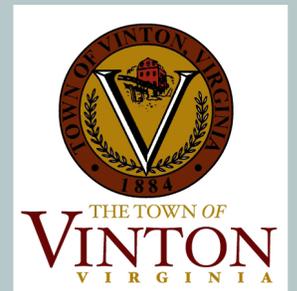


2014

# WESTERN VIRGINIA REGIONAL DESIGN AND CONSTRUCTION STANDARDS





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**WESTERN VIRGINIA  
REGIONAL STANDARDS  
AND SPECIFICATIONS FOR WATER AND SEWER**

**Table of Contents**

**Request for Waiver, Modification, or Field Change Form**

**Utility Acceptance Certificate**

**Design Standards Water**

DSW-1	Water Systems.....	pp	1-10
-------	--------------------	----	------

**Design Standards Sanitary Sewer**

DSS-1	Sanitary Sewer Systems.....	pp	11-20
DSS-2	Sanitary Sewer Lift Station.....	pp	21-38
DSS-3	FOG Policy.....	pp	39-54

**Construction Specifications**

CS-1	General Water and Sewer.....	pp	55-62
CS-2	Water Distribution Piping.....	pp	63-76
CS-3	Sanitary Sewer Collection Piping.....	pp	77-90
CS-4	Sanitary Sewer Closed Circuit Television Inspection .....	pp	91-100
CS-5	Clearing and Grubbing.....	pp	101-104
CS-6	Rock Excavation .....	pp	105-108
CS-7	Stream and/or Highway Crossings .....	pp	109-112
CS-8	Horizontal Directional Drilling (HDD) Methodology.....	pp	113-120
CS-9	Seeding and Mulching .....	pp	121-126

**Water Detail Drawings**

**Sewer Detail Drawings**

**General Water and Sewer Detail Drawings**

REQUEST FOR WAIVER, MODIFICATION, OR FIELD CHANGE

WESTERN VIRGINIA REGIONAL STANDARDS  
AND SPECIFICATIONS FOR WATER AND SEWER

Item/Standard: \_\_\_\_\_

Water and Sewer Section Number: \_\_\_\_\_

Project: \_\_\_\_\_

Station/Location: \_\_\_\_\_

Project Inspector: \_\_\_\_\_

Project Engineer: \_\_\_\_\_

Person Making Request: \_\_\_\_\_

Name & Title

\_\_\_\_\_  
Company Name

\_\_\_\_\_  
Telephone Number

**Justification/Reason for Request:**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Participating Utility Inspector Comments:**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Participating Utility Department Comments:**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

\_\_\_\_\_  
APPROVED      \_\_\_\_\_ DISAPPROVED

\_\_\_\_\_  
Participating Utility Representative

Western Virginia Water Authority  
**UTILITY ACCEPTANCE CERTIFICATE**

This is to certify that the following described improvements have been constructed in accordance with the Western Virginia Water Authority Design and Construction Standards. The contractor, developer and surety remain bound by the terms of any applicable agreement(s), and/or (performance, payment, maintenance) guarantee(s).

SUBDIVISION/PROJECT: \_\_\_\_\_

DEVELOPER: \_\_\_\_\_

CONTRACTOR: \_\_\_\_\_

DESIGN FIRM/ENGINEER: \_\_\_\_\_

Project Type: \_\_\_\_\_ Approximate Lots Served: \_\_\_\_\_

Plan Number: \_\_\_\_\_ Approval Date: \_\_\_\_\_ DEQ (If Applicable): \_\_\_\_\_

Construction Start Date: \_\_\_\_\_

WATER: Pressure Test: \_\_\_\_\_ Bacteriological Test: \_\_\_\_\_

Tracer Wire Continuity Test: \_\_\_\_\_ (Non-metallic pipe only)

SEWER: Line Pressure Test: \_\_\_\_\_ MH Test: \_\_\_\_\_ Camera Inspection: \_\_\_\_\_

Date of Receipt: As- Builts: \_\_\_\_\_ Easements Recorded: \_\_\_\_\_

**DATE OF SUBSTANTIAL COMPLETION:** \_\_\_\_\_

If Punch List is attached, this list of items shall be completed or corrected prior to Final Acceptance. This list may not be all-inclusive, and the failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with applicable Agreement(s). Upon Substantial Completion, the Authority may begin use of the accepted water/sewer improvements, however maintenance will remain the responsibility of the Developer/Contractor until Final Acceptance is issued by the Authority.

Punch List Items Complete: \_\_\_\_\_ Maintenance Guarantee Received: \_\_\_\_\_

**DATE OF FINAL ACCEPTANCE:** \_\_\_\_\_

Water Main (length): (8")\_\_\_\_\_ (other)\_\_\_\_\_ Value: \$\_\_\_\_\_

Water Services (number): (1")\_\_\_\_\_ (other)\_\_\_\_\_ Value: \$\_\_\_\_\_

Water Hydrants (number): \_\_\_\_\_ Value: \$\_\_\_\_\_

Sewer Gravity Main (length): (8")\_\_\_\_\_ (Other)\_\_\_\_\_ Value: \$\_\_\_\_\_

Sewer Pressure Main (length): ( " )\_\_\_\_\_ Value: \$\_\_\_\_\_

Sewer Manholes (number): \_\_\_\_\_ Value: \$\_\_\_\_\_

Sewer Services (number): (4")\_\_\_\_\_ (6")\_\_\_\_\_ Value: \$\_\_\_\_\_

Other Utility Improvements Accepted: \_\_\_\_\_ Value: \$\_\_\_\_\_

Inspector: \_\_\_\_\_ WVWA Project Manager: \_\_\_\_\_

C: Contractor, Developer, T Lane, N Carroll, Y Doolittle (WO), B Hutchison & N Clouse (ENG), T Lawfield  
Project File\*, Design Engineer\* Building Dept. of Locality\*, VDOT\*, Fire Marshal of Locality\* (\*if applicable)

**DSW-1**  
**DESIGN STANDARDS FOR WATER SYSTEMS**

1.1 GENERAL

- A. The following standards and specifications represent the minimum requirements for all public water systems within the service area of the Participating Utility, hereinafter “Participating Utility” or “owner”. Before construction is commenced, plans and specifications shall be reviewed and approved by the appropriate participating utility, and all construction shall be in accordance with the approved construction documents.
- B. Systems shall be designed to meet or exceed Virginia Department of Health Office of Drinking Water, Water Works Regulations, latest edition.
- C. Water mains shall be located within public rights-of-way or waterline easements, and shall be located no closer than five feet (5') from the edge of the easement or right-of-way line unless otherwise approved by the Participating Utility.
- D. Water supply systems, as described above, shall be designed by a Professional Engineer, licensed by the Commonwealth of Virginia whose seal and signature shall be placed on each plan sheet. A Land Surveyor licensed by the Commonwealth of Virginia may design such portions of a water supply system as provided by the Code of Virginia, Title 54, Section 54-17.1, 3(b).
- E. The Western Virginia Regional Standards and Specifications for Water and Sewer (Standards) shall be followed unless specified deviation therefore is authorized, in writing, by the Participating Utility. Deviations require use of the Request for Waiver, Modification or Field Change Form. When such deviations affect fire protection, approval by the Fire Marshal of the local jurisdiction shall also be obtained. Unless otherwise stated, all standards referenced in this Section shall refer to the latest revision or revised edition of the referenced manual.
- F. For agreements between the Participating Utility and the Contractor, the term “Participating Utility” shall substitute for “Owner” in all cases.

2.1 MINIMUM WATER MAIN SIZES

- A. Generally, the minimum water main size is twelve inches (12”) when located along a primary or other major roadway. Eight inch (8”) mains may be used elsewhere, but only when interconnected in a grid system no more than one-thousand-five-hundred feet (1,500') apart. Six inch (6”) mains may be used in dead end or cul-de-sacs beyond the last fire hydrant, if the block is less than six-hundred feet (600') in length. For streets with cul-de-sacs or dead ends beyond the last fire hydrant, in which all adjacent properties are evaluated and it is determined that the water line cannot and will not be extended in the future, two inch (2”) pipe may be used for the last three-hundred feet (300') when approved by the Participating Utility. The type of services installed along the two inch (2”) pipe must be evaluated to guarantee adequate flow to meet all existing and future demands at these services.

- **Two-inch lines are not allowed in the City of Salem or Town of Vinton**

- B. Fire hydrants shall not be installed on lines less than six inches (6") in diameter. Unless specifically approved otherwise by the Fire Marshal, no plantings or erection of other obstructions shall be made within a four-foot (4') radius of any fire hydrant, or at any location that would restrict access to the fire hydrant from the street. The ground surface within this same radius shall be level.

## 2.2 FIRE HYDRANT LOCATIONS

The following are general minimum design guidelines. Specific requirements shall be determined by the Jurisdictional Fire Marshal's Office.

- A. In residential areas, hydrants shall be located at street intersections and at intermediate locations where necessary, as determined by the Fire Marshal's Office. In no case shall the distance between fire hydrants, measured along the centerline of accessible streets, be greater than one-thousand feet (1,000').

- B. Within one-hundred feet (100') of any standpipe or sprinkler system fire-department connection, where those systems are required in buildings.

- C. As required by the following schedule as given by use group, the distance shall be measured to the most remote part of the structure the hydrant will serve.

Industrial buildings	250 feet
School buildings	300 feet
Commercial, Churches & Office Buildings	350 feet
Apartments, Multi-family & Townhouses	250 feet
Single family detached dwellings	500 feet*

\* Measured along centerline of street to the center of front property line for single-family detached dwellings only.

- D. All hydrants shall be a minimum of fifty feet (50') away from buildings other than single-family detached dwellings. The location of all new and existing hydrants that are to serve the property shall be shown on the plans.

## 2.3 WATER SYSTEM DESIGN

Water systems shall be designed to adequately supply normal and peak demands for all customers, maintaining a static pressure of not less than twenty-five (25) pounds per square inch at all points of delivery, and shall have adequate capacity to deliver not less than the fire flows listed below, for a minimum of two hours, with a residual pressure of not less than twenty (20) pounds per square inch at the service connection based on the greater of maximum hour or maximum day plus applicable fire flows. In those cases where the existing source of supply cannot deliver fire flows at adequate pressures, the design engineer shall submit a request for waiver. Fire flows shall be analyzed and presented separately, and pipes shall be sized to meet the calculated requirements of simultaneous peak domestic and fire flow. The Participating Utility can require higher design pressure if required by site conditions.

- A. Peaking Factors and Demands for Design:

1. Peak Hour Factor: 4
2. Maximum Day Factor: 2.5
3. Average Day Factor: 1
4. Residential demand per Equivalent Residential Connection (ERC): 0.5 GPM.

5. Industrial or commercial demands shall be based upon best engineering judgment.
  6. When the number of residential units is less than 1000, the formula  $Q=11.4N^{0.544}$ ; is acceptable for estimating maximum hour domestic demand flow where Q=total gallons per minute and N=total number of residential units.
- B. Fire Flow Requirements Based on Flow from a single two and one-half inch (2 ½") Nozzle:
1. Fire flow requirements shown below are for guidance only, the jurisdictional Fire Marshal shall determine required fire flows.
  2. Residential single-family/duplex:
    - a. A static pressure (PSI) and modeled fire flow (GPM) based on existing mains shall be shown on plans at each fire hydrant location.
    - b. Residential property with over 100' between buildings - 500 GPM.
    - c. Residential property with 31'-100' between buildings - 750 GPM.
    - d. Residential property with 11'-30' between buildings - 1,000 GPM.
    - e. Story and one-half residential - 1,000 GPM.
    - f. Two-story residential, congested area - 1,500 GPM.
    - g. Residential property with 10' or less between buildings - 1,500 GPM.
  3. Multi-family/Commercial/Industrial:
    - a. Apartments, townhouses up to 2-1/2 stories -1,500 GPM.
    - b. Minor mercantile and congested apartments, 2 to 3 stories - 2,000 GPM.
    - c. Industrial, shopping centers, and mercantile districts - 2,500 GPM.

In areas of mixed-use development, higher fire flow shall govern. Fire flows indicated above are for new development. Where size and scope of the development exceeds these requirements, additional flow shall be provided in accordance with ISO (Insurance Services Organization) requirements as reviewed by the Fire Marshal.
- C. In order to properly evaluate water systems and hydraulic conditions, all submitted plans shall be based upon actual USGS Datum and not assumed topographical elevations.

## 2.4 LOCATION

Water lines shall be located outside pavement whenever possible. Water lines shall be laid with a minimum parallel offset of four feet (4') from centerline of the pipe to either face of concrete curbing.

## 2.5 VALVES

Whenever possible, all valves shall be located outside the paved area. Valve vaults located within paved areas shall be set with the covers exposed and flush with street surface, to the satisfaction of VDOT or the local jurisdiction. If street surfaces are renewed or replaced by Developer or Owner after water system has been approved and accepted by the Participating Utility, but while such streets are still the obligation of the Developer or Owner, valve vaults shall be readjusted by developer. Valve vaults located in sodded or other off-street areas shall be so set with the covers exposed and flush with finished surface elevation. Valves shall be installed at the intersection of water lines. Generally, four (4) valves will be used at crosses and three (3) valves at tees. A valve shall also be installed at least every one-thousand feet (1,000') on distribution mains. A valve shall be installed between the last service and the terminus of any water main that can be extended in the future.

## 2.6 DEAD-END MAINS

- A. Dead-end waterlines shall be eliminated wherever possible by looping of water mains. Any dead-end water main that can be extended at a future date must have a valve within thirty-six feet (36') of the end of the main. Any water main that can be extended across an adjoining street shall be extended across that street as part of the initial construction. The termination point shall be designed to insure minimal surface destruction when extension is constructed. In no case shall the end of a pipeline terminate in a paved area, or under concrete curb or gutter. No service or fire hydrant shall be installed between valve and end of line that can be extended.
- B. Developers are required to extend on-site water mains to the limits of their developments, for existing or possible future system looping and/or additional supply sources for the development.

## 2.7 MINIMUM COVER

All pipes shall be installed at a minimum depth of thirty-six inches (36") from established final grade to the top of the pipe. Water pipe shall not be installed at depths exceeding six feet (6') unless specifically approved by the Participating Utility.

## 2.8 BLOW-OFFS

A means to flush and drain dead-end lines shall be provided as indicated in the Standard Details. All transmission mains will be provided with blow-off valves at strategic low points in the line. The point of connection to the water main shall be located near the bottom of the main to facilitate removal of accumulated sediment. Fire hydrants may be used at low points in place of blowoffs, if approved by Participating Utility.

## 2.9 COMBINATION AIR-VALVES

Combination air valves shall be placed at strategic high points in the system to provide for the release of trapped air. Combination air valve shall be installed as indicated in the Detail Drawings.

## 2.10 CROSS CONNECTIONS

Cross connection and backflow prevention shall be designed and reviewed to insure compliance with the governing cross connection and backflow ordinances.

## 2.11 PUBLIC WATER EASEMENTS

- A. All water easements shall be a separate dedicated water easement and shall not be included in a Public Utility Easement.
- B. Water mains may be installed on private property if a water easement with a minimum width of twenty feet (20') is duly recorded for the proper installation, maintenance, operation, replacement, or removal of the water facilities. The Participating Utility shall be given recorded easements from all parties possessing or having legal interest in the property. Additional easement widths will be required if both water and sewer mains are located in the same easement. The easement width may be reduced in certain areas with written approval of the Participating Utility, when the twenty foot (20') easement would constitute a significant hardship for the development. In no case will an easement of less than twenty feet (20') be allowed for lines twelve inches (12") in diameter or larger.
- C. Increased easement widths may be required by the Participating Utility when determined necessary due to large lines or excessive depths which will require special trench excavation in order to comply with applicable State and Federal safety regulations. Additional 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 and rounded up to nearest foot. See Detail Drawings.
- D. Any water meter located on private property shall require a waterline easement giving the Participating Utility the right of access to water service connection, water meter, and associated appurtenances, for the purpose of maintenance, operation, and replacement.
- E. No permanent structure, including but not limited to sheds, fences, retaining walls, patios, as well as trees or shrubbery, shall be placed or constructed within an easement. Any damage to shrubs that are located within the easement that may be caused by the legal use of the easement by the Participating Utility shall be the responsibility of the property owner.
- F. Where deemed necessary by the Participating Utility, and in order to ensure maximum utilization of public water systems, it will be required that appropriate public easements be provided to adjacent properties for access or extension of said public water system.

## 3.1 SURFACE WATER CROSSINGS

- A. Surface water crossings, both over and under water, present special problems and shall be discussed with the Participating Utility before final plans are prepared.
  - 1. Above Water Crossings - The pipe above water crossings shall be:
    - a. Adequately supported;
    - b. Protected from damage from freezing;
    - c. Accessible for repair or replacement; and
    - d. Above 100 year flood level or sufficiently protected from floatable debris.
    - e. Minimum class 350 restrained joint ductile iron pipe (DIP).

## 2. Under Water Crossing:

- a. Pipe shall be in accordance with one of the following methods:
  - i. Open Cut - Class 350 restrained joint DIP shall be used with a minimum of six inches (6") on all sides being concrete encased within the one hundred (100) year floodway limits. Refer to General Detail Drawings.
  - ii. Directional Drill – HDPE pipe shall be used in accordance with the requirements of CS-7 Item 2.1.B and shall be encased in HDPE unless otherwise approved by the Participating Utility.
- b. Valves shall be provided at both ends of the water crossing so that the section can be isolated for tests or repair; the valves shall be easily accessible and not subject to flooding by the 100-year storm event.
- c. Permanent sample taps shall be installed on each end of the crossing and at reasonable distance from each side of the crossing to facilitate testing.

### 4.1 WATER STORAGE FACILITIES

- A. Water storage facilities shall be designed and constructed to meet the requirements of ANSI/AWWA D100 for "Welded Carbon Steel Tanks" or ANSI/AWWA D103 for "Factory Coated Bolted Steel Tanks" for water storage, latest edition, except as specified otherwise. Precast concrete water storage reservoirs may be required by the Participating Utility under specific conditions that require below ground reservoirs. An NSF approved active mixing system shall be installed in all tanks.
- B. Steel Standpipe, Reservoirs and Accessories:
  1. Supplemental Information to both ANSI/AWWA D100 and ANSI/AWWA D103.
    - a. Earthquake Design: Seismic Zone 2 using fixed percentage method of 5%.
    - b. Electric Power: Developer/Contractor's obligation
    - c. Compressed Air: Developer/Contractor's obligation
    - d. Concrete Work: Comply with all requirements of ACI 301.
  2. Supplemental Information to ANSI/AWWA D100.
    - a. Corrosion Allowances: 1/16-inch for parts in contact with water.
    - b. Submit written report certifying work inspected as set forth in ANSI/AWWA D100, Sec. 11.2.1. Mill and shop inspection by commercial inspection agency is required.
    - c. Submit details of all welded joints referenced on design drawings in accordance with ANSI/AWWA D100, Sec. 1.3.

- d. Mill Scale: Completely remove by blast cleaning or pickling. (SSPC-SP10 or SSPC-SP8)
  - e. Butt-joint welds subject to secondary stress where thickness is greater than three-eighths inch (3/8") shall have complete joint penetration welds.
  - f. Radiographic tests shall be required and film shall become property of the Participating Utility.
  - g. Protective Coatings:
    - i. Surface preparation and coating systems specifications will be provided by the Participating Utility at the time of plan preparation.
    - ii. First anniversary inspection in compliance with ANSI/AWWA D102 will be required.
    - iii. Paint color shall be as selected by the Participating Utility from the manufacturer's available colors.
3. Supplemental Information to ANSI/AWWA D103.
- a. Tank Bottom: Concrete slab and steel base setting ring is required.
  - b. Full five (5) year manufacturer's warranty on factory coating is required.
4. The following accessories, in addition to those required by either ANSI/AWWA D100 or ANSI/AWWA D103, shall be provided and installed.
- a. Exterior safety cage, rest platform and roof ladder, handrails to accessories in conformance with OSHA. A fall prevention system, which complies with applicable OSHA regulations, is acceptable as a substitute for the cage and rest platform. All tanks with ladders shall include a climbing deterrent device to prevent unauthorized climbing of ladder. This device must be reviewed and approved by the Participating Utility prior to installation.
  - b. Overflow to ground, 1,000 GPM minimum, located near roof opening. Provide coarse screen and concrete splash pad and erosion-protected channel from overflow to drainage system or natural channel.
  - c. Screen vent against insects, provide special vent to insure fail-safe operation in event insect screens frost over.
  - d. Removable silt stop.
  - e. Separate drain line to drainage system or natural channel with erosion protection.
  - f. SCADA System to indicate water level in order to comply with VDH requirements. SCADA shall match the existing system of the Participating Utility or as specified by the Participating Utility.

## C. Disinfection

1. After all painting and coating schedules have been completed and the specified drying times have elapsed, the Developer/Contractor shall proceed to disinfect the interior surfaces of the standpipe structure utilizing one of the following disinfection methods:
  - a. Tank shall be filled to overflow level with potable water to which enough chlorine has been added to produce an initial chlorine concentration of 50 mg/l in the full tank. The full tank should stand for 24 hours; however, in no case, shall it stand less than 6 hours. At the end of the holding period, the highly chlorinated water shall be drained to waste, the tank refilled with potable water and tested for bacteriological quality.
  - b. All interior surfaces of the tank shall have applied to them a strong chlorine solution containing at least 200 mg/l of free available chlorine. The chlorine solution shall be applied with either spray equipment or brushes. Any equipment used to apply the chlorine solution shall either be new or previously used only for disinfection purposes. Strong chlorine solution shall remain in contact with tank surfaces for at least 30 minutes. Tank shall then be filled with potable water to overflow level and tested for bacteriological quality.
  - c. Potable water containing a free chlorine residual 50 mg/l shall be placed in the tank to such a depth that when the tank is filled, the resulting chlorine concentration in the water will be at least 2 mg/l. The water containing 50 mg/l of chlorine shall stand in the tank for 24 hours. The tank shall then be filled with potable water and allowed to stand for 24 hours. At the end of the second 24-hour period, the chlorine residual shall be at least 2 mg/l. After bacteriological analysis of the water for quality, the tank may be placed in service without draining the water used to disinfect it.
2. Two consecutive bacteriological samples collected at 24-hour intervals shall be obtained from the standpipe structure before the tank is placed into service. The bacteriological test form shall be marked "CONSTRUCTION SAMPLE". Analysis of the samples shall be performed by a laboratory certified by the Division of Consolidated Laboratory Services (DCLS). If contamination is indicated in the bacteriological samples, the disinfection procedure shall be repeated at the Developer/Contractor's expense.

## 5.1 WATER PUMP STATIONS

- A. Water pump stations shall be designed and constructed to meet the Standards of the Virginia Department of Health, and in addition to meet the following:
- B. All pump stations shall be designed with two pumps, or as required by the Participating Utility, each capable of pumping 100 percent of the peak day design flow without overloading. Hydraulic-actuated or electrically-actuated pump control valves shall be provided for each pump unless otherwise approved by the Participating Utility.

- C. Pump stations shall be controlled by pressure devices installed on a separate sensing line at the point of storage. For pump stations not located at storage facilities, pump control information shall be transmitted to pump station as required by Participating Utility.
- D. Pump controllers shall include provisions for alternating plus backup control of pumps.
- E. Electrical Requirements:
  - 1. Motors 5 horsepower and above shall be 3 phase. Where 3 phase is available, Motors larger than 3 horsepower shall be 3 phase. Variable Frequency Drives (VFD) may be required by the Participating Utility.
  - 2. Three phase Motors shall have phase protection on individual phases which also protect when running, as manufactured by Square D, Allen-Bradley or equal as approved by the Participating Utility.
  - 3. Three phase Motors shall each have an individual poly-phase starter unless provided with VFD.
  - 4. All pumps shall be controlled by starters with individual HOA switches.
  - 5. Starters shall be sized one size larger than horsepower required. Heaters shall be sized for actual current load.
  - 6. All control circuits shall be 120 volt.
  - 7. Electrical service shall be provided with lightning arresters.
  - 8. Electrical panel shall have a minimum of 20 circuits.
  - 9. All electrical wiring shall be placed in conduit.
  - 10. Water pump stations shall be considered a wet location for interpretation of the National Electric Code requirements.
  - 11. All receptacles and switches shall have a minimum 20-amp rating, and shall have GFCI protection.
  - 12. All electrical equipment and panels shall be manufactured units with UL listing and shall include the manufacturer's warranty.
  - 13. A non-automatic transfer switch shall be installed on load side of service disconnect. Switch shall be rated same as or higher than service disconnect.
- F. Hour run meters shall be required for each pump motor.
- G. A master water meter shall be provided with 4/20mA output register.
- H. All pump stations installed above ground shall be of masonry construction with masonry or frame roof with 50-year life expectancy. Exterior shall be brick faced or washed pebble and shall have zero-maintenance fascia, soffit and trim. Pre-hung insulated steel doors with minimum size 3'-0" x 6'-8" shall be used. Precast buildings may be used with approval from the Participating Utility.

- I. Pump houses shall have adequate insulation to protect equipment and reduce heating cost.
- J. Adequate lighting, heating, ventilation, and drainage shall be provided for pump stations.
- K. Below or in-ground pump stations may be approved by the Participating Utility for special application on an individual basis. Such approval will only be given when such design meets all the above requirements and adequate provisions are made for the prevention of flooding, safe working conditions, efficient access system and adequate area for maintenance and operation of the pump station.
- L. Minimum size structures to house a pump station shall be 8 feet x 10 feet x 8 feet high.
- M. All pump stations shall comply with applicable UNIFIED STATEWIDE BUILDING CODE Codes, and applicable jurisdictional permits shall be secured.
- N. All pump station piping and fittings shall be flanged unless otherwise approved by the Participating Utility.
- O. Isolation valves shall be installed at the intake and discharge of all pumps, and on the suction and discharge mains for pump station isolation. Isolation valves shall be required between the connection to the piping and all gauges and all other smaller diameter taps.
- P. Bleeder valves (petcocks) shall be provided on all pump discharge lines.
- Q. Pump shutoff controls (low pressure cut-off switch) to shut off pumps is required for each pump, along with (high level pressure switch) with manual reset when discharge pressure exceeds 85 psi, unless otherwise approved by the Participating Utility.
- R. Gauges and meters - The station shall have indicating, totalizing, and recording metering of the total water pumped.

Each pump shall:

1. Have a standard pressure gauge on the discharge line.
2. Have a compound gauge on its suction line; and
3. Have recording gauges in the larger stations as required by the Participating Utility.

**- END OF SECTION -**

**DSS-1**  
**DESIGN STANDARDS FOR SANITARY SEWER SYSTEMS**

1.1 GENERAL

- A. The following standards represent the minimum requirements for all public sanitary sewer systems within the service area of the Participating Utility, hereinafter "Participating Utility" or "Owner". Design of sanitary sewer systems shall also be in accordance with the Virginia Department of Environmental Quality (DEQ) Sewage Collection and Treatment (SCAT) Regulations. Before construction is commenced, plans and specifications shall be reviewed and approved by the Participating Utility and/or DEQ if required. All subsequent work shall be constructed in accordance with the approved plans.
- B. If public sewer is not available, the property owner shall acquire necessary VDH approval prior to a building permit being issued.
- C. Sanitary sewers shall be designed to serve all lots, including lateral connections between the sewer main and the property line being served.
- D. Any plan approval required by the local jurisdiction(s), shall be obtained by the Developer prior to plan approval by the Participating Utility.
- E. DEQ approval is required for gravity sewer projects with an average daily flow greater than 40,000 gpd, pump station projects greater than 2,000 gpd (average daily flow), and sewage treatment plants.

2.1 GENERAL DESIGN CRITERIA

- A. Non Sanitary Sewer Flows Prohibited
  - 1. The Participating Utility's sanitary sewer system is designed to provide conveyance with total containment. New sewers, extensions, or replacements, not designed to provide total containment for the design period shall 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. This criteria established herein is required in order for the Participating Utility to comply with the Virginia Pollutant Discharge Elimination System (VPDES) Permit Regulation authorizing the discharge of pollutants, under prescribed conditions, to State waters pursuant to the Virginia Department of Environmental Quality (VDEQ), Regulation 9 VAC-25-31.
- C. All sanitary sewer design shall comply with the approved latest edition of Local Government Comprehensive Plan, and Commonwealth of Virginia Sewage Collection and Treatment Regulations, as applicable.
- D. 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 Participating Utility's sanitary sewer system when requested.

- E. The horizontal and vertical separation between sewers and waterlines shall be in accordance with the requirements of CS-1 Item 3.2, Separation of Water Lines and Sanitary Sewer.
- F. 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 twenty-four inches (24") in diameter, the crossing must be specifically designed and construction details provided.
- G. A plan and profile of the sanitary sewer system is required.
- H. Sewers not located within public streets or right-of-ways, shall have dedicated access easements to all manholes, sewer lines and laterals.

## 2.2 TRIBUTARY POPULATION

Sanitary sewers shall be designed for the estimated ultimate tributary population. Consideration shall be given to domestic, commercial, institutional, and industrial waste water flows in determining the capacity of the system. The design shall be based on approved estimates of anticipated populations and flows for a period of 50 years hence, or the entire sewershed 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 Participating Utility approves otherwise.

## 2.3 SEWAGE FLOW

- A. Determining the average design flow shall be the first step in the sizing of sanitary sewerage systems. Peak factors and average daily flow rates shall be in accordance with DEQ Sewage Collection and Treatment Regulations (SCAT). Actual design quantities may be substituted for the average design flows, provided supporting data is furnished to and approved by the Participating Utility.
- B. 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.
- C. Ventilation of gravity sewer systems shall be provided where continuous watertight sections greater than one-thousand feet (1,000') in length occur.
- D. All sanitary sewer plans submitted to the Participating Utility for review shall provide detailed calculations and include a separate sheet with the following information:
  - 1. Date
  - 2. Project Title
  - 3. Project Location
  - 4. Design Flows (both average and peak)
  - 5. Pipe Material & Diameter
  - 6. Length

## 2.4 SEWER MAIN SIZE AND DEPTH

- A. No public sanitary sewer main shall be less than eight inches (8") in diameter, except for sewer force mains.
- B. All sewer mains and service laterals shall have a minimum cover of three feet (3') (See Section CS-3, Item 3.4).

- C. Depth of sanitary sewer mains shall be limited to the following:
  - 1. Twenty feet (20') when no laterals are connected to the main.
  - 2. Fifteen feet (15') when sewer laterals are connected to the main.
- D. 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 twelve feet (12') 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.
- E. The elevation of the lowest finished floor served shall be a minimum of three feet (3') above the top of the main at the point where the service lateral connects to the main. All design/construction plans shall include a table that lists elevations of each finished floor served, and the corresponding top of the main elevation.

