DESIGN AND CONSTRUCTION STANDARDS FOR SANITARY SEWER

SECTION 200.0 APPLICABILITY

A. If public sewer is located within 250 feet of the proposed dwelling/dwellings, the owner is required to extend and connect onto the public system.

B. If public sewer is not available, the owner is required to acquire necessary Health Department approval prior to a building permit being issued by County.

C. Sanitary sewers shall be designed to serve all lots, including lateral connections between the trunk sewer and the property line being served.

D. Plan approval of any outside jurisdiction involved shall be obtained by the developer prior to plan approval by the County.

E. The Virginia Department of Environmental Quality (DEQ) approval is required for projects involving any sewer pump station discharging into a gravity collector or interceptor line.

F. A preconstruction conference shall be held on all sewer projects by Botetourt County at least one day prior to any construction work being performed. The contractor's superintendent/foreman shall also attend this meeting.

SECTION 200.1 GENERAL

A. Type of Sewers

1. The County of Botetourt Sewage System is designed to provide conveyance with total containment. New sewers, extensions, or replacements, not designed to provide total containment for the design period will not be permitted.

2. Under no circumstances shall storm water, surface water, ground water, roof runoff, subsurface drainage or untreated industrial process water be discharged into any public sanitary sewer system.

B. Compliance with Design Criteria

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

SECTION 200.2 DESIGN CRITERIA

A. All sanitary sewer design shall comply with the approved Botetourt County Water and Sewer Construction Standards and Specifications, and Commonwealth of Virginia Sewage Collection and Treatment Regulations as applicable.

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

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

C. Tributary Population

Sewerage facilities shall be designed for the estimated ultimate tributary population. Consideration shall be given to domestic, commercial, institutional, and industrial wastes in determining the capacity of the system. The design shall be based on approved estimates of anticipated populations and flows for a period of 20 years hence, or the entire watershed shall be assumed to be completely developed according to the Comprehensive Plan and/or sewer master plan, whichever provides the greater sewerage flow, unless the County approves otherwise.

D. Sewage Flow

1. Determining the average design flow shall be the first step in the sizing of sanitary sewerage systems. Actual design quantities may be substituted for the average design flows, provided supporting data is furnished to and approved by the County.

2. Sewers shall be designed to carry a peak flow when full as determined by applying the appropriate peak flow factor to the average design flow according to the Virginia Department of Environmental Quality.

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

E. Location of Sewers and Manholes

1. In general, sewer lines and manholes shall be located within legally established public streets or right-of-way wherever possible. If sewers cannot be located in right-of-way or public streets, then access easements to all manholes, sewer line and laterals shall be provided. Botetourt County may require “Access Easements” from a public right-of-way to the mainline sewer for ingress/egress.

   a) In streets, manholes shall be located beyond the spread of stormwater gutter flow.

   b) Sanitary sewer pipe and manholes shall not be located within the paved portion of privately owned and maintained streets or common driveways without the prior written approval of the County. This provision does not preclude the crossing of these driveways at generally 90 degrees with a sanitary sewer pipe.

   c) The horizontal and vertical separation between sewers and waterlines shall be in accordance with the requirements of Botetourt County's Design and Construction Standards for Water facilities (Section 106.0, Separation of Water Lines and Sanitary Sewers.)

   d) Sanitary sewers shall be designed such that they do not create skewed crossings with other utilities with an acute angle of less than 45 degrees, 90 degrees is preferred. Where skewed crossings are unavoidable due to existing utilities and involves any pipe larger than 24 inches in diameter, the crossing must be specifically designed and construction details provided.

   e) A table of bearings and distances shall be provided on all construction drawings for sanitary sewer construction, in order to accurately locate the utility. The table of bearings and distances is not required on early submissions, but is required prior to final plan approval. The engineer or surveyor shall supply as-builts for the installation of all sewer systems.

   f) Plan and profile of the sanitary sewer system is required.

   g) The deflection angle from the inflow pipe to the outflow pipe at any junction shall not be less than 90 degrees unless approved in writing by the County.

   h) Where feasible, a table of lateral elevations at cleanout invert and minimum building sewer elevations shall be included in plans. Building sewer elevation shall be a minimum of two feet above cleanout invert elevation.

2. Proposed sanitary sewers to be publicly maintained shall not be located within the plane of influence of the building footing and in no case closer than one-half the required easement width from an existing or proposed building.

