bottom of the trench shall be accurately graded to provide a uniform bearing and support for each section of pipe on undisturbed soil along the entire length of the pipe, except where it is necessary to excavate for bell holes and for the proper sealing of pipe, except where it is necessary to excavate for bell holes and for the proper sealing of pipe joints. Bell holes and depressions for joints shall be only of such length, depth, and width as required to make a proper joint. Bell holes and depressions for joints shall be backfilled with granular material and compacted. Do not carry excavation below the established grades unless unsuitable materials incapable of supporting the pipe are encountered. Wherever the soils encountered at the trench bottom are incapable of adequately supporting the pipe, the trench shall be over excavated until a stable foundation is reached. Fill the over excavation with a granular material having a maximum particle size of 1-inch, place in 6 inch lifts and compact until the trench bottom is brought to grade.



Remove and properly dispose of all water entering the trench excavation. Dewatering equipment shall be sized to maintain the trench in a satisfactory condition for pipe laying. Pipe laying will be permitted only where the depth of water is maintained below the invert of the pipe joint. Dispose of water in a suitable manner without damage to adjacent property or in a manner protective of public health and convenience.

Do not open more than 150 feet of trench in advance of completed pipe laying. Excavation at manholes and similar structures shall be sufficient to have a minimum of 12 inches of clear area between their outer surface and the embankment or sheeting.

210.05 Blasting:

Blasting, where required shall be done with great care and in accordance with all applicable Federal, State and local laws, ordinances, and regulations. The contractor/developer shall be responsible for obtaining all required permits and bonds prior to blasting. Permits must be on site and available for review upon request by the Town and County. Any damages to foundations, structures, facilities, pipelines, utility conduits or any other damages attributed to the use of explosives shall be corrected at the contractor/developer's expense. The contractor/developer shall provide the owners of adjacent buildings, structures and properties, in writing, a description of the blasting and seismic operations, prior to blasting.

When explosives are used, work shall be executed by persons who are properly licensed to use explosives. Each blast shall be covered with rubber tire or steel mats. Blasting is not permitted within 24 feet of utilities, facilities or structures. Blasting closer than 24 feet must be pre-approved by the Town and County providing the project engineer can demonstrate that the safety or soundness of existing facilities are not in any manner endangered. Blasting shall not occur within 300 feet of any radio transmitter or radio frequency emission equipment. The magazine keeper shall maintain accurate records and inventory for all explosives, detonators and equipment from time of delivery, until used or removed from the site. The contractor/developer shall provide the required security for the site.

210.06 Backfill:

Backfill in areas subject to vehicular traffic or structural loading shall begin at the top of the granular bedding and placed in lifts no greater than 8 inches thick. Compact each lift to 95 percent of the maximum dry density as determined by ASTM D698, AASHTO T99 or VTM-1. Backfill material shall be free of organic materials, frozen clods, highly plastic silts or clays and other unsuitable materials. Rock pieces larger than 1 inch in any dimension shall not be used in the backfill which is within 2 feet of the pipe. Stone or rock larger than 5 inches in any dimension shall not be used in the backfill for sewers or structures.

Backfill in areas not subject to vehicular traffic shall be compacted to 90 percent of the maximum dry density as determined by ASTM 0698, AASHTO T99 or VTM-1. Backfill within existing or proposed rights-of-way that will be accepted into the VDOT system shall be



accomplished in full conformance with all applicable VDOT standards. Dispose of surplus materials in approved areas.

210.07 Pipe Installation:

All sanitary sewer systems under construction shall be plugged as directed by the Town and County on the downstream end until placed in service. No inflatable plugs shall be used for this purpose. Pipe and fittings shall be carefully handled with slings or other devices to prevent damage to protective coatings or joints. Lifting equipment shall be satisfactorily rated to handle the pipe sizes used. Each section of pipe shall be thoroughly inspected for defects before being lowered into the trench. Lay pipe true to line and grade with bells upstream and joint such that the completed pipe will have a smooth invert. Shape bedding to the curvature of both the bell and barrel of the pipe. Keep trench free of water while the work is in progress. Brush the ends of the pipe so that proper joints can be made. As the work progresses, the interior of the pipe shall be cleared of dirt, cement, or other superfluous material. Close the exposed end of pipe and fittings to prevent earth, water or other substances from entering the pipe. During freezing or inclement conditions trench shall be completely backfilled at the end of the day.

210.08 Service Connections:

Extra heavy cast iron soil pipe, SDR 35, and schedule 40 PVC pipe connections to sewers shall be made by means of a commercially manufactured tee, wye branch or approved saddle.