## 2.5 LOCATION

- A. 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.
- B. 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 Participating Utility.

## 2.6 SLOPE ANCHORAGE

Concrete anchors shall be placed on sanitary sewer lines with grades of 20 percent or greater. Minimum anchorage shall be provided such that anchors are not located over thirty-six feet (36') center 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 Participating Utility. All slopes over 20 percent shall require the use of restrained joint DIP, restrained joint pressure-rated PVC, or HDPE with fused collar(s). ASTM D3034 SDR 26 gravity sewer pipe shall be restrained at all joints with Ford UFR1390-P-x-I or approved equal when installed on slopes over 20 percent. SDR 35 gravity sewer pipe shall not be installed on grades of 20 percent or greater. Refer to General Detail Drawings.

## 2.7 SEWER MANHOLES

- A. Manholes within the paved area of streets should be located at the center of the travel lanes.
- B. Manholes where the invert is lower than the normal groundwater elevation (i.e., along creeks, rivers, low-lying areas, etc.) shall have a full exterior coating and joint wrap applied in addition to joint sealant.
- C. 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 Participating Utility. This provision does not preclude the crossing of these driveways at generally 90-degrees with a sanitary sewer pipe.

- D. The deflection angle from the inflow pipe to the outflow pipe at any junction shall not be less than 90-degrees. Where more than one (1) inflow line enters a manhole, the deflection angle shall be less than 90° between the inflow lines (i.e., no inflow line shall direct flow up another inflow line).
- E. 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, or 0.50 feet for a change of flow direction equaling 90-degrees unless otherwise approved by the Participating Utility.
- F. Manholes for access to sewer lines shall be provided at:
1. At all intersections of differing size sewers,
  2. At all points of change in horizontal alignment,
  3. At all points of change in grade,
  4. At the end of all sanitary sewer lines,
  5. At intervals not exceeding four hundred feet (400') on all sewers fifteen inches (15") in diameter or less and not exceeding six-hundred feet (600') on all sewers larger than fifteen inches (15") in diameter,
  6. A sampling manhole may be required for non-residential users. The sampling manhole may be used in lieu of the required cleanout at the property/easement line. Sampling manholes shall be tested by either vacuum method or exfiltration. Flow shall pass straight through sampling manhole, i.e., 180 degrees.
- G. When it is necessary due to steep slopes, increased velocity or invert elevation differences equal to or greater than twenty-four inches (24"), 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 (6"). The minimum diameter manhole for use with an inside drop connection shall be five feet (5'). Only one inside drop shall be installed per five-foot (5') diameter manhole. Two inside drop connections may be made in a six-foot (6') diameter manhole. These provisions apply for both sewer main and lateral connections. Refer to Detail Drawings.
- H. Outside drop manhole connections may be acceptable only with written approval from the Participating Utility.
- I. Manholes for sewers up to fifteen inches (15") in diameter shall not be less than four feet (4') inside diameter. Manholes for sewers up to thirty-six inches (36") shall be in accordance with manufacturers recommendations, but shall not have an inside diameter of less than five feet (5'). If hydraulic characteristics do not permit use of a four-foot inside diameter manhole, a five-foot diameter manhole or special manhole detail must be provided. The participating Utility will provide manhole dimensions for sewers over thirty-six inches (36").
- J. When designing new sewers to tie into existing sewers, the connection shall be made by one of the following methods:

1. Connection to an existing manhole - Connection to the existing manhole must

be configured so that the invert of the new tie-in is not established lower than the existing bench.

2. 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 per Detail Drawings. This method will require pumping of existing flows during installation. Testing shall be by the vacuum test method.
  3. Straddle manhole – (If approved by the Participating Utility) Straddle manholes may be used for installations not suitable to the above two methods. Refer to Detail Drawings. A Participating Utility inspector must be present during installation of all straddle manholes. Testing shall be by the vacuum test method.
- K. 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 shown in Detail Drawings.
- L. Sewers adjacent to or crossing streams, estuaries, lakes and reservoirs shall be designed, constructed and protected in accordance with requirements of the DEQ Sewerage Collection and Treatment Regulations, except that:
1. The connection of sanitary sewer mains shall be made only at manholes. The pipe material must be the same from manhole to manhole. Connections to existing manholes shall be made in accordance with CS-3 PART THREE – EXECUTION Item 3.10 PIPE CONNECTION AT MANHOLES.
  2. Sewer lines crossing streams shall be Class 350 restrained joint DIP, C906-DR 11 HDPE, or equivalent and concrete encased unless otherwise approved by the Participating Utility. Refer to General Detail Drawings. Ductile Iron Pipe, if used, shall be lined with Protecto 401™ Epoxy, or approved equal. Pipe shall be provided with a minimum of one foot of cover over the concrete encasement where the stream is located in rock and three feet (3') minimum cover where the stream is located in other materials. The cover requirements may be lessened with the approval of the Participating Utility in an area that will not interfere with future improvements to the channel bottom.
  3. Sewer lines shall not be located within stormwater management impoundment areas unless there is no alternative. The Participating Utility may approve sewer lines within a stormwater management impoundment area only if such sewer lines are designed and constructed to site specific conditions that will protect the sewer line from future excavation and dredging.
  4. **Siphons are not allowed** unless approved by the Participating Utility. If allowed, inverted siphons shall not be less than two (2) barrels, with a minimum pipe size of six inches (6") 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 three feet (3') per second for average flows. The inlet and outlet shall be arranged so that

normal flow may be diverted to one (1) barrel so that either barrel may be removed for service or cleaning.

## 2.8 SANITARY SEWER SERVICE LATERALS

- A. Sanitary sewer cleanouts shall be:
1. Located at the property line or sanitary sewer easement line contiguous to the property. Refer to Detail Drawings.
  2. A traffic bearing cleanout box is required if located in paved areas. Refer to Detail Drawings.
  3. For open cuts, the minimum slope for four inch (4") lateral shall be 2.0 percent and six inch (6") shall be 1.0 percent. For 6" laterals installed by horizontal directional drilling, the minimum slope shall be 2.0 percent. Maximum slope of service lateral shall be 100 percent within public easements or right-of-ways.
  4. The horizontal angle of the lateral from the sewer main shall not exceed 45 degrees, and shall discharge in the direction of flow.
- B. No service connections shall be made to a trunk line fifteen inches (15") or greater in diameter without written permission from the Participating Utility.

## 2.9 HYDRAULIC CRITERIA

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

- A. Sewers shall have a uniform slope and alignment between manholes.
- B. 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.
- C. All sewers shall be designed and constructed to give mean velocities, when flowing full, of not less than 2.0 feet per second, based on Manning's formula using an "n" value of 0.013. The following are the recommended minimum slopes which should be provided; however, slopes greater than these are desirable.

<u>Sewer Size</u>	<u>Minimum Slope in Feet per 100 Feet**</u>
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

\*\* In no case shall terminal lines with less than 20 residential connections have a slope of less than one percent unless approved by the Participating Utility.

- D. The maximum permissible velocity occurring with average flow shall be 10 feet per second (before applying peak flow factor).
- E. 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 ANSI/AWWA specifications approved by the Participating Utility and shall be anchored as specified below.
- F. Benches in terminal manholes shall be built at a slope of not less than one inch per foot. Minimum Permissible Depth.
- G. In general, 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 Participating Utility is required for reduction in line sizes.

## 2.10 SANITARY SEWER FORCE MAINS

- A. The minimum size for force mains shall be four inches (4") except when using grinder pumps.
- B. At pumping capacity, a minimum velocity of two feet per second shall be maintained.
- C. A sewage air relief valve shall be placed at the necessary high points in the force main to release trapped air.
- D. Maximum velocity shall be eight feet per second.
- E. All force mains shall connect to a cleanout with a drop stack connection at the right-of-way or easement line. From there the flow shall be gravity into the public system. See Detail Drawings.
- F. All pipe used for force mains shall be pressure type with pressure type joints. (restrained joint PVC SDR 21, CL 200 minimal, HDPE DR 9, or Yelomine SDR 21).
- G. Anchorage shall be provided where deemed necessary by the Participating Utility, refer to the Commonwealth of Virginia Sewage Collection and Treatment Regulations for testing and anchorage guidelines of force main sewers.
- H. Receiving gravity flow sewage system shall be analyzed for adequacy to handle peak force main discharges.

## 2.11 PUBLIC SANITARY SEWER EASEMENTS

- A. All sanitary sewer easements shall be a separate dedicated sanitary sewer easement and shall not be included in a Public Utility Easement.

- B. Sanitary Sewer mains may be installed on private property if a sewer easement with a minimum width of twenty feet (20') is duly recorded for the proper installation, maintenance, operation, replacement, or removal of sewer facilities. The Participating Utility shall be given recorded easements from all parties possessing or having legal interest in the property. Additional easement widths will be required if both water and sewer mains are located in the same easement. The easement width may be reduced in certain areas with written approval of the Participating Utility, when the twenty foot (20') easement would constitute a significant hardship for the development. In no case will an easement of less than twenty feet (20') be allowed for lines twelve inches (12") in diameter or larger.
- C. Increased easement widths may be required by the Participating Utility when determined necessary due to large lines or excessive depths which will require special trench excavation in order to comply with applicable State and Federal safety regulations. Additional 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 foot. See Detail Drawings.
- D. No permanent structure, including but not limited to sheds, fences, retaining walls, patios, as well as trees or shrubbery, shall be placed or constructed within an easement. Any damage to shrubs that are located within the easement that may be caused by the legal use of the easement by the Participating Utility shall be the responsibility of the property owner.
- E. Where deemed necessary by the Participating Utility, 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.

### 3.1 PRIVATE SEWAGE LIFT STATIONS

- A. Private sewage lift stations (i.e., those stations not accepted into the Participating Utility's sewer inventory and privately maintained) may be approved by the Participating Utility under the following conditions.
  - 1. Private sewer lift stations shall meet the construction requirements of the applicable building/plumbing code and may only accept flows from private sewer systems limited to:
    - a. Building laterals
    - b. Collector laterals
    - c. Private sewer systems entirely on a single lot of record

### 3.2 PUBLIC SEWAGE LIFT STATIONS

- A. Public sewage lift stations shall meet the requirements of the Participating Utility's Sewer Lift Station Design Standards.
- B. Due to the excessive operation and maintenance cost of public sewer pump stations, these stations will only be accepted under a waiver request. These requests must include all alternatives to the lift station including the cost to provide gravity sewer service to the property. The cost for the off-site gravity sewer extension must exceed the cost of the lift station by a factor of three.

- C. The inability to obtain off-site public easements for a gravity sewer extension will not in itself be justification to install a lift station. Public sewage pump stations will not be approved where on-site systems are feasible in any form or configuration or where common sewer force mains with individual (private) pumps at each house are possible.

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**SANITARY SEWER LIFT STATION DESIGN STANDARDS**

1.1 GENERAL

- A. As required by the Western Virginia Regional Design & Construction Standards, a consultant or developer proposing to construct a lift station and force main system must prepare a present value analysis of the cost of constructing gravity mains compared to the cost of the lift station/force main system. This analysis must show that the lift gravity sewer extension is more than three (3) times the cost of a lift station/force main system. Lift stations will only be considered a viable option if the cost analysis clearly shows that the gravity sewers are not economically feasible. Lift stations will not be allowed where an acceptable alternative gravity route exists, including those provided through directional drilling. The inability to obtain off-site public easements for a gravity sewer extension will not in itself be justification to install a lift station.
- B. All public lift stations shall be located on Participating Utility owned property. Property conveyance shall occur at Substantial Completion.
- C. Lift Station design must consider the potential for expansion to build-out densities, based on jurisdictional Comprehensive Plans for the lift station's feasible sewershed area. The lift station design must be based on both the total number of acres and number of Equivalent Residential Connections (ERC) to be developed. The flow capacities are determined in accordance with applicable chapters and sections of the Virginia Sewage Collection and Treatment (SCAT) Regulations, latest edition.
- D. Lift stations may be submersible, suction lift self-priming, or packaged wet suction lift depending on station size/capacity, head requirements and motor horsepower. Table 1 outlines the allowable design criteria for each type of lift station.
- E. All lift stations must be designed to meet the requirements of Article 2 of the latest edition of the SCAT Regulations, and contemporary industry practices. An application or submittal for a lift station must satisfy all State requirements, which include final construction plans and a design report prepared by a Virginia Licensed Professional Engineer.
- F. The Firm Pumping Capacity of all lift stations must be such that the expected peak flow can be pumped to its desired destination. Firm Pumping Capacity is defined as total station, maximum pumping capacity with the largest pumping unit out of service.
- G. Lift Station sites must be large enough to provide adequate clearance for unimpeded maintenance operations. The paved area surrounding the lift station components including, but not limited to, the wet/dry wells, pumps/motors, valves, and vaults must be large enough to permit heavy equipment and vehicles ample room to maneuver. Design of access roads must minimize turns and achieve the straightest possible alignment to allow safe access for large maintenance vehicles.

**TABLE 1 - LIFT STATION DESIGN CRITERIA**

Station Type	Maximum Motor Horsepower
Suction-lift/Self-priming**	No restrictions
Submersible	No restrictions
Packaged Suction Lift	100 HP

\*\* Total dynamic suction lift at “pumps off” elevation, and required net positive suction head at design operating conditions must not exceed 22 feet. Limit vertical lift to 16 feet.

- H. The lift station must have an access road located in a dedicated right-of-way or permanent easement. The road surface must have a minimum width of 14 feet and must be constructed for access in all weather conditions. The road surface must be above the water level caused by a 25-year storm event. In a phased development, a stabilized access road may be accepted during the initial phase, with paving to be accomplished in a later, agreed upon, phase. Limit the slope to no more than 8 percent (8%), to allow for access by large emergency or maintenance equipment.
- I. Provide two 8-foot gates for a 16-foot clearance to allow access by large maintenance equipment. Turnarounds may be required for stations constructed along heavily traveled streets. Allow sufficient space for unhindered service vehicle access to wet well. Provide a minimum setback distance from the curb/edge of roadway to the gate of thirty feet. Lift stations are not allowed within the street right-of-way.
- J. The lift station, including all electrical and mechanical equipment, must be protected from a 100-year flood event, and be fully operational during such event.
- K. To provide for protection of the lift station, including mechanical and electrical equipment, from access by any unauthorized person, the lift station must be enclosed within an intruder resistant fence or located entirely within a lockable structure. An intruder resistant fence must consist of a minimum of a chain link fence 6-feet in height, with a 1-foot section above consisting of 3 strands of barbed wire “up-riggers.”
- L. One or more lockable aluminum hatch covers must be installed in the wet well cover for access to the wet well and pump(s). Minimum hatch dimensions must be 3 feet by 3 feet, or large enough to allow plentiful room for removal of submersible pumps and access to wet well.
  - 1. Provide 316 stainless steel hinges.
  - 2. Provide non corrosive locking bar to keep lid open.
  - 3. Provide stainless steel spring for opening assistance.
  - 4. Ensure cover does not protrude into the channel frame when in the open position.
  - 5. Frame design should limit water intrusion into wet well.
  - 6. Frame shall be capable of supporting a minimum load of 300 lb per square foot in non-traffic locations.
  - 7. Frame shall be AASHTO H-20 load rated if there is likelihood of vehicles impacting frame.
- M. Provide a reinforced concrete base slab, or other appropriate feature, sized adequately to counteract buoyancy, and provide supporting design calculations.

- N. Grade site so that storm runoff drains away from the wet well and pumping structures.
- O. Provide 1-inch water service (5/8-inch meter) with anti-siphon backflow prevention device, atmospheric or hose connection. If public water service is not available, a waiver must be obtained from the Participating Utility.
- P. Provide calculations (in engineering report) to determine potential for hydrogen sulfide suppression in force main and wet well, and provide recommendations.
- Q. All exposed pipe, valves, and fittings outside the wet well must receive after installation, a two-coat Epoxy coating system suitable for the environment, and with finish coat in accordance with the color-coding set forth in Table 2, below. Approved manufacturers are Tnemec, Carboline, Sherwin-Williams, PPG, and M.A.B. Paints.
- R. All pump discharge pipe and fittings within wet well, except 316 Stainless Steel and PVC, must receive after installation, a two-coat Epoxy coating system suitable for the environment. Approved manufacturers are Tnemec, Carboline, Sherwin-Williams, PPG, and M.A.B. Paints. All bolts required on discharge piping shall be stainless or galvanized.

**TABLE 2 - LIFT STATION COLOR CODES**

TYPES OF EQUIPMENT	COLOR
1. Pump Suction Piping	Gray – Pantone Number 431 U
2. Header and Force Main Piping	Gray – Pantone Number 431 U
3. Pump/Motors and Mounts	Gray – Pantone Number 431 U
4. Potable Water Line	Avalon Blue – Pantone Number 558 C
5. Compressed Air Line (where used)	Green – Pantone Number 349
6. Power Conduit	Orange – Pantone Number 166
7. Control/Instrumentation Conduit	Yellow – Pantone Number 109
8. Recycle water pipe	Purple – Pantone Number 521 C

2.1 WET WELL DESIGN

- A. Wet wells shall be a minimum of seventy-two inches (72") in diameter, or larger if necessary to accommodate pumping equipment for submersible stations. Depth of wet wells on submersible lift stations must consider adequate submergence of the pumps and emergency storage requirements.
- B. Emergency Storage includes additional volume within the wet well as well as capacity of sanitary collection system upstream from the lift station. The maximum elevation allowed for Emergency Storage shall be at least three feet below the lowest finished floor being served by the lift station. Emergency Storage capacity must be supported by calculations in the engineering report. Design Emergency Storage for a minimum of 2 hours above the high-level alarm set point.
- C. The lift station design must minimize odor potential. Locate incoming well gravity pipes to reduce turbulence. Minimize retention times in wet well. Total detention times greater than 180 minutes may require odor control measures.

- D. No fixed ladders are permitted in the wet well; however, when used elsewhere, ladders must have rungs with non-skid surfaces and must comply with all other requirements of OSHA 1910.27, Fixed Ladders.
- E. The wet well floors must have a minimum of 10 percent slope to the pump intakes and have a smooth finish. There must be no wet well projections that will allow deposition of solids under normal operating conditions. Include anti-vortex baffling on all lift stations with greater than 5 MGD Firm Pumping Capacity.
- F. Fillets shall be installed along wet well walls at a minimum slope of 1:1.
- G. Based on peak flow, pump cycle time must not be less than those in Table 3.

**TABLE 3 - MINIMUM PUMP CYCLE TIMES**

<b>Pump Horsepower</b>	<b>Minimum Cycle Times (minutes)</b>
Submersible pumps	6
Non-submersible pumps	10

- H. Construct precast wells with a monolithic base structure. The minimum wall thickness must be eight inches (8") for all wet wells. The minimum base thickness must be twelve inches (12"). The precast top slab must have a minimum thickness of ten inches (10"). Fiberglass wet wells may be used contingent to prior approval by Participating Authority.
- I. Line interior of precast wet well with an epoxy coating system. Approved manufacturers are Raven, Tnemec, Belzona, Sika, and Carboline. Alternatively, a high-density polyethylene (HDPE) and Polypropylene Copolymer (PPR) thermal plastic liner installed at the foundry as an integral part of the concrete casting process, as manufactured by AGRU Sure Grip is also approved.
- J. The exterior of precast wet well must be coated with a coal-tar epoxy system. Coating must be continuous, free of "pin holes" and/or voids, and it's to be applied in accordance with manufacturer instructions. After wet well top slab, base and all sections have been permanently set in place, seal outside with a chemically compatible non-shrink grout prior to exterior application of protective epoxy coal tar coating. Approved manufacturers are Koppers, Tnemec, and Sherwin-Williams.
- K. The wet well shall be placed on compacted native soil (or rock) with a minimum of twelve inches (12") of compacted #57 stone bedding to support the base of the structure.
- L. All backfill shall be placed in ten inch (10") maximum lifts, compacted to 90% of standard proctor.
- M. Use 316 Stainless Steel screens on passive ventilation, gooseneck type or turbine, to prevent the entry of birds or insects to the wet well. If passive ventilation is provided for the wet well, any mechanical and electrical equipment in the wet well must be of explosion-proof construction. Size the passive ventilation to vent at a rate equal to the maximum pumping rate of the station and not exceed 600 fpm through the vent pipe. The minimum air vent size must be 4-inch diameter. Vent outlets must be at least 1 foot above the 100-year flood elevation.

- N. All equipment within the wet well shall be explosion proof. However non-explosion proof equipment may be approved with the addition of proper ventilation. If explosion proof mechanical and electrical equipment is not provided throughout the wet well, use continuous mechanical ventilation to ventilate the wet well. Size the ventilation equipment for 12 air changes per hour and construct of corrosion resistant material. In residential areas, there may be a need for reducing potential odors from the ventilated wet well.
- O. Provide permanent mechanical ventilation for dry wells located below the ground surface and for wet wells having screens or mechanical equipment requiring regular maintenance and inspection.
- P. Connection between wet well and dry well ventilation systems is not allowed.
- Q. Care shall be taken when locating intake for dry well ventilation such that odors from the wet well are not vented into dry weather structure.
- R. Provide multiple air inlets and outlets in dry wells over 15 feet deep. Do not use dampers on exhaust or fresh air ducts. Also avoid fine screens or other obstructions within air ducts to prevent clogging.
- S. Provide manual lighting/ventilation switches to override automatic controls installed for intermittently operated lighting/venting equipment.
- T. Incorporate hoisting equipment, or access for hoisting equipment, for removal of pumps, motors, valves, etc. into the design.
- U. All ancillary hardware in wet well, chains, cables and slide rails must be 316 stainless steel.
- V. Upon approval by the Participating Utility fiberglass reinforced polyester (FRP) wet wells shall be manufactured from commercial grade polyester resin or vinyl ester resin, with fiberglass reinforcements. The wet well shall be manufactured in one-piece.
1. The resins used shall be a commercial grade unsaturated polyester resin.
  2. The reinforcing materials shall be commercial Grade "E" type glass in the form of mat, continuous roving, chopped roving, roving fabric or a combination of the above, having a coupling agent that will provide a suitable bond between the glass reinforcement and the resin.
  3. If reinforcing materials are used on the surface exposed to the contained substance, it shall be a commercial grade chemical-resistant glass that will provide a suitable bond with the resin and leave a resin rich surface.
  4. Fillers, when used, shall be inert to the environment and wet well construction. Additives, such as thixotropic agents, catalysts, promoters, etc., may be added as required by the specific manufacturing process to be used. The resulting reinforced plastic material must meet the requirement of this specification.
  5. The exterior surface shall be relatively smooth with no sharp projections. Handwork finish is acceptable if enough resin is present to eliminate fibers from showing. The exterior surface shall be free of blisters larger than 1/2 inch in diameter, delamination, and fiber show.

6. The interior surface shall be resin rich with no exposed fibers. The surface shall be free of grazing, delamination, and blisters larger than 1/2 inch in diameter, and wrinkles of 1/8 inch or greater in depth. Surface pits shall be permitted up to 6 square feet if they are less than 3/4 inch in diameter and less than 1/16 inch deep.
7. The bottom to be fabricated using fiberglass material. Bottom to be attached to wet well pipe with fiberglass lay-up to comply with ASTM-D3299 specifications. Reinforcement, if needed, shall be fiberglass channel laminated to wet well bottom per ASTM.-D3299.
8. The fiberglass wet well top shall be fabricated using fiberglass material. Top to be attached to wet well pipe with fiberglass lay-up to comply with A.S.T.M.-D3299 specifications. Reinforcement, if needed, shall be fiberglass channel laminated to wet well bottom per ASTM-D3299.
9. Effluent, service, or discharge lines may be factory installed. Approved methods are PVC sewer pipe, Inserta-Tee fittings, or Kor-N-Seal boots. Installation of stubouts to be fiberglass lay-up to comply with ASTM-D3299.
10. The complete wet well shall have a minimum dynamic-load rating of 16,000 ft-lbs. To establish this rating, the complete wet well shall not leak, crack, or suffer other damage when load tested to 40,000 ft-lbs and shall not deflect vertically downward more than 1/4 inch at the point of load application when loaded to 24,000 lbs.
11. The (FRP) wet well shall be installed in strict accordance with the wet well manufacturer recommendations.
12. Each wet well shall be marked with the following information:
  - a. Manufacturer's name or trademark
  - b. Manufacturing special number
  - c. Total length and nominal diameter

Approved manufacturer is L.F. Manufacturing, Inc. or approved equal.

### 3.1 PUMPING EQUIPMENT

- A. Provide a minimum of two pumps, and controls to alternate lead and lag pumping. All pumps, regardless of station design, must be electric, centrifugal non-clogging units capable of passing an incompressible 3-inch sphere, and must have no less than 4-inch diameter suction and discharge openings. Inspection and cleanout plates, located both on suction and discharge sides of each pump, are required for all non-submersible pumps to facilitate locating and removing blockage-causing materials unless the pump design accommodates easy removal of the rotation elements. Specify pumps and motors suitable for continuous operation at full nameplate load while the motor is completely submerged, partially submerged, totally non-submerged or self-priming pump. Regardless of station type, specify single speed pumps. With prior approval from the Participating Utility, Variable Speed Drives (VFD's) with high efficiency motors may be allowed.

- B. Pumps must be capable of meeting all system hydraulic conditions without overloading the motors. In addition, a minimum of 5-hp motor is required, unless prior arrangements have been made and approved by the Participating Utility. Submit pump head capacity curves to Participating Utility, along with the lift station plans. Base the curves on friction losses through force mains, headers and pump risers.
- C. All lift stations must operate automatically based on the water level in the wet well. Locate wet well level mechanisms so that they are unaffected by currents, rags, grease, or other floating materials. All level mechanisms must be fully accessible without entering the wet well.
- D. Submersible Lift Stations
  1. The lift station must consist of a minimum of two submersible centrifugal sewage pumps, guide rails, wet well access, discharge seal and elbow, motor control center, starters, liquid level control system and all hardware necessary to make a complete working system. Approved pump manufacturers are ITT Flygt, Hydromatic, ABS, and Yeoman.
  2. The proposed elevation of all critical components must be shown in the drawings including pump intake line inverts, control and alarm levels, top of the wet well, top of the dry well, influent line invert(s).
  3. Pumps must be readily removable and replaceable without dewatering the wet well or disconnecting any piping in the wet well.
  4. All electrical equipment/panels must be above ground and located above the 100-year flood plain.
  5. Each pump must be furnished with a discharge connection system, which will permit removal and installation of pump without the need for the operator to enter the wet well. Discharge seal must be metal-to-metal; no gaskets allowed.
- E. Non-packaged Suction Lift/Self-priming Stations
  1. Suction lift stations must meet all applicable requirements in this standard, as well as those required by Article 2 of the latest edition of the SCAT Regulations. The lift station must consist of a minimum of two self-priming, horizontal, centrifugal sewage pumps, wet well access, discharge seal and elbow, motor control center, starters, liquid level control system and all hardware necessary to make a complete working system. Supply and warranty will be through a single company. Approved pump manufacturers are Hydromatic, Gorman Rupp, ITT Goulds and Mapeco.
  2. Suction-lift stations using dynamic suction lifts exceeding the limits outlined in the following paragraphs will not be approved. Detailed calculations must include static suction lift as measured from the "lead pump off" elevation to the centerline of the pump suction, friction and other dynamic head losses altitude correction, required net positive suction head and a safety factor of 4 feet.
  3. The pump equipment pad or compartment must be above grade or offset and must be physically located no closer than twelve inches (12") from the wet well to prevent the humid and corrosive atmosphere from entering the

compartment. Wet well access must be provided through another opening on the wet well cover, three feet (3') by three feet (3') minimum dimensions.

4. Self-priming pumps must be capable of priming and repriming at the "lead pump on" elevation. Self-priming and repriming must be automatically accomplished within 60 seconds under design operating conditions.
5. Suction piping must not exceed the size of the pump suction and must not exceed 22 feet in total length and less than 16 feet vertical lift. The total of the dynamic suction lift at the "pump off elevation" and required net positive suction head at design operating conditions must not exceed 22 feet.
6. Use "T" fittings on the individual suction lines, instead of 90-degree elbows, at the last turn before the pumps, to facilitate suction line cleaning.
7. Flexible coupling similar to Metraflex 100 HT shall be installed on the suction lines to reduce vibrations and facilitate removal.
8. A ¾-inch bleeder valve and piping must be installed on the discharge side of the pump housing and terminate back into the top of the wet well for priming and cleaning of the pumps. Piping shall be schedule 40 PVC.
9. Use flanged fittings for piping at the pumps to facilitate pump removal.
10. Provide heavy duty and supported pulley guards.
11. Pump and motor configuration shall be belt drive with drive end of motor (rotating counter clock-wise) opposing driven end of pump (rotating clock-wise), and motor located above pump on adjustable hinged mounting base allowing access to pump. Minimum number of belts is 2 for motors up to 10 HP, 3 belts for motors larger than 10 HP and up to 30 HP, 4 belts for motors larger than 30 HP.
12. Motor base shall be hinged, bolt adjustable and manufactured as a primed single frame. Motor base size shall accommodate NEMA mounting dimensions. The motor and base fit shall provide tolerance for alignment, ease of belt adjustment and tensioning without removal of guards, as well as simple removal and replacement of belts, sheaves, and pumps. Equipment shall be supported by concrete or steel frame support bases used as part of the noise and vibration isolation of the equipment. Motor manufacturer shall furnish the support bases and properly size them for the mounted motor and base and grout as necessary for stable footing.

#### 4.1 STATION PIPING

- A. Each non-submersible pump must have a separate suction pipe. Eccentric reducers must be used on suction pipes in lieu of a concentric reducer. Pipes in wet wells of suction lift pumps must be equipped with a turndown type flared intake and consist of ductile iron or 316 stainless steel.
- B. The design must consider surge effects and provide protection where necessary. Surge relief must be contained in the system. Damping check valves or pump control valves are required where head exceeds 100 feet.
- C. All main piping must have manual vents and drains to allow draining of sewage prior to piping disassembly.