3. Manholes for access to sewer lines shall be provided at:

   a) At all intersections of differing size sewers that are 27 inches in diameter or smaller.

   b) At all points of change in alignment.

   c) At all points of change in grade.

   d) At the terminal end of the sanitary sewer line. At the terminal end of a 6" sanitary sewer line, a clean-out may be used if less than or equal to 400 lineal feet.

   e) At intervals not exceeding 400 feet on all sewers 15 inches in diameter or less and not exceeding 500 feet on all sewers larger than 15 inches in diameter.

   f) A sampling and/or metering manhole may be required for all non-residential users. The sampling manhole may be used in lieu of the required cleanout at the property/easement line.

4. When it is necessary, due to steep slopes, increased velocity or invert elevation differences equal to or greater than 24 inches, a drop connection shall be employed. The maximum difference in elevation between the influent and effluent flows within the manhole itself shall be six inches. The minimum diameter manhole for use with an inside drop connection shall be five feet. Only one inside drop shall be installed per five-foot diameter manhole. Two inside drop connections may be made in a six-foot diameter manhole. These provisions apply for both sewer main and lateral connections. Refer to Detail Drawings.

5. Outside drop manhole connections are acceptable for use in Botetourt County. Refer to Detail Drawings.

6. Manholes for sewers up to 16 inches in diameter shall not be less than four feet inside diameter (except inside drops, see paragraph 4). Manholes for sewers up to 36 inches shall have an inside diameter of not less than five feet.

7. When designing new sewers to tie into existing sewers, the connection shall be made by one of the following methods.

   a) <u>Connection to an existing manhole</u>. Connection to the existing manhole must be configured so that the invert of the new tie-in

is established a minimum of 0.1 feet above the invert out. The contractor shall core drill thru the bench to establish a trough for the flow. An alternate to core drilling thru the bench, which must be approved by Botetourt County, is to establish the invert at the bench and form a new trough with grout.

b) New in-line manhole. The new manhole shall be set after removal of the existing pipe and installation of proper bedding material. Refer to Detail Drawings. The invert of the base section shall match the slope of the removed pipe. Outlet pipe shall be connected to the manhole boot. Inlet connection shall be made with a 6-foot pipe stub connected to the manhole boot and to the existing pipe by a Fernco coupling or approved equal as per Detail Drawings. This method will require pumping of existing flows during installation. Testing shall be by the vacuum test method as per ASTM C1244.

c) Straddle manhole. Straddle manholes may be used for installations not suitable to the above two methods. Refer to Detail Drawings. Special care shall be taken to make the manhole watertight and to protect the integrity of the existing pipe. Outside of existing pipe shall be thoroughly cleaned and waterstops installed prior to placing of concrete. All existing concrete that comes in contact with new concrete shall be etched and have a bonding agent applied. A County inspector must be present during installation of all straddle manholes. Testing shall be by the vacuum test method as per ASTM C1244.

8. All new sanitary sewer manholes shall be precast concrete in accordance with ASTM-C478 consisting of precast concentric riser reinforced sections, an eccentric conical or flat top section, and a base section conforming with the typical manhole as shown in Detail Drawings.

9. Sewers adjacent to or crossing streams, estuaries, lakes and reservoirs shall be designed, constructed and protected in accordance with requirements of the Virginia Department of Environmental Quality Sewage Collection and Treatment Regulations, except that:

a) The connection of sanitary sewer lines shall be made only at manholes. The type of material must be the same from manhole to manhole.

b) Sewer lines crossing streams shall be Class 52 Ductile Iron pipe and concrete encased. Reference Detail Drawings. Pipe shall be provided with a minimum of one foot of cover over the concrete encasement where the stream is located in other

materials. The cover requirements may be lessened with the approval of the County in an area that will not interfere with future improvements to the channel bottom.

c) Sewer lines shall not be located within stormwater management impoundment areas.

d) Inverted siphons shall not be less than two (2) barrels, with a minimum pipe size of six (6) inches and shall be provided with necessary appurtenances for convenient flushing and maintenance; the manholes shall be designed to facilitate cleaning; and, in general, sufficient head shall be provided and pipe sizes selected to secure velocities of at least 3.0 feet per second for average flows. The inlet and outlet details shall be arranged so that normal flow is diverted to one (1) barrel so that either barrel may be removed for service or cleaning.

10. Water tight manholes shall be located where the top elevation is lower than the 25 year flood/wave action or in areas where there is a possibility that water may pond, be subject to stromwater runoff or as required by Botetourt County.

11. Sewer located in areas of unstable soil conditions or other special circumstances may need to be encased in concrete, relocated or redesigned as required by the County.

F. Sanitary Sewer Lateral Cleanouts

1. Sanitary sewer cleanouts will be:

a) Located at the property line or sanitary sewer easement line contiguous to the property. Refer to Detail Drawings.

b) A traffic bearing type cleanout box is required if located in pavement areas. Refer to Detail Drawings.

c) Minimum slope for residential service lateral shall be 2.08 percent (1/4”:12”). Minimum slope for commercial service lateral shall be 1.04 percent (1/8”:12”). Maximum slope of service lateral shall be 45 degrees within public easements or right-of-ways.

