Smyth County

Water and Wastewater Specifications

And Standard Details

Prepared For:
Smyth County, Virginia

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SPECIFICATIONS

DIVISION 02: SITE WORK

02200 - Sitework Procedures
02300- Earthwork
02370- Erosion and Sediment Control
02400- Boring and Jacking
02510- Water Distribution Systems
02514- Disinfection of Water Distribution Systems
02518- Precast Structures for Water
02520- Pipe and Pipe Fittings
02522- Valves and Specialties
02530- Sanitary Sewerage Systems
02532- Sewer Manholes and Cleanouts
02535- Sewage Force Main Systems
02920- Lawns and Grasses

DETAILS

WD – WATER
Details 1 - 15

SD - SEWER
Details 1 - 5

P – PUMP CONTROL
Details 1 - 2

APPENDIX A – UNIT PRICE DESCRIPTIONS
1.0 GENERAL REQUIREMENTS

1.1 Use of Standards

1.1.1 These standards apply to water distribution system improvements and/or sanitary sewer collection system improvements which will be owned and operated by Smyth County (hereinafter “the County”). In addition to those projects administered and funded by the County, these standards apply to private developers who construct water and/or sewer facilities which will come under the ownership of the County. However, the use of these standards will be applied differently depending on whether the project is constructed by the County or a private developer, as noted below.

1.1.2 In general, the standard specifications present the minimum technical requirements for the construction of water distribution system improvements and sanitary sewer collection system improvements. The specifications do not address technical requirements for treatment facilities or project-specific components such as pump stations, storage tanks, etc.

1.1.3 For projects administered and funded by the County, the term “Owner” in the standard specifications means Smyth County, “Engineer” means the Smyth County Engineer or his designated agent, and “Contractor” means the entity under contract to the County to perform the work.

1.2 Private Development Use

1.1.4 With respect to private development, the private developer is the Owner of the facilities until they are completed and accepted by the County for ownership, operation and maintenance. Therefore, the term “Owner” in the standard specifications means Private Developer. It is the responsibility of the private developer to acquire the appropriate professional services, as noted below.

1.1.5 For private development projects, the term “Engineer” in the standard specifications means the engineer (or other appropriately licensed design professional) hired by the private developer. Unless specifically stated in writing, the County does not and will not accept any of the responsibilities of the Engineer for private development projects. It is the responsibility of the Engineer to perform, or have performed under his supervision, inspections of the work necessary to certify that the work has been completed in accordance with the approved plans and specifications. The County may perform inspections as it feels necessary to protect its own interests, but the County will rely on the certification of completion statement by the design professional as evidence that the work has been completed in accordance with the approved plans and specifications.

1.1.6 For private development projects, the term “Contractor” in the standard specifications means the contractor hired by the private developer. The County has no direct authority over the private developer’s contractor. These standards and specifications do not and are not intended to define the relationship between the Contractor and the Owner or between the Owner and the Engineer.
1.3 General Design Requirements

1.3.1 The design of all water and sewer extensions and modifications shall be performed under the direction of a professional engineer licensed to practice in the Commonwealth of Virginia in accordance with Title 54.1, Chapter 3 of the Code of Virginia, as amended. Where applicable, design may be performed under the direction of a certified land surveyor in accordance with Sec. 54.1-408 of the above cited Code.

1.3.2 All design shall conform to the requirements of the Virginia Department of Health Waterworks Regulations [12VAC5-580], the Virginia Department of Environmental Quality Sewage Collection and Treatment Regulations [9VAC25-790], and to the requirements of other State and Federal Agencies having jurisdiction.

1.3.3 All design shall conform to the requirements of Smyth County. Where the requirements of the State and County are in conflict, the more restrictive requirements shall govern.

1.3.4 The Engineer shall be responsible for obtaining the reviews and necessary approvals of all drawings and specifications by applicable County, State, and Federal agencies having jurisdiction. Copies of such approvals shall be submitted to the County as the time of final review by the County.