- D. Floor drains from valve vaults to wet wells must be designed to prevent gas from entering the valve vault. Such designs must include flap valves, "P" traps, submerged outlets, or a combination of these devices. Sump pumps are acceptable in lieu of floor drains.
- E. Provide reinforced concrete or metal manufactured supports for pipes between wet well and drywell or pump pad, where appropriate.
- F. Lift station piping must be ductile iron and must have flanged connections to allow for removal of pumps and valves without interruption of the lift station operations. Wall penetrations must be designed to allow for pipe flexure while excluding exfiltration or infiltration. Pipe suction velocities must be between 2 and 6 feet per second. Provide restrained flexible couplings on all outlet pipes within 2 feet of the station wall.
- G. Use forty-five (45) degree ductile iron elbows for pump discharge piping turns.
- H. Install vacuum gauges with ball valves on the suction lines at pump housings. Install pressure gauges with ball valves on the discharge line of each pump. All gauges shall be provided with diaphragm seal and snubber.

#### 5.1 STATION VALVES

- A. Plug Valves: To be installed on the upstream side of the check valve. Eccentric Plug Valve - Shall conform to A WW A C517 and shall have an exterior coating of fusion bonded epoxy. Valve body and plugs shall be ASTM A 126 Class B cast iron. Plugs shall be solid one piece with a cylindrical seating surface eccentrically offset from the center of the shaft. Plug facing shall be Buna-N with a minimum hardness (Shore A) of 70 durometer. Seats shall be 1/8" inch thick nickel raised surface. Bearings shall be sintered, permanently lubricated 316 stainless steel. Packing shall be adjustable v-type packing. Washers at the top and bottom of the plug journal shall be provided to keep grit and debris out of the bearings and packing. Plug valves in the horizontal position shall be installed so that the plug rotates upward as the valve opens. Full size port is required when available for given valve size. The operator nut and stem shall be protected during shipping and installation.
- B. Check Valves: FL. X FL. check valve must be installed on the discharge side of each pump, followed by a full-closing isolation valve on each pump. Check valves must be swing type with an external lever. If the full-closing valve is other than a rising stem gate valve, the valve must include a position indicator to show its open or closed position. Where static head conditions are above 100 feet the check valve shall be provided with an external damper. Approved check valve manufacturers are Clow F5345, Mueller #2600-6-01, Kennedy IBBM Swing Check Valve, American "50" Line with Weight and Lever.
- C. Butterfly valves, tilting disc check valves, or other valves utilizing a tilting disc in the flow line are not allowed.

#### 6.1 FORCE MAIN

- A. Install the Force Main at least 3 feet below finished ground surface, and higher than the gravity inlet line elevation.
- B. Install locator wire in accordance with standards and detail drawings.

- C. Provide mechanical restraints on all buried force main piping, in accordance with Western Virginia Regional Design and Construction Standards, latest edition.
- D. Install a gate valve on all force mains immediately outside the lift station.
- E. No segment of the Force Main can have zero slopes, to limit the accumulation of gases. Low points must also be avoided to prevent the accumulation of solids.
- F. Force Mains must transition into a gravity line within a manhole in a manner that minimizes agitation of sewage. The crowns of the force main and outlet gravity line must match, with bench grouting installed to direct flow into the outlet with a minimal change in the gravity flow angle.
- G. Size Force Mains so that flow velocity is between two (2.0) and six (6.0) feet per second at ultimate development. Force mains leaving the lift station shall be one pipe size larger than the individual pump discharge pipe.

## 7.1 ELECTRICAL EQUIPMENT

- A. Electrical service must be 277/480-volt, 3-phase, 4-wire. Minimum service size must be 200 amps with minimum 10KVA transformers. Single-phase systems are not allowed. Use the following color scheme:
  - 1. Phase A: Purple
  - 2. Phase B: Brown
  - 3. Phase C: Yellow
- B. Due to the potential presence of hydrogen sulfide and other corrosive gases, greases, oils, and other constituents frequently present in sewage, all mounting hardware must be Type 316 Stainless Steel. All enclosures must be Type 316 Stainless Steel, and disconnects must be FRP-NEMA 4X. All enclosures and disconnects must be lockable with a padlock.
- C. Main electrical disconnect must be equal to Square D, Class 3110, 600-volt class, heavy duty, service rated safety switch, NEMA 4X, with all copper current carrying parts, Model H36\_DS. Provide with fusing class size based on the characteristics of the motor loads served and the available fault current. Approved Manufacturers: Square D, Siemens, General Electric, Cutler-Hammer.
- D. Electrical equipment must comply with the National Electrical Code (NEC) requirements for Class 1, Group C and D, Division 1 locations. Additionally, equipment located in wet wells must be suitable for use under corrosive environments. Each flexible cable must be provided with a watertight seal and separate strain relief.
- E. Free-standing electrical service and transfer switch must be housed in heavy-duty electrical weatherproof, NEMA 4X, stainless steel enclosures securely mounted on a rack a minimum of 24" above the ground. Provide 120-volt duplex, GFI, receptacle in a weatherproof box.
- F. All electrical equipment must be protected during a 100-year flood event and be protected from potential flooding from the wet well. If the electrical equipment is raised significantly to be above the 100-year flood event, then a platform must be constructed with rails and adequate working clearance in front of the electrical equipment, with permanent ladder or steps for access. As a minimum, Motor Control Centers must be mounted on a 4-inch tall concrete housekeeping pad. All

electrical equipment and connections in wet wells and dry wells must be explosion proof unless continuous ventilation is provided.

- G. Mounting rack must be constructed of PVC-coated steel, epoxy coated steel, or Type 316 stainless steel strut, 1-1/2" minimum, mounted on 3" galvanized steel pipe. Approved manufacturers: Unistrut, Kindorf, and B-Line. Touch up any scratches where coatings are applied. Close all exposed pipe ends with proper size PVC plug caps. The control panel, main disconnect, and junction boxes must be mounted directly to the rack. Locate Surge Arrestor in separate enclosure adjacent to the service disconnect. Do not use the electrical service pole as one of the supports.
- H. Provide connector for emergency generator with manual transfer switch. Generator connectors must be Crouse-Hinds, cam-lok, E1016 or 1017 Series, male Type 5 connectors – 3-phases, ground and neutral, must be mounted in a panel adjoining the manual transfer switch. The manual transfer switch must be equal to Square D, Class 3140, 600-volt class, double throw, non-fused safety switch, NEMA 4X, Model 8234\_DS. Size the transfer switch to handle the entire load of the lift station. Approved Manufacturers: Square D, Siemens, General Electric, and Cutler-Hammer.
- I. Provide terminal blocks and panel wiring for future remote start & stop contacts.
- J. If a dry well is used, consider it a confined space, and provide explosion proof dry well lighting adequate to illuminate the ladder and the floor of the dry well.
- K. Electrical conduit must be rigid steel galvanized to 90° turn down from lift station slab. Vertical PVC conduit entering underground condition should not extend more than 6-inches above grade. There should not be any PVC above grade. Underground vertical PVC conduit shall not extend closer than six inches (6") from finish grade.
- L. All underground electrical conduits must be grey, rigid nonmetallic conduit (RNC). Field manufactured bends are not permitted. Only factory fabricated conduit bends are allowed. Buried conduit must have a cover depth of eighteen inches (18") to twenty-four inches (24") beneath the finished surface. Conduit must comply with minimum NEC bend radius and not burned or kinked.
- M. All exposed pipe must be epoxy coated or PVC coated rigid metal conduit (RMC). Apply touch-up epoxy or PVC coatings to field cut pipe threads. Electrical conduit must be RMC to 90-degree turn down from lift station slab.
- N. Provide general illumination of 1.0 foot-candle (average) on the lift station equipment areas. Use Metal Halide fixtures for general illumination. Provide task lighting at the electrical control rack.
- O. Provide ability to operate station with one pump removed for maintenance, by utilizing a local-remote switch and no parallel switching in order to allow for proper lockout procedures. Where applicable, provide local disconnect at motor per NEC.
- P. Provide explosion proof local control in dry well, when one is used, to operate pumps for testing.
- Q. Install all conduit runs in initial construction sized to meet ultimate electrical and instrumentation needs.

- R. The pump controller shall be provided with lead-lag controls within a NEMA 4X enclosure.
- S. Special considerations for submersible stations:
  1. Design electrical supply, control and alarm circuits to allow for disconnection outside the wet well. Terminals and connectors must be protected from corrosion by location outside the wet well in a NEMA 4X enclosure.
  2. Locate the motor control center outside the wet well, readily accessible and protected by conduit seals, to meet the requirements of the National Electrical Code to prevent the atmosphere of the wet well to enter the control center. The seal must be so located that the motor may be electrically disconnected without disturbing the seal.
  3. Pump motor cables must meet the requirements of the National Electrical Code for flexible cords in wastewater lift stations. Power cord terminal fittings must be corrosion-resistant and constructed in a manner to prevent entry of moisture into the cable, and must be provided with strain relief appurtenances.

#### 8.1 STATION CONTROLS, INSTRUMENTATION AND MONITORING

- A. Primary level monitoring system must be of the ultrasonic, radar, or submersible pressure transducer type. Accepted manufacturers are Siemens (Milltronics HydroRanger 200), Greyline Instruments, Endress-Hauser, or approved equal.
- B. Install high level floats as a backup to ultrasonic systems, to operate in case of control system malfunction. The float control junction box must be located on top of the wet well and made of PVC.
- C. Install low level cutoff float as backup to ultrasonic system to prevent pumps from running under dry condition.
- D. Place the control system transducer or float controls in an area of the wet well which is removed from the effects of the influent flow(s) being received.
- E. Lift station must be capable of delivering all anticipated peak flows with the largest unit out of service. The “lead” pump is turned on at the first “on control elevation” and the “lag” pump will start with a rising liquid level at the “second on control elevation.” The “lead” and “lag” pumps will continue to operate until the “pump off control elevation” is reached. The “lead” and “lag” must automatically alternate between the two pumps at the completion of each pumping cycle. The “lag” pump must; however, start if the “lead” pump fails to start at the beginning of a cycle.
- F. Provide adequate support to prevent the communication/control box cabinet from leaning.
- G. Provide a Raco (4 Channel Verbatim Cellularm) and TelularSX5E Digital Cell phone or current Participating Utility standard. An audio-visual alarm system (red flashing light and horn) must be provided for all lift stations on the side of the control panel, not on top. All alarm conditions must be transmitted to a location(s) where 24-hour assistance is available. The alarm system must be activated in case of power outage, pump failure, or a specified high wet well water level.

System must have a 3-hour battery backup and an automatic dialing capacity of at least 8 telephone numbers. Contact Participating Utility for latest guidance on telemetry requirements.

- H. Provide run-time meters for each pump that records pump run time.
- I. If specifically required by Participating Utility, provide flow-measuring devices with instantaneous rate indicators, totalizers and recorders designed specifically for sewage force mains on the discharge side of the lift station. Meters (Flowtronics or approved equal) must be in an approved vault. Flow display to be installed at lift station electrical/controls rack.

## 9.1 EMERGENCY PROVISIONS

- A. Design lift stations to prevent overflow from the lift station due to loss of power or mechanical failure within the operating time frames defined in this section. An audio-visual alarm system (red flashing light and horn) must be provided for all lift stations. All alarm conditions must be transmitted, through use of an auto-dialer system or telemetering system, to a location(s) where 24-hour assistance is available. The alarm system must be activated in case of power outage, pump failure, or a specified high wet well water level. In addition to the alarms and telemetering requirements, all lift stations must be provided with service reliability based on the options detailed in paragraphs 1-4, below:
  - 1. The retention capacity shall have the wet well and incoming gravity sewer lines designed to insure that no discharges of untreated wastewater will occur at the station or any point upstream for a period of time equal to the longest electrical outage recorded during the past 24 months. If no records are available, the designer must use 180 minutes of Average Daily Flow (ADF) to calculate required retention capacity. A minimum of a 120-minute retention period using Average Daily Flow (ADF) must be used even when power company records indicate a shorter period of outage. Power outage records must be on the utility company letterhead, bear the signature of a utility representative, identify the location of the lift station, list the total number of outages that have occurred in the past 24 months, and indicate the duration of each power outage. For calculation purposes, the start of the outage period or mechanical failure must begin at the wet well elevation equal to the high-level alarm set point. Generator receptacle requirements of 7.1 paragraph H above must be met.
  - 2. The lift station may meet the emergency power requirement by arranging for the facility to receive electrical service through either two separate electrical distribution circuits or from separate power companies that have a fully automatic switch over capability designed to assure continuous service. The two distributions lines must be physically separated, not carried on the same pole, and obtain their power from different substations. If separate distribution circuits originate from the same substation, overall substation reliability must be demonstrated. Generator receptacle requirements of 7.1 paragraph H above must be met.
  - 3. Furnish a standby power generator to the lift station.
  - 4. The use of a spill containment structure as a means of providing service reliability is prohibited. Spill containment structures may be used in addition to one of the service reliability options detailed in this section, provided a detailed management plan for cleaning and maintaining the spill

containment structure is discussed in the final engineering design report. Additionally, any spill containment structures must be fenced with a six-foot fence that has a minimum of 3 strands of barbed wire and a locked gate. Spill containment structures must not be used to reduce other power reliability requirements in any way.

- B. Emergency (quick-connection) pump by-pass system shall be provided at all lift stations. Connection must be sized according to station and header pipe size, and must consist of a gate valve, adapter flange with "quick-disconnect" male fitting with dust cap. Provide a check valve to allow flow only in the direction of Force Main.

## 10.1 SUBMITTAL REQUIREMENTS

- A. An engineering design report that include system curves, pump curves and head calculations (Total Dynamic Head including friction losses and Total Discharge Head). Calculations and pump curves at both minimum (all pumps off) and maximum (last normal operating pump on) static heads and for a C value of both 100 and 140 must be provided for each pump and for the combination of pumps (modified pump curves). Where a suction lift is required, the report must include a calculation of the available net positive suction head (NPSH) and a comparison of that value to the required NPSH for the pump(s) as specified in Article 2 of the latest edition of the SCAT Regulations.
- B. The engineering design report must be presented in the following format:
  - 1. TITLE PAGE - Title page should include the project name, date, developer/owner's name and engineering firm preparing plans.
  - 2. SEWER SYSTEM INFORMATION
    - a. Introduction
      - i) Type, location and size of development
      - ii) Number of and range in size of lots or buildings to be serviced
    - b. Existing Sewer System
      - i) Location and type of gravity system the force main will discharge into.
      - ii) Future of sanitary sewer service.
      - iii) State whether the entire development will be serviced by the proposed phase or if several phases will be involved.
      - iv) State the number of lots this phase will encompass initially and finally if future phases are to be constructed.

## 11.1 LIFT STATION AND FORCE MAIN DESIGN CALCULATIONS

(The following formulas are provided as guidelines. The design engineer can use other formulas of preference to achieve the same results.)

- A. Site Characteristics, and allowances for Calculating Flows:
  - 1. Equivalent Residential Connections (ECU's) @ 300 gals/day per ECU
  - 2. Commercial SF @ 0.07 gals/day per SF
  - 3. Multi-family Units @ 0.70 ECUs per Unit
  - 4. Peaking Factor
  - 5. Inflow and Infiltration (I/I) Allowance of 300 GPD/acre
  - 6.  $ADF (GPD) = \text{Residential (single and multi-family)} + \text{Commercial GPDs}$
  - 7.  $ADF (GPM) = ADF (GPD) / 1440 (\text{Min/Day})$

8. Peaking Factor = 2.5 for Proposed Residential Development
9. PDWF (GPD) = PF \* ADF
10. PDWF (GPM) = PF \* ADF (GPM)
11. Inflow and Infiltration (I/I): Total Development Acreage \* 300 GPD/acre
12. PWF (GPD) = PDWF (GPD) + I/I (GPD)
13. PWF (GPM) = PWF (GPD) / 1440 (Min/Day)

B. Average Dry Weather Flow (ADF): This is the flow developed without the maximum flow peaking factor. This flow is used to determine the average detention time in the wet well.

C. Peak Dry Weather Flow (PDWF): This flow is used to determine pipe size in the collection system.

D. Peak Wet Weather Flow (PWF): This flow is used to determine the lift station design capacity. All lift stations must be designed to handle the maximum wet weather flow for its service area.

E. Minimum Dry Weather Flow (MDWF): This is used to determine the maximum detention time in the wet well.

$$\text{MDWF} = (0.2 * (0.0144 * \text{ADF})^{0.198}) * \text{ADF}$$

F. Minimum Pump Requirements (Peak Wet Weather Flow, PWF):

1. For two-pump stations, size each pump to handle PWF
2. Calculate Total Dynamic Head (TDH = H<sub>s</sub> + L<sub>f</sub>):

Static Head (H<sub>s</sub>)

E<sub>h</sub> = Maximum force main elevation

E<sub>1</sub> = Wet well low water elevation

$$H_s = E_h - E_1$$

Loss (L<sub>f</sub>) due to friction in force main

Length = Total equivalent length of force main and piping

L<sub>f</sub> = Length x Friction Factor (Use Hazen-Williams C of 100 & 140 for friction losses)

3. Plot System Curve on Pump Curve and determine operating point to select proper pump sizes

G. Net Positive Suction Head: For suction lift stations, compare the net positive suction head (NPSH<sub>R</sub>) required by the pump with the net positive suction head available (NPSH<sub>A</sub>) in the system, at the operating point. The NPSH available must be greater than the NPSH required.

$$\text{NPSH}_A \text{ (suction lift)} = P_B - H_S - P_V - H_{fs}$$

Where;

P<sub>B</sub> = barometric pressure in feet absolute, use 33.4 feet

H<sub>S</sub> = minimum static suction head, in feet

P<sub>V</sub> = vapor pressure of liquid in feet absolute, use 1.4 feet

H<sub>fs</sub> = friction loss in suction, in feet

Velocity Produced in Force Main [2 to 6 fps]

H. Storage Requirements:

1. Required Wet Well Volume (volume between “pump on” and “pump off” elevation):

$$V_r \text{ (Gals)} = \text{Pump GPM} * T \text{ (Minimum Cycle Time, Table 3)}$$

2. Volume of Storage (Vs):

$$V_s \text{ (Gals)} = \text{ADF (GPD)} * [(2 \text{ hr. min. storage}) / 24 \text{ hours per day}]$$
$$V_s \text{ (CF)} = V_s \text{ (Gals)} / 7.481 \text{ Gal per CF}$$

3. Dimensions of Storage Facility: Use Table 2 for Wet Well diameter, minimum 72-inch diameter

$$\text{Wet Well Depth} = \frac{4 * V_s \text{ (CF)}}{\pi(d^2/4) * (\text{Wet Well diameter})^2}$$

- I. Buoyancy Checks: A buoyancy check must be performed for the lift station wet well and the retention chamber.

- J. Cycle Times: Calculate detention times (Td) for Average Dry Weather Flow, Maximum Wet Weather Flow, and Maximum Dry Weather Flow.

$$T_d = T_f + T_e$$

Where;

Tf = time to fill wet well in minutes =  $V_r / i$

Te = time to empty wet well in minutes =  $V_r / (Q - i)$

Vr = Required Wet Well Volume

i = Flow into the station for given condition

Q = Pump capacity in gpm

- K. Average Detention Time: (based on Average Dry Weather Daily Flow):

$$T_f = V_r / \text{ADF (GPM)}$$

$$T_e = V_r / (Q - \text{ADF})$$

$$T_d \text{ (ADF)} = T_f + T_e$$

$$T_f = V_r / \text{MDWF (GPM)}$$

$$T_e = V_r / (Q - \text{MDWF})$$

$$T_d \text{ (MDWF)} = T_f + T_e$$

- L. Maximum Detention Time: (based on Minimum Dry Weather Flow): Discuss odor control if any of the detention times exceeds 180 minutes.

- M. Total Cycle Times:

Pump ON for Te

Pump OFF for (2) Tf + Te

The pump is on for one pumping cycle of Te and off for 2 storage cycles of Tf plus one pumping cycle of Te because pumps alternate.

N. LISTING OF RESULTS FROM THE DESIGN CALCULATIONS TO BE PRESENTED IN THE FOLLOWING ORDER:

1. Number of Lots or Buildings
2. Population Equivalent
3. Average Daily Flows in GPM
4. Peak Daily Flows in GPM
5. The Volume of the Retention Chamber
6. Static Head
7. Total Dynamic Head
8. The Pump Selected (including type, manufacturer, model number, size, Hp, RPM, phase and GPM)
9. Net Positive Suction Head Available (NPSH) for suction pumps
10. Total Detention Times for Maximum Dry Weather Flow and Average Dry Weather Flow
11. Total Cycle Times for Maximum Dry Weather Flow and Average Dry Weather Flow
  - a. Number of Minutes ON (Pumping Time)
  - b. Number of Minutes OFF (Fill Time)
12. Size and Length of Force Main
13. Velocity Maintained in Force Main
14. Force Main Retention Time (at initial flows and at design flows)
15. Wet well buoyancy calculations.

O. COST EFFECTIVENESS ANALYSIS

1. A detailed cost estimate comparing the costs of gravity sewer verses the costs of a lift station and force main system.

**- END OF SECTION -**

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**DSS-3**  
**FATS, OILS AND GREASE (FOG) DISCHARGE POLICY**

1.1 GENERAL

- A. Fats, oil and grease (FOG) in wastewater can result in the decreased carrying capacity of sewers due to congealed, cooled grease which coats the inside of the pipes. Once a pipe becomes constricted, the potential for a blockage increases. Blockages can and will eventually cause sanitary sewer overflows.
- B. The following is the FOG Policy for the Participating Utility including grease interceptor sizing examples in Appendix A, Best Management Practices in Appendix B, and FOG Policy definitions in Appendix C. The purpose of establishing the FOG Policy is to protect public health by eliminating sanitary sewer system overflows due to FOG and reduce the amount of FOG discharged to the sanitary sewer system while reducing maintenance costs for the Participating Utility's customers and improving operation of the collection system. Any wastewater, which contains FOG, shall only be discharged into the Participating Utility's sanitary sewer system under the conditions of this Policy and with a valid FOG discharge permit.
- C. A FOG discharge permit shall be required of any customer of the Participating Utility including businesses, institutions, or establishments participating in the preparation or service of food, where fats, oil and grease may be discharged into a public sewer, except as provided in item 1.1, E. and in accordance with the schedule provided in item 1.1, D. Such customers shall obtain a FOG discharge permit from the Participating Utility as a condition of wastewater service. Grease interceptors, waste oil collection devices or other applicable pretreatment units shall be installed, operated, maintained, and repaired solely at the customer's expense.
- D. Schedule for Compliance with the FOG Discharge Policy
  - 1. New construction of any establishment meeting the criteria of item 1.1, C. shall obtain a FOG discharge permit and be in full compliance with its construction requirements before commencing any wastewater discharges to the sanitary sewer system.
  - 2. Existing structures meeting the criteria of item 1.1, C. due to a change of use shall obtain a FOG discharge permit and be in full compliance with its provisions within 6 months of issuance.
  - 3. Existing structures meeting the criteria of item 1.1, C. being renovated or expanded shall obtain a FOG discharge permit and be in full compliance with its provisions within 6 months of issuance.
    - a. Existing structures being renovated or expanded that already have a FOG discharge permit shall contact the Participating Utility to determine if a modification is needed.
  - 4. Existing establishments determined by the Participating Utility to be contributing FOG to the sanitary sewer system in excess of 200 mg/L as total recoverable FOG, are causing increased downstream maintenance of the sanitary sewer system, or are contributing to downstream backups or overflows due to grease blockages shall obtain a FOG discharge permit and be in full compliance with its provisions within 6 months of issuance.

5. Regardless of permit status, establishments causing FOG blockages shall also be responsible for costs incurred by the Participating Utility to remedy the effect of the establishment's FOG discharge.

E. Exceptions

1. Establishments meeting the criteria of item 1.1, C. that use disposable service ware and have less than 25 seats will not be required to install a grease interceptor. This exception does not apply to wholesalers, commercial kitchens or take-out only establishments. The establishment shall complete and submit a FOG discharge permit application showing fixtures, seat count and certify usage of disposable service ware and shall comply with all other provisions of the FOG Policy. Exception must be pre-approved by Participating Utility prior to: construction of new establishment; beginning modifications and/or opening of a new establishment in an existing building; or beginning construction of new seating addition or kitchen expansion of an existing establishment.
2. A FOG discharge permit shall not be required for single-family residences unless such residences have been converted for commercial food preparation use.
3. A FOG discharge permit shall not be required for duplexes, triplexes, quadplexes, or apartment complexes. However, multifamily dwellings which are found to be contributing FOG in sufficient quantities to cause main line blockages or increased maintenance in the sanitary sewer system shall be required to obtain a FOG discharge permit.
4. Single service kitchens with no food preparation (microwave heating and serve only), and which use only disposal service ware will not be required to install a grease interceptor. This applies only to establishments that are not serving the general public. The establishment shall complete and submit a FOG discharge permit application showing number of fixtures, seat count, and certify usage of disposable services ware and shall comply with all other the provisions of the FOG Policy. Exception must be pre-approved by Participating Utility prior to: construction of new establishment; beginning modifications and/or opening of a new establishment in an existing building; or beginning construction of new seating addition or kitchen expansion of an existing establishment.

- F. The Participating Utility reserves the right to waive portions of the FOG Policy at its discretion. If a properly-sized grease interceptor cannot be accommodated within the property of existing establishments, a waiver may be requested from the Participating Utility. For existing establishments, the establishment shall demonstrate to the satisfaction of the Participating Utility that the installation of a grease interceptor would be unfeasible and or would cause an undue hardship in the utilization of the building as a food service establishment. The establishment seeking the waiver shall submit a written request to the Participating Utility detailing the reasons and issues supporting the waiver request. The establishment shall complete and submit a FOG discharge permit application and shall comply with all other provisions of the FOG Discharge Policy as well as the Best Management Practices (BMP) of Appendix B. A waiver to the grease interceptor installation requirement shall not relieve the establishment of other FOG Policy requirements such as the use waste oil barrels to dispose of waste cooking grease as detailed in item 5.1, C.

1. For any establishment granted a waiver that fails to comply with the provisions of the FOG Policy (except as waived) or fails to comply with the BMPs of Appendix B, the Participating Utility reserves the right to require the establishment to install a grease interceptor or pay monthly fees for noncompliance.

## 2.1 DESIGN OF GREASE INTERCEPTORS

- A. Grease interceptors shall be designed and constructed in accordance with the provisions of the FOG Policy, in accordance with the most current edition of the Participating Utility's Design and Construction Standards and in compliance with the requirements of the Virginia Department of Health (VDH). Refer to Sewer Detail Drawings.
- B. Design and construction shall be approved by the Participating Utility's Engineering Services Division.
- C. The establishment shall hire an engineering firm to prepare site layout, size the grease interceptor and prepare a plan detailing connection to the Participating Utility's sanitary sewer.
- D. The discharge from the following fixtures shall be included: all sinks, dishwashers, floor drains in food preparation and storage areas, food waste grinders and any other fixtures through which grease may be discharged.
- E. Grease interceptors shall include isolation valving in the inlet piping to the interceptor to stop flow for cleaning purposes.
- F. Grease interceptors shall be installed on the customer's property and in a location outside of the customer's establishment, which provides access for inspection, cleaning, and maintenance, including pumping.
- G. Wastewater from sanitary establishments shall not be introduced into the grease interceptor under any circumstances.
- H. Grease interceptors are to be installed at a minimum distance of 10 ft. from sinks and dishwashers to allow for adequate cooling of wastewater. The influent to interceptors shall not exceed 140 degrees Fahrenheit (140° F). The temperature at the flow control device inspection port shall be considered equivalent to the temperature of the influent.
- I. Where food-waste grinders are installed, the waste from those units may discharge directly into the sanitary sewer system or pass through the grease interceptor according to applicable plumbing codes. For grease interceptors with discharges from a food grinder, the grease interceptor size shall be increased by 30% of the sizing requirement.
- J. Drains that receive "clear waste" only, such as from ice machines, condensate from coils and drink stations, may be plumbed to the sanitary system without passing through the grease interceptor with the condition that the receiving drain is a "hub" type with a minimum of two inches above the finished floor.
- K. All waste shall only enter the grease interceptor through the inlet flow control device.

- L. Grease interceptors shall conform to the following criteria when being designed and constructed:
1. New in-ground grease interceptors shall be **no less than 750 gallons** total capacity. The maximum capacity of any grease interceptor shall be 1500 gallons unless advised otherwise by the Participating Utility's Engineering Division. Where sufficient capacity cannot be achieved with a single interceptor, installation of grease interceptors in series shall be required.
  2. Minimum 2:1 length to width ratio.
  3. Twelve inches (12") of freeboard at grease interceptor top.
  4. Inlet and outlet tees. Inlet and outlet tees must be plugged at the top of the sanitary tee and be a minimum of four inches (4") in diameter.
  5. Access openings over the inlet and outlet (each compartment) within the grease interceptor. Each opening shall be twenty-four inches (24") in diameter and contain pick bars. All covers shall be constructed of cast iron or equivalent traffic bearing material and allow for proper maintenance and inspection.
  6. Manholes and covers must extend to the finished grade and be installed to exclude the entrance of ground water, surface or storm water into the interceptor. Frames and covers shall be watertight.
  7. Manhole covers shall:
    - a. Have the word "Grease" cast into the manhole cover
    - b. Contain no holes
    - c. Be a gasket design to prevent inflow of stormwater
  8. Full size cleanouts shall be installed on the inlet and outlet sides of the interceptor and extended to grade.
  9. Have a minimum concrete compressive strength of 3,500 psi.
  10. Joints should be properly sealed to prevent infiltration or exfiltration. A non-monolithic unit shall have the following:
    - a. A ConSeal CS-102 Butyl Rubber Sealant (or equivalent) in the joint
    - b. 24" ConSeal CS-212 Polyolefin Backed Exterior Wrap (or equivalent) installed per manufacturer's spec and centered over the exterior of the joint.
  11. Grease interceptors must meet a minimum structural design of 150-pounds per square foot for non-traffic installations. For vehicular traffic conditions the grease interceptor shall be designed to withstand AASHTO H-20 wheel loads.
  12. Grease interceptors shall meet the following standards: ASTM C-1227 (Septic Tanks), C-913 (Pre-cast Concrete Water and Wastewater Structures), ACI-318 (Design) and ASTM C-890 (for establishing Minimum Structural Design Loading).