Four-inch sewer clean outs shall be installed at the property line or edge of right-of-way for all service lines. All clean-outs shall have brass caps.

Clean-outs to be installed within areas of possible traffic loading shall have a cast iron (C.I.) sanitary tee, C.I. riser and brass cap.

Saddles used for making the sewer service connection to sewers shall be of the strap-on type with an O-Ring seal and stainless steel strap. Saddles shall be specifically designed to adapt to the type of pipe used.

Secure the saddle to pipe with a 24 gauge by 2.5 inch wide stainless steel strap and silicon bronze or stainless steel T-bolts and nuts. When a saddle is installed on an existing line, it shall be subjected to a 10 foot hydrostatic head (4.3 psi) prior to cutting sewers with a tapping machine.

Sewer service connections shall be plugged with a pipe stopper manufactured for such service. The stopper shall be capable of sustaining, without failure or leakage, an internal pressure head of 10 feet (4.3 psi).

Private Service Connections: Building sewer connections from the property line to the building, except when within a dedicated easement, shall be installed in accordance with VUSBC.



210.09 Manholes:

Sanitary sewer manholes shall consist of precast reinforced concrete sections, an eccentric conical section, and an expanded base section that conform to the details shown in this manual. Manholes shall conform to ASTM-C478 standard. The precast base section shall be installed on a compacted granular foundation prepared similarly to that required for the proper installation of the sanitary sewer.

Manholes shall have lifting lugs or keyways. No lifting holes through the manhole wall are permitted. Joints shall be formed entirely of concrete employing a round rubber gasket, and when assembled, shall be self-centering and make a uniform watertight joint. In addition to the O-Ring gasket, a cold applied joint sealer may also be used to assist in sealing the joint from either internal or external hydrostatic pressure. Other joint systems acceptable to the Town and County may be used. The joint design shall meet the requirements of ASTM C443 and the gaskets shall meet ASTM C-361. No mortar joints will be permitted. The exterior of all precast manhole sections shall have a waterproof coating.

The invert channels of the manhole shall be smooth and semi-circular in shape, conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in the size and grade of the channels shall be made gradually. The invert channels shall be brought to grade and formed with brick and mortar. The bench of the manhole outside of the channels shall be an even float finish and shall slope toward the channels with a minimum slope of one-quarter (0.25) of an inch per foot of run. The invert channel depth will be at least 0.8 times the diameter of the pipe for lines 8 to 12 inches in diameter. The minimum difference in the elevation of the inverts of incoming and outgoing pipes shall be 0.2 feet.

Standard manhole drop connections shall be installed where indicated on the project plans. Drop connections shall conform to the details shown in this manual. The drop pipe and fitting shall be the same type and specification as the sanitary sewer. Encase exterior drop connections entirely with Class A3 concrete. All manholes with an inside drop will have a minimum inside diameter of 5 feet.

Manholes shall be constructed with manhole frames, covers and steps. Adjusting rings may be used to bring the top of the manhole to the final grade when this cannot be accomplished with standard precast sections, upon approval of the Director(s). Adjusting rings shall not be permitted to adjust the grade more than 12 inches. Adjustments larger than 12 inches will be made with the riser sections. Manholes shall have an internal or external manhole chimney seal between the manhole frame, adjusting rings and cone section. The frames and covers shall be of the type and duty shown on the project plans.



210.10 Pipe Connections at Manholes:

Manholes shall be supplied with an approved, flexible pipe connection suitable for the pipes and manholes specified. Flexible gaskets for pipe connections to manholes shall be made with a flexible rubber manhole sleeve with a flanged waterstop cast into the manhole base by the manufacturer or other flexible connectors acceptable to the Town and County. Flexible gasket for pipe connections shall meet the requirements of ASTM C-923. The sleeve shall be secured to the pipe by means of a stainless steel clamp.

Precast manholes shall be manufactured for the specified number and proper location of connections required. Manholes with extra connections or openings which must be bricked up, or otherwise changed in configuration, are not acceptable. Connections to existing manholes, when approved by the Town and County, shall be made by coring the manhole and installing a rubber boot.

210.11 Acceptance Tests:

Sewers will be inspected to determine if any deviation from line and grade has occurred. Sanitary sewer mains will be inspected by Closed Circuit Television camera (CCTV) or the pipe alignment will be checked by illuminating the interior of the pipe. The inspection will be performed by the Town and/or County Field Inspector(s). Any deficiencies, such as: Sags (bellies) in the pipe, rolled joints, leaks, damaged pipe or out of round pipe shall be corrected before acceptance by the Town and County.