1.3.5 Record drawings shall be submitted in a compatible AutoCAD format and approved by the County prior to final acceptance of the project.

1.4 Submittal Requirements

1.4.1 Plan review submittal – Design engineer shall review internally then submit two (2) copies of plan set to Smyth County. Smyth County shall provide written comments on submittal to engineer, which engineer shall address and resubmit to Smyth County. Following Smyth County’s approval, engineer shall submit plans to the appropriate regulatory agency for review.

1.4.2 Concurrent with technical drawing submittal, the Erosion & Sediment Control and Stormwater Plan shall be submitted to the appropriate County Building Department in accordance with County Standards.

1.5 Easements

1.5.1 Permanent easements shall be designated for all water and sewer lines and appurtenances except where they are installed within Virginia Department of Transportation right-of-way or existing easements dedicated for utilities. In general, permanent easements should be 20 feet in width, centered on the pipeline. Temporary easements should be a minimum of 40 feet and be of sufficient width to allow the contractor adequate room to safely construct the utilities.
2.0 DESIGN PHASE GUIDELINES

2.1 Water Systems

2.1.2 General Guidelines for pump stations are available in the Details – Sheet P-1 and P-2

2.2 Sanitary Sewer Systems

2.2.2 General Guidelines for pump stations are available in the Details – Sheet P-1 and P-2

2.3 Division 1 Specifications

2.3.1 When the County is the Owner, the Engineer must develop Division 1 sections, as appropriate, to cover unit prices, payment procedures, contract modification procedures, project meetings, construction schedules, submittal procedures, regulatory requirements, quality control, temporary facilities and controls, construction layout, closeout procedures, and whatever other requirements are determined appropriate by the Engineer.

2.3.2 On unit price contracts, unit price items should be clearly delineated and described. In general, the County prefers units to be all inclusive. Examples for specific unit price break-downs should be followed and are available in Appendix A. Written approval from the County shall be obtained prior to including unit price break-downs differing from those shown in Appendix A.

2.3.3 Submittal requirements may vary from project to project. In particular, the County’s role in reviewing submittals may be greater on some projects. Thus the Engineer should seek the County Engineer’s guidance in developing these requirements.

2.3.4 Quality control specifications must be provided to stipulate requirements for quality assurance and control (e.g., reference standards; manufacturer’s instructions, field services and reports; testing laboratory services). In general, testing services shall be arranged and paid for by the Contractor, unless otherwise arranged with the County.

2.3.5 Closeout procedures must include requirements for warranties, and operations and maintenance data, as appropriate; and project record drawings (see below).

3. CONSTRUCTION PHASE GUIDELINES

3.1 Submittals

3.1.1 For projects requiring the County’s review and approval of submittals, the Engineer shall forward one copy of each submittal, as appropriate, to the County Engineer as soon as the submittal is received from the Contractor. The Engineer will complete the review after receiving comments from the County Engineer.

3.2 Notifications and Inspections

3.2.1 On private development projects, the developer must notify the County at least 48 hours prior to starting construction on any water or sewer facilities to be later dedicated to the County.
3.2.2 When construction of water or sewer facilities is substantially complete, the developer or Engineer must provide to the County: 1) a written statement by the design professional confirming that the work was installed in accordance with the approved plans and specifications, and 2) copies of test results for any tests stipulated in the Standard Specifications or otherwise required by regulatory agencies (e.g. pressure and leakage tests, and bacteriological tests).

3.3 Record Drawings

3.3.1 The Contractor must maintain, during the progress of the work, a continuous record of all field deviations from the plans, showing all revisions on a set of original Contract Drawing prints. Such changes must be made in red utilizing standard drafting techniques. Each sheet must be marked “Record Drawing” near the title block, and must be certified as to correctness by the Contractor and submitted to the Engineer.