13. A licensed Virginia design professional will specifically design cast in place grease interceptors.
  14. A Participating Utility inspector shall inspect the grease interceptor prior to installation. Contractor shall contact the utility forty-eight (48) hours prior to installation to schedule an inspection. The Participating Utility will not accept a grease interceptor that has not been inspected prior to installation.
  15. Prior to inspection, the contractor shall submit a shop drawing of the grease interceptor to the Participating Utility's engineering department. The shop drawing shall list "*Grease Interceptor for (insert the actual project name here)*" as the heading of the drawing. The Participating Utility reserves the right to waive the shop drawing requirement.
- M. In approving an establishment's grease interceptor design, the Participating Utility does not accept liability for the failure of a system to adequately treat wastewater to achieve effluent quality requirements specified under this policy. It is the responsibility of the establishment to insure the appropriate level of treatment necessary for compliance with the FOG Policy and applicable regulations.
- N. It is suggested but not required that all new buildings, such as malls, strip centers, etc., containing sections designated for commercial enterprise, provide a stub-out for a separate waste line for future grease interceptor installation. The designer of such new structures shall consider suitable physical property space and sewer gradient that will be conducive for the installation of an exterior grease interceptor(s) for any flex space contained within the building. Physical property restrictions and sewer gradient shall not be a basis for a waiver to install a grease interceptor after the effective date of this policy.

### 3.1 PLAN SUBMITTAL REQUIREMENTS

The following procedures are to assist the applicant in permit application, plan submittal, and permit issuance.

- A. Establishments required to install a grease interceptor shall submit the following to the Participating Utility:
1. A completed FOG discharge permit application.
  2. Detailed calculations by A & E firm, licensed engineer, or competent design professional showing size of the grease interceptor. An example of grease interceptor sizing is contained in Appendix A.
  3. A complete list of all fixtures. For all sinks, list dimensions and drain sizes. For all dishwashers, list discharge flow rates as determined by the manufacturer's specifications.
  4. Plans showing:
    - a. Location of grease interceptor, inverts and elevation of manholes.
    - b. Fixture plumbing.
    - c. Grease interceptor detail showing correct sizing information.
    - d. Grease recycling barrels located near the dumpster area.
- B. Two (2) copies of calculations and plans are to be submitted to the Participating Utility.

- C. All interceptor construction details shall be reflected in the as-builts submitted to the Participating Utility upon substantial completion or completion of construction.

#### 4.1 FOG DISCHARGE PERMIT

- A. A FOG discharge permit is required of establishments identified in item 1.1, C. to discharge wastewater the sanitary sewer system. A completed "FOG Discharge Permit Application" shall be submitted to the Participating Utility under the schedule in item 1.1, D. The permit sets the terms and conditions to achieve compliance with the FOG Policy and shall include installation of a grease interceptor unless excepted or waived, recycling or disposal of waste oil, fats & grease, as required by item 5.1, C. and implementation of all other provisions of the FOG Policy. Certain FOG discharge permits may require compliance with the Best Management Practices of Appendix B. FOG discharge permits may contain specific milestone dates to be met by the establishment.
- B. The terms and conditions of the permit are subject to modification by the Participating Utility at any time as just causes exist. The establishment shall be informed of any proposed changes in the issued permit at least thirty days prior to the effective date of the change(s). Any changes or new conditions in the permit shall include a reasonable time schedule for compliance.
- C. An establishment may request a waiver under the terms of item 5.1, F. to certain portions of the FOG Policy. Establishments may request a modification to an existing FOG discharge permit to comply with renovation or expansion requirements.
- D. Any requests for extensions of FOG discharge permit milestone dates must be made in writing to the Participating Utility, at least thirty (30) days in advance of the date.
- E. As a condition precedent to the granting of a permit, the permittee agrees to hold harmless the Participating Utility and the Participating Utility's employees from any liabilities arising from the establishment's operations.

#### 5.1 ESTABLISHMENT RESPONSIBILITIES

- A. Discharge Criteria
  - 1. Where fats, oil and grease are by-products of food preparation and/or cleanup, reasonable efforts shall be made to separate waste fats, oil and grease into a separate containers for proper disposal. Waste fats, oil and grease shall not be discharged to any drains or grease interceptors. Such waste shall be placed in a container designed to hold such waste and either recycled or disposed of at suitable locations in accordance with item 5.1, C.
  - 2. Adequately sized grease interceptor shall mean a grease interceptor that does not allow a discharge of wastewater containing fats, oil or grease in excess of 200 mg/l or has not been found to be contributing to line stoppages or require sewer maintenance to prevent stoppages from occurring. It is the responsibility of the establishment to insure compliance with the sanitary sewer discharge limitations.

B. Maintenance, Record Keeping, and Grease Removal

1. Grease interceptors shall be kept free of inorganic solid materials such as grit, rocks, gravel, sand, eating utensils, cigarettes, shells, towels, rags, etc., which could settle into this pocket and thereby reduce the effective volume of the grease interceptor.
2. Grease interceptors shall meet the FOG Policy's compliance requirements and be maintained for efficient FOG removal and shall be cleaned every 90 days. Some establishments may need to clean interceptors more frequently. It is the responsibility of the establishment to monitor and clean interceptor as needed but no less than 90 days. It is recommended that establishments with food grinders discharging to their grease interceptors be cleaned every 30 days. The Participating Utility reserves the right to adjust cleaning frequency of individual establishments as needed.
3. Interceptor Maintenance Log
  - a. Every establishment having a grease interceptor shall maintain a log of each pumping for the previous three (3) years. This log shall include the date, time, name of the waste hauler and shall be kept in a conspicuous location on the premises of the establishment for inspection. Trip tickets or manifests shall be maintained for a period of 3 years to substantiate the maintenance log. Establishments shall keep their FOG discharge permit with the log. Permit and log shall be made immediately available to Participating Utility staff upon request.
  - b. A copy of the information required in the maintenance log must be submitted to the Participating Utility annually including trip tickets or manifests. The annual reporting period shall be July 1 through June 30 of each year. The report shall be submitted to the Participating Utility within thirty (30) days after the end of the reporting period.
4. Cleaning Procedures
  - a. An owner, manager or employee of the establishment shall supervise grease interceptor cleaning, and shall be physically present and observe the entire cleaning operation.
  - b. The owner, manager or employee of the establishment shall cause the liquid waste hauler, transporter, or other person cleaning or servicing the grease interceptor to evacuate all contents, including floating materials, wastewater, and bottom sludges and solids. Skimming the surface layer of waste material, partial cleaning of the interceptor or use of any method that does not remove the entire contents of the collection device is prohibited. The suction of the floating materials shall be done prior to removal of other contents. After complete evacuation, the walls, top, and bottom of the interceptor shall then be thoroughly scraped and the residue removed. The interceptor shall then be washed down and the residue removed. Upon completion of the servicing, the employee witnessing the cleaning shall make an inspection of the interior of the interceptor and then sign the trip ticket or manifest. The employee shall make an appropriate entry in the establishment log.

- c. Each grease interceptor pumped shall be fully evacuated unless the volume is greater than the tank capacity of the vacuum truck in which case the transporter shall arrange for additional transportation capacity so that the grease interceptor is fully evacuated within a twenty-four hour period.
- d. The return of gray water back into the interceptor from which the waste was removed is prohibited.
- e. All waste removed from each grease interceptor shall be disposed of at an establishment permitted and authorized to receive such waste in accordance with all applicable federal, state, and local regulations. In no way shall the pumped material be returned to any private or public portion of the sanitary sewer system. Additionally, material removed from a grease interceptor shall not be recycled so as to become a food product or part of a food product for animal or human consumption.
- f. It shall be a violation for an establishment to allow grease interceptor waste to be removed from the premises by a transporter that does not have all applicable federal, state, or local permits or registrations. Transportation and disposal of grease or other materials generated by a grease interceptor shall be subject to all applicable federal, state and local regulations.
- g. It is strictly prohibited for any non-water portion of the grease interceptor's contents to be pushed or flushed into the public sanitary sewer at any time. (See item A. Section 7.1 "Violations of Policy")

C. Waste Oil Disposal

- 1. All establishments shall use waste oil barrels or containers to dispose of waste fats, oil and grease. Such material shall be recycled or disposed of through an establishment permitted and authorized to receive such waste in accordance with all applicable federal, state, and local regulations.

D. Compliance Requirements

- 1. Establishments shall comply with the milestone dates of FOG discharge permits.
- 2. Establishments not in compliance with the cleaning requirements of the FOG Policy shall clean the grease interceptor within 10 business days after the date the establishment receives written notice from the Participating Utility.

6.1 MONITORING, INSPECTION AND ENTRY

A. Right of Entry - Inspection and Sampling

The Participating Utility shall have the right to enter the premises of any establishment to determine whether the establishment is complying with all requirements of the FOG Policy, any wastewater discharge permit or order issued hereunder. Establishments shall allow the Participating Utility ready access to all parts of the premises for the purposes of inspection, sampling, records examination and copying, and the performance of any additional duties during reasonable business hours.

1. Where an establishment has security measures in force, which require proper identification and clearance before entry into its premise, the establishment shall make necessary arrangements with security so that, upon presentation of suitable identification, Participating Utility staff will be permitted to enter immediately for the purposes of performing specific responsibilities.
2. The Participating Utility shall have the right to set up on the establishment property, or require installation of, such devices as are necessary to conduct sampling and/or metering of the establishment's operations.
3. The Participating Utility may require the establishment to install monitoring equipment as necessary. The establishment's sampling and monitoring equipment shall be maintained at all times in a safe and proper operating condition by the establishment at the establishment's expense. All devices used to measure wastewater flow and quality shall be calibrated at least annually to ensure accuracy.
4. Any temporary or permanent obstruction to safe and easy access to the establishment to be inspected and/or sampled shall be promptly removed by the establishment at the written or verbal request of Participating Utility staff and shall not be replaced. The costs of clearing such access shall be born by the establishment.
5. Unreasonable delays in allowing Participating Utility staff to access the establishment's premises shall be a violation of this policy.
6. No new establishment will be allowed to initiate operations until a grease interceptor is installed, approved and inspected by the Participating Utility. The Participating Utility reserves the right to suspend service if the grease interceptor is not in compliance with the FOG Policy.

#### 7.1 VIOLATIONS OF POLICY

- A. No establishment shall discharge wastewater to the sanitary sewer system in violation of the FOG Policy or the Participating Utility's pretreatment discharge limitations.
- B. It shall be a violation of the FOG Policy for any establishment to:
  1. Modify a grease interceptor structure without the consent or approval of the Participating Utility including alteration or removal of any flow constricting devices so as to cause flow to rise above the design capacity of the grease interceptor.
  2. Provide false maintenance records.
  3. Cause or permit the plugging, blocking, or interference with a grease interceptor or permits others to cause such interference.
  4. Not comply with the provisions of a FOG discharge permit or the FOG Policy.
- C. No customer or establishment, including non-permitted establishments, shall discharge grease in excess of 200 mg/l to the sanitary sewer collection system. If

such discharge occurs, the customer or establishment shall be considered in violation of this policy and subject to the remedies described herein.

- D. No establishment shall contribute or cause to be contributed into the grease interceptor or the sanitary sewer system any of the following:
1. Hot water running continuously through grease interceptor;
  2. Concentrated alkaline or acidic solutions;
  3. Concentrated detergents, emulsifiers, de-emulsifiers, surface active agents, enzymes, degreasers, solvents or any type of product that will liquefy grease interceptor wastes;
  4. Any substance that may cause excessive foaming in the sanitary sewer system;
  5. Any substance capable of passing the solid or semi-solid contents of the grease interceptor to the sanitary sewer system;
  6. Hazardous wastes including concentrated cleaners, pesticides, herbicides, paints, solvents, gasoline or other petroleum products; or
  7. Waste fats, oils and grease not generated as part of the wastewater system.
- E. When the Participating Utility finds that a user has violated, or continues to violate, any provision of this policy or the Participating Utility's Wastewater Rules and Regulations, a wastewater discharge permit or order issued hereunder, or any other pretreatment standard or requirement, the Participating Utility may serve upon that user a written Notice of Violation (NOV). Within ten (10) days of the receipt of this notice, an explanation of the violation, verification of grease interceptor cleaning, and a plan for the satisfactory correction and prevention thereof, to include specific required actions, shall be submitted by the user to the Participating Utility. Submission of this plan in no way relieves the user of liability for any violations occurring before or after receipt of the Notice of Violation. Nothing in this section shall limit the Participating Utility to take any action, including emergency actions or any other enforcement action, without first issuing a Notice of Violation. The Participating Utility may suspend water and/or sewer service, when such suspension is required in order to stop an actual or threatened discharge that:
1. Presents or may present an imminent or substantial endangerment to the health or welfare of persons or the environment;
  2. Causes blockages or excessive maintenance to be performed to prevent stoppages in the sanitary sewer collection system; or
  3. Causes interference to the sanitary sewer collection system or treatment plant.
- F. Any customer or establishment notified of a suspension of the water or sewer service shall immediately stop or eliminate the discharge. In the event of a failure of the customer or establishment to comply voluntarily with the suspension order, the Participating Utility shall take such steps as deemed necessary, including immediate termination of water or sewer service, to prevent or minimize damage to the sanitary sewer system or sewer connection or endangerment to any

individuals. The Participating Utility shall reinstate the water or sewer service when such conditions causing the suspension have passed or been eliminated. A detailed written statement submitted by the customer or establishment describing the cause(s) of the harmful discharge and the measure(s) taken to prevent any future occurrence shall be submitted to the Participating Utility within fifteen (15) days of the date of occurrence.

- G. Any customer or establishment may appeal the actions of the Participating Utility by submitting a notice of appeal to the Executive Director within fourteen days from the receipt of a suspension notice from the Participating Utility or other notice requiring action, imposition of a fee, or notice of service termination. An appeal request will not delay action by the Participating Utility.
- H. The Executive Director shall conduct a hearing on all appeals within fourteen days of the receipt of notice of appeal. The notice of appeal shall state the technical grounds and objections for the appeal. At the hearing, the Executive Director shall hear and investigate any objection that may be raised and take such action as may be appropriate under the facts and circumstances established. In all other respects, the substantive and procedural requirements for this appeal shall comply with the applicable provisions of the Code of Virginia (1950) as amended.
- I. The Executive Director shall render a decision within five business days of the date of the hearing. The customer or establishment requesting the appeal may petition the Participating Utility's Board of Directors to review the decision or take other such action as permitted by applicable Virginia law. The Participating Utility reserves the right to seek reimbursement of administrative and operational costs and legal fees resulting from enforcement of this policy.

## 8.1 FEES AND COSTS

- A. Progression of fees for violations of the FOG Policy:
  - 1. First occurrence will result in a warning letter and placement of the establishment on a list for increased observation. Notification will be made to the Virginia Health Department.
  - 2. Second occurrence will result in a letter of violation. For establishments without a FOG discharge permit, the establishment shall apply for a permit. For establishments with a FOG discharge permit, the Participating Utility may require submission of a grease interceptor design, maintenance information and/or other corrective actions within 30 days. Collection system cleaning costs will be applied.
  - 3. Third occurrence will include assessment of cleaning costs and noncompliance fees.
  - 4. Fourth occurrence or failure to pay assessed costs or fees in the time specified shall result in termination of service.
- B. Establishments granted a waiver under item 5.1, F. that are in noncompliance with the FOG Policy or BMPs shall pay a noncompliance fee of \$50 per month in addition to any other fees identified in this section.
- C. Any establishment that is identified, in whole or in part, as the source of a sanitary sewer blockage and/or overflow, will be assessed a noncompliance fee

of not less than \$500 and not more than \$2,500, plus costs for clean up, property damage, regulatory fines and applicable administrative and legal costs.

- D. Each failure to meet individual requirements of the FOG Policy including grease interceptor maintenance or documentation requirements is considered to be a separate violation of the FOG Policy subject to enforcement.

## Appendix A Sizing

**This Appendix is intended to be example guidance for the designer. To determine the size of an exterior, in-ground grease interceptor using the Manning Formula, the calculation is:**

Gallons of interceptor =  $(((1) = \text{GPM/fixture} \times (2) = \text{total \# fixture ratings of grease-laden waste streams}] + (3) \text{ direct flow from a dishwasher, laundry washer, glass washer (in GPM)})) \times (4) (30 \text{ minute retention time})$

Components of equation are:

1. GPM/fixture – This is derived from the Manning Formula. It takes into account the slope; roughness of the pipe (plastic) used, and pipe diameter size. The drainage rates of various pipe diameter sizes are:
  - 0.5 inch pipe diameter = 0.8 GPM/fixture
  - 1.0 inch pipe diameter = 5.0 GPM/fixture
  - 1.5 inch pipe diameter = 15 GPM/fixture
  - 2.0 inch pipe diameter = 33 GPM/fixture
  - 2.5 inch pipe diameter = 59 GPM/fixture
  - 3.0 inch pipe diameter = 93 GPM/fixture
2. Fixture Ratings of Grease-Laden Waste Streams: Fixtures that have more grease in their waste stream received higher values while less grease corresponds to a lower value. Common Commercial Kitchen Fixtures and their Corresponding Rating (each) are:
  - 2, 3, or 4 compartment pot sink = 1.0
  - 1 or 2 compartment meat prep sink = 0.75
  - Pre-rinse sink = 0.5
  - 1 or 2 compartment vegetable prep sink = 0.25
  - Can wash = 0.25
  - Mop sink = 0.25
  - Floor drain = 0.00
3. Direct Flow from Dishwashers, Laundry washer, and Glass washer: These flows must be added directly to the GPM flow because their potential for discharging large quantities of water in a short time period. Since these appliances have pumps, the Manning Formula cannot be applied to predict flow; must use manufacturer's discharge rate for flow in GPM but not less than the draw down rate.
4. Thirty (30) minute retention time.

### **Example #1**

A restaurant has the following fixtures in their kitchen (all fixtures have a 1.5 inch pipe diameter):

- (1) 3-compartment pot sink
- (1) pre-rinse sink
- (1) 2- compartment vegetable prep sink
- (1) dishwasher that discharges 10 GPM

Using the formula to size exterior grease interceptors, gallons needed for grease interceptor =

$$\begin{aligned} & [[15 \text{ GPM} \times [1 + 0.5 + 0.25] + 10 \text{ GPM}] \times 30 \text{ minutes} = \\ & [[15 \text{ GPM} \times 1.75] + 10 \text{ GPM}] \times 30 \text{ minutes} = \\ & 26.25 \text{ GPM} + 10 \text{ GPM} \times 30 \text{ minutes} = \\ & 36.25 \text{ GPM} \times 30 \text{ minutes} = \end{aligned}$$

1087 gallons round up to the next nearest size =

1,250 gallons grease interceptor is required

Example #2: A restaurant has the following fixtures:

A 0.5 inch pipe diameter: Pre-rinse sink

A 1.5 inch pipe diameter:

- (1) 3-compartment pot sink
- (1) pre-rinse sink
- (1) meat prep sink
- (1) vegetable prep sink

A 3.0 inch pipe diameter:

- (1) can wash

Using the formula to size exterior grease interceptors:

For the pre-rinse sink: take  $0.8 \text{ GPM} \times 0.5 = 0.4 \text{ GPM}$

For the 1.5" pipe diam. fixtures:  $15 \text{ GPM} \times [1 + 0.5 + 0.75 + 0.25] = 15 \text{ GPM} \times 2.5 = 37.5 \text{ GPM}$

For the can wash:  $93 \text{ GPM} \times 0.25 = 23.25 \text{ GPM}$

Add  $23.25 \text{ GPM} + 37.5 \text{ GPM} + 0.4 \text{ GPM} = 61.15 \text{ GPM} \times 30 \text{ minutes} = 1835 \text{ gallons};$

round up to the next nearest size = 2,000 gallon grease interceptor is required (Two 1,000 gallon in series).

## **Appendix B Best Management Practices**

**Unless required by a specific establishment FOG DISCHARGE PERMIT, this Appendix is intended to be operational guidance.**

### **1. FOR CLEAN KITCHEN PRACTICES**

- I. Provide regular training to and monitoring of employees on proper and consistency implementation of BMPs to reduce grease discharges to sewer.
- II. Dispose of food waste directly into trash containers.
- III. Dry wipe pots, pans and dishware prior to washing.
- IV. Use absorbent material to soak up FOG under fryer baskets.
- V. Post "NO GREASE" signs above sinks and on the front of dishwashers.
- VI. Properly dispose of all yellow grease into recycling barrels. No yellow grease/oil shall be poured into a drain or flushed into sanitary sewer collection system.
- VII. Place covers on containers before transporting used oil and grease to recycling barrels.

### **2. FOR RECYCLING FOG**

- I. FOG waste can be recycled by rendering or recycling companies.
- II. Collect and recycled used cooking oil in appropriate barrels for recycling.
- III. Collecting and recycling used oil greatly minimizes the amount of FOG that is introduced into the sewer system.

### **3. FOR GREASE INTERCEPTOR OPERATION (if applicable)**

- I. Observe proper grease interceptor cleaning and maintenance procedures to ensure that the device is operating properly. Regular and proper service maximizes interceptor efficiency, prevents spills and minimizes odor.
- II. Train all staff to regularly check the depth of solids and thickness of retained FOG. As a general rule, an interceptor loses its effectiveness when excessive amount of FOG and/or solids accumulate. The frequency of servicing is determined by the accumulation rate of FOG and solids.
- III. Call a pumping company to service the grease interceptor. Have a licensed and certified hauling, rendering or pumping company clean, pump down, and service the grease interceptor regularly.
- IV. Carefully check the interceptor after service to ensure that service was performed correctly.

## Appendix C Definitions

- 1) **Establishment** shall mean customer of the Participating Utility as described in item 1.1, C. engaging in any of the following:
  - a) Commercial food preparation and food service establishment, including but not limited to bakeries, butcher shops, cafes, clubhouses, commercial kitchens, delicatessens, fat rendering plants, ice cream parlors, hospitals, meat packing plants, restaurants, schools, slaughter houses, soap factories, and similar establishments, especially where meat, poultry, seafood, dairy products or fried foods are prepared or served;
  - b) All shopping centers with food processing establishments and / or food courts; and
  - c) All new areas of intensified dwelling, including, but not limited to: adult day care establishments, assisted living establishments, convalescent homes, day nursing and childcare establishments in which food preparation occurs, hotels/motels in which there is a commercial food preparation service, nursing homes, retirement and life care communities and homes, and truck stops with commercial food service.
- 2) **New construction** shall mean any establishment constructed after the effective date of the FOG Policy
- 3) **Existing structures** shall mean any establishment constructed prior to the effective date of the FOG Policy.
- 4) **Change of use** shall mean conversion of an existing structure not previously meeting the definition of an establishment.
- 5) **Renovated** shall mean modifications sufficient to require issuance of a building permit from the locality in which the establishment is situated.
- 6) **Expanded** shall mean establishment modifications that add seating capacity or increases the number of fixtures in the kitchen area.
- 7) **Wholesalers or commercial kitchens** shall mean establishments that meet the requirements of item 1.1, C. but do not have retail sales.

- END OF SECTION -

**CS-1**  
**GENERAL WATER AND SEWER SPECIFICATIONS**

**PART ONE - GENERAL**

1.1 QUALITY ASSURANCE

- A. Qualifications of manufacturers - Products used in this Work shall be produced by manufacturers regularly engaged in the manufacture of similar items and with a history of quality production acceptable to the Participating Utility.
- B. Qualifications of installers - Use experienced workers to ensure proper installation of the products specified herein. In the acceptance or rejection of installed Work, no allowance shall be made for the lack of experience on the part of the workers.
- C. Main line construction can only be performed by Class A contractors licensed by the Commonwealth of Virginia.
- D. A preconstruction conference shall be held on all water and sewer projects by the at least two days prior to any construction work being performed. The contractor shall have a representative of appropriate authority at this meeting. Prior to the start of construction, contractor must have an approved set of Construction Documents on-site.

1.2 LINES AND GRADES

- A. Pipes shall be laid true to the lines and grades shown on the Drawings except as authorized by the Participating Utility. The grade shown on the profile is the invert to which the work must conform. Work not conforming to the grade shall be corrected by the CONTRACTOR at his own expense in a manner acceptable to the Participating Utility.
- B. Locations of water and sewer lines
  - 1. The locations of the proposed lines are shown on the Drawings.
  - 2. The Participating Utility reserves the right to make changes in lines and grades of pipe lines, and in locations of pipes and/or appurtenances when such changes may be necessary or advantageous.
  - 3. Any deviation in location or line grade of sewer, or the location or elevation of a water line, structure or appurtenance as shown on the Contract Drawings, will require a revision of the Drawings clearly showing the proposed deviation, and shall be submitted to the Participating Utility for review and approval before any changes are constructed. Design Engineer of Record must concur in any revision of Drawings. Minor field changes may be made with approval of the Participating Utility's construction inspector.

1.3 SUBMITTALS

- A. General - All submittals shall be made in accordance with Section 6.17 (Shop Drawings and Samples) of the Standard General Conditions of the Engineers Joint Contract Document Committee (EJCDC), 2002 edition. CONTRACTOR shall furnish engineering data covering design and installation. Submittal shall be made in a timely manner so that the project schedule can be met.

- B. Shop drawings - As a minimum, the following shop drawing information shall be submitted to the Participating Utility for review and approval:
1. Complete bill of materials to be provided for the work described under this Section.
  2. Manufacturer's catalog cut sheets for all materials to be provided under this Section.

#### 1.4 RESPONSIBILITY FOR MATERIALS

- A. Material furnished by CONTRACTOR - The CONTRACTOR shall be responsible for all material furnished by him, and shall replace at his own expense all such material found defective in manufacture or damaged in handling after delivery by the manufacturer. This shall include the furnishing of all materials and labor required for the replacement of installed material discovered defective prior to the Final Acceptance of the Work.
- B. Material furnished by Participating Utility - The CONTRACTOR'S responsibility for material furnished by the Participating Utility shall begin at the point of delivery to CONTRACTOR. Materials already on the site shall become the CONTRACTOR'S responsibility on the date of the award of the Contract. The CONTRACTOR shall examine all material furnished by the Participating Utility at the time and place of delivery to him and shall reject all defective material. Any material furnished by the Participating Utility and installed by the CONTRACTOR without discovery of such defects will, if found defective prior to Final Acceptance of the Work, be replaced with sound material by the Participating Utility. The CONTRACTOR, however, shall, at his own expense, furnish all supplies, labor and facilities necessary to remove said defective material and install the sound material in a manner satisfactory to the Participating Utility.

#### 1.5 PRODUCT HANDLING

- A. Handling of Materials
1. All materials furnished by the CONTRACTOR shall be delivered and distributed by the CONTRACTOR. Materials furnished by the Participating Utility shall be picked up by the CONTRACTOR at points designated by the Participating Utility and hauled to and distributed at the site.
  2. Pipe, manholes, appurtenances, etc., shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall such materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.
  3. In distributing the material at the site of work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench.
  4. Pipe shall be so handled that any coating and lining shall not be damaged. If, however, any part of coating or lining is damaged, repair or replacement shall be made by CONTRACTOR at his expense in a manner satisfactory to the Participating Utility.

- B. Storage of Materials - CONTRACTOR shall be responsible for safe storage of material furnished by or to him, and accepted by him, and intended for the Work, until it has been incorporated in completed Project. Interiors of all pipes, fittings and other accessories shall be kept free from dirt and foreign matter at all times.
- C. Damaged Material - Any material furnished by Participating Utility that becomes damaged by CONTRACTOR after acceptance shall be replaced by CONTRACTOR at Contractor's expense.

#### 1.6 COMPLIANCE WITH UNDERGROUND UTILITY DAMAGE PROTECTION ACT

CONTRACTOR shall be responsible for notifying "Miss Utility" in accordance with "Miss Utility" rules and guidelines prior to any excavating operations. CONTRACTOR shall be aware of and comply with all provisions of the Virginia Underground Utility Damage Protection Act as enforced by the State Corporation Commission.

#### 1.7 COMPLIANCE WITH VA DEPARTMENT OF TRANSPORTATION STANDARDS

CONTRACTOR shall be aware of and comply with all provisions of the locality and Virginia Department of Transportation (VDOT) as contained in the latest editions of the VDOT Road and Bridge Specifications, VDOT Road and Bridge Standards, VA Work Area Protection Manual and VDOT Land Use Permit Manual.

#### 1.8 ALTERNATIVES

Type of pipe material used in construction of the specified water or sewer pipeline as specified herein shall be at CONTRACTOR's option unless a specific type of pipe is required by note on the Drawings.

#### 1.9 WARRANTY

All Work, including equipment and materials, shall be warranted to be free from defects in materials and workmanship for a minimum of one (1) year following Final Acceptance by the Participating Utility. Participating Utilities may have differing requirements for Final Acceptance.

### **PART TWO - EXECUTION**

#### 2.1 EXCAVATION

- A. Excavation shall conform to the lines and grades shown on the plans. Trench shall be dug so that pipe can be laid to the alignment and depth required. 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.
- B. CONTRACTOR shall install all sheeting, bracing, shoring, sloping or benching necessary to perform the Work, to protect existing structures and all excavations as required for safety, in conformance with all local, state and federal safety regulations. CONTRACTOR shall comply with OSHA Subpart P, Excavations 29 CFR 1926.650, .651 and .652. Compliance with provisions of the Overhead High Voltage Line Safety Act is required.
- C. Trenches are not to be left open overnight unless adequate safety precautions are

taken. Where consistent with safety and space considerations, excavated material is to be placed on uphill side of trenches. Pipe shall not be strung along trench in excess of that which can be installed each day.

- D. Not more than one-hundred-fifty feet (150') of trench shall be opened in advance of the completed pipe laying.
- E. Wherever foundation material is incapable of properly supporting the pipe or structure, in the opinion of the Participating Utility, a geotechnical consultant shall design a site-specific remedy. CONTRACTOR shall adhere to recommendations of the geotechnical consultant.
- F. Dewatering equipment shall be sized to maintain the trench in a satisfactory dewatered condition suitable for pipe laying and backfilling. Pipe installation 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.
- G. Trench shall be excavated to depth required so as to provide a uniform and continuous bearing support for pipe on solid and undisturbed ground at every point between bell holes, except that it will be permissible to disturb and otherwise damage finished surface over a maximum length of eighteen inches (18") near middle of each length of pipe by withdrawal of pipe slings or other lifting tackle. (DIP ONLY-see item H. below) Damaged area shall be refinished as near as possible. Any part of bottom of trench excavated below specified grade, shall be backfilled with approved materials, and be thoroughly compacted. Finished subgrade shall be prepared accurately by means of hand tools.
- H. Bedding shall be placed as required by the pipe manufacturer's written installation instructions. Under no circumstances shall plastic pipe be installed in an open trench without bedding.
- I. Bell holes shall be provided at each joint to permit the jointing to be made properly and to permit maximum bedding length.
- J. Ledge rock, boulders, and large stones shall be removed to provide a clearance of at least six inches (6") below and on each side of pipe and appurtenances being laid and any part or projection of such rock, or stone. Subgrade shall be made by backfilling with compacted gravel or clean selected soil (if approved by governing entity).
- K. All bedding and backfill placed from bottom of trench to one foot above the pipe shall be placed in 6" lifts; backfill in this area shall not contain stones or earth clods greater than one inch in diameter. No stone, rock, or earth clod larger than five inches (5") in its greatest dimension shall be used in the backfilling one foot above the pipe to the finished grade on any water or sewer line. All bedding and backfill outside traffic areas shall be compacted to at least 90% of maximum theoretical density as determined by ASTM D 698, or 95% density of in-situ material; beginning at one foot above the pipe to finished grade, the backfill shall be placed in 10" lifts. All bedding and backfill located within traffic areas shall be compacted to at least 95% of maximum theoretical density as determined by ASTM D 698; beginning at one foot above the pipe to finished grade, the backfill shall be placed in 6" lifts. All backfill material shall be free of perishable material, frozen clods, sticky masses of clay and other unsuitable matter.
- L. Backfill and replacement in existing or proposed roads shall be executed in full

accordance with requirements of the Virginia Department of Transportation, or other applicable local government standards. All materials excavated, but not used in backfilling, shall be properly removed and disposed of by the CONTRACTOR in an approved location provided by the contractor.