G. Hydraulic Criteria

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

1. Sewers shall have a uniform slope and alignment between manholes.

2. At all manholes where a smaller diameter sewer discharges into a larger one, the invert of the larger sewer shall be lowered so that the energy gradients of sewers at junction are at the same level. Generally, this condition will be met by placing the 0.8 depth of flow or diameter in each sewer at the same elevation.

3. Sewer shall be designed to be free-flowing with the hydraulic grade below the crown and with hydraulic slopes sufficient to provide an average velocity of not less than 2.0 feet per second when running full to maintain a cleansing flow. Computations of velocity of flow shall be based on a PVC pipe coefficient of roughness "n" in the Manning formula of n=0.014.

4. In no case shall terminal lines with less than 20 residential connections have a slope of less than one percent unless approved by the County.

5. The maximum permissible velocity occurring with average flow shall be 10 feet per second (before applying peak flow factor).

6. Where due to steep grades, velocity exceeds 10 feet per second, and/or where drop manholes are impractical for reduction of velocity, the sewer shall be designed with an abrasion resistant material meeting ASTM or AWWA specifications approved by the County and shall be anchored where appropriate.

7. In general, the following are minimum slopes in feet per hundred feet to be provided for pipes flowing at full depth to one-half of full depth:

Sewer Size	Minimum Slope in Feet per 100 Feet
8 inch	0.40
10 inch	0.28
12 inch	0.22
14 inch	0.17
15 inch	0.15
16 inch	0.14
18 inch	0.12
21 inch	0.10
24 inch	0.08
27 inch	0.067
30 inch	0.058
36 inch	0.046

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

9. Minimum Permissible Depth

All sewer mains and service laterals shall have a minimum cover of three feet.

10. In general, the maximum allowable depths to inverts of various types and sizes of pipe is dependent on different types of bedding, earth loading and live loading. Pipes with less than minimum cover and pipe with cover greater than 18 feet require pipe strength calculations to be submitted with the design. The maximum depth for all types of pipe shall be in accordance with manufacturer's specifications and recommendations.

11. Slope Anchorage

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

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

13. Locator wire sized #10 and detection tape shall be installed. Refer to Detail Drawings.

H. Public Easements

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

    a) Public easement width shall be determined based on a one-to-one side slope measured from outside edge of pipe extending from invert of the pipe at its lowest point below proposed grade between manholes and rounded up to nearest five feet. See Detail Drawings.

    b) Minimum public easement width for sanitary sewers shall be 25 feet.

c) Increased/decreased public easement widths may be required by County for unusual situations or circumstances.

2. No privately owned permanent structure or landscaping other than shrubs shall be permitted within a public easement. Any damage to shrubs that are located within the easement that may be caused by the legal use of the easement by the County shall remain with the property owner.

3. Where deemed necessary by the County, and in order to ensure maximum utilization of public sanitary sewer systems, it will be required that appropriate public easements be provided to adjacent properties for access or extension of said public sewer system.

SECTION 200.3 STRUCTURAL

A. General

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

- END OF SECTION -

SANITARY SEWER

201.00 PIPE MATERIALS

A. Bedding: All pipe (PVC and ductile iron) up to and including eighteen inch (18") shall be bedded in compacted granular material and compacted granular bedding shall completely cover the pipe barrel to a depth of 6" over top of pipe. The granular material shall be well-graded, crushed stone meeting the requirements of VDOT gradation 57 or 67 stone. Bedding for pipe larger than eighteen inches (18") shall be designed on an individual basis and approved by the Engineering/Utility Department. Refer to Detail Drawings.

B. Pipe Material Selection: The pipe materials listed hereunder have been approved for use in Botetourt County. However, the acceptability of specific pipe material for use within a specific soil type or condition shall be determined by the Engineering/Utility Department on an individual basis at the time of design review of the plans. The type or types of pipe allowable for use on any specific project shall be shown on the approved construction plans.

1. Ductile Iron Pipe: Ductile iron pipe shall be centrifugally cast manufactured in accordance with ANSI Specification A21.51, latest revision, and shall be cement mortar lined in accordance with ANSI Specification A21.4-80. Slip joint or mechanical joint pipe shall be used for gravity sewers. Slip joint pipe shall be designed in accordance with ANSI standard A21-50 and specified according to ANSI standard A21-11. Class 51 pipe shall be minimum strength used in all sewer applications. May only be used upon approval of Engineering/Utility Department. Gaskets shall be furnished by the manufacturer and installed in accordance with his recommendations. Ductile iron pipe shall be used in exposed pipe installations, and where approved by the Engineering/Utility Department when other pipe materials are subject to crushing.