An acceptance test is required for all sanitary sewer mains and manholes. The preferred method of testing for mains is air and vacuum testing for manholes. When testing with air, test methods and acceptability criteria shall be in accordance with ASTM-F1417. Vacuum testing methods and acceptability criteria shall be in accordance with ASTM-C1244; with the exception that vacuum testing shall be done after backfill has been placed around structure.

An acceptance test shall be specified for all sanitary sewer mains and manholes. The test may be either a water test or air test. Where water testing is specified (exfiltration), the leakage outward shall not exceed 50 gallons per inch of nominal pipe diameter per mile per day (2400 gpd/mi maximum) for any section of the system including manholes. Where the exfiltration test is employed, a minimum of 4 feet of head at any point in the line and a maximum head of not more than 10 feet shall be used. Where air testing is specified, test methods and acceptability criteria shall be in accordance with ASTM F 1417. Air testing of sewer lines shall generally be acceptable for all types of pipe materials.

If air testing is employed, manholes shall be tested by exfiltration or vacuum test. Use inflatable stoppers to plug all lines into and out of the manhole being tested. The stoppers shall be positioned in the lines far enough from the manhole to insure testing to those portions of the lines not air tested. The manhole shall then be filled to the top with water. A 24 hour soak shall be allowed. Leakage shall not exceed 0.25 gallon per hour for a four hour test period.



The contractors shall furnish weirs, standpipes, pipe plugs, water, pressure gauges, stop watches, air compressor, hose and such materials and assistance as required to perform these tests. All acceptance tests shall be conducted by the contractor in the presence of the Town and/or County. Acceptance tests shall not be made until the sanitary sewer, manholes and required sewer service connections, as shown on the approved project plans, have been installed; sewer trenches backfilled and compacted to finished sub-grade.

Sanitary sewer lines, structures, facilities or appurtenances not meeting the requirements of these standards shall be replaced or repaired in a manner approved by the Town and County. Defective materials, pipe or fittings shall be completely removed and replaced with new materials. Evidence of excessive leakage, unsatisfactory alignment or poor workmanship shall be justification for the Town and County to require complete removal of the entire line between manholes and reconstruction in accordance with the plans and specifications and the standards of this manual.

Whenever it has been necessary to construct underdrains or place gravel under pipelines in order to dewater the trench during construction of the sewers, the acceptance test will not be made until pumps (which have been used in the dewatering process) have been disconnected.

Schedule all acceptance tests with the Town and/or County at least 48 hours in advance. Each section of completed sewer shall be tested. Generally, sewers will be tested from manhole to manhole. The test procedure shall be conducted in the following manner:

1. Low Pressure Air Testing Procedure:

a. Equipment:

- (1) Plugs: Use either mechanical or pneumatic plugs designed to resist internal test pressures without the aid of external bracing or blocking. If pneumatic plugs are used, provide separate, dedicated hoses to inflate from the aboveground control panel.
- (2) Controls: Employ aboveground air control equipment that includes a shut-off valve, pressure regulating valve, pressure relief valve, input pressure gauge and a continuous monitoring pressure gauge with a range of 0 to 10 psi. Using monitoring gauge with a face diameter of 4-inches, minimum divisions of 0.10 psi and an accuracy of 0.25 percent of full scale. Conduct all air used through the aboveground control equipment.
- (3) Supply and pressure hoses: Use separate hoses to 1) introduce low-pressure air into the test sections and 2) for continuous monitoring of pressure build-up in the test section.

b. Safety: Notwithstanding the testing of plugs described in Paragraph 4, brace every test plug against the manhole wall to further insure no movement during the



test. Do not pressurize test sections above 9 psi except for leak location equipment where the plugs are securely tied together. Allow no one into a manhole adjoining a line being tested until test pressures have been totally relieved.

- c. Line Preparation: Make certain all service laterals, stubs and fittings in the test section have been properly capped or plugged to eliminate any air loss that could produce erroneous test results. Restrain all closures to prevent a blow-off during testing.

Wet the interior surfaces of porous pipe materials to reduce air loss during testing.

- d. Installation of Test Plugs: Seal test the plugs before installation in the pipeline by installing them in the ends of a section of the pipe above-ground and pressurizing the section to 9 psi. No one is allowed along the alignment of the pipe during this procedure until the test pressure has been totally relieved. Plugs shall hold against this pressure without bracing and without any movement out of the pipe.

When placing plug in pipe, inspect visually to determine any possible shear failure at the interface with the manhole wall which may be covered by the plug and not revealed by the air test. Repair any defects so discovered before proceeding.