- M. Stockpile areas shall be selected and maintained in compliance with all local, state and federal regulations.

## 2.2 SEPARATION OF WATER LINES AND SANITARY SEWERS

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

1. Materials and types of joints for water and sewer pipe;
2. Soil conditions;
3. Service branch connections into the water line and sewer lines;
4. Compensating variations in the horizontal and vertical separations;
5. Space for repairs and alterations of water and sewer mains;
6. Offsetting of pipes around manholes;
7. Identification of the physical restraints preventing normal separation.

- B. Parallel Installation

1. Normal Conditions - Water lines shall be laid at least ten feet (10') horizontally from a sewer line or sewer manhole whenever possible, distance shall be measured edge-to-edge unless determined by the Participating Utility to be unusual conditions.
2. Unusual Conditions - When local conditions prevent a horizontal separation described above, the following construction shall be used:
  - a. Bottom (invert) of water main shall be at least eighteen inches (18") above top (crown) of sewer.
  - b. Where this vertical separation cannot be obtained, sewer shall be constructed of ANSI/AWWA approved water pipe, hydrostatically pressure tested in place without leakage prior to backfilling. Pressure test shall be at 30 psi.
  - c. Sewer manhole shall be of watertight construction and tested in place.
3. No drinking well shall have a sanitary sewer line within 50' unless adequate protection is provided in accordance with B.2.b above.

- C. Crossing

1. Normal conditions - water lines crossing over sewers shall be laid to provide a separation of at least eighteen inches (18") between the bottom of the water line and the top of the sewer whenever possible.
2. Unusual conditions - when conditions prevent a vertical separation as described above, and when approved by the Participating Utility, the following construction shall be used:

- a. Sewers passing over or under water lines shall be constructed of ANSI/AWWA approved water pipe, hydrostatically pressure tested in place without leakage prior to backfill. Pressure test shall be at 30 psi. In no case shall the separation between the sewer and water lines or casing pipes be less than six inches (6").
  - b. Water lines passing under sewers shall, in addition, be protected by providing:
    - i. Vertical separation of at least eighteen inches (18") between the bottom of the sewer and the top of the water line;
    - ii. Adequate structural support for sewers to prevent excessive deflection of joints and settling on and breaking of the water line;
    - iii. Length of water (pipe) shall be centered at the point of the crossing so that joints shall be equidistant and as far as possible from sewer.
3. Intersections - No water pipes shall pass through or come in contact with any part of a sewer or sewer manhole.
4. Other Utilities
- a. When other underground utilities (storm drains, gas, electrical, etc.) cross within six inches (6") to eighteen inches (18") above or below water lines, adequate structural support of the utilities shall be provided.
  - b. Water lines shall be placed over storm drains wherever practical.
  - c. Parallel installations shall have a minimum horizontal clearance of two feet (2') from edge of pipe to edge of other utility.
  - d. Other underground utility structures shall have a minimum clearance of five feet (5') from edge of structure to edge of water or sewer structure.

## 2.3 CARE AND RESTORATION OF PROPERTY

- A. All equipment shall be operated with care to prevent damage to existing structures and/or wires.
- B. On paved surfaces, the CONTRACTOR shall not use or operate tractors, bulldozers, or other power-operated equipment treads or wheels which are so shaped as to cut or otherwise damage such surfaces.
- C. All surfaces that have been damaged by CONTRACTOR's operations shall be restored to a condition at least equal to that in which they were found immediately prior to beginning of operations. Suitable materials and methods shall be used for such restoration.
- D. CONTRACTOR shall replace and repair all lawns, terraces, shrubs, trees, plants, fences, sidewalks, curbs, cross walks, gutters, driveways, ditches, steps, mail boxes or pavements, and repair and make good all other damage, that may occur during construction work. CONTRACTOR will be held responsible for all damage that may occur after pipeline is constructed and which may be directly or indirectly attributed to operations as they are carried out. CONTRACTOR shall not operate equipment

or store materials on private property without first having obtained written consent of property owner.

- E. CONTRACTOR's attention is directed to importance of maintaining closed fences and/or gates on all property thus protected at present. In the event that fences are encountered in the line of the Project, or along rights-of-way, temporary fences shall be installed by CONTRACTOR before removal of existing fences. Temporary fences shall be installed totally on the Project easement near appropriate boundary of the right-of-way. Such temporary fence shall be of like quality and design as fence being replaced, and shall be maintained by CONTRACTOR in efficient condition until replaced by him with replacement fence. After construction has progressed beyond location of temporary fence, temporary fence shall be removed and permanent replacement fence, of quality and design at least equal to that existing, shall be erected on easement, in same location(s) as before construction.
- F. Wherever, with property owner's written permission, it is necessary that gates in fenced lands be opened, or used periodically, the CONTRACTOR shall use special caution to prevent the escape of, or damage to, livestock, horses, or other property thus now protected, including the installation of cattle-guard devices, if necessary.
- G. Damage to, or loss of, fenced property, real, live or other, shall be totally the responsibility of CONTRACTOR, and CONTRACTOR shall save harmless the Participating Utility from any and all claims arising out of such damage or loss.
- H. Restoration of existing property or structures shall be done as promptly as practicable and shall not be left until the end of the construction period.

#### 2.4 PROTECTION OF EXISTING STRUCTURES, PRIVATE PROPERTY, AND RIGHTS-OF-WAY

- A. All existing pipes, poles, wires, fences, curbing, property-line markers, and other structures which, in the opinion of the Participating Utility must be preserved in place without being temporarily or permanently relocated, shall be carefully supported and protected from damages by CONTRACTOR, and in case of damage, CONTRACTOR shall notify the appropriate party so that proper steps may be taken to repair any and all damage done. When owners do not wish to make the repairs themselves, all damage shall be repaired by CONTRACTOR, or, if not promptly done by him, Participating Utility may have repairs made at expense of CONTRACTOR.
- B. All utility services shall be supported by suitable means so that the services shall not fail when tamping or settling occurs.
- C. CONTRACTOR shall not be compensated for any additional work involved if utilities or underground structures cross trench line transversely above or below a water or sewer line.
- D. CONTRACTOR shall consult Participating Utility or his representatives prior to removing or disturbing any tree, shrub, bush, fence, sidewalk, building structure, or improvement that may be encountered in the line of a water or sewer line or in path of the easement, or right-of-way secured by the Participating Utility. Immediately upon completion of laying of necessary pipe, fittings, and appurtenances through each piece of private property, CONTRACTOR shall backfill the trench, tamping same in a careful and workmanlike manner, replacing

sod, lawns, bushes, shrubs, or whatever else may have been removed, disturbed or altered during progress of the work.

- E. Property corners, monuments, etc. that are disturbed during construction shall be replaced by a surveyor licensed in the Commonwealth of Virginia. UNLESS REPLACING PROPERTY CORNERS/MONUMENTS IS A SEPARATE BID ITEM, NO PAYMENT WILL BE MADE FOR REPLACING SURVEY REFERENCES.

## 2.5 AS-BUILTS

- A. Approved as-builts, completed by a licensed engineer or surveyor, are required prior to Substantial Completion.

**- END OF SECTION -**

**CS-2**  
**WATER DISTRIBUTION PIPING**

**PART ONE - GENERAL**

1.1 DESCRIPTION

- A. Work included - Provide all labor, material and equipment necessary to excavate pipe trenches and backfill after the installation of the pipe, all in accordance with the Drawings and as specified herein.
- B. Related work specified elsewhere
  - 1. General Water and Sewer Specifications – Section CS-1
  - 2. Rock Excavation – Section CS-6
  - 3. Stream and/or Highway Crossings – Section CS-7
  - 4. Horizontal Directional Drilling (HDD) Methodology – Section CS-8
  - 5. Seeding and Mulching – Section CS-9
- C. General Conditions - Any reference to General Conditions refers to the EJCDC C-700 Standard General Conditions of the Construction Contract (2002 edition).

1.2 APPLICABLE ANSI/AWWA STANDARDS

The following ANSI/AWWA Standards (latest revision) are hereby incorporated by reference. Where a conflict exists between these written standards, and the standards incorporated by reference, the Participating Utility will determine which standard shall apply. In general, the Participating Utility will select the Standard that gives a final product that is in best interest of the Participating Utility. Applicant shall provide the Participating Utility with manufacturer's certification that materials meet these standards.

- A100 Standard for water wells.
- C104 Standard for cement-mortar lined for ductile-iron and gray-iron pipe and fittings.
- C110 Standard for ductile-iron and gray-iron fittings.
- C111 Standard for rubber gasket joints for ductile-iron and gray-iron pipe and fittings.
- C115 Standard for flanged ductile-iron and gray-iron pipe with threaded flanges.
- C150 Standard for thickness design of ductile-iron pipe
- C151 Standard for ductile-iron pipe
- C502 Standard for dry-barrel fire hydrants
- C504 Standard for rubber-seated butterfly valves  
(approved for 14 inch or larger)
- C506 Standard for backflow prevention devices
- C508 Standard for swing-check valves
- C509 Standard for resilient-seated gate valves
- C515 Reduced-wall, resilient-seated gate valves
- C550 Standard for protective interior coatings for valves and hydrants
- C600 Standard for installation and testing of ductile-iron  
water mains and their appurtenances
- C602 Standard for cement-mortar lining of water pipe lines in place
- C651 Standard for disinfecting water mains
- C652 Standard for disinfection of water storage facilities
- C900 Polyvinyl chloride (PVC) pressure pipe & fabricated fittings, 4 In. Through 12 In. for  
water transmission and distribution (DR-14 minimum class to be considered).
- C905 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through  
48 In. for water transmission and distribution.

- C906 Polyethylene (PE) pressure pipe & fittings, for water distribution and transmission (DR-11 minimum class to be considered).
- C909 Molecularly oriented polyvinyl chloride (PVCO) pressure pipe, for water (Minimum class 200 to be considered).
- D100 Standard for welded steel tanks for water storage
- D102 Standard for painting steel water storage tanks
- D103 Standard for factory-coated bolted water storage tanks

## **PART TWO – PRODUCTS**

### 2.1 WATER PIPE AND APPURTENANCES

#### A. General

All pipe for water main construction shall be one of the following or as directed by the Participating Utility:

1. Ductile iron pressure pipe (DIP) of the push-on joint or mechanical joint variety, conforming to ANSI/AWWA C151, latest revision. For all pipe twelve inches (12") in diameter or smaller, the minimum pressure class (PC) shall be 350, the minimum thickness class shall be 50. Water mains larger than twelve inch (12") diameter in size shall have a wall-thickness as determined by thickness design of ductile-iron pipe ANSI/AWWA C150, or:
  - **DIP is the only pipe material approved for use in the City of Salem and the Town of Vinton.**
2. Polyvinyl chloride (PVC) conforming to ANSI/AWWA C900 with ductile iron pipe size (DIPS) O.D. dimension ratio (DR) 14 PC 305 shall be minimum requirements for all four-inch through 12-inch (4"-12") PVC pipe. Two-inch (2") diameter iron pipe size (IPS) standard dimension ratio (SDR) PVC pipe shall be the only IPS SDR PVC used as part of any water system. All PVC pipe larger than two inch (2") shall be DIPS O.D. DR. Water mains larger than twelve inch (12") diameter in size shall meet the requirements of ANSI/AWWA C905 for DR 18, PC 235, and have integral bell with bonded in ring and spigot joint. On specific authorization of the Participating Utility, transmission lines may be PVC meeting ANSI/AWWA C905 with DR-25, PC 165 rating, or:
3. Polyethylene (PE) conforming to ANSI/AWWA C906, with dimension ratio (DR) 11, PE 4710 shall be minimum for PE pipe. PE pipe shall be assembled and joined using the butt-fusion method in strict compliance with the manufacturer's recommendations, or:
4. Molecularly oriented polyvinyl chloride (PVCO) conforming to ANSI/AWWA C909, pressure class 235 shall be minimum for PVCO pipe. This material is only acceptable for water mains up to twelve inch (12") diameter in size.
5. Brass pipe and fittings shall conform to the latest edition of the Safe Drinking Water Act and the Reduction of Lead in Drinking Water Act amendment.

#### B. Ductile Iron Standard Mechanical Joint Pipe

1. All ductile iron standard mechanical joint water pipe shall conform to ANSI/AWWA C151/A21.51 and shall be lined with cement mortar and have a

protective exterior coating. Linings and protective coatings equal to "Enameline" with tar coating in the exterior will be considered as a satisfactory lining for water pipe; however, any substitution in pipe lining and/or coating from ANSI/AWWA C104/A21.4 shall be specifically approved by the Participating Utility.

2. Joints of standard mechanical joint pipe shall conform to ANSI/AWWA C111/A21.1.
3. High strength steel tee head bolts, hex nuts, cast or ductile iron glands and rubber gaskets shall be as furnished by the pipe manufacturer. All tee bolts and nuts shall be constructed of same size and type material as head bolts and hex nuts.
4. In making connections of ductile iron pipe using standard mechanical joint, the gland followed by the rubber gasket shall be placed over plain end of the pipe, which shall be carefully inserted and aligned into socket end of pipe line. Gasket shall then be pushed into position so that it is evenly seated in the socket. Gland shall then be moved into position against face of the gasket, bolts inserted and made finger tight. Bolts shall then be tightened in accordance with ANSI/AWWA C600 (75-90 FT-LB Torque for pipe size 4-12"). All other requirements concerning bedding, alignment, and cleaning of pipe before making joint shall be followed.

C. Ductile Iron Pipe - "Push-On Joint"

1. All "push-on" or "slip" joint pipe shall conform to requirements of standard mechanical joint pipe in regard to strength, class, protective coatings, etc.

D. Restrained Joint Pipe Systems

1. Approved restrained joint pipe systems shall be installed according to the manufacturer's recommendations and include the following:
  - a. Mechanical joint pipe with use of joint restraint gland such as EBAA Iron "Mega-Lug", Ford "Uni-Flange", Romac Industries "Grip Ring", US Pipe "MJ Field Lok", Tyler Union "Tuf Grip", or other restraint gland as approved by the Participating Utility.
  - b. Ductile iron pipe push-on joint with use of U.S. Pipe "Field LOK" gaskets, American Ductile Iron Pipe "Fast Grip", or approved equal.
  - c. Restrained joint ductile iron pipe such as U.S. Pipe "TR FLEX" pipe, American Ductile Iron Pipe "Flex Ring", or other restraint joint pipe as approved by the Participating Utility.
  - d. Restrained joint C900 DR 14 PVC pipe such as Diamond Lok-21 or approved equal.
  - e. Ductile iron, PE, or PVC pipe push-on joints, valves or hydrants with use of Mueller Company "AquaGrip" system.

E. PVC Plastic Bell and Spigot Joint

1. PVC pipe meeting the ANSI/AWWA Specification C900 for dimension ratio

(DR) 14, pressure class 305, may be used for water lines. DR-18 or DR-25 may be used as noted above for pressure pipe larger than twelve inches (12") in diameter.

2. PVC pipe shall be installed, bedded and backfilled according to the manufacturer's written instructions.
3. All service line connections to PVC pipe shall be made using a stainless steel service saddle and full port, Teflon coated ball valve corporation stop. Service saddle shall be of the extra wide or double-band type and manufactured specifically for PVC pipe. No direct tap to PVC pipe shall be permitted.
4. Only bell and spigot with elastomeric gasket joints shall be used. Solvent-cement joints or use of couplings shall not be allowed.

F. PE Pipe

1. PE pipe shall be high density polyethylene meeting the ANSI/AWWA Specification C906 for dimension ratio (DR) 11, ductile iron pipe size (DIPS) O.D., and applicable requirements of ASTM D3350, may be used for water lines.
2. PE pipe shall be installed, bedded and backfilled according to the manufacturer's written instructions.
3. All service line connections to PE pipe shall be made using a fused service saddle and full port, Teflon coated ball valve corporation stop. No direct tap to PE pipe shall be permitted.
4. PE pipe shall be assembled and joined at the site using the butt-fusion method to provide a leak proof joint. Threaded or solvent-cement joints and connections shall not be permitted. All equipment and procedures used shall be used in strict compliance with the manufacturer's recommendations.
5. Qualifications of Personnel: HDPE pipe jointing shall be performed by personnel certified by the pipe manufacturer in the use of butt-fusion equipment and recommended methods for new pipe connections. Personnel directly involved with installing the new pipe shall have current certification in the proper methods for handling and installing the HDPE pipe. Certification shall be performed by a qualified representative of the pipe manufacturer.
6. Butt-fused joint shall be true alignment and shall have uniform roll-back bead resulting from the use of proper temperature and pressure. Joint shall be allowed adequate cooling time before removal of pressure. Fused joint shall be watertight and shall have tensile strength equal to that of the pipe. All joints shall be subject to acceptance by the Participating Utility and/or his representative prior to insertion. All defective joints shall be cut out and replaced at no cost to the Participating Utility.
  - a. Any section of the pipe with a gash, blister, abrasion, nick, scar, or other deleterious fault greater in depth than ten percent (10%) of the wall thickness, shall not be used and must be removed from the site. However, a defective area of the pipe may be cut out and the joint fused in accordance with the procedures stated above.



1. Hydrants shall be traffic model, dry-barrel type, meeting ANSI/AWWA C502 latest revision standard; see Fire Hydrant Assembly Detail for approved manufacturers and models.
2. Hydrants shall be of compression type with main valve openings not less than five and one-quarter inches (5 ¼") in diameter. Hydrants shall have cast or ductile iron body with full, bronze trim, and shall withstand a hydrostatic test pressure of 300 psi. Hydrants shall have a six inch (6") connection base for setting with a minimum of thirty-six inches (36") cover on connection pipe. Hydrants shall be equipped with hose connections as follows:

Two each 2-1/2", N.S.T. hose connections

One each 4-1/2", N.S.T. pumper connections

3. Hydrant shall be operated by a National Standard one and one half inch (1-1/2") pentagon shaped, operating nut, opening counterclockwise. Direction of opening shall be clearly marked by an arrow cast on outside of hydrant. Hydrants shall be connected to the main with a six-inch (6") pipe and shall be controlled by an independent six-inch (6") gate valve. Six-inch (6") gate valve shall be located as near to service main as practical, and connected to the tee with tie rods. A gravel dry well shall be provided for hydrant drain. Fire hydrant drain shall be plugged if drain hole is located below the water table.
4. Hydrant assembly shall be restrained from connection to distribution main to hydrant. Approved restraint methods shall include threaded "Corten" rodding between hydrant, hydrant valve and connection to water distribution main with concrete thrust blocks behind hydrant and distribution main tee fitting. Approved mechanical joint gland restraint may be used in lieu of concrete thrust blocking. High pressure (over 120 psi) requires the use of all three restraints.
5. Public hydrant barrels shall be painted silver with an oil-based paint. Private hydrant barrels shall also be painted silver with an oil-based paint unless otherwise specified by the jurisdictional Fire Marshal. Bonnets will be painted by the jurisdictional fire departments.

#### L. Valve Vaults

1. Valve vaults shall be used for all main line valves unless otherwise approved in writing by the Participating Utility. All vaults shall be precast manhole cone sections with water manhole covers as shown in the Detail Drawings.
  - **Western Virginia Water Authority and the Town of Vinton require valve vaults on main line valves, City of Salem will allow screw-type valve boxes.**

#### M. Valve Boxes

1. All valve boxes, base extensions, head and cover shall be of cast or ductile iron. Valve boxes shall be Screw Type with round head marked "Water" in letters not less than one inch (1"). Shaft diameter shall not be less than five inches (5"). Valve boxes shall have a minimum range of extension to fit two inch (2") to twelve inch (12") valves inclusive, placed on mains at depths of

three feet (3'), to five feet (5') of cover in order that cover of the valve box is set to finished grade. Valve boxes shall be Mueller Company 10364, Tyler/Union 6850 series 562-S, or approved equal. Valve boxes shall be centered over valve screw and set plumb, and shall be installed upon the valve with the use of a Valve Box Adaptor II as manufactured by Adaptor, Inc. or approved equal. Valve boxes shall only be allowed on fire hydrant valves or on other installations when approved in writing by the Participating Utility.

N. Water Service Connection – Standard

1. Standard meter connection shall be installed when static pressure is less than 120 PSI.
2. Water meter box and accessories therein necessary for Standard meter installation shall be furnished and installed by CONTRACTOR just within right-of-way/easement at the property line as shown on construction plans. Water meter box and meter setter shall be furnished and installed as shown in the Detail Drawings. All meter setters shall be equipped with an integral lockable valve and check valve.
3. For pressure ranging between 80 – 120 PSI it is recommended that a pressure reducing valve (PRV) be installed on the private side of the water meter to protect the private plumbing, and to ensure compliance with Uniform Statewide Building Code, and/or the governing jurisdictions building code requirements. It is encouraged that the PRV be installed in a separate meter box just downstream of the water meter box. This installation will allow easy access for maintenance and will reduce the pressure on the service line between the PRV and the structure.

O. Water Service Connection - High Pressure

1. High Pressure meter connection shall be installed when main line pressure exceeds 120 PSI. High Pressure service incorporates installation of water meter and individual three-quarter inch (3/4") pressure reducing valve in a standard tandem meter setter and box situated just within right-of-way/easement at the property line as shown on construction detail.
2. Water meter, three-quarter inch (3/4") pressure reducing valve with integral pressure relief valve, connecting S-bar, and accessories therein necessary for High Pressure meter installation shall be furnished and installed by CONTRACTOR just within right-of-way/easement at the property line as shown on construction plans. Water meter box and tandem meter setter shall be furnished and installed as shown in the Detail Drawings. All meter setters shall be equipped with an integral lockable valve and check valve.

- **High Pressure configuration is not allowed in City of Salem or Town of Vinton service areas, all water services installed in these localities shall be “Standard”.**

- P. 1” to 3” Water Services - All water service pipe from the connection at the main to the meter box assembly shall be "K" type copper or Polyethylene (PE). PE tubing shall be produced with PE 4710 bimodal resins. It shall be SODR-9, copper tube size (CTS), meeting the requirements of AWWA C901 and ASTM D2737 and pressure rated for 200 psi. Tubing shall be certified according to NSF 61 and the same shall be indicated on the pipe. Tubing shall be Endopure by Endot

Industries, Inc. or equal. All connections shall use approved CTS compression connection fittings. Pipe stiffeners/inserts for PE tubing shall be used in accordance with manufacturer's recommendations. The minimum size service connection shall be one inch (1") outside diameter for both single and double setters. Fittings for service lines shall meet ANSI/AWWA Specification C800. Solder connection shall not be used for underground service.

- Q. Water Services Larger Than 3" - All water services larger than three inches (3") are to be reviewed and approved by the Participating Utility on an individual basis.
- R. Water Meters - All water meters shall be installed by the Participating Utility per the current fee schedule.
- S. Wet Taps - Consult the Participating Utility for their policy regarding taps to existing mains.
- T. Pipeline Bedding Materials - Where pipeline installation requires granular bedding materials, they shall meet requirements of VDOT gradation. See General Detail Drawings.
- U. Special Conditions - The Participating Utility may require special material and/or construction be used where normal water pressure exceeds pressure rating used in these standards and where design will not permit reducing pressures to acceptable levels.

### **PART THREE - EXECUTION**

#### **3.1 WATER LINE CONSTRUCTION**

##### **A. General**

1. Except as specifically modified below, water line construction shall meet requirements of ANSI/AWWA C600 latest edition Standards. Pipe, fittings, valves, hydrants and accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall such materials be dropped. Pipe shall be so handled that any coating or lining is not damaged.
2. The water main shall be laid and maintained to the required lines and grades with fittings, valves, hydrants and accessories set at the required locations as indicated on the approved drawings for the project. All valve and hydrant stems shall be set plumb. Whenever obstructions not shown on the plans are encountered during progress of the work and interfere to such an extent that altering the drawings is required, the Participating Utility approval shall be given before such alterations are put into effect. Any such alternative design shall be designed or approved by the Engineer-of-Record for the original design.
3. No pipe shall be laid in water or when, in the opinion of the Participating Utility, trench conditions are unsuitable. If the Participating Utility is of the opinion that trench bottom consists of wet, washable material or is otherwise incapable of properly supporting the pipe or structures, such material shall be removed and replaced with proper bedding material in addition to the standard bedding required.

4. All construction of water mains and appurtenances in the Participating Utility shall be in strict accordance with drawings and specifications prepared as part of the Contract Documents and as approved by the Participating Utility. All materials shall be new and unused. Prior to construction of the approved water main, CONTRACTOR shall provide horizontal field stakeout in order that water line and appurtenances may be constructed in accordance with Contract Drawings.
5. Slopes over 20% require restrained joints and anchor blocks in accordance with Anchor Block Detail drawing.

B. Installation of Pipe and Fittings

1. When installing pipe in trench, proper implements, tools, and facilities satisfactory to the Participating Utility and as recommended by material manufacturer shall be provided and used by the CONTRACTOR for safe and convenient prosecution of the work. All pipe, valves, fittings, hydrants and accessories shall be carefully lowered into trench, piece by piece, by means of a derrick, ropes, slings or other suitable tools or equipment in such a manner as to prevent damage to water main material and any protective coatings and linings. Under no circumstances shall water main materials be dropped or dumped into trench. Pipe and fittings shall be inspected for defects, and while suspended above grade, be rung with a light hammer to detect cracks.
2. All lumps, blisters and excess coal tar coatings shall be removed from ends of ductile iron pipe, and outside of the spigot and inside of the bell shall be wiped clean and dry and free from oil and greases before the pipe is laid.
3. Every precaution shall be taken to prevent foreign material including nonpotable water from entering the pipe while it is being placed in the line. If the pipe-laying crew cannot put the pipe into the trench and in place without getting earth into it, 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, no debris, tools, clothing, or other materials shall be placed in the pipe. At the end of each day a watertight plug shall be placed in the end of all pipe opening.
4. After placing a length of pipe in the trench, the spigot end shall be centered in the open bell of the pipe line and the pipe pushed home as recommended by the manufacturer. Water pipe shall be laid with the bell facing the direction of the laying.
5. No stub of any water main shall terminate with a capped or plugged valve. Where a valve is required to be installed near a stub end, not less than thirty-six feet (36') of pipe shall be installed between valve and plugged stub end of pipe for adequate anchoring.
6. Cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or cement lining and so as to leave a smooth end at right angles to axis of the pipe.
7. When machine cutting is not available for cutting metal pipe twenty inches (20") in diameter or larger, the electric-arc cutting method will be permitted using a carbon or steel rod. Only qualified and experienced workmen shall be

used for this work. Flame cutting of metal pipe by means of oxyacetylene torch will not be allowed.

8. Whenever it is necessary to deflect pipe from a straight line, either in vertical or horizontal plane, to avoid obstructions or plumb stems, or where long-radius curves are approved, the amount of deflection allowed shall not exceed the maximum required, for satisfactory joining of the pipe, as specified herein. Maximum deflection permitted per joint shall be in accordance with ANSI/AWWA C600 Table 3 for push-on joint and Table 4 for mechanical joint pipe. C900 PVC pipe deflection may not exceed 75% of manufacturer's recommendation. See Detail for Joint Deflection Allowance.
9. All tees, bends, plugs, caps, and fire hydrants shall be substantially braced, blocked and/or strapped to prevent any movements by providing adequate reaction backing and/or tie rods. Reaction backing shall be designed and installed as indicated in the Detail Drawings. Hydrants shall be set to established finished grade as follows:
  - a. Bottom of the four and one-half inch (4-1/2") nozzle shall be between eighteen inches (18") and twenty-four inches (24") above finish elevation, and at a minimum of six feet (6') or maximum of twelve feet (12') from edge of the shoulder on streets without curb and gutter and between eighteen (18") and twenty-four inches (24") above elevation of the curb on streets with curb and gutter and at a minimum of two feet (2') and maximum of four feet (4') behind the curb as indicated in the Detail Drawings.
  - b. Two and one-half inch (2-1/2") hose connections shall have a minimum of four feet (4') clearance on all sides.
  - c. Surface shall be approximately level within a four-foot (4') radius of the hydrant.
10. Locator wire shall be installed with all non-metallic pipe. Warning tape shall be required for ALL pipe installed by open trenching. Refer to Detail Drawings.

#### C. Installation of Valves, Air Relief Assemblies and Blow-Off Chambers

1. During construction, air and sediment accumulations may be removed through a standard fire hydrant. Compressed air and/or pumping may be used for dewatering mains through hydrants.
2. 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 relief valves be connected directly to any sewer.
3. Such 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 in areas with a sufficiently deep water table.

#### D. Connection of HDPE Pipe to Ductile Iron Fittings

1. HDPE Pipe shall be joined to ductile iron fittings, valves, and fire hydrants with

the use of an HDPE Mechanical Joint adapter in strict compliance with the manufacturer's recommendations.

2. HDPE Mechanical Joint adapters shall be either butt-fused or electro-fused to the HDPE pipe to provide a leak proof joint. Ductile iron fitting, gate valve, or fire hydrant shall be bolted to the M.J. adapter with the use of an M.J. accessory kit in compliance with the manufacturer's recommendations. The M.J. adapter and M.J. accessory kit shall both have a pressure rating equal to or greater than the pressure rating of the HDPE pipe. Stainless steel stiffeners/inserts shall be used. Approved M.J. adapter and M.J. accessory kit manufacturers include IntegriFuse by Integrity Fusion Products, Inc., DriscoPlex by Performance Pipe, or an approved equal.
3. Ductile iron fittings, valves and hydrants with integral HDPE stub-outs shall be either butt-fused or electro-fused directly to the HDPE pipe. All gate valves with integral HDPE stub-outs of 4" or smaller size shall incorporate an HDPE valve foundation to prevent operating torque being transferred from the valve to the pipe connections.