2. Polyvinyl Chloride (PVC): PVC sewer pipe shall be manufactured in accordance with ASTM Designation 3034-77 (SDR 35). Gravity sewer pipe shall be unplasticized polyvinyl chloride with integral rubber ring wall bell and spigot joints furnished in 12.5' and 20' nominal lengths. Installation of PVC gravity sewer pipe and fittings shall be in accordance with ASTM Designation 2321 and manufacturer's recommendations.

    a. 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 placement of the pipe; i.e., PVC pipe shall not be strung out on the job site in excess of one day's work.

b. The Engineering/Utility Department may require additional strength PVC pipe including SDR-26, SDR-21, DR-18 or concrete encasement of SDR-35, or both where depth exceeds twelve feet (12') and where additional protection is required for the pipe.

3. Molecularly Oriented Polyvinyl Chloride (PVCO) pressure pipe: PVCO pipe meeting the AWWA Specification C909 for DR 18, pressure class 150 may be used for areas where pressure pipe is specified. Installation of PVCO pipe shall be approved by Botetourt County.

4. PVC (Ribbed Pipe): Ultra-Rib pipe meeting ASTM F-794 with a stiffness factor of 46 may be used on County projects. Installation shall be in strict compliance with manufacturer's written instructions. All fittings used shall be designed specifically for pipe used and be approved for use by same manufacturer of pipe. Connections to manholes shall be made by manufacturer's recommended methods and approved by Engineering/Utility Department.

C. Service Connections: Polyvinyl chloride (PVC) sewer pipe conforming to ASTM Designation 3034-77 (SDR-35); or Schedule 40 PVC pipe conforming to ASTM Designation 1785-76 shall be used between the sewer main and the cleanout. SDR-21 PVC pipe shall be used where additional strength pipe is required.

1. The PVC SDR 35 joints shall be made with bonded-in-bell elastomeric seal. Schedule 40 PVC joints shall be made with a solvent weld bell and spigot joint using PVC pipe cleaner and glue as supplied by the manufacturer.

2. No-hub pipe shall not be permitted.

3. There shall be no bends in service line from main to cleanout except as indicated on approved Botetourt County Sewer Detail Drawings.

D. Air Release Valve: Force main vacuum/air release valve shall be Crispin Model S20 or equal with a 1/2" orifice and 2-inch screened inlet furnished with backflushing attachment.

E. pH Determinations: Pipe selected on a basis of pH shall be verified by the Engineering/Utility Department.

F. There shall be no change in pipe size and/or material from manhole to manhole.

202.00 SANITARY SEWER CONSTRUTION

202.01 General Requirements: All construction of sanitary sewer mains and appurtenances in Botetourt County shall be in strict accordance with plans and specifications prepared as part of the Contract Documents and as approved by the Engineering/Utility Department. All materials shall be new and unused. Prior to construction of the approved sanitary sewer, Contractor shall provide field stakeout including adequate line and grade stakes in order that sanitary sewer and appurtenances may be constructed in accordance with Contract Drawings.

If any deviation is contemplated in location or line grade of any sewer, structure or appurtenance as shown on the Contract Drawings, a revision of the Drawings showing the proposed deviation shall be submitted to the Engineering/Utility Department for review and approval before any changes are constructed. Design Engineer of Record must concur in any revision of drawings.

202.02 Excavation: Excavation shall conform to the lines and grades shown on the plans. The width of excavation for trenches shall be a minimum of 24" plus the outside diameter of the pipe. Excavation shall not be carried below the established grades and any excavation below the required level shall be backfilled with suitable, thoroughly compacted granular bedding material. Contractor shall install all sheeting, bracing, and shoring necessary to perform the work, to protect existing structures and all excavations as required under Virginia OSHA Regulations. Compliance with provisions of the Overhead High Voltage Line Safety Act is required.

Dewatering equipment shall be sized to maintain the trench in a satisfactory de-watered condition suitable for pipe laying and backfilling. Pipe laying will be permitted only where the depth of water is maintained below the bedding material. Bedding material shall not be placed on unstable trench material.

Not more than one hundred fifty feet (150') of trench shall be opened in advance of the completed pipe laying. Trench walls shall be protected in accordance with current OSHA regulations. Excavation at manholes and similar structures shall provide a minimum clearance of eighteen inches (18") between the outer surface of the structure and the embankment or sheeting.