- e. Line Pressurization: Introduce air into the sealed line until the internal pressure is 4 psi greater than the average back pressure of any groundwater above the pipe, as determined in Section i, Determining Groundwater Impact, but not greater than 9 psi. If no groundwater is present, raise internal pressure to 4.0 psi. Maintain this pressure for a period of at least five minutes, by adjusting the air supply as necessary, to permit air temperature to reach interior ambient temperature.
- f. Timing Pressure Drop: After temperatures have equalized and pressure in the pipe has stabilized, shut off or disconnect the air supply hose and observe the continuous monitoring gauge for a period of ten minutes or until the pressure decreases 0.5 psi, whichever occurs first. At that point, begin timing the test with a quality stopwatch. Continue timing until the pressure has dropped another 0.5 psi, whichever occurs first. At that point, begin timing the test with a quality stopwatch. Continue timing until the pressure has dropped another 0.5 psi or until the time shown on the drawings for the section undergoing the test has elapsed, whichever is the lesser. If test times are not shown on the drawings, extract or calculate correct test times from data contained in Table 210-2, herein. The test may be discontinued only after the prescribed time has elapsed if the 0.5 psi drop has not occurred.
- g. Criteria for Acceptance: If the time shown or calculated according to Table 210-2, herein, for the designated pipe size and length elapses before the air pressure



drops 0.5 psi, the section undergoing the test shall have passed and shall be presumed to be free from defects.

- h. **Criteria for Failure:** If the pressure drops 0.5 psi before the time shown or calculated according to Table 210-2 for the designated pipe size and length has elapsed, the air loss rate shall be considered excessive and the section of pipe has failed the test.
- i. **Determining Groundwater Impact:**
 - (1) **General:** This paragraph shall apply only where groundwater is known to exist or is anticipated above the sewer line to be tested. Every manhole need not have a groundwater test pipe installed. The engineer will assist the contractor/developer in selecting key manholes sufficient to establish a groundwater profile for the test area.
 - (2) **Groundwater test pipe installation:** During the manhole installation, install an 8-inch diameter PVC pipe in the vertical position adjacent to the manhole that extends from the base of the manhole structure to a point approximately 2 feet above finished grade. Once all testing is completed, the contractor/developer will remove the pipe or abandon in place as directed by the Town and/or County(s) field inspector.
 - (3) **Establish Groundwater Profile:** Immediately before air testing, determine the groundwater level. Measure the difference between the water level in the pipe and the invert of the sewer pipe to be tested in feet. If a test pipe is not adjacent to the section of line to be tested, groundwater height may be estimated based on available information from nearest known test point on the project.
 - (4) **Determine Groundwater Back Pressure:** Divide the average height of groundwater over the pipe by 2.31. Use the result to increase the test pressure prescribed in Paragraph e, Line Pressurization of this section.
- j. **Effect of Connected Laterals:** Since the volume of the laterals is normally insignificant when compared to the volume of the main, neglect the lengths of connected laterals when determining the length of pipeline to be tested. If any sections have a total length less than the maximum length for minimum time shown in Table 210-2, Column 4, fails when tested the engineer will re-compute the test time to take into account the additional length of pipe in the laterals. If the test time determined by this calculation is short enough to allow the section to pass, then the section shall be presumed to be free of defects and comply with this section. No such calculation will be made for sections longer than the maximums referred to in Table 210-2.



TABLE 210-2

Minimum Specified Time Required
 For a 0.5 psi Pressure Drop
 For
 Size and Length of Pipe Indicated

Nominal Pipe Diameter (inches)	Minimum Time		Maximum Length for Minimum Time (feet)	Additional Time For Longer Lengths (seconds per foot)
	Minutes	seconds		
4	1	53	597	0.19
6	2	50	398	0.43
8	3	47	298	0.76
10	4	43	239	1.19
12	5	40	199	1.71
14	6	37	171	2.33
15	7	5	159	2.67
16	7	33	149	3.04
18	8	30	133	3.85
20	9	27	119	4.75
21	9	55	114	5.24
24	11	20	99	6.84
27	12	45	88	8.65
30	14	10	80	10.69
33	15	35	72	12.93
36	17	0	66	15.39
42	19	50	57	20.94
48	22	40	50	27.35

2. Exfiltration Testing:

- a. Service laterals, stub and fittings into sewer lines being tested should be properly capped or plugged, and carefully braced to resist the thrust actions developed by the internal water pressure. In preparing the blocking of plugs or end caps, recognize that the 5 to 10 feet of head in the standpipe will exert considerable thrusts against the plugs or caps. For example, a 10 foot head will generate a total force of 215 pounds against an 8-inch plug. Further considerations must be given

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to the fact that greater pressures will be developed in the downstream portion of the line, due to lower elevations, than in the upper reaches of the sewer line.