E. Transitioning from HDPE Pipe to Ductile Iron Pipe

1. One of the following two methods shall be used to restrain the pipe at the transition of HDPE and ductile iron to prevent pullout at the ductile iron joints.
  - a. Install a fused HDPE collar restraint on each end of the HDPE pipe near the material transition in compliance with the manufacturer's recommendations. The collar restraint shall then be cast in concrete in accordance with the Anchor Block Detail in the General Detail Drawings.
  - b. Restrained joints, in accordance with 2.1.D of this section, shall be installed in the ductile iron pipe beginning at the material transition and continuing for the distance shown in the Minimum Thrust Restraint of Pipe Joints Design Lengths Detail for valve/plug and the appropriate pipe size and material. This distance may be specified otherwise by the Participating Utility.

### 3.2 HYDROSTATIC TEST FOR LEAKAGE

A. General

1. All new water mains shall be tested, after backfilling, to a hydrostatic pressure of 100 psi above design water pressure for the system or 200 psi, whichever is greater, unless otherwise required by the Participating Utility. Allowable leakage shall be calculated by the following formula:

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

Where:

L = testing allowance (makeup water) in gallons per hour  
S = length of pipe tested in feet  
D = nominal diameter of pipe in inches  
P = average test pressure during leakage test in psi.

\* If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

- B. No water line shall be placed in service until the leakage is less than the allowable leakage as indicated above. Testing of water mains shall only be done after installation of all valves, taps and service laterals are complete. All portions of the water system, including hydrants and service lines, shall be subject to hydrostatic pressure during the leakage test. Testing of water mains shall be observed and documented by the Participating Utility's Inspector/Engineer.
- C. All high points and service lines in portion of system under test shall be vented and all air expelled from system prior to beginning test. All 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.
- D. After section of system under test has reached required pressure as stated above, said pressure shall be maintained for two (2) hours. The test pressure shall not vary by more than +/- 5 psi for the duration of the test. At conclusion of pressure test, volume of makeup water required to refill pipeline shall be determined by measurement with displacement meter or by pumping from vessel of known volume.
- E. All joints or fittings at which leakage occurs shall be reworked to insure tightness. All visible leaks shall be repaired regardless of amount of leakage. If measured amount of leakage exceeds testing allowance the pipeline shall be repaired and retested until leakage is within limit set by the referenced specification. Methods of repair prior to retesting will be done with the Participating Utility's approval and inspection. Repairs of new construction will be by adjustment or replacement of material only. The use of repair clamps or bell clamps will not be acceptable.

### 3.3 DISINFECTION OF WATER MAINS

- A. General - After testing and before final inspection of the completed systems, water mains and service laterals shall be flushed and disinfected in accordance with ANSI/AWWA Specification C651 latest revision. Flushing shall be accomplished at a flow velocity of not less than 2.5 feet per second.
- B. Disinfection Procedures
  1. Disinfection as described in ANSI/AWWA C651 - "Placing of granular calcium hypochlorite tablets" shall be used. Five-gram (5g) calcium hypochlorite tablets with 3.25 gram available chlorine per tablet shall be attached at the inside top of the pipe by an adhesive such as Permatex No. 2 or equal. The following number of tablets for the given pipe size shall be used for an initial dose of twenty-five (25 mg/L) chlorine:

<u>Pipe Diameter</u>	<u>Number Tablets Per 18-20 Ft. Pipe Section</u>
6"	1
8"	2
10"	3
12"	4
16"	7

or the number of tablets equal to  $0.0012d^2L$  rounded to the next higher integer, where d is the inside diameter, in inches, and L is the length of the pipe section, in feet. Use of the continuous feed or slug method of disinfecting may

only be used to re-chlorinate a water pipe after the initial disinfection or in other specific cases approved by the Participating Utility.

2. Disinfection solution shall remain in pipe line for not less than twenty-four (24) hours, after which time a chlorine residual of 10 ppm at all parts of line shall be required.
3. Following chlorination, piping shall be thoroughly flushed. Water in the new main shall be proven comparable in quality, by testing, to the existing public water supply. AWWA Standards require at least two consecutive satisfactory bacteriological samples (taken twenty-four hours apart) from distribution system for every twelve hundred feet (1,200') of pipe before system can be placed in service. The Participating Utility will pay the cost of lab testing for first set of bacteriological samples. Developer/Contractor shall pay all costs associated with disinfection and testing of installed facilities and any additional bacteriological samples required after first set.

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**CS-3**  
**SANITARY SEWER COLLECTION PIPING**

**PART ONE - GENERAL**

1.1 DESCRIPTION

- A. Work included - Furnish all labor, materials, tools and equipment necessary to install, backfill and test all sanitary sewer collector lines and associated structures in accordance with the Drawings and as specified herein.
- B. Related work specified elsewhere:
1. General Water and Sewer Specifications – Section CS-1
  2. Clearing and Grubbing - Section CS-5
  3. Rock Excavation - Section CS-6
  4. Stream and/or Highway Crossings – Section CS-7
  5. Horizontal Directional Drilling (HDD) Methodology – Section CS-8
  6. Seeding and Mulching - Section CS-9
- C. General Conditions – Any reference to General Conditions refers to EJCDC C-700 Standard General Conditions of the Construction Contract (2002 edition).

**PART TWO - PRODUCTS**

2.1 STRUCTURAL REQUIREMENTS

- A. Structural Design of Sewers - Structural design of sewers shall conform with the methods given in the ASCE Manual Number 37 - "Design and Construction of Sanitary and Storm Sewers". In the use of this manual, backfill weight shall equal 130 pounds per cubic feet and  $K_u$  shall be 0.130. The live load for sewers subject to traffic effect shall be determined from a minimum wheel load equivalent to an AASHTO H-20 loading (16,000 pound wheel load). An allowance of fifty percent (50%) 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 lengths of rigid pipe shall be measured in terms of ultimate three-edge bearing strength divided by a safety factor of 1.5. Allowable load shall be working strength times a 2.5 load factor for concrete cradle or arch bedding and times a 1.9 load factor for Class B gravel bedding condition.

2.2 SEWER PIPE AND MATERIALS

- A. General - All sanitary sewer pipe installed shall conform to the type, classification, and sizes as shown on the Drawings and as specified herein. The pipe materials listed below have been approved for use by the Participating Utility. However, the acceptability of specific pipe material for use within a specific soil type or condition shall be determined by the Participating Utility on an individual basis at the time of design review of the Drawings. The type or types of pipe allowed for use on any specific project shall be shown on the approved Drawings.

1. One type and class of pipe shall be used from manhole to manhole unless approved in writing by the Participating Utility. Any changes in size, kind, type and class of pipe being installed shall be made at manholes only.
2. Pipe plugs shall be of the same material as the pipe. The cost of furnishing and placing pipe plugs shall be included in the unit prices bid for furnishing and installation of pipe and pipe stubs.

B. Pipe Material

1. Ductile Iron Pipe - Ductile iron pipe shall be centrifugally cast manufactured in accordance with ANSI/AWWA C151/A21.51, latest revision. Slip joint or mechanical joint pipe shall be used for gravity sewers. Slip joint pipe shall be designed in accordance with ANSI/AWWA C150/A21.50 and specified according to ANSI/AWWA C111/A21.11. Class 350 pipe shall be minimum strength used in all sewer applications. All ductile iron pipe and fittings shall be lined with Protecto 401™ Epoxy, or approved equal. Cement lining is not acceptable. Gaskets shall be furnished by the manufacturer and installed in accordance with their recommendations. Ductile iron pipe shall be used in exposed pipe installations, or where approved by the Participating Utility 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 14' and 20' nominal lengths. Installation of PVC gravity sewer pipe and fittings shall be in accordance with ASTM Designation D 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 laid along proposed alignment in excess of one day's work.
  - b. Additional strength PVC pipe including ASTM D3034 SDR-26, ASTM D2241 SDR-21, C900 DR-18 or concrete encasement of SDR-35, or both, shall be required where depth exceeds twelve feet (12') or where additional protection is required for the pipe as determined by the Participating Utility.
3. PVC (Ribbed Pipe) - Ultra-Rib pipe meeting ASTM F-794 with a stiffness factor of 46 may be used on Participating Utility 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 the Participating Utility.
4. PE Pipe - PE Pipe may be allowed by the Participating Utility based on project type and conditions. Polyethylene plastic pipe shall be high density polyethylene pipe which meets the applicable requirements of ASTM F714 Polyethylene (PE) Plastic Pipe (SDR-PR) based on Outside Diameter, and ASTM D3350 cell classification 345464E.

- a. Dimension Ratios: The minimum wall thickness of the polyethylene pipe used as gravity sewer line shall be a minimum of SDR 17. Additional strength pipe material may be required for deep sewer lines.
  - b. All pipes shall be made of virgin material. No rework except that obtained from manufacturer's own production of the same formulation shall be used.
  - c. The pipe shall be homogenous throughout and shall be free of visible cracks, holes, foreign material, blisters, or other deleterious faults.
  - d. For sewer installations, interior of pipe shall have a light reflective color to enhance viewing for television inspection.
  - e. PE pipe for sewer installations of four inch (4") diameter or larger shall be straight pipe sections of 40' or shorter. Rolled pipe is not approved for use.
  - f. All service line connections to PE pipe shall be made using a fused service saddle. No direct tap to PE pipe shall be permitted.
  - g. PE pipe shall be assembled and joined at the site using the butt-fusion method to provide a leak proof joint. Threaded or solvent-cement joints and connections shall not be permitted. All equipment and procedures used shall be used in strict compliance with the manufacturer's recommendations.
  - h. Qualifications of Personnel - HDPE pipe jointing shall be performed by personnel trained in the use of butt-fusion equipment and recommended methods for new pipe connections. Personnel directly involved with installing the new pipe shall receive training in the proper methods for handling and installing the HDPE pipe. Training shall be performed by a qualified representative.
  - i. Butt-fused joint shall be true alignment and shall have uniform roll-back beads resulting from the use of proper temperature and pressure. Joint shall be allowed adequate cooling time before removal of pressure. Fused joint shall be watertight and shall have tensile strength equal to that of the pipe. All joints shall be subject to acceptance by the Participating Utility and/or his representative prior to insertion. All defective joints shall be cut out and replaced at no cost to the Participating Utility. Any section of the pipe with a gash, blister, abrasion, nick, scar, or other deleterious fault greater in depth than ten percent (10%) of the wall thickness, shall not be used and must be removed from the site. However, a defective area of the pipe may be cut out and the joint fused in accordance with the procedures stated above. In addition, any section of pipe having other defects such as concentrated ridges, discoloration, excessive spot roughness, pitting, variable wall thickness or any other defect of manufacturing or handling as determined by the Participating Utility and/or his representative shall be discarded and not used.
5. Sanitary Sewer Force Main - Sanitary sewer force main shall be constructed of SDR-17 PVC pipe, Certa-Lok Yelomine or approved equal, ANSI/AWWA C900 DR-18 PVC pipe, or Class 350 ductile iron pipe and be joined with push-on joints as indicated on Drawings. High-density polyethylene (HDPE)

DR-11 pipe is also acceptable for sewer force mains 2" or greater in diameter, and DR-9 is acceptable for lines under 2" in diameter. HDPE pipe joints shall be connected using heat fusion, electrofusion, thermal welding and flanges in conformance with manufacturer's recommendations. Restrained joints shall be used for all bends and fittings. All valves, fittings, and other related appurtenances shall be rated for a minimum working pressure of 150 pounds per square inch (PSI).

- C. Casing Pipe - Casing pipe shall be steel or HDPE in accordance with general water and sewer drawings and VDOT Road and Bridge Standards.
- D. Combination Air Valve - Force main combination air valve shall be in accordance with Sewer Detail Drawings.
- E. Bedding - Bedding, haunching, and initial backfill construction shall be in accordance with the manufacturer's recommendation and requirements of governing jurisdiction. See General Detail Drawings.
- F. Service Connections - Polyvinyl chloride (PVC) sewer pipe conforming to ASTM Designation D3034 (SDR-26) shall be used between the sewer main and the cleanout. Sewer lateral fittings shall be of same SDR rating as sewer main. Schedule 40 solvent weld pipe and fittings may be used for sewer lateral and cleanout assembly with approval from the Participating Utility. ASTM D2241 SDR-21 PVC pipe shall be used where additional strength pipe is required.
  - 1. The PVC SDR 26 joints shall be made with bonded-in-bell elastomeric seal.
  - 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 Sewer Detail Drawings.
- G. 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 potable, 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, BASF "Masterlow 555" or approved equal, 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.

### **PART THREE - EXECUTION**

#### **3.1 GENERAL REQUIREMENTS**

- A. All construction of sanitary sewer mains and appurtenances shall be in strict accordance with Drawings and Specifications approved by the Participating Utility. 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 Drawings.

#### **3.2 EXCAVATION**

- A. Dewatering equipment shall be sized to maintain the trench in a satisfactory dewatered 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.
- B. 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.

#### **3.3 BACKFILL**

- A. Manholes and cleanouts shall be backfilled in same manner as the sewer pipe.

#### **3.4 PIPE INSTALLATION**

- A. 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 Participating Utility may require additional cover as needed for pipe protection. Sewers, which have a depth of cover less than three feet (3'), shall be approved and installed as per the Participating Utility's written instructions.
- B. 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.

- C. 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 in accordance with pipe manufacturer's recommendations. 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.
- D. 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.
- E. Locator wire shall be installed on all non-metallic force main pipe. Warning tape shall be required for ALL pipe installed by open trenching. Refer to General Detail Drawings.
- F. Connection of HDPE Pipe to Ductile Iron Fittings
  - 1. HDPE Pipe shall be joined to ductile iron fittings, valves, and fire hydrants in accordance with Section CS-2, 3.1.D of these standards.
- G. Transitioning from HDPE Pipe to Ductile Iron Pipe
  - 1. Transitions from HDPE pipe to ductile iron pipe shall be installed in accordance with Section CS-2, 3.1.E of these standards.

### 3.5 BY-PASS PUMPING DURING SEWER LINE INSTALLATION

- A. CONTRACTOR shall be responsible at all times for maintaining sewer flows during the work to include any required by-pass pumping of wastewater between manholes during installation of sewer lines and/or manholes. By-pass pumping system shall provide continuous full conveyance and containment of wastewater present during the work and shall not surcharge the upstream (suction) manhole by more than two feet (2') above the manhole invert. CONTRACTOR shall be liable for any damage caused by backups or overflows.
- B. CONTRACTOR shall furnish all pumps, pipe, fittings, plugs, etc. required to perform by-pass pumping operation. Backup or replacement pumping equipment shall be available to the project site to ensure that continuous by-pass pumping can be provided. All pumping equipment shall be provided with sufficient mufflers to prevent excessive noise.
- C. Authorization from the Participating Utility shall be required to utilize by-pass pumping overnight or during the weekends. In the event it is not possible to temporarily reconnect sewer lines at the end of the work day or over week-ends, CONTRACTOR shall be responsible for operating and maintaining by-pass pump

operations around the clock to insure continued conveyance of existing wastewater flows.

- D. By-pass pumping shall not be diverted to another sanitary sewer system without the approval of the Participating Utility.
- E. A by-pass pumping plan shall be submitted for approval prior to beginning the work. This plan shall outline the by-pass pumping procedures and include the capacity and components of all by-pass pumping equipment.

### 3.6 TRENCH DEWATERING DURING SEWER LINE INSTALLATION

- A. All ground water that may be found in the trenches and any water that may get into them from any cause whatsoever shall be pumped or bailed out so that the trench shall be dry during the pipe laying period. No water shall be permitted to reach concrete until it has set sufficiently. All water pumped from the trenches shall be disposed of in a manner satisfactory to the Participating Utility. The CONTRACTOR shall provide at least two (2) pumps for each trench opened in wet ground and at the same time, he shall have one (1) pump in reserve.
- B. If, during any time that the CONTRACTOR is permitted to lay pipe in a trench containing unavoidable trench water and construction is interrupted for any reason, the open ends of pipe shall be closed by watertight plugs or caps, or other means approved by the Participating Utility. In any case, such protection shall be provided when work is suspended overnight or on weekends and holidays, regardless of the condition of the trench with respect to water at the time that the work is suspended.
- C. The CONTRACTOR shall be responsible for the protection of all structures, including pipes and manholes, against any tendency to float under conditions of high water, whether due to high ground water or flood conditions on the project site. It shall be the responsibility of the CONTRACTOR to take whatever steps may be required, including the installation and operation of pumps and pumping systems, well points or relief devices, to prevent any structure from floating during construction.
- D. Cost of the necessary pumps, well points or other appurtenances required to prevent flotation shall be included in the unit prices bid in the proposal for the various bid items, and no extra compensation shall be allowed for such work. Any damage which may occur to any part of the work as the result of the flotation effect of ground or flood waters shall be repaired in a manner fully satisfactory to the Participating Utility, at no additional cost to the Participating Utility.
- E. The CONTRACTOR shall provide and place all necessary flumes or other channels of adequate size to carry temporarily all streams, brooks, stormwater or other water, which may flow along or across the lines of the pipe line. All flumes or channels thus utilized shall be tight so as to prevent leakage into the trenches. Water pumped from trenches shall be led to natural watercourses. Existing sewers shall not be employed as a drain for the removal of dewatering wastes.

### 3.7 SERVICE CONNECTIONS

- A. Service connections to the sewer main shall be made by means of a commercially manufactured tee, wye, or wye branch. Service laterals may also be connected to the sewer system at a manhole using inside drop connection. 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.

- B. All taps to an existing pipe will be performed by the Participating Utility or may be performed by the CONTRACTOR if approved and inspected by the Participating Utility. A minimum of 48 hours notification is required by the Participating Utility when scheduling sewer taps.
- C. Sewer service line shall be four inches (4") minimum for single-residential service and six inches (6") minimum for combined-residential (maximum 2 equivalent residential connections), or non-residential services. Sewer cleanouts shall be same size as service line and shall be installed per the Participating Utility's 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.
- D. 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 3.10.
- E. No connection shall be made to the vertical portion of a cleanout except for private force mains. Refer to Sewer Detail Drawings for specific requirements including the use of Schedule 40 material.
- F. 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.
- G. A sampling manhole, which conforms to Detail Drawings, shall be installed on the sewer service lateral for non-residential facilities as required by the Participating Utility. 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 either vacuum method or exfiltration. Flow shall pass straight through sampling manhole, i.e., 180 degrees.

### 3.8 MANHOLES

- A. Only precast manhole sections shall be used. Manholes shall be constructed with manhole frames, covers and steps. Frames and covers shall be in conformance with Sewer Detail Drawings. Bolt-down covers are to be used in areas subjected to flooding or as directed by Participating Utility.
- B. Casting shall be best quality tough, gray iron, free from defects, blow holes, and other imperfections and shall meet the requirements of ASTM Designation A48, Class 35 and current edition of AASHTO M 306. 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. Locations and type of manhole vents will be as indicated on the Drawings.
  - **WVWA will require its logo in top of casting, in accordance with Standard Details.**

- C. Covers shall be furnished with two means of lifting, pickbar and pick slot. Covers that rock under normal load, 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 or AASHTO H-20 load rated HDPE grade rings. Sealant shall be used between each grade ring to provide a water tight seal.
- D. If steps are required by the Participating Utilities for manholes, steps shall be made of fiberglass construction, cast iron, or steel and shall have a plastic coating. Steps shall be spaced sixteen inches (16") apart. The first step shall be within twelve inches (12") of the cover. The bottom step shall be within twenty-four inches (24") of the bottom of the manhole.
- E. 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 Participating Utility. 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. If manhole is installed with steps, they shall be vertically aligned over manhole bench. Access hole in flat top manhole section shall be centered over manhole steps.
- F. 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.
- G. 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 with an approved non-shrink grout after installation.
- H. A cold applied butyl mastic joint sealer manufactured specifically for the purpose or other approved gasket material in accordance with ASTM C443 and meets ASTM C1244 testing standards 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.
- I. All straddle manhole and all field-constructed inverts shall be with ready mix (3,000 psi) concrete and shall only be used with approval of Participating Utility.
- J. Standard manhole drop connections shall be installed where indicated on the drawings. Drop connections shall conform to the Detail Drawings.
- K. 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. The horizontal deflection angle from the inflow pipe to the outflow pipe at any junction shall not be less than 90-degrees. Invert benches shall be constructed of ready mix concrete (3,000 psi) over the entire existing bench.

- L. 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, or 0.50 feet for a change of flow direction equaling 90-degrees unless otherwise approved by the Participating Utility.
- M. Where grade rings are required to meet specified grade, the maximum height/thickness and minimum number of rings shall be used. Cone sections and grade rings shall be predrilled with matching holes to accept threaded rod installation. Refer to Detail Drawings.

### 3.9 PIPE CONNECTION AT MANHOLES

- A. 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-degrees 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, or approved equal.
- B. Connection to existing manhole shall be made by coring existing manhole and installing rubber boot in accordance with above. Core to be made by the CONTRACTOR with Participating Utility inspector on-site.
- C. 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 the inside of the 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 stainless steel band(s) in groove(s) at pipe receiving end of boot and tighten clamps to manufacturers recommended 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 Standards.
- D. 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 Participating Utility. Any approved field modification(s) or repairs shall be performed by a qualified person(s) approved by the manufacturer.
- E. 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.
- F. Abandonment of manholes and sewer lines shall be performed in accordance with the Detail Drawings.

- G. An approved water stop shall be used around pipe at manhole connection of straddle manhole. Refer to Detail Drawings.

### 3.10 ACCEPTANCE TESTS

#### A. General

1. Sewers will be inspected to determine if any deviation from line and grade have occurred. Following successful leak test and prior to Substantial Completion, a CCTV inspection shall be performed by the CONTRACTOR, and a copy of the digital video disk provided to the Participating Utility. Any defects identified by the CCTV inspection shall be corrected by the contractor, retested and re-televised as required by the Participating Utility. Participating Utilities reserve the right to require an additional CCTV inspection prior to the end of the Warranty Period.
2. Air testing shall be used; test methods and acceptability criteria shall be in accordance with the Uni-Bell low pressure air test. Air testing of gravity lines shall be required for all types of pipe and materials.

#### B. Manhole Acceptance Tests

1. Manholes, including frame, shall be tested by vacuum testing in accordance with ASTM C1244, latest revision, 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 ten inches (10") Hg. The time for the vacuum to drop from ten inches (10") to nine inches (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. All acceptance tests shall be conducted by CONTRACTOR in the presence of a Participating Utility's inspector.
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. The CONTRACTOR shall schedule all acceptance tests with the project 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.

#### C. Sewer Pipe Testing Procedures

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 Participating Utility 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. PVC and PE – ASTM F1417, latest revision  
Ductile iron pipe – ASTM C924, latest revision
  - b. The CONTRACTOR shall thoroughly clean and remove all debris, silt, earth or other materials from the sewer prior to acceptance testing.
  - c. Proper test plugs shall be supplied and installed by the 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.
  - d. If pipe to be tested is expected to be below ground water table, the 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. Back pressure to be calculated by multiplying height (in feet) of groundwater above pipe invert x 0.433 to obtain back pressure in units of PSI.
  - e. The 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.
  - f. 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.
  - g. The 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 between 3.5 and 4.0 psi.

- h. 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 Sewer Detail Drawings for time and length of test section for various diameters of the sewer. All pipes fifteen inches (15") or less shall be tested for a pressure drop of 1.0 psi gauge.
  - i. Pipe which fails to maintain the stipulated pressure for a period equal to or greater than the holding time shown in the above referenced tables shall be deemed to have failed the low pressure air test and is unsatisfactory for acceptance by the Participating Utility. Any sewer that fails to pass this test **shall be replaced by the CONTRACTOR at his expense**. A single coupling or pair of repair clamps shall be allowed between manholes to facilitate replacement of defective materials or workmanship.
4. Sewer Force Main Testing Procedure – Sewer force mains shall be hydrostatically tested per ANSI/AWWA 605-94 at 150% of the design operating pressure or a minimum pressure of 50 psi for 30 minutes. Allowable leakage shall be the same as established for water pipe lines in the Standards.

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## CS-4

# SANITARY SEWER CLOSED CIRCUIT TELEVISION (CCTV) INSPECTION

## **PART ONE - GENERAL**

### 1.1 DESCRIPTION

- A. To ensure compliance with the Standards, newly installed public sanitary sewer may have a Closed Circuit Television (CCTV) inspection performed by the Participating Utility at the Participating Utility's expense. These inspections will be at the discretion of the Participating Utility. If inspection identifies necessary corrective action after the first CCTV inspection, any subsequent CCTV inspections will be performed at the CONTRACTOR's expense.
- B. Specific projects, when stated in the project plans, shall require CCTV inspection to be performed by the CONTRACTOR in accordance with this section per the Contract Documents. Inspection(s) shall be performed prior to Substantial Completion and/or prior to expiration of the Warranty Period, as determined by the Participating Utility.

### 1.2 REFERENCES

- A. The CCTV inspection shall be in accordance with the most recent National Association of Sewer Service Companies (NASSCO) Pipeline Assessment and Certification Program (PACP) standards as published at the date of the contract.

### 1.3 SUBMITTALS

- A. Contractor shall submit the following:
  - 1. Copy of camera operator's PACP Certification
  - 2. Color video on Digital Video Disc (DVD) with required audio and alphanumeric data. Spliced video footage will not be accepted. File format must be in Microsoft Access (.mdb). Codes and Scoring Scheme must be in PACP format. DVD shall be in accordance with paragraph 3.4 of this section.
  - 3. A typed report, in accordance with PACP standards, noting lateral locations, structural damage, defects and sags. Report shall be in accordance with paragraph 3.4 of this section.
  - 4. Typed corrective action report stating problem(s) and proposed repair.

### 1.4 QUALITY ASSURANCE

- A. Inspection and reporting shall be performed by certified users who have successfully completed the Pipeline Assessment and Certification Program (PACP) user course from the National Association Sewer Service Companies (NASSCO) and have a valid certificate number.

## **PART TWO – PRODUCTS**

### 2.1 EQUIPMENT

- A. Select and use CCTV equipment that will produce color video on a standard DVD. The camera, television monitor, and other components of the video system shall be capable of producing picture quality to the satisfaction of the Participating Utility; if any of the video is found to be unsatisfactory by the Participating Utility, the CONTRACTOR will be required to re-inspect the section in question at CONTRACTOR's expense.
  
- B. Pipe Inspection Camera:
  - 1. Camera manufacturer shall be certified by NASSCO.
  - 2. The camera shall be specifically designed and constructed for operation in connection with sewer inspection and pipe joint sealing and testing.
  - 3. Specifications:
    - a. Minimum illumination: 1.5 lux.
    - b. Remote focus, iris, and light intensity control:
      - i. The adjustment of focus and iris will allow optimum picture quality and a focal range adjustable from 100 mm to infinity.
      - ii. The light source will be adjustable to allow an even distribution of light around the sewer perimeter without loss of contrast, flare out of picture, or shadowing.
    - c. Operative in 100 percent humidity conditions.
    - d. Head shall rotate 270 degrees on axis and 360 degrees on arc.
  - 4. A remote reading footage counter, accurate to two-tenths (.2) of a foot, shall be used.
  
- C. Camera Transport Unit:
  - 1. The camera shall be mounted on a tractor with wheels suitable sized for each pipe diameter.
  - 2. The transport unit will be capable of moving the camera through the sewer using either a rubber tired or crawler tractor.
  - 3. The transport unit will be capable of passing over minor surface imperfections including but not limited to broken joints and solid debris up to 1.5" in height.
  - 4. Transport using a float or skid for tow through the sewer will only be permitted where the condition of the sewer precludes the use of a tractor and shall be authorized by the Project Manager.
  - 5. If the camera is towed the supporting equipment shall not impede the view of the camera and will be stable to ensure steady and smooth progress.

6. The camera transport shall permit complete inspection of the sewer from the center of the start manhole to the center of the finish manhole.
7. The camera transport and cable will be capable of inspecting a minimum of 650' of sewer from a single access point.
8. The transport unit will use a remote reading counter to measure distance traveled from the center of the start manhole. This information will be recorded in feet to the nearest tenth (.1).
9. The camera transport will permit the adjustment of camera height so as to position the center of the lens in the center of circular sewers and two thirds of the vertical dimension above the invert of egg shaped sewers.

D. Inspection Vehicle:

1. Inspect sewers using a self-contained inspection unit conforming to the following minimum criteria.
  - a. Unit shall be configured with separate areas for CCTV viewing and equipment storage.
  - b. Unit shall be equipped with a cellular telephone and a suitable communication system linking all crew members.
  - c. Unit shall be equipped with fans and blowers to remove any fog (steam), which may be present in the sewer at the time of the inspection.
2. Inspect sewers using an integrated CCTV sewer inspection system consisting of cameras, lighting, transport, cables, power source, monitor, videocassette recorder, digital video recorder, and other related equipment.
3. Video overlay equipment shall be capable of superimposing alpha-numeric information, as required in paragraph 3.2.K.1 of this section, onto the video tape and capable of providing a minimum of 15 lines of information, 30 characters per line.

## 2.2 REPORTING SOFTWARE

- A. PC based software specifically designed for collecting, cataloging, and reporting CCTV Inspection reports using PACP format.
- B. Software shall be certified by NASSCO.

## **PART THREE – EXECUTION**

### 3.1 PUBLIC NOTIFICATION

- A. A public notification program shall be implemented, and shall as a minimum require CONTRACTOR to be responsible for contacting each home or business connected to the sanitary sewer and informing them of the work to be conducted and if the sewer service will be off-line. CONTRACTOR shall also provide the following:

1. Written notice to be delivered to each home or business describing the work, schedule, how it affects them, and a local telephone number of CONTRACTOR they can call to discuss the project or any problems which could arise.
2. When sewer service will be interrupted, the following steps shall be taken.
  - a. Personal contact and attempted written notice the day prior to the beginning of work being conducted on the section relative to the residents affected.
  - b. Personal contact with any home or business which cannot be reconnected within the time stated in the written notice.