Rock excavation: All blasting operations shall be in accordance with existing ordinances and regulations. Where excavation is made in fractured rock or

boulders, no rock shall remain nearer than six inches (6") to any part of the sewer pipe when laid, nor shall rock project beyond the lines and grades of masonry structures. No blasting shall be performed within forty feet (40') of a tested or completed sewer. The ends of sewers adjacent to blasting shall be covered to avoid receiving debris.

Wherever foundation material is unsuitable, it shall be excavated until a stable foundation is achieved. Granular material, VDOT stone type 21A, shall then be placed in six inch (6") layers and compacted until the trench bottom has been stabilized. Standard granular pipe bedding material shall be placed as heretofore specified.

All material excavated but not used in backfill shall be properly removed and disposed of by contractor in a location approved by the Engineering/Utility department.

203.03 Backfill: Backfill shall begin at the top of the standard granular bedding and shall be placed in six (6") layers and shall be thoroughly tamped to ninety-five percent (95%) of the maximum theoretical compaction density as determined by a standard proctor on the material until the top of the pipe has a minimum cover of one foot (1'). Remainder of the backfill shall be in two foot (2') layers and shall be thoroughly tamped to 90% of the maximum theoretical density as determined by a standard proctor on the material. Testing may be required by Botetourt County and shall be performed by an independent laboratory at the developer's expense. The minimum testing shall be one test per job or 1000 feet. Location of test will be at the discretion of the Botetourt County field inspector. The contractor will be responsible for correcting any areas that fail, and retesting will be required. If the County representative requires additional test, the responsibility of payment for testing will be based upon the test results.

Backfill material shall be free of perishable material, frozen clods, sticky masses of clay and other unsuitable matter. Rock pieces larger than one inch (1") shall not be used in the backfill which is within two feet (2') of the pipe. No rock over five inches (5") in its greatest dimension shall be used in any backfill. Manholes and cleanouts shall be backfilled in same manner as the sewer pipe. Backfill material shall not be dropped directly on the pipe from a height greater than three feet (3').

Backfill in areas not subject to vehicular traffic shall be compacted to such a degree that any subsidence will not be objectionable or detrimental to normal use. Backfill and replacement in existing or proposed roads shall be executed in full accordance with the requirements of the Virginia Department of Transportation Standards.

203.04 Pipe Installation: All gravity sewer mains, service laterals and force mains shall have a minimum cover of three feet (3') as measured from top of pipe to

finish grade. The Engineering/Utility Department may require additional cover as needed for pipe protection.

All pipe and fittings shall be carefully handled with non-metallic slings or other approved devices to prevent damage to protective coatings or joints. Lifting equipment shall be satisfactorily rated to handle the pipe sizes used. Pipe shall not be dumped or dropped into trench. Each section of pipe shall be thoroughly inspected for defects before being lowered into the trench.

Pipe shall be laid true to line and grade with bells upstream and shall be jointed together such that the completed pipe will have a smooth invert. Pipe shall be pushed home by hand. The use of equipment (i.e. backhoe) shall not be permitted. Cutting of pipe shall be performed by sawing. Standard bedding shall be shaped to the curvature of both the bell and barrel of the pipe. The trench shall be kept free of water while the work is in progress. The ends of the pipe shall be cleaned so that proper joints can be made. As the work progresses, the interior of the pipe shall be cleared of dirt, cement, or other deleterious material.

Except as required for use of a laser level, exposed end of all pipe and fittings shall be fully closed to prevent earth, water or other substances from entering pipe. Trench shall be completely backfilled at end of each workday. When new pipe is tied into an existing manhole, new pipe shall be plugged with a standard sewer plug and shall remain plugged until all new line(s) that will flow to existing manhole have been completed, tested, and accepted.

203.05 Service Connections: SDR 35 and schedule 40 PVC pipe lateral service connections to the sewer main shall be made by means of a commercially manufactured tee, tee-wye, or wye branch. Service laterals may also be connected to the sewer system at a manhole. A sewer cleanout the same size as the service line shall be installed in accordance with the Detail Drawings. Pipe material shall be of the same type to and including the cleanout stack.

All taps to an existing manhole or mainline sewer pipe shall be made by licensed professional plumber and inspected by Botetourt County.

Sewer service line shall be four inches (4") minimum for residential service and six inches (6") minimum for non-residential service. Sewer cleanouts shall be same size as service line and shall be installed per Botetourt County Sewer Detail Drawing. Additional sections of pipe shall be installed behind cleanout as indicated on detail drawings to prevent conflict with other utilities generally located in this area. All service laterals shall have locator wire and warning tape installed in the trench as per standard details.

Sewer service connections from manhole or sewer main to the cleanout shall be installed with the same care as the sewer main. Proper excavation, slope of pipe and standard granular bedding shall be provided throughout. All gravity sewer mains and service laterals shall be air tested. For air testing procedures see Section 203.10.