3.4 Acceptance

3.4.1 Acceptance shall be granted only after the following are completed or obtained (where applicable):

- Acceptable Pressure Test
- Acceptable BAC-T Results
- Engineer’s Statement of Completion
- Agency Approval – VDH Concurrent C.T.O
- Approved Record Drawings
- Approved Operation and Maintenance Manuals
- VDOT Permit
SECTION 02200

SITE PREPARATION

PART 1  GENERAL

1.01  DESCRIPTION
General instructions for sitework.

1.02  SCOPE
Sitework shall include site preparation, earthwork, site improvements, landscaping and paving/surfacing.

1.03  QUALITY ASSURANCE
A. Prior to beginning work, become thoroughly familiar with site conditions and all specifications, drawings, and other requirements.
B. Comply with all pertinent codes and regulations.
C. Perform all required tests in accordance with section requirements.

1.04  SUBMITTALS
A. Shop drawings, product data.
B. Releases.
C. Disinfection and bacteriological reports.
D. Pressure test logs.
E. Project Record Documents.
F. Operating and maintenance data.

1.05  PERMITS
Obtain required permits from appropriate authorities before sitework begins.

1.06  DUST CONTROL
A. Use all means necessary to control dust on and near the Work, and on and near all off-site borrow areas, if such dust is caused by the Contractor's operations during performance of the work, or if resulting from the conditions in which the Contractor leaves the site.
B. Thoroughly moisten all surfaces as required to prevent dust from being a nuisance to the public, neighbors, and concurrent performance of other work on the site.
1.07 MAINTAINING TRAFFIC
   A. Do not close or obstruct roadways without permits.
   B. Conduct operations with minimum interference to public or private roadways.
   C. Maintain designated temporary roadways, walkways and detours for vehicular and pedestrian traffic.

PART 2 PRODUCTS
2.01 GENERAL
   In accordance with the provisions of individual specification sections and Drawings.

PART 3 EXECUTION
3.01 SITE INSPECTION
   Prior to all work, carefully inspect the entire site and all objects designated to be removed and to be preserved.

3.02 CLARIFICATION
   The Drawings do not purport to show all objects existing on the site. Before commencing any work, verify with the Engineer all objects not clearly identified to be removed or to be preserved and any discrepancies not fully resolved.

3.03 PRIOR CONDITIONS INSPECTIONS
   A. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where installation may commence in accordance with the original design, all pertinent codes and regulations, and all applicable portions of the referenced standards.

   B. In the event of discrepancy, immediately notify the Owner's Representative and do not proceed with installation in non-conforming areas until all identified discrepancies have been fully resolved.

3.04 PROTECTION AND SAFETY
   Verify all required protection devices are in place and operational.

   A. Establish extent of sitework by area and elevations; designate and identify datum elevation.

   B. Set required lines and levels.

   C. Maintain bench marks, monuments and other reference points.

3.05 UTILITIES
A. Before starting excavation, establish location and extent of utilities occurring in work area and disconnect or arrange for the disconnection of all utility services designated to be removed, performing all such work in accordance with the requirements of the utility company, agency, or entity involved.

B. Maintain, re-route or extend as required, existing utility lines to remain which pass through work area in accordance with the requirements of the utility company, agency, or entity involved.

C. Preserve in operating condition all active utilities traversing the site and designated to remain.

D. Remove abandoned utility service lines from areas of excavation; cap, plug or seal such lines and identify at grade.

E. Accurately locate and record abandoned and active utility lines, re-routed or extended, on Record Drawings.

F. Notify the Owner's Representative immediately when active utilities are encountered which are not shown on Drawings. The work shall be adequately protected, supported or relocated as directed by the Engineer.

3.06 PROCEDURE
Provide sitework in accordance with lines and levels required for construction of the Work, including space for forms, bracing and shoring, foundation drainage systems, applying dampproofing and waterproofing, and to permit inspection.

3.07 EXCESS WATER CONTROL
A. Do not place, spread, or roll fill material during unfavorable weather conditions. Do not resume operations until moisture content and fill density are satisfactory.