### 3.2 PROCEDURE

- A. The CONTRACTOR shall schedule and coordinate inspection.
- B. CCTV inspection shall occur no earlier than twenty four hours after completion of backfill compaction. The sewer pipe shall be clean and free of dirt and debris.
- C. Participating Utility inspector shall be on-site during the inspection. The CONTRACTOR shall notify inspector twenty four hours in advance of scheduling CCTV work.
- D. Just prior to beginning the CCTV work, the CONTRACTOR shall supply adequate clean water to the upstream manhole until the Participating Utility's inspector, by visual inspection, confirms flow through the downstream manhole.
- E. If sewage flow is allowed prior to CCTV work, the Participating Utility shall determine which provisions, such as bypass pumping, plugs, etc. will be required to control flow during CCTV work.
- F. Use a steel tape to measure manhole depths to the nearest ½ inch.
- G. All measuring equipment shall be calibrated for accuracy before the work starts and maintained throughout the work.
- H. Evacuate all fog (steam) from the sewer.
- I. Manholes shall be measured from rim to invert and the depth recorded on the inspection header.
- J. Keep camera lens clean at all times and keep the sewer clear of fog (steam) during the entire inspection.
- K. The video operator shall acquire a continuous, digital, video of each sewer reach, and maintain a log noting location and description of all sags, laterals, structural and material defects.
  1. The following information shall be provided as alphanumeric data on the recorded DVD video at the start of each survey for 15 seconds:
    - a. Contractor's Name

- b. Contract ID / Project Name
  - c. Project Manager
  - d. Inspector
  - e. Date and Time of Inspection
  - f. Weather
  - g. Unique Start and Finish Manhole ID's. – In accordance with paragraph 3.3.B.
  - h. Pipe Material
  - i. Pipe Diameter
- L. The camera shall be moved through the line at a speed of no greater than 30 feet per minute and shall pan/tilt at each sewer defect and lateral to provide a complete view of each location.
- M. The sewer line shall be inspected manhole to manhole.
- N. The camera should be centered in the middle of the pipe. Position tolerances will be +/- ten percent (10%) of the vertical dimension of the sewer.
- O. Wherever possible, gravity mains shall be televised in the downstream direction.
- P. CONTRACTOR, under the supervision of Participating Utility's representative, or their designee, may install plugs in the sewers to prevent the flow of sewage during inspection for a period as agreed to by Participating Utility.
- 1. The plugs must then be removed until normal flow conditions resume, after which they may be installed again for the period discussed above.
  - 2. Plugs shall only be installed when and for the time period directed by the Project Manager where the existing flow hinders a proper inspection.
- Q. Footage measurements shall begin at the centerline of the upstream manhole, unless otherwise specified by the Participating Utility.
- 1. Footage shall be shown on the video data view at all times and manually checked by use of a walking meter, roll-a –tape, or other suitable device.
  - 2. The distance between manhole centers shall be accurate within 0.5 percent.
  - 3. If the distance measurement does not satisfy the accuracy requirements re-inspect the line at CONTRACTOR's expense.
  - 4. Ensure that the automatic distance measurement is displayed on-screen at all times during the inspection.
- R. Provide video showing full circumference of pipe inlet, pipe outlet, and every lateral.
- S. Lighting should be set to allow for clear visibility without excessive reflection and should allow realistic colors to be visible.
- T. The iris of the camera should be adjusted to allow for a sharp focused image and the lens should be kept clean and free of obstructions. Keep the picture in focus

during the inspection from the point of observation to a minimum of two pipe diameters ahead.

- U. The operator should follow the manufacturer's instructions to achieve the proper color correction.
- V. Stop Camera:
  - 1. The camera shall be stopped at all laterals adjusted for a clear picture and an orbital scan of the lateral taken pausing at the invert of the service lateral to detect dirt or infiltration.
  - 2. Stop camera for 2 seconds at major defects and connections, junctions, and major branches.
  - 3. Rotate and pan the camera to provide a perpendicular view of all major defects, connections, junctions, and major branches.
  - 4. Major defects to include but not be limited to deformed sewers, displaced bricks, holes, large displaced joints, missing bricks, missing mortar, obstructions, and large open joints.
  - 5. The camera shall also be stopped at any suspected or confirmed defects, the focus properly adjusted and a clear digital video taken.
  - 6. Areas suspected of leaking shall be paused long enough to determine if a leak exists currently or if deposits have occurred.
- W. CONTRACTOR must inform Participating Utility 's representative immediately of any obstruction encountered, locations of hazardous atmosphere, or sewers that are in immediate danger of structural failure while the inspection is still in progress.
- X. The video shall identify deviations from uniform slope by providing the beginning and ending distance from a given manhole and measuring and recording the maximum depth of any standing water.
- Y. Reverse Set-up:
  - 1. If inspection of an entire sewer cannot be completed due to a collapse, excessive deformation or solid debris, intruding connections, obstructions, or large displaced joints, move equipment to the downstream manhole and attempt inspection in the upstream direction.
  - 2. Advise the Project Manager if complete manhole-to-manhole inspection still cannot be performed.
  - 3. Jointly, CONTRACTOR and Project Manager will decide to:
    - a. Abandon the inspection or
    - b. Re-perform the inspection subsequent to:
      - i. Performing solid debris cutting;
      - ii. Removing intruding connections;

- iii. Modifying the camera setup (position and/or method of transport);  
or
  - iv. Completing emergency repairs.
4. Track all locations where a complete inspection could not be obtained. Review these locations with the Project Manager on a daily basis.
- a. Record the Sewer ID number & Work Order No., steel tape measurement, length inspected (up and downstream), length of missing video and the reason the inspection could not be completed.

### 3.3 RECORD KEEPING

- A. Code the sewer condition in accordance with the NASSCO PACP requirements.
- B. CCTV inspections shall use unique identification numbers established and provided by Participating Utility in the upstream manhole number and the downstream manhole number fields. These unique identifiers for each manhole will be provided on the project plans or webGIS. CONTRACTOR shall contact the Project Manager for proper manhole identification numbers regarding new sewer construction if not shown on the project plans.
- C. Where numbers are not provided or where connectivity is not as shown on the Project Documents, include a digital sketch showing the numbering created in the field and/or correct connectivity. The sketch does not need to be created digitally. A legible PDF of a hand sketch will be acceptable.
- D. All notes or coded references shall have footages recorded with them.
- E. Quality Control/Quality Assurance Procedures:
  - 1. CONTRACTOR shall implement a formal coding accuracy verification system at the onset of the work to ensure that these accuracy requirements are met. Use the following procedure as a base and adjust review frequency as required:
    - a. Calculate accuracy as a function of the number of defects or construction features not recorded (omissions), and the correctness of the coding and classification recorded.
    - b. Verify coding accuracy on a random basis, on a minimum of 10% of the inspection reports or one per videotape, whichever is greater.
    - c. Perform a minimum of two accuracy verifications for each operator for each week working.
    - d. Re-code inspections not satisfying the accuracy requirements and check the accuracy of the inspection immediately preceding and following the noncompliant inspection verified by CONTRACTOR.
    - e. Repeat this process until the preceding and subsequent inspections meet the accuracy requirements.

### 3.4 DOCUMENTATION

- A. Color video recordings in digital format shall be made of the television inspections and two copies each shall be supplied to the Project Manager along with a computer generated inspection report.
- B. Within two working days after the completion of the CCTV inspection, the contractor shall present the Participating Utility's representative with the referenced deliverables.
- C. Video Recording:
  - 1. Picture Quality:
    - a. Ensure that digital MPEG video playback provides a minimum of 250 lines of resolution around the periphery of the picture.
    - b. Confirm resolution by recording a RETMA type resolution chart or an equivalent approved by the Project Manager. Use the following procedure:
      - i. Set-up the camera and accessories as is done for actual inspection (i.e. video signal routed through the cable reel, video overlay system etc.);
      - ii. Show the camera being introduced and reaching its final position for the test;
      - iii. Fill monitoring screen with the resolution chart image;
      - iv. Illuminate the resolution chart evenly and uniformly without reflection;
      - v. Ensure that the illumination source accurately simulates the lighting used in the sewer;
      - vi. Record test video for 30 seconds;
      - vii. Identify camera on the recording; and
      - viii. Record the test at the start of a tape or digital recording.
  - 2. Digital File Format:
    - a. Digital Format Video will be in conformance with the following requirements:
      - i. HQ-VCD MPEG1 Requirements.
      - ii. Picture Size: NTSC 352 x 240 @ 29.97 frames per second.
      - iii. Data/Bit Rate: MPEG-1 @ 2.4 Mbits/sec.
- D. Reports:
  - 1. General:
    - a. Rehabilitation:

- i. Only post-installation reports need to be submitted to Project Manager.
    - ii. Rehabilitation Contractor and CCTV subcontractor, where such relationship exists, shall make their own agreement as to type and frequency of reports.
  - b. CCTV Contract:
    - i. Submit all referenced reports to Project Manager.
2. Television inspection logs shall clearly show the location, in relation to adjacent manholes, of each source of infiltration discovered. Other data of significance including the locations of service connections, joints, defective materials, unusual conditions, roots, storm sewer connections, collapsed sections, presence of scale and corrosion and other discernible features shall be recorded.
  - a. Two copies of such records shall be supplied to ENGINEER in printed and digital formats as well as digital video.
3. Reports generated by the computer software shall be consistent with PACP requirements.
4. Submit hard and digital copies of observation report with still images and CCTV inspection results with a pipe run graph.
5. Use video capture equipment capable of capture with no frame loss to obtain digital video from first generation recordings. Digital video recordings can be saved to a hard drive and transferred to recordable media (DVD) for submission.
  - a. Each inspection will be contained within one complete single digital file that will be produced in one of the following ways:
    - i. Use a computer system and video capture card to capture the original recording continuously, regardless of the progress of the inspection. Edit the original raw digital file to remove pauses where inspection progress is not continuous before submission.
    - ii. Use a computer system and video capture card intermittently to capture the original recording. Edit the original raw digital file to form one continuous file for submission.
    - iii. Use specialized video recording equipment capable of pausing and resuming live recording to capture original recording. Produce a single file for submission.
    - iv. Use non-linear video editing software to edit digital videos. Do not recompress edited digital files.
  - b. Ensure each digital video file contains a unique file name with a maximum of 64 characters. Submit proposed naming methodology to Project Manager for review and approval.

6. Video must be able to be viewed using Windows Media Player 9 Series and have the ability to use all features of the video player including fast forward capability.
7. Each DVD shall be permanently labeled with the following information:
  - a. Job/Work Order No.
  - b. Contractor Name
  - c. CD No.
  - d. Date(s) Televised
  - e. Date Submitted
  - f. From:
  - g. To:
8. These DVDs will become the property of the Participating Utility.
9. CONTRACTOR shall ensure that Participating Utility's manhole numbers and project numbers are used on all inspection reports. Failure to include this information on all hard-copy, video and digital data provided may result in delay of payment for work completed.
10. If more than one inspection is provided on a single DVD, then CONTRACTOR shall submit with the DVD a table of contents identifying the inspected sewer segments contained on the DVD.
11. The Project Manager or their designated representative will review inspection DVDs to ensure compliance with the specifications; only inspections which match Participating Utility's database and have a minimum accuracy for header information of 95%, and a minimum detail accuracy for defects and features of 80% will be accepted.
12. If any DVD is of such poor quality that the Project Manager is unable to evaluate the condition of the sewer/lateral, CONTRACTOR shall be required to re-CCTV the sewer and provide a DVD of good quality at no additional cost to the Participating Utility.

### 3.5 CORRECTIVE ACTION REQUIREMENTS

- A. All sags shall be evaluated by the Participating Utility for determination of corrective actions.
- B. Corrective action for material defects or other construction defects shall be in compliance with the Standards, latest edition.
- C. The CONTRACTOR shall repair and/or make all corrective action requirements at no cost to the Participating Utility.
- D. Repaired sections shall be re-inspected from manhole to manhole with a video report submitted to the Participating Utility for review. All follow-up Inspection work shall be at the expense of the CONTRACTOR, and shall be done in conformance with this section of the Standards, latest edition.

**- END OF SECTION -**

**CS-5  
CLEARING AND GRUBBING**

**PART ONE - GENERAL**

1.1 DESCRIPTION

- A. Work included - Perform all clearing and grubbing as specified herein. Such work includes but is not limited to the following:
1. Perform all clearing and grubbing necessary and required
  2. Site clearing
  3. Tree and shrub removal and/or replacement
- B. Related work specified elsewhere:
1. Water Distribution Piping - Section CS-2
  2. Sanitary Sewer Collection Piping - CS-3
  3. Seeding and Mulching - Section CS-9

1.2 PROTECTION

Streets, roads, adjacent property and other works to remain shall be protected throughout the Work.

1.3 REQUIREMENTS OF REGULATORY AGENCIES

State and local code requirements shall control the disposal of trees, shrubs, and any other debris.

**PART TWO - PRODUCTS**

2.1 MATERIALS

Materials shall be at the CONTRACTOR's option as specified herein.

**PART THREE - EXECUTION**

3.1 CLEARING

- A. CONTRACTOR shall limit his clearing to the area actually needed for construction and wherever possible to avoid clearing large trees.
- B. Limits of clearing shall be within the right-of-way, or easements obtained by the Participating Utility.
- C. Individual trees, groups of trees and other vegetation, which may be designated to be salvaged, shall be protected, left standing and uninjured.
- D. Remove trees, saplings, shrubs, bushes, vines and undergrowth within the limits of clearing to the heights above ground (ag) given in the following table:
1. Trees over 6 inches (6") in diameter: 12 inches (ag)

2. Shrubs, bushes and trees under 6 inches (6") in diameter: 3 inches (ag)
3. Vines and undergrowth: 2 inches (ag)

### 3.2 GRUBBING

- A. Limits of grubbing shall coincide with the limits of clearing.
- B. Remove all stumps, roots over four inches (4") in diameter, and matted roots within the limits of grubbing to a depth of twenty-four inches (24") below existing ground surface. Engineering requirements shall control removal of stumps smaller than four inches (4") in diameter under fills, foundations, or any construction in contact with the stumps.

### 3.3 TRIMMING OF TREES/SHRUBS

- A. When required, with the Participating Utility's approval, trees shall be trimmed to remove branches or roots, which interfere with construction or traffic.
- B. When trimming trees located in the right-of-way within the City of Roanoke, CONTRACTOR shall coordinate work with the Urban Forester.
- C. When in VDOT right-of-way, written permission and a Permit is required for the following: Trimming trees and/or shrubs, and for cutting tree roots larger than 3" in diameter.

### 3.4 SALVAGE

- A. It shall be understood and agreed upon by the CONTRACTOR that only those trees directly interfere with the construction of the work shall be removed. Within the limits of clearing all trees four inches (4") in diameter and smaller may be removed. No tree five inches (5") or larger in diameter that does not directly interfere with the construction of the work shall be removed without the express written approval of the Participating Utility.
- B. Material which is to be salvaged, as a result of the CONTRACTOR's clearing operations, shall include the following items which are to be turned over to the property owner if the Participating Utility so desires:
  1. Logs over 12-inches, butt diameter
  2. Branches over 6-inches, butt diameter
  3. Parts suitable for use as mulch
  4. Live plants suitable for replanting
- C. All ornamental trees and shrubs within temporary construction easements shall be carefully uprooted, stored, and replanted after construction is complete, unless otherwise directed. Ornamental trees and shrubs, which do not survive for a period of at least one (1) year, shall be replaced at the CONTRACTOR's expense. Unless clearly indicated on the plan, CONTRACTOR should only clear trees necessary to perform the Work within the easement noted. Trees should not be removed from the temporary easement area unless it is necessary for performance of the Work or when the root structure of the tree would be damaged by the Work.
- D. All salvageable material not desired by the property owner shall be removed at CONTRACTOR's expense. Any desirable top-soil should be stock piled for possible use during Seeding and Mulching.

### 3.5 DISPOSAL

- A. Burning - Burning of materials on the site by the CONTRACTOR will not be permitted until all applicable permits have been obtained and copies of all permits are filed with the Participating Utility.
- B. Removal:
1. Material to be removed shall be removed from the site daily as it accumulates.
  2. Should the CONTRACTOR elect to continue work beyond normal working hours, material to be removed shall not be allowed to accumulate for more than 48-hours.
  3. Prior to depositing surplus material at any off site location, the CONTRACTOR shall obtain a written agreement with the owner of the property on which the disposal is proposed. The agreement shall state that the owner of the property gives permission for the CONTRACTOR to enter and deposit the material at no expense to the owner. A copy of the agreement shall be furnished to the Participating Utility.

### 3.6 MEASUREMENT AND PAYMENT

No separate measurement and payment will be made for clearing and grubbing as they are considered incidental items to the Work to which they are related and the costs, therefore, shall be included in the values bid for the appropriate items.

**- END OF SECTION -**

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**CS-6**  
**ROCK EXCAVATION**

**PART ONE - GENERAL**

1.1 DESCRIPTION

- A. Work included - Furnish all labor, material and equipment to excavate and dispose of rock as specified herein.
- B. Related work specified elsewhere:
  - 1. Stream and/or Highway Crossings - Section CS-7
  - 2. Water Distribution Piping - Section CS-2
  - 3. Sanitary Sewer Collection Piping - CS-3

1.2 DEFINITION

- A. The word "rock," wherever used as the name of excavated material or material to be excavated, shall mean boulders and pieces of concrete or masonry exceeding 1/3 cubic yards in volume; or solid ledge rock which, in the opinion of the Participating Utility, requires, for its removal drilling and blasting, wedging, sledging, barring, or breaking up with power-operated tools.
- B. No soft or disintegrated rock which can be removed with a hand pick or power-operated excavator and/or loader; no loose, shaken, or broken stone in rock fillings or elsewhere; no frozen earth or existing paving; and no rock exterior to the maximum limits of measurement allowed, which may fall into the excavation, will be measured or allowed.

1.3 REQUIREMENTS OF REGULATORY AGENCIES

- A. Observe all municipal ordinances and State and Federal laws relating to the transportation, storage, handling and use of explosives.
- B. The licensed blaster(s) shall at all times have his license on the work site and shall permit examination thereof by officials having jurisdiction.

**PART TWO - MATERIALS**

2.1 EXPLOSIVES

- A. Where blasting is permitted, explosives shall be kept on the site only in such quantity as may be needed for the work under way and only during such times as they are being used.
- B. Explosives shall be stored in a secure manner, separate from all tools and flammable substances.
- C. Caps or detonators shall be safely stored at least a distance of one-hundred feet (100') from explosives.
- D. When need for explosives has ended, all such materials remaining at site shall be promptly removed from the premises.

## **PART THREE - EXECUTION**

### 3.1 GENERAL

- A. Excavate rock (as defined above), if encountered, to the lines and grades indicated on the Drawings or as required and dispose of the excavated material.
- B. Rock in pipe trenches shall be excavated so as to be not less than six inches (6") from the invert of the pipe.

### 3.2 BLASTING

- A. All operations involving explosives shall be conducted by experienced personnel only, with all possible care to avoid injury to persons and damage to property. All licenses and blasting permits shall be kept on the job site at all times blasting is performed.
- B. Blasting shall be done only with such quantities and strengths of explosives and in such manner as will break the rock approximately to the intended line and grades and yet will leave the rock not to be excavated in an unshattered condition.
- C. Care shall be taken to avoid excessive cracking of the rock upon or against which any structure will be built, and to prevent damage to existing pipes or other structures and property above or below ground. The responsibility for accurately locating and for the complete protection of such items in the event of blasting for rock excavation and all repair to and/or replacement of same shall be the full obligation of the CONTRACTOR. In all cases of blasting, the prepared blast shall be carefully covered with an approved blasting mat so placed that the area affected by the explosion is positively confined.
- D. All blasting shots shall be covered with blasting mats or other approved material such that all structures, persons, and property are protected from injury. A pre-blast survey may be required if blasting is required in close proximity to structures.
- E. Sufficient warning shall be given to all persons in the vicinity of the work before a charge is exploded. Flagmen shall be employed to direct traffic as required.
- F. The Participating Utility may prohibit blasting whenever it is felt that the protection provided is inadequate. Extreme care shall be used whenever blasting for the removal of hard materials is necessary.
- G. Blasting shall be prohibited on Sundays, Holidays, and between the hours of 7:00 p.m. and 7:00 a.m., unless previously approved in writing by the Participating Utility and the applicable local government.
- H. Only the quantity and strength of explosives necessary for proper trench excavation shall be used. All explosives shall be detonated by an approved electric blasting device. Under no circumstances shall electric current from batteries, telephone or power lines be used for detonation.

- I. The CONTRACTOR shall take into consideration location of existing utilities, or other structures when blasting. The CONTRACTOR shall be responsible for taking all necessary precautions during blasting and general construction activities such that existing structures and facilities are protected from damage and will not be affected by construction activities.
- J. The CONTRACTOR shall be responsible for notifying and coordinating with the proper authorities, utility companies, and potentially affected parties prior to and during all blasting activities.
- K. **When rock is encountered, the CONTRACTOR shall notify the Construction Inspector in order that the quantities can be measured, unless unclassified excavation is specified.**
- L. No blasting shall be performed within forty feet (40') of a tested or completed sewer or water line. The ends of sewer or water lines adjacent to blasting shall be covered to avoid receiving debris.

### 3.3 MEASUREMENT FOR PAYMENT

All rock excavation shall be paid for as an incidental part of the item on which the work is done except where a separate, unqualified item for rock excavation is indicated in the Bid Proposal or where rock excavation is ORDERED as an EXTRA by the Participating Utility, by WRITTEN ORDER. Where payment for rock excavation is established by the proposal or ORDERED as an EXTRA by the Participating Utility, the CONTRACTOR shall be paid only for the quantity of rock removed, measured as follows:

- A. For all masonry structures such as buildings, tanks, vaults, catch basins, manholes and the like, the horizontal rock measurement shall be made to include 2-1/2 feet from the outside face of finished vertical sidewall of such structure and the vertical rock measurement shall be made from the top elevation of the rock, before disturbed or removed, to the elevation of the under or lower side of the bottom concrete slab of the structure. Any projection below the bottom slab of any structure required for sump, well, or other pertinent construction shall be measured separately.
- B. For installation of pipe lines and fittings the horizontal rock measurement shall be the nominal outside diameter of the pertinent pipe plus sixteen inches (16"), except, however, that no horizontal measurement shall be considered to be less than twenty-seven inches (27"); the vertical rock measurement shall be made from the top elevation of the rock, before disturbance or removal, to an elevation of nine inches (9") below the bottom outside surface of the pipe for pipe having a diameter of eight inches (8") through twenty-four inches (24"), and to an elevation of twelve inches (12") below the bottom outside surface of the pipe for all pipe having a diameter greater than twenty-four inches (24").

### 3.4 EXCESS ROCK EXCAVATION

If rock excavated beyond the limits of payment indicated on the Drawings, specified, or authorized in writing by the Participating Utility, the excess excavation whether resulting from over breakage or other causes, shall be backfilled, by and at the expense of the CONTRACTOR, as specified below:

- A. In pipe trenches, excess excavation above and below the elevation of the pipe bedding shall be filled as specified in Section CS-3 - SANITARY SEWER COLLECTION PIPING.
- B. In excavations for structures, excess excavation in rock beneath foundations shall be filled with concrete, which shall be Class A or B, at the CONTRACTOR's option.
- C. Quantity of rock for which payment will be made for installation of each fire hydrant will be limited to a rectangular area, top of which is upper surface of the rock, bottom of which is two feet (2') below bottom-most point of the hydrant, in place, and of a square measurement of three feet (3') on each of the four sides. Rock section excavation required for installation of fire hydrants shall not be less than stipulated above.

### 3.5 SHATTERED ROCK

If rock below normal depth is shattered due to drilling or blasting operations and such shattered rock is unfit for foundations, the shattered rock shall be removed and the excavation shall be backfilled as described above in EXCESS ROCK EXCAVATION. All such removal and backfilling shall be done at the expense of the CONTRACTOR.

### 3.6 BLASTING RECORDS

Keep and submit to the Participating Utility an accurate record of each blast. The record shall show the date, time of blast, general location of the blast, the depth and number of drill-holes, the kind and quantity of explosive used, and other data required for a complete record.

### 3.7 PROTECTION OF EXISTING UTILITIES AND STRUCTURES

Attention of the CONTRACTOR is specifically called to the fact that certain sections of the sewer line extension in the work that may be constructed in close proximity to existing buildings, storm sewers, gas lines, underground telephone cables, and private water mains. The responsibility for accurately locating and for the complete protection of such items in the event of blasting for rock excavation and all repair to and/or replacement of same shall be the full obligation of the CONTRACTOR. In all cases of blasting, the prepared blast shall be carefully covered with an approved blasting mat so placed that the area affected by the explosion is positively confined.

**- END OF SECTION -**

**CS-7**  
**STREAM AND/OR HIGHWAY CROSSINGS**

**PART ONE - GENERAL**

1.1 DESCRIPTION

- A. Work included - Perform all labor, material and equipment to install casing pipe for stream and/or highway crossings in accordance with the Drawings and as specified herein.
  
- B. Related work specified elsewhere:
  - 1. Water Distribution Piping - Section CS-2
  - 2. Sanitary Sewer Collection Piping – Section CS-3
  - 3. Horizontal Directional Drilling (HDD) Methodology -Section CS-8
  - 4. Seeding and Mulching - Section CS-9

1.2 PROTECTION

Streets, roads, adjacent property and other works to remain shall be protected throughout the Work.

**PART TWO - PRODUCTS**

2.1 MATERIALS

- A. Steel casing pipe shall be smooth wall steel pipe conforming to the materials standards of ASTM A139, Grade B. Joints of steel pipe shall be butt welded, watertight, in accordance with the American Welding Society's recommended procedures. The minimum casing wall thickness shall be in accordance with the table below unless otherwise specified or required by a governing entity.

<u>Casing Size</u>	<u>Minimum Casing Wall Thickness*</u>
Less than 18"	0.250"
18"	0.250"
24"	0.375"
30"	0.500"
36"	0.500"
48"	0.500"

**\* VDOT right-of-way requires minimum casing wall thickness of 0.500" for steel casing pipe. Refer to most recent edition of Virginia Road and Bridge Specifications.**

- B. HDPE casing pipe shall be high density polyethylene pipe which meets the applicable requirements of ASTM F714 Polyethylene (PE) Plastic Pipe (SDR-PR) based on Outside Diameter, ASTM D3350 and cell classification 345464E. The minimum wall thickness of the polyethylene pipe shall be DR-11. Pipe shall be continuously joined by butt fusion method, and installed in accordance with manufacturer's written instructions, and water and sewer piping specifications contained herein.
  
- C. Carrier pipe shall be ductile iron, ANSI/AWWA C151, restrained joint pipe as indicated on the drawings or HDPE in accordance with the Standards.

- D. Refer to the Pipe Support in Casing Pipe Detail in the General Detail Drawings for casing pipe size table. Casing pipe size shall be in accordance with the table unless otherwise approved by the Participating Utility.
- E. Pressure injected grout shall be a sand and cement grout mixture, consisting of 1.0 part cement, 2 parts sand (100 percent passing the No. 3/8 sieve and 94 to 100 percent passing a No. 4 sieve). Dry grout mix shall be combined with the minimum amount of water to achieve the necessary consistency and containing 3 to 7 percent entrained air. Maximum grouting pressure shall be 30 psi.

### **PART THREE - EXECUTION**

#### **3.1 STREAM CROSSING**

Unless directed otherwise by permits issued by applicable Federal and/or State agencies, the following procedure shall be utilized:

- A. The CONTRACTOR shall construct crossings of streams in the "dry" by providing a temporary cofferdam or bulkhead of non-erodible material. Cofferdam or bulkhead shall not obstruct more than one-half of water surface at any time and shall not extend more than three feet (3') above the normal water surface. CONTRACTOR shall not be allowed to operate construction equipment on the native stream bottom, except during removal of the cofferdam. The CONTRACTOR is hereby advised that the level in the stream(s) can increase rapidly due to rainfall in the upstream watershed.
- B. Non-erodible shall be defined as #1 coarse aggregate as defined in the Virginia Department of Transportation Road and Bridge Specifications" 2002 Edition. An earth core for the cofferdam may be constructed over the proposed excavation; however, the non-erodible material shall be in place prior to placement of the earth, so that the erodible earth does not come in contact with the flowing water.
- C. The CONTRACTOR shall construct crossings as indicated in the details and shall then completely remove cofferdam, bulkhead, or whatever equipment or material that was used to construct the crossing. Bottom of the stream in the construction area shall be restored to its original cross section. All disturbed areas on the banks of streams shall be seeded and mulched as specified in Seeding and Mulching CS-9.
- D. River/Stream crossing permits required from Virginia Marine Resource Commission and/or US Army Corps of Engineers have been obtained by the Participating Utility and are made part of the Standards. Requirements of these permits are considered Special Conditions of the Standards.
- E. Sewers located in streams will be tested in place and shall have zero leakage.

#### **3.2 HIGHWAY CROSSING – BORE & JACK METHOD**

- A. Pipeline crossings under highways shall be installed in a steel casing pipe installed by the "drive casing as you go" boring and jacking method, unless otherwise indicated. Lengths of steel pipe shall be welded to preceding length installed. Voids between exterior of casing pipe and the ground shall be filled with pressure injected grout. Carrier pipe shall be protected on spiders or RACI spacers spaced per manufacturer's recommendations. Ends of casing pipe shall be plugged prior

to backfilling. If trench is allowed to be open cut, casing pipe shall be provided unless otherwise indicated and trench shall be backfilled and pavement restored within one (1) day of placing casing pipe.

- B. The jacking operation shall be carried on in such a manner that settlement of the ground or the highway above the pipeline will not occur. Low pressure drilling fluids may be used with boring and jacking operation when bores exceed one-hundred feet (100'). (No jetting of fluids will be allowed.) Excavation shall not precede the jacking operation more than is necessary. The CONTRACTOR shall repair or replace, as directed by the Participating Utility, at the CONTRACTOR's expense, casing pipe which is damaged during the jacking operation.
- C. After installation of casing pipe and grout, if required, carrier pipe shall be installed. Carrier pipes shall be supported by steel saddles strapped to the pipe with steel straps, as specified.
- D. All operations of the CONTRACTOR shall be subordinate to the free and unobstructed use of the highway right-of-way for passage of traffic without delay or danger to life, equipment or property. The CONTRACTOR shall provide all necessary flagging, warning devices, flagmen, bracing, bulkheads, and shields to ensure complete safety to all traffic at all times. The CONTRACTOR shall notify the appropriate personnel in each locality, such as, Police, Fire and/or Rescue Departments, and Traffic Engineering Departments, etc. when restricting traffic to one lane.
- E. When highway crossing permits have been obtained by the Participating Utility the permits and the requirements of the permit are made a part of the Standards.