No connection shall be made to the vertical portion of a cleanout except for private force main.

All sewer service connections or portions of sewer service connections outside of the public right-of-way or sewer easement shall be privately owned and maintained.

A sampling and/or metering manhole, which conforms to Detail Drawings, may be installed on sewer service lateral for non-residential facilities. Manholes may be installed at property line in lieu of cleanout or between cleanout at the property line and the facility. Sampling manholes shall be tested by vacuum method.

203.06 Traps/Separators: Grease traps, volatile liquid separators, or other such devices may be required by the Utility Director on non-residential facilities where, due to the nature of their operation, it is deemed necessary.

Grease trap or volatile liquid separator is to be located externally in a manner so that all discharges from the kitchen plumbing except garbage grinders, pass through the grease trap or volatile liquid separator prior to entering the sanitary sewer; all other domestic waste water shall by-pass the grease trap.

Grease trap or volatile liquid separator designs shall be reviewed on an individual basis during the plan review process. A minimum grease capacity of 500 gallons or 20 minutes of peak flow storage shall be provided per each grease trap.

Adequate access for inspection and maintenance of grease trap or volatile liquid separator is to be provided. Owner of facility served by a grease trap or volatile liquid separator shall be responsible for proper operation and maintenance.

203.07 Manholes: Only precast manhole sections shall be used. Manholes shall be constructed with manhole frames, covers and steps. Frames and covers shall be East Jordan Iron Works, Inc. Watertight Manhole Frame Model #1045Z, Watertight Cover Model #1040AGS and Bolt-down Manhole Cover Model #1040ACLGS. Bolt-down Model to be used in areas subjected to flooding or as directed by Botetourt County. Botetourt County approved concrete manholes and frames and covers shall be from manufacturers with a VDOT approved Quality Assurance program.

Casting shall be best quality tough, gray iron, free from defects, blow holes, and other imperfections and shall meet the requirements of ASTM Designation A-48, Class 20. The castings shall be sound, free to form and thickness, cleaned by means of sand blast and neatly finished. The material bearing surfaces shall be machine ground and finished to insure satisfactory seating. Covers shall have the words "Sanitary Sewer" cast into the top. Castings shall receive one coat of black asphaltum paint at the factory. Locations and type of manhole vents will be as indicated on the approved plans and as per Detail Drawings. Change in location must be approved by the Engineering/Utility Department.

Covers shall be furnished with means of lifting. Covers that rock under normal load or will not seat will be rejected. Frames shall be bolt-down type, with butyl mastic sealer placed between frame and manhole. Mortar shall not be permitted. Frames shall have a nut and washer installed on top and bottom to facilitate minor elevation adjustments. The adjustment space between the bottom of the frame and the top of the manhole section shall be formed and filled with 3000 psi concrete.

Steps for manholes shall be made of steel and shall have a plastic coating. Steps shall be spaced 16 inches (16") apart. The first step shall be within 12 inches (12") of the cover. The bottom step shall be within 24 inches (24") of the bottom of the manhole.

Precast concrete manholes shall consist of precast reinforced concrete sections, an eccentric conical section and a standard base section with poured uniform bottom inverts. Flat top manholes can be used only with approval of the Engineering/Utility Department. Where soil conditions dictate their use, expanded base section, extending a minimum of four inches (4") and a maximum of eight inches (8") beyond the outside vertical wall (riser section) of the manhole shall be used. Manhole shall be installed with steps vertically aligned over manhole bench. Access hole in flat top manhole section shall be centered over manhole steps.

Precast base section shall be installed on a compacted stabilized foundation of bedding material foundation prepared similar to that required for the proper installation of the adjacent sewer pipe as described elsewhere in these Specifications.

Precast manhole sections shall be manufactured in accordance with ASTM Designation C478, latest revision. Each section shall have not more than two (2) holes for the purpose of handling and setting. These holes shall be tapered and shall be plugged up with rubber stoppers and an approved non-shrink grout after installation.

A cold applied butyl mastic joint sealer manufactured specifically for the purpose shall be used to make a watertight joint between manhole sections and/or grade rings. Mortared joints are not permitted. All new manholes shall be pre-cast concrete inverts except straddle manhole. All straddle manholes and all field-constructed inverts shall be with ready mix (3000 psi) concrete and shall only be used with approval of the Engineering/Utility Department.

Standard manhole drop connections shall be installed where indicated on the drawings. Drop connections shall conform to the Detail Drawings.

Manholes that are 15' in depth or deeper shall have a safety slab installed as per the detail drawings.

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. Invert benches shall be constructed of ready mix concrete (3,000 psi) over the entire existing bench.