- b. Insert a tapped, plumber's type plug and tighten in the inlet pipe of the downstream manhole to which the water supply connection is made for filling the pipe.
- c. Insert and securely tighten a tapped plumber's type plug in the inlet pipe of the upper manhole for connection to the standpipe. The standpipe is then placed in this manhole and connected to the tapped plug. The standpipe must be capable of handling from 5 to 10 feet of water head to determine the tightness and soundness of the sewer line.
- d. Introduce water into the line at the downstream (lower) manhole until the standpipe in the upstream manhole has been completely filled. By filling the line from the lowest level, the air in the line is easily pushed ahead, and finally expelled through the standpipe at the upper end of the test section. Care should be taken to minimize entrapped air which will give distorted test results. The rate of drop in the standpipe may be quite rapid until the air has been expelled.
- e. After filling with water, allow the line to stand for at least several hours before beginning the test. During this time, some water absorption into the manhole structures will take place. After the water absorption has been stabilized, the water level in the standpipe is checked and water added, if necessary.
- f. The test is now ready to begin. The drop in the standpipe is measured and recorded over a 10 minute period. To verify the first results, a second 10 minute test is required. This will also verify whether a stable condition exists in the line.
- g. Convert the measured drops in the standpipe to leakage in terms of gallons per inch, diameter per mile, per day. (Caution should be taken about conducting exfiltration tests on sewer lines laid on steep grades.)

Consideration must be given to the downstream portion of the system to prevent excessive pressures in these lower lines). For these installations and where the upstream manholes are very deep, it is not advisable to fill the standpipe or manhole to the top when performing the test.

- h. Sewers and house connections that fail to pass this test, shall be replaced by the contractor/developer. A single clamp shall be allowed between manholes to facilitate the replacement of defective materials or workmanship.



3. Manhole Vacuum Testing:

a. Equipment:

(1) Plugs: Use either mechanical or pneumatic plugs capable of resisting test pressures without bracing.

(2) Vacuum Tester: Use vacuum tester as manufactured by P. A. Glazing or acceptable substitute. The tester shall be capable of testing the manhole from the rim of the cover frame to the invert.

b. Safety: Brace every test plug against the manhole wall to insure no movement during the test. Do not draw greater than 10-inch Hg vacuum on the manhole. Allow no one into a manhole under vacuum.

c. Manhole Preparation: Make certain all manhole boots, stubouts, and pipe plugs are secured to prevent movement while vacuum is drawn.

d. Installation of Test Device: Install the vacuum tester according to requirements of tester manufacturer. Install the tester so that the manhole is tested from the rim of the cover frame to the invert.

e. Drawing Vacuum on Manhole: Draw 10 inch Hg vacuum on manhole following tester manufacturer's procedures.

f. Timing Pressure Drop: When 10 inch Hg vacuum has been drawn, isolate and stop vacuum pump. Record time for vacuum to drop to 9 inch Hg.

g. Criteria for Acceptance: If the time shown in Table 210-3, herein, for the designated manhole diameter and height elapses before the vacuum drops 1.0 inch Hg, the manhole undergoing test shall have passed and shall be presumed to be free from defects. For testing purposes, the diameter of the manhole is the diameter of the base section, regardless of reducers.

h. Criteria for Failure: If the vacuum drops 1.0 inch Hg before the time shown in Table 210-3 for the designated manhole diameter and height has elapsed, leakage shall be considered excessive and the manhole has failed the test.



TABLE 210-3

Minimum Specified Time Required
For a 1.0 inch Hg Vacuum Drop
For
Height and Diameter of Manholes shown

Manhole Height, rim to invert (feet)	Times to drop 1 inch Hg, in seconds		
	4 feet diameter	5 feet diameter	6 feet diameter
10 feet or less	60	75	90
>10' but \leq 15'	75	90	105
>15' but \leq 25'	90	105	120
> 25 feet	105	120	135

210.12 Force Main Testing:

Sewer force main testing shall be in accordance with water main leakage tests.

220 ON-SITE SEWAGE DISPOSAL SYSTEMS

220.01 Applicability:

Developments located in rural areas of Culpeper County, as designated as Service Areas, by the Master Water and Sewer Plan shall be prohibited from having on-site sewage disposal systems. However, on-site disposal systems are allowed to serve individual lots in the development area where a public sewer system cannot be made available. The County shall make the decision whether or not public sewer system can be made available.



Water Distribution System Details & Sewage Collection System Details