### 3.3 HIGHWAY CROSSING - OPEN CUT METHOD

- A. Any crossing that is made using the open cut method shall be performed in accordance with Virginia Department of Transportation standards and the governing locality's standards.
- B. When highway crossing permits have been obtained by the Participating Utility the permits and the requirements of the permit are made a part of the Standards.

### 3.4 MEASUREMENT AND PAYMENT

Measurement and payment for stream and/or highway crossings shall be made per linear foot of casing pipe installed for each casing size as specified or indicated on the Drawings. Unit Price shall reflect complete installation of respective casing pipe.

**- END OF SECTION -**

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**CS-8**  
**HORIZONTAL DIRECTIONAL DRILLING (HDD) METHODOLOGY**

**PART ONE - GENERAL**

1.1 DESCRIPTION

- A. Work included - Furnish all labor, materials, tools and equipment necessary to provide for installation of HDPE and/or restrained joint or fused C900 PVC water pipe line and gravity sewer pipe line using current horizontal directional drilling technology in accordance with the Drawings and as specified herein.
  
- B. Related work specified elsewhere
  - 1. General Water and Sewer Specifications – Section CS-1
  - 2. Water Distribution Piping - Section CS-2
  - 3. Sanitary Sewer Collection Piping - Section CS-3
  - 4. Stream and/or Highway Crossings – Section CS-7
  
- C. General - This specification defines the approved method and material for the installation of water lines, gravity sewer lines, and HDPE casing pipes utilizing horizontal directional drilling technology.
  
- D. Definition - Horizontal directional drilling (HDD) involves utilization of an electronically tracked bore-head to guide the borehole to a pre-designed configuration. The HDD process begins with boring a small, horizontal pilot hole with a continuous string of steel drill rod. When the bore-head and rod emerge on the opposite end of the crossing, a back reamer is attached to the drill rod string and pulled back through the pilot hole. The reamer serves to enlarge the pilot hole to allow the HDPE or restrained joint PVC pipe to be pulled through from the opposite end of the borehole. The size of the drilling equipment and required support equipment shall be determined by the CONTRACTOR based on the diameter and length of pipe to be installed.

1.2 QUALITY ASSURANCE

- A. Contractor Certification – The CONTRACTOR shall be certified by the particular horizontal directional drilling manufacturer that CONTRACTOR is a fully trained user of the drilling equipment.
  
- B. Qualifications of Personnel - HDPE pipe jointing shall be performed by personnel certified in the use of butt-fusion equipment and recommended methods for new pipe connections. Personnel directly involved with installing the new pipe shall receive training in the proper methods for handling and installing the HDPE pipe. Training shall be performed by a qualified representative.

1.3 SUBMITTALS

- A. Shop drawings - As a minimum, the following data and shop drawing information shall be submitted to the Participating Utility for review and approval:
  - 1. Before beginning work, The CONTRACTOR shall submit to the Participating Utility for approval, the vendor's shop drawings, catalog data and specific manufacturer's technical data showing complete information on material

composition, physical properties, and dimensions of new pipe and fittings. Include manufacturer's recommendations for handling, storage, and repair of pipe and fittings, which are damaged.

2. A certificate of "Compliance with Specification" shall be furnished for all materials supplied.
3. The CONTRACTOR shall submit certification of workmen training for all personnel involved in installation of pipe.
4. The CONTRACTOR shall submit a work plan to the Participating Utility for acceptance. Work plan shall address preparation steps required for pre-installation.
5. The CONTRACTOR shall submit information to the Participating Utility for approval of the procedure and the steps to be followed for installation of the HDPE or restrained joint PVC pipe utilizing horizontal directional drilling technology, even if the process is named in the specification. Any proposed changes in installation procedures shall require submittal of revised procedures for acceptance by the Participating Utility.
6. The CONTRACTOR shall submit to the Participating Utility for approval, full details about component materials and their properties, except those protected by trade secrets which may harm their claim to the product.

## **PART TWO - PRODUCTS**

### **2.1 MATERIALS**

- A. HDPE Pipe - Polyethylene plastic pipe shall be high density polyethylene pipe which meets the applicable requirements of ASTM F714 Polyethylene (PE) Plastic Pipe (SDR-PR) based on Outside Diameter, ASTM D3350 and cell classification 345464E.
  1. Sizes of the pipe to be used for installation of water and sewer lines shall be as directed by the Participating Utility.
  2. All pipe shall be made of virgin material. No rework except that obtained from manufacturer's own production of the same formulation shall be used.
  3. The pipe shall be homogenous throughout and shall be free of visible cracks, holes, foreign material, blisters, or other deleterious faults.
  4. Dimension Ratios: The minimum wall thickness of the polyethylene pipe shall be as follows:

Potable water line: DR-11  
Gravity sanitary sewer line: SDR 17 and 345464E to assist video taping  
Sanitary sewer force main: DR-11
  5. For sewer installations pipe material color shall be white, black or whatever is specified with interior of pipe having a light reflective color to enhance viewing for CCTV inspection.

6. Installation Method: HDPE pipe shall be continuously joined with a minimum length, which shall be that deemed necessary by the CONTRACTOR to effectively span the required distance from the inlet to the outlet of the respective pipe, unless otherwise specified. The CONTRACTOR shall verify the lengths in the field before manufacturing.
7. HDPE pipe shall be installed according to the manufacturer's written instructions for installation by horizontal directional drilling.

B. PVC Restrained Joint Pipe

1. PVC pipe meeting the ANSI/AWWA Specification C900 for dimension ratio (DR) 14, pressure Class 305, shall be used for water lines. DR-25 pipe may be used for gravity sewer pipe installations. SDR-21 or DR-14 pipe may be used for sanitary sewer force mains. Pipe shall be Certa-Lok C900, restrained joint PVC, pipe or approved equal.
2. PVC pipe shall be installed according to the manufacturer's written instructions for installation by horizontal directional drilling.
3. Pipes shall be joined using non-metallic couplings, which have been designed with the pipe as an integral system for maximum reliability and interchangeability. High-strength, flexible thermoplastic splines shall be inserted into mating precision-machined grooves in the pipe and coupling to provide full, 360-degree restraint with evenly distributed loading at the joint. No external pipe-to-pipe restraining devices, which clamp onto or otherwise damage the pipe surface as a result of point loading shall be permitted. Solvent-weld cement joints shall not be allowed.

C. PVC Fusible Pipe

1. PVC pipe meeting the ANSI/AWWA Specification C900 for dimension ratio (DR) 14, pressure Class 305, with ductile iron O.D. shall be used for water lines. DR-25 pipe may be used for gravity sewer pipe installations. SDR-21 or DR-14 pipe may be used for sanitary sewer force mains.
2. Sizes of the pipe to be used for installation of water and sewer lines shall be as directed by the Participating Utility.
3. All pipe shall be made of virgin material. No rework except that obtained from manufacturer's own production of the same formulation shall be used.
4. The pipe shall be homogenous throughout and shall be free of visible cracks, holes, foreign material, blisters, or other deleterious faults.
5. Color Coding: Pipe shall be blue for potable water, green for sanitary sewer, and purple for raw or reclaimed water.
6. Installation Method: Fusible PVC pipe shall be continuously joined with a minimum length, which shall be that deemed necessary by the CONTRACTOR to effectively span the required distance from the inlet to the outlet of the respective pipe, unless otherwise specified. CONTRACTOR shall verify the lengths in the field before manufacturing.

7. PVC pipe shall be installed according to the manufacturer's written instructions for installation by horizontal directional drilling.

## 2.2 EQUIPMENT

### A. Directional Drilling Machine

1. Directional drilling equipment shall be self-powered and self-contained. Equipment shall be designed and manufactured with an electronically tracked bore-head so as to guide the borehole to a desired configuration, both horizontally and vertically.
2. Directional drilling equipment shall generate sufficient torque and thrust/pullback force to drill a pilot hole, enlarge the pilot hole by back reaming and pull the pipeline back through the enlarged hole.
3. The CONTRACTOR shall comply with manufacturer's specifications as to the machine size requirement for a given diameter and length of pipe, as well as parameters of the required size machine for percentage of upsize allowed.

### B. Vacuum Excavation Unit

1. Directional drilling operations shall be assisted by use of an adequately sized vacuum excavation system mounted on either a trailer or truck body.
2. Vacuum excavation system shall provide sufficient storage tank capacity and power pack to efficiently remove drilling fluid from the insertion pit during horizontal directional drilling operations.
3. Vacuum excavation system shall be equipped with a high-pressure water system designed to assist with "pothole" excavation operations.

### C. Drilling Fluid Management System

1. Directional drilling operations shall be assisted by use of a truck mounted drilling fluid mixing system.
2. Fluid management system shall include two mixing tanks to allow for flexibility in mixing, transferring and delivering drilling fluid.
3. Fluid management system shall have the capability to transfer between tanks while providing drilling fluid to the directional drilling machine.

## 2.3 SHIPPING & HANDLING

HDPE and/or PVC pipe materials and fittings shall be protected from kinking and gouging during shipping, handling, and storage.

## 2.4 MATERIAL TESTING

Tests for compliance with this specification shall be made as specific herein and in accordance with the applicable ASTM Specification. A certificate with this specification shall be furnished, upon request, by the manufacturer for all material furnished under this specification. Polyethylene plastic pipe and fittings not meeting the requirements of this specification may be rejected.

## **PART THREE - EXECUTION**

### 3.1 HORIZONTAL DIRECTIONAL DRILLING OPERATION AND PIPE INSTALLATION

#### A. Access to the project site

1. Access to the site of the project under construction shall be primarily by respective pipeline easement and/or existing road rights-of-way.
2. Access through private property will not be permitted without the explicit written permission of the property owner. Two (2) copies of such written permission shall be given to the Participating Utility for review and records. At all locations where the CONTRACTOR desires to enter the easement from a road, an access approach will be constructed. All construction within the road right-of-way shall conform to the standards and requirements of the Virginia Department of Transportation and the governing localities.
3. Whenever such access approaches are in use, a flagman shall be posted at the State road. Whenever such access approaches are not in use, a barricade, a chain, fence or gate will be installed to prevent unauthorized and accidental entry to the project site.
4. The CONTRACTOR shall not employ those portions of the pipeline easement, which have had pipe line construction completed by others, as an access route, without express permission from the Participating Utility in writing.

#### B. Pre-Installation Preparations – The CONTRACTOR's work plan shall address the following minimum preparations/steps, unless approved otherwise by the Participating Utility.

1. SAFETY: The CONTRACTOR shall carry out operations under this section in strict accordance with all applicable OSHA Standards. Particular attention is drawn to those safety requirements involving work on an elevated platform and entry into a confined space. It shall be the CONTRACTOR's responsibility to comply with OSHA Standards and Regulations pertaining to all aspects of the work.
2. DIVERSION PUMPING: When required for acceptable completion of the directional drilling and pipe installation process, the CONTRACTOR shall provide for continuous sewage flow around section(s) of pipe designated for pipe installation.
  - a. By-passing of sewage flow shall be accomplished by use of a diversion pump and piping system. Diversion pump and bypass lines shall be of adequate capacity and size to handle the flow. All costs for by-pass pumping required during installation of the pipe shall be paid in conformance with the respective bid item.
  - b. The CONTRACTOR shall be responsible for continuity of sanitary sewer service to each facility connected to the section of sewer during execution of the Work.

- c. If sewage backup occurs and enters buildings, the CONTRACTOR shall be responsible for clean-up, repair, property damage cost and claims.

C. Installation Procedures - General: All approved installation instructions and procedures submitted shall be carefully followed during installation. The Participating Utility shall provide all grade profiles and field stakeout required for pipe centerline grade and offsets. Any proposed changes in installation procedures shall require submittal of revised procedures and acceptance by the Participating Utility.

1. Equipment used to perform the work shall be located as far away from buildings as possible. Provide enclosed, insulated power packs for all mechanical equipment to reduce machine noise, as required to meet local requirements.
2. The CONTRACTOR shall install all pulleys, rollers, bumpers, alignment control devices and other equipment required to protect existing structures, and to protect the pipe from damage during installation. Lubrication shall be used as recommended by the manufacturer. Under no circumstances will the pipe be stressed beyond its elastic limit.

D. Pipe Joining of HDPE Pipe

1. HDPE pipe shall be assembled and joined at the site using either the butt-fusion or electro-fusion method to provide a leak proof joint. Threaded or solvent-cement joints and connections shall not be permitted. All equipment and procedures used shall be used in strict compliance with the manufacturer's recommendations. Fusing shall be accomplished by personnel certified, as fusion technicians, by a manufacturer of polyethylene pipe and/or fusing equipment.
2. Butt-fused joint shall be true alignment and shall have uniform roll-back beads resulting from the use of proper temperature and pressure. Joint shall be allowed adequate cooling time before removal of pressure. Fused joint shall be watertight and shall have tensile strength equal to that of the pipe. All joints shall be subject to acceptance by the Participating Utility and/or his representative prior to insertion.
3. All defective joints shall be cut out and replaced at no cost to the Participating Utility. Any section of the pipe with a gash, blister, abrasion, nick, scar, or other deleterious fault greater in depth than ten percent (10%) of the wall thickness, shall not be used and must be removed from the site. However, a defective area of the pipe may be cut out and the joint fused in accordance with the procedures stated above. In addition, any section of pipe having other defects such as concentrated ridges, discoloration, excessive spot roughness, pitting, variable wall thickness or any other defect of manufacturing or handling as determined by the Participating Utility and/or his representative shall be discarded and not used.
4. Terminal sections of pipe that are joined within the insertion pit shall be connected with a full circle pipe repair clamp or equal. Butt gap between pipe ends shall not exceed one-half ( $\frac{1}{2}$ ) inch. Unicore Plastic Fusion System may be used to butt fuse the sewer pipe material.

E. Connection of HDPE Pipe to Ductile Iron Fittings

1. HDPE Pipe shall be joined to ductile iron fittings, valves, and fire hydrants in accordance with Section CS-2, 3.1.D of these standards.
- F. Transitioning from HDPE Pipe to Ductile Iron Pipe
1. Transitions from HDPE pipe to ductile iron pipe shall be installed in accordance with Section CS-2, 3.1.E of these standards.
- G. Pipe Joining of Restrained Joint PVC Pipe
1. Restrained joint PVC shall be assembled and joined at the site using non-metallic couplings designed with the pipe as an integral system. Pipe and coupling shall be restrained using high-strength, flexible thermoplastic splines inserted into mating precision-machined grooves in the pipe and coupling. Threaded or solvent-cement joints and connections shall not be permitted.
- H. Locator wire - shall be installed with all non-metallic pipe. Refer to Detail Drawings.
- I. Field Testing of Sewer Pipe
1. Pipe shall be internally inspected and repaired in accordance with sanitary sewer CCTV inspection specification CS-4.
  2. Defects, which may affect the integrity or strength of the pipe in the opinion of the Participating Utility, shall be repaired or the pipe replaced at the CONTRACTOR's expense.
  3. Service Reconnection:
    - a. Once installation of sewer pipe has been completed, the CONTRACTOR shall reconnect existing live service connections. These services shall be reconnected by one of the approved methods listed in Paragraph (e.) below.
    - b. All sewer service connections shall be identified and located prior to pipe insertion operations to expedite reconnection. Upon commencement of pipe installation, pipe insertion shall be continuous and without interruption from one manhole to another, except as approved by the Participating Utility and/or their representative. Upon completion of installation of new sewer pipe, the CONTRACTOR shall expedite reconnection of services so as to minimize any inconvenience to customers.
    - c. Installed pipe shall be allowed manufacturer's recommended amount of time, but not less than four (4) hours, for cooling and relaxation due to tensile stressing prior to reconnection of service lines, sealing of the annulus or backfilling of the insertion pit. Sufficient excess length of new pipe, but not less than four inches (4"), shall be allowed to protrude into the manhole to provide for occurrence of pipe relaxation.
    - d. Following relaxation period, the annular space may be sealed. Sealing shall be made with material approved by the Participating Utility and/or his representative and shall extend a minimum of eight inches (8") into the

manhole wall in such a manner as to form a smooth, uniform, watertight joint.

- e. Sewer service connections shall be connected to new pipe by various methods that are compatible with the new HDPE sewer pipe. If a saddle is used, secure saddle in place and drill a hole (equal to the inside diameter of the saddle outlet) in the pipe.
    - i. Mechanical saddles shall be made of polyethylene pipe compound that meets the requirements of ASTM D1248, Class C, have stainless steel straps and fasteners, neoprene gasket and backup plate. Mechanical saddles shall be Strap-On-Saddle Type as manufactured by Driscopipe or approved equal.
    - ii. INSERTA TEE by INSERTA FITTINGS Co. shall also be allowed to be used. Also approved is the Unicore Plastic Fusion System that uses butt-fusion to connect a tee or prefabricated polyethylene saddle or equivalent to sewer pipe material.
4. Finished Pipe
- a. Installed sewer pipe shall be continuous along entire length of each pipe segment from manhole to manhole and shall be free from visual defects such as foreign inclusions, concentrated ridges, discoloration, pitting, and other deformities.
  - b. Pipe with gashes, nicks, abrasions, or any such physical damage, which may have occurred during storage and/or handling and which are larger/deeper than 10 percent (10%) of the wall thickness shall not be used and shall be removed from the construction site.
  - c. Sewer pipe passing through or terminating in a manhole shall be carefully cut out in a shape and manner approved by the Participating Utility. Installed sewer pipe shall meet the leakage requirements of the pressure test as specified.
  - d. HDPE or PVC pipe within the manhole shall be neatly cut off at least a minimum of 4" away from manhole wall. The invert in the manhole shall be a smooth continuation of the pipe(s) and shall be merged with other lines, if any. Channel cross-section shall be U-shaped with a minimum height of half pipe diameter to three-fourths of pipe diameter for fifteen inch and larger. The side channels shall be built up with mortar/concrete to provide benches at a maximum of 1 in 12 pitch towards the channel.
  - e. All manholes shall be individually inspected for water migration, cutoffs, benches, and invert works.

5. Process Limitations:

Though installation process may be licensed or proprietary in nature, The CONTRACTOR **SHALL NOT** change any material, thickness, design values or procedural matters stated or approved in SUBMITTALS, without Participating Utility's prior knowledge and pre-approval.

**- END OF SECTION-**

**CS-9  
SEEDING AND MULCHING**

**PART ONE - GENERAL**

1.1 DESCRIPTION

A. Work included

1. Preparation of ground, seeding, protection and cleanup of Work areas designated for grading and seeding operations.
2. Disking and harrowing of ground for seeding purposes where grade is undisturbed by construction unless otherwise specified.
3. Proper protection of seeded, disturbed, or a combination of both, areas from erosion.

B. Areas responsible for:

1. All areas within the construction easement.
2. All areas disturbed by the CONTRACTOR and his personnel during construction of project under contract.

1.2 QUALITY ASSURANCE

A. Selection of materials

1. The selection of all materials required from the Drawings and the standards shall be subject to the Engineer's approval.
2. The Participating Utility shall have the right to reject any and all materials, which do not meet the Specification requirements or are not otherwise satisfactory at any stage of operations.
3. The CONTRACTOR shall remove all rejected materials immediately from the site at no additional cost to the Participating Utility.

B. Execution of the Work

1. The execution of all grading, seeding and other operations required under the Drawings and Standards shall be subject to Participating Utility's approval.
2. The Participating Utility shall have the right to reject any and all methods of operations found unacceptable for the Work required.

## **PART TWO - PRODUCTS**

### **2.1 FERTILIZER**

Grade 10-10-10 fertilizer, uniform in composition, free-flowing, and suitable for application with approved equipment, shall be provided. Deliver fertilizer to the site in bags or other convenient containers, each fully labeled, conforming to applicable commonwealth or state fertilizer laws, and bearing the name, trade name or trademark, and warranty of the producer.

### **2.2 LIMESTONE**

Furnish agricultural-grade limestone ground to pass an 8-mesh sieve with 25% passing a 100-mesh sieve. In addition, calcareous limestone shall contain not less than 50% calcium oxide, and dolomitic limestone shall contain not less than 40% magnesium oxide. Coarser materials may be acceptable provided the specified rates of application are increased proportionately, on the basis of quantities passing the 8- and 100-mesh sieves, but no additional payment shall be made for increased quantity.

### **2.3 MULCH**

Furnish threshed straw of cereal grain such as oats, wheat, barley, rye, rice, etc. or grass hay. Materials that contain objectionable weed seeds or other species that might be detrimental to planting being established or to adjacent farmland shall not be acceptable.

### **2.4 SEED**

- A. Furnish seed labeled Virginia CERTIFIED or APPROVED, unless written exception is granted. Furnish seed in sealed, standard containers unless written exception is granted. Seed that is wet or moldy or that has been otherwise damaged in transit or stage shall not be acceptable.
- B. Mixtures - Furnish seed of Southern Lawn turf type tall fescue blend, Blue Tag Certified or equivalent.

### **2.5 TEMPORARY SEEDING**

Between April 16 and August 31, temporary seeding shall consist of German Foxtail Millet, applied at a rate of 30 lbs/acre. Between October 21, and February 14, temporary seeding shall consist of winter rye (cereal rye), applied at rate of 120 lbs/acre. Temporary seed may be broadcast, and shall be fertilized with an organic based fertilizer (14-3-6) at a rate of 1½ lbs of nitrogen per 1.0 square feet, and mulched with continuous straw bale coverage at a rate of 80 bales/acre.

### **2.6 SOIL FOR REPAIRS**

For fills and topsoiling areas to be repaired, soil shall be of at least equal quality to existing in areas adjacent to the area to be repaired. Soil used shall be free from roots, stones, and other materials that hinder grading, planting, and maintenance operations and free from objectionable weed seeds and toxic substances.

### **2.7 TOPSOIL**

Topsoil stockpiled under other sections of these Standards shall be utilized and shall contain no rocks or lumps two-inches (2") in greatest dimension. If stockpiled topsoil is

unavailable, the CONTRACTOR shall import the soil, subject to Participating Utility's approval.

## 2.8 WATER

Water shall be free from oil, acid, alkali, salt, and other substances harmful to growth of grass, and shall be from a source approved prior to use by Participating Utility.

## **PART THREE - EXECUTION**

### 3.1 GENERAL

- A. Area and requirements of Work - All disturbed ground areas within limits of construction shall be graded, topsoiled, tilled, fertilized, limed, seeded, and mulched. For cut and fill areas which consist of primarily rock or rough rock/soil, topsoiling, and tilling shall be waived.
- B. Equipment - Provide equipment in good condition for the proper ground preparation and for hauling and placing of materials. Equipment shall be approved before work is started.

### 3.2 PREPARATION OF GROUND SURFACE

- A. Clearing - Prior to grading and tilling, vegetation that may interfere with operations shall be moved and grubbed; remove collected material from site, or when suitable, used material for mulch as approved by Participating Utility. Clear surface of stumps, roots, cable, wire, rocks or lumps greater than two inches, and other materials that might hinder Work or subsequent maintenance.
- B. Grading - Maintain previously established grades on the areas to be treated in a true and even condition; make necessary repairs to previously graded areas. Where grades have not been established, grade areas as shown on the Drawings, and leave all surfaces in an even and properly compacted condition to prevent formation of depressions. Finished grade shall be such that after subsequent treatments, i.e. tillage, topsoiling, and planting, planted grade shall join 1-inch (1") below adjoining surfaced grade of walks and drives.
- C. Tillage - After areas required to be treated have been brought to grades shown, till soil to a depth of at least three inches (3") by plowing, disking, harrowing, or other approved operations until condition of soil is acceptable. Perform Work only during periods when, in the CONTRACTOR'S or the Participating Utility's opinion, beneficial results are likely to be obtained. When drought, excessive moisture, or other unsatisfactory conditions prevail, Work shall be stopped when directed. Level undulations or irregularities in surface before next specified operation.
- D. Topsoiling
  - 1. Distribute topsoil uniformly and spread evenly to a settled thickness of four inches (4"). Spread topsoil so that planting can proceed with little additional soil preparation or tillage.
  - 2. Level surface irregularities resulting from topsoiling or other operations to prevent depressions. Adjust grade to assure that planted grade will be 1 inch

(1") below adjoining grade of any surfaced area in accordance with requirements of Paragraph 3.2, B.

3. Topsoil shall not be placed when subgrade is frozen, excessively wet, extremely dry, excessively compacted, or in a condition detrimental to proposed planting or grading.
4. Pulverize soil compacted by construction equipment or soil on compacted cut slopes or grades to a minimum depth of two inches (2") by disking or plowing before applying topsoil.

E. Fertilizing

1. Distribute fertilizer uniformly at a rate of 25 pounds per 1,000 square feet over areas to be seeded, and incorporate it into soil to a depth of at least three inches (3") by disking, harrowing, or other acceptable methods. Incorporation of fertilizer may be part of operation specified in Paragraph 3.2, C.
2. If liquid fertilizer is used, apply it in amounts sufficient to provide the same value of nutrients per unit of surface area specified for dry fertilizer. If a liquid fertilizer is used in a hydroseeder, apply material on a poundage basis mixed with same volume of water used with dry fertilizer.
3. Use of approved hydraulic equipment or seed drill equipped to sow seed and distribute fertilizer at the same time shall be acceptable.

F. Liming - Immediately following or simultaneously with incorporation of fertilizer, distribute limestone uniformly at a rate of 80 pounds per 1,000 square feet, and incorporate it into soil to a depth at least three inches (3") by disking, harrowing, or other acceptable methods. Incorporation of limestone along with fertilizer may be part of the operation specified in paragraph 3.2. C.

G. Leveling - Level surface irregularities resulting from tillage, fertilizing, liming, or other operations before seeding.

### 3.3 PLANTING SEED

A. General - All permanent seeding shall be applied between March 15 and April 15, or between September 1 and October 15. All seeding done outside these periods shall be temporary, for erosion control only. Unless otherwise directed in writing. Application rate shall be 8 lbs. per 1,000 sq. ft.

1. Employ a satisfactory method of sowing, using approved mechanical power-drawn drills or seeders, mechanical hand-seeders, hydraulic seeders, or other approved methods. When drills are used, provide markers or other means to ensure that successive seeded strips will overlap or be separated by a space no greater than equipment row spacings.
2. When delays in operations extend work beyond the most favorable planting season for species designated or when conditions are such by reason of drought, high winds, excessive moisture, or other factors that satisfactory results are not likely to be obtained, halt work as directed and resume only when conditions are favorable or when approved alternate or corrective measures and procedures have been effected.

3. If inspection during seeding operations or after there is show of green indicates that strips wider than space between rows planted have been left unplanted, or other areas skipped, sow additional seed at no additional cost to Participating Utility.
- B. Broadcast seeding - Broadcast seed either by hand or with approved hydraulic seeding equipment, as specified hereinbefore, in combination with fertilizer, or with other approved sowing equipment at the rate shown under Paragraph 2.4, B.
1. Distribute seed uniformly over designated areas.
  2. Sow half of seed with sower moving on one direction, other half with sower moving in opposite direction.
  3. Seed shall be covered to an average depth of 1/4" by brush harrow, spike-tooth harrow, chain harrow, cultipacker, hand rake, or other approved device.
  4. Seed shall not be broadcast during windy weather.

### 3.4 COMPACTING

- A. Equipment - Immediately after the seeding operation has been completed, the surface shall be compacted by a cultipacker, roller, or other approved equipment weighing 100 to 160 pounds per linear foot of roller.
1. When planting by machine, the roller shall be operated immediately behind the planter unless otherwise directed. Under certain soil conditions, the Participating Utility may direct that rolling be delayed for 15 to 30 minutes following planting to avoid balling the soil on the roller or squeezing water out of furrows.
  2. If the soil is of such type that a smooth or corrugated roller cannot be operated satisfactorily, a pneumatic-tired roller, not wobble-wheel, shall be used. A roller having tires of sufficient size shall be used, or sufficient passes of the roller shall be made, to cover the soil surface completely.

### 3.5 MULCHING

- A. Conditions - Straw or hay mulch shall be spread uniformly in a continuous blanket, using 100 pounds per 1,000 square feet.
- B. Equipment - Mulch shall be spread by hand or by a manure spreader, a blower-type mulch spreader, or other suitable equipment.
- C. Method:
1. Mulching shall be started at the windward side of relatively flat areas, or at the upper part of a steep slope, and continued uniformly until the area is covered. The mulch shall not be bunched.
  2. Immediately following spreading, the mulch shall be anchored to the soil by a V-type wheel land packer, a scalloped-disk land packer designed to force mulch into the soil surface, or other suitable equipment.

3. The number of passes needed, not to exceed three, shall be determined by the Participating Utility.

### 3.6 WATERING

- A. Water shall be delivered in a manner that will ensure that the upper six inches (6") of the soil surface is moistened. Distribution shall be at an even rate and in a manner to prevent erosion.
- B. Watering equipment of a type that prevents damage to finished surface shall be used.

### 3.7 ESTABLISHMENT AND MAINTENANCE

- A. General - Protection shall be provided against traffic or other use by erecting barricades immediately after treatment is completed, and by placing warning signs, as directed, on various areas. The CONTRACTOR shall assume responsibility for proper care of seeded areas while grass is becoming established for three months after completion of treatment on the entire project, unless desired cover is established in a shorter period of time and the Participating Utility shortens the responsibility period. When any portion of the surface becomes gullied or otherwise damaged or treatment is destroyed, the affected portion shall be repaired to re-establish condition and grade of soil and treatment prior to injury, as directed. Repair work required because of faulty operations or negligence on the part of the CONTRACTOR shall be performed without additional cost.
- B. Postplanting fertilization - From 40 to 60 days after seeding or planting, Grade 10-10-10 fertilizer shall be applied uniformly at a rate of 15 pounds per 1,000 square feet over areas seeded or planted. Fertilizer conforming to physical condition, packaging, and marking as specified shall be provided. Fertilizer shall be applied when grass blades are dry to minimize burning. When water is available, the planted area shall be irrigated to thoroughly moisten the upper six inches (6") of the soil surface after the fertilizer is applied. The Participating Utility shall designate areas needing further refertilization at least 15 days before application is required.
- C. Reseeding - The Participating Utility shall designate areas requiring reseeding at least 15 days before the period specified for reseeding. Seed specified shall be drilled at 4 pounds per 1,000 square feet, in a manner that will cause minimum disturbance to existing stand of grass, and at an angle of not less than 15 degrees from direction of previously seeded rows.
- D. Mulching - Mulched areas shall be maintained until all work or designated portions thereof have been completed and accepted. Any damage shall be repaired, and mulch material that has been removed by wind or other causes shall be replaced and secured.

**- END OF SECTION -**