The invert channel shall be at least 0.75 times the diameter of the pipe in depth. The minimum difference in elevation of inverts of incoming and outgoing pipes shall be 0.10 feet.

Where grade rings (8" wall) are required to meet specified grade, 12" maximum height/thickness and minimum number of rings shall be used. Cone sections and grade rings shall be drilled with matching holes to accept threaded rod installation. Refer to Detail Drawings.

203.08 Pipe Connection at Manholes: All new manholes shall be supplied with an approved flexible boot connection suitable for specified pipe and manhole. All rubber boots for 8 inch (8") pipe shall have a maximum flexibility of 24° in any direction from center. Boot flexibility for pipe sizes larger than 8 inch (8") shall be per the manufacturer's recommendations. Twenty inch (20") and larger pipe connections shall have the first joint located four feet (4') from the inside face of the manhole. Flexible joint manhole connection shall be as manufactured by Pres-Seal Gasket Corporation, Fort Wayne, IN; or approved equal.

Manhole to pipe installation procedures shall be as follows:

1. After manhole has been set to line and grade, inspect flexible connector boot for damage and clean out inside of boot. Clean surface of pipe barrel to be installed.

2. Insert pipe into connector boot until end of pipe breaks plane of manhole wall and flush with manhole invert. Position pipe in center of connector.

3. Install take-up clamp(s) in groove(s) at pipe receiving end of boot and tighten clamps to 60 in/lbs. of torque **PRIOR** to adjusting pipe to desired angle of deflection.

4. After desired deflection angle of pipe has been achieved, install bedding and backfill material in accordance with these Construction Standards.

Precast manhole sections shall be manufactured for the specified size, angle and number of pipe connections required. Field modification or abandonment of any part of a precast manhole will not be permitted without written approval of the Engineering/Utility Department. Any approved field modification(s) or repairs shall be performed by a qualified person(s) approved by the manufacturer.

Inside of manholes (walls, steps, invert, pipe connections, benches) and frame and cover shall be kept clean and free of dirt, stone, mastic, trash and construction materials. Manholes shall be cleaned prior to testing.

Abandonment of manholes and sewer lines shall be performed in accordance with the Detailed Drawings.

A rubber water stop shall be used around pipe at manhole connection of straddle manhole. Refer to Detail Drawings.

203.09 Hydraulic Cement Mortar and Gravel: Cement mortar and grout shall consist of a mixture of hydraulic cement, fine aggregate, water and admixture.

1. Cement shall be Portland Cement Type I or II.

2. Fine Aggregate Grade C shall be used.

3. Water used with cement or lime shall be clean, clear, and free of oil, acid, salt, alkali, organic matter or other deleterious substances.

4. Admixtures shall conform to Section 217 of VDOT Specifications.

5. Hydraulic cement mortar and grout shall contain from 3 to 7 percent entrained air. Air entrained cement may be used in lieu of plain cement and air entraining admixture. Mortar and grout shall be mixed with a minimum amount of water necessary to obtain required consistency. Mortar and grout shall be properly cured and protected for not less than three (3) days.

   a. **Cement Mortar** shall consist of one part hydraulic cement, 2 1/2 parts fine aggregate by weight and sufficient water to produce a stiff mix. Grade C Fine Aggregate shall be used.

b. **Non-Shrink Mortar** shall consist of one part hydraulic cement, 2 1/2 parts fine aggregate by weight, a set retardant or other admixture which will reduce the amount of required mixing water and sufficient water to produce a stiff mix. Grade C Fine Aggregate shall be used.

c. **Cement Grout** shall consist of one part hydraulic cement, 2 parts fine aggregate by weight and sufficient water to produce a free flowing mix. Grade A fine aggregate shall be used.

d. **High Strength Grout and Mortar** shall consist of a prepackaged, non-shrink hydraulic cement mixture with a 7-day compressive strength of at least 4,000 psi when tested in accordance with ASTM C109 and with a 7-day bond strength of at least 1,000 psi when tested in accordance with VTM-41, except that epoxy will not be used to develop the bond.

203.10 Acceptance Tests: Sewers will be inspected to determine if any deviation from line and grade has occurred. Pipe alignment will be checked by the mandrel test. If pipe shows poor alignment, displaced pipe, or any defect, including a visible leak, defect shall be corrected before leak testing of the pipe. All sewer lines are subject to internal inspection and testing by closed circuit TV by the Engineering/Utility Department based upon inspection results at the developer's expense.

Air testing shall be used; test methods and acceptability criteria shall be in accordance with ASTM F1417 and the Uni-Bell low-pressure air test. Air testing of gravity lines shall be required for all types of pipe and materials.

A. Manhole Acceptance Tests as per ASTM C1244

1. Manholes, including frame, shall be tested by vacuum testing from the top of the frame. Inflatable stoppers shall be used to plug all lines into and out of the manhole being tested including any vent line. 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. Vacuum tests shall be made with a vacuum of 10" Hg. The time for the vacuum to drop from 10" to 9" of Hg must be greater than 60 seconds.

2. Contractor shall furnish weirs, stand pipes, pipe plugs, water, pressure gauges, stop watches, air compressor, vacuum pump, hose and such materials and assistance as required to perform these tests. Contractor shall conduct all acceptance tests in the presence of the project engineer or a County Inspector. All testing shall be documented by the project engineer.

3. Acceptance tests shall not be made until sanitary sewer, manholes and proposed sewer service connections, as shown on the approved sewer plans, have been installed, the sewer trenches (including manholes and cleanout stacks) backfilled and compacted to finished sub-grade.

4. Contractor shall schedule all acceptance tests with the project engineer and county inspector at least forty-eight (48) hours in advance. Each section of completed sewer shall be tested from manhole to manhole. No sewers or sewer service connections are to be excluded from this testing procedure.

B. Sewer Pipe Testing Procedures as per ASTM F1417

1. Whenever it is necessary to construct underdrains or place gravel under pipe lines in order to dewater trench during construction of sewers, acceptance test will not be made until any pumps, which have been used in dewatering process, have been disconnected or drains have been taken out of service.

2. Contractor shall schedule all acceptance tests with the project engineer and the Engineering/Utility Department at least forty-eight (48) hours in advance. Each section of completed sewer shall be tested. Generally, sewers will be tested from manhole to manhole. No sewer or sewer service connection is to be excluded from this testing procedure.

3. Low Pressure Air Testing Procedure - The test procedure shall be conducted in the following manner: (Vacuum test of manholes is generally inverse of low pressure air test of sewer lines)

   a. Contractor shall thoroughly clean and remove all debris, silt, earth or other materials from the sewer prior to acceptance testing.

   b. Proper test plugs shall be supplied and installed by Contractor. Test gauges used in air test procedure shall have a range of 0-10 psi and shall be calibrated in divisions of 0.10 psi with an accuracy of +/- one percent. Test gauges shall be calibrated at least once a year and the date and results displayed on the equipment including date of calibration. Calibrations shall be certified by an independent testing lab. Test gauges shall be located outside of manhole during testing.

   c. If pipe to be tested is expected to be below ground water table, Contractor shall either:

      - Install a small diameter perforated vertical pipe from invert elevation of the sewer to the surface prior to backfilling; or

- Insert a pipe probe by boring or driving into the backfilling material adjacent to the invert elevation of the pipe, and determine the depth of the ground water level above the pipe invert immediately prior to acceptance testing the sewer.

- All gauge pressures for test shall be increased by the amount of this back pressure due to ground water over the invert of the pipe.

- In lieu of the above water depth determination, Contractor may add three (3) psi to the gauge pressure in the test.

d. Contractor shall add air slowly to the portion of the pipe under test until the internal air pressure is raised to 4.0 psi gauge plus the ground water pressure.

e. As a safety precaution, no one shall be allowed in manhole after air pressure is increased in the sewer line. If the inspector suspects that the test plug may be leaking, pressure shall first be relieved before any adjustments are made to eliminate air leakage at the plug.

f. Contractor shall allow air temperature to stabilize for at least two (2) minutes with the pipe subjected to an internal pressure of 4.0 psi by adding only the amount of air required to maintain the pressure.

g. After temperature stabilization, the test will begin. If the internal air pressure decreases, the time required for the pressure to drop from 3.5 to 2.5 psi gauge will be observed and recorded. The time interval shall be compared with the established standards in accordance with details BC# SS-27/28 for time and length of test section for various diameters of the sewer. All pipes 15 inches or less shall be tested for a pressure drop of 1.0 psi gauge.

h. Pipe which fails to maintain the stipulated pressure for a period equal to or greater than the holding time shown in Table I shall be deemed to have failed the low pressure air test and is unsatisfactory for acceptance by the County. Any sewer that fails to pass this test **shall be replaced by the Contractor at his expense**.

204.00 CONVEYANCE OF SEWER SYSTEM

Prior to Botetourt County acceptance of a sewer system, the following items must be submitted:

1. Documentation of the following test results:

    a. Manhole Vacuum Test
    b. Sewer Line Air Test
    c. Sewer Line Mandrel

2. Record drawings (as-builts) in reproducible format

    a. One (1) complete reproducible set
    b. One digital copy (AutoCad)

3. Deed conveying the system from the owner/developer to Botetourt County.

4. Plat showing all easements.

5. Submittal of a one-year warranty contract from date of acceptance.