B. Provide berms or channels to prevent run-off into sub-grade; promptly remove all water collecting in depressions.

C. Provide and maintain at all times during construction, ample means and devices with which to promptly remove and dispose of all water from every source entering the excavations. Dewater by means which will ensure dry excavations and the preservation of the final lines and grades of bottoms of excavations.

3.08 SURPLUS MATERIALS
A. Remove surplus backfill materials from site, or as otherwise directed by Owner.

B. Leave stockpile areas completely free of all excess fill materials.

3.09 REMOVAL OF DEBRIS
A. Promptly remove cleared debris from site. Burning of debris on site is not permitted, unless permission is obtained from applicable regulatory authority.
B. Obtain permission, as required, from applicable regulatory authority for disposal of debris at waste disposal site.

C. Remove surplus equipment and tools from the site.

END OF SECTION
SECTION 02300
EARTHWORK

PART 1  GENERAL

1.01  WORK INCLUDED

A. General site excavation, filling, and backfilling.
B. Excavation and backfilling for building foundations, site structures, and roadways.
C. Excavation and backfilling for utilities.
D. Blasting.
E. Finish grading.

1.02  RELATED SECTIONS

A. Section 02370 Erosion and Sediment Control
B. Section 02510 Water Distribution
C. Section 02530 Sanitary Sewerage
D. Section 02920 Lawns and Grass

1.03  REGULATIONS

A. Comply with all codes, laws, ordinances and regulations of governmental authorities having jurisdiction over this part of the work.
B. Work within existing or proposed Virginia State Rights-of-Way shall meet all requirements of the Virginia Department of Transportation.

1.04  SUBMITTALS

The Contractor shall submit to the Engineer for approval the following proposed materials and equipment to be used on the project:

A. Engineered Fill Materials
B. Granular Material (Bedding)
C. Aggregate Backfill Material

1.05  REFERENCES

A. Virginia Department of Transportation (VDOT) Road and Bridge Specifications, latest edition.
B. American Society of Testing Methods (ASTM)
1.06 EXAMINATION OF SITE AND RECORDS

A. The Contractor shall examine the site, the Drawings, and records of existing subsurface soil conditions for the project available (if any) through the Engineer to determine the conditions under which the work will be performed. The Contractor shall formulate his own conclusions as to the subsurface conditions and shall remove all materials to the design subgrades indicated or hereinafter specified.

B. Subsurface soil investigation data, including records of test borings are made available (if any) for information only and are not guaranteed to represent all subsurface conditions that will be encountered. Additional test borings or other exploratory operations may be made by the Contractor at no cost to the Owner.

1.07 PROTECTION OF UTILITIES

A. The location of existing utilities, including underground utilities, is indicated on the Drawings insofar as their existence and location were known at the time of preparation of the Drawings. However, this shall not be construed as a guarantee that such utilities are in the location indicated or that they actually exist, or that other utilities are not within the area of operations. The Contractor shall make all necessary investigations to determine the existence and locations of such utilities.

B. The Contractor shall contact “Miss Utility” (1-800-552-7001) at least three (3) working days in advance of planned work.

C. Report any uncharted or incorrectly charted lines to the Engineer for further direction.

D. Protect all existing service lines and related structures encountered in the excavation work. Where such lines and structures have been undermined due to excavation work, provide suitable supports. If damaged, repair such lines or structures or arrange for their repair with the proper authority. The Contractor shall pay for any damage to and for maintenance and protection of existing utilities and structures.

1.08 PROTECTION OF TREES

A. Protect all trees which are indicated on the Drawings to remain or to be relocated. Box trunks of such trees with 2-inch thick wood planks secured to trunks with wire or metal straps. Material or debris shall not be piled under such trees.

B. Excavating or extensive grading shall not be performed under such trees within the spread of the branches. If excavation under such trees is necessary, and is approved, roots which are over 1 inch in diameter shall not be cut. Where branches of such trees are removed to facilitate construction, or the trees are inadvertently damaged, all damage to such trees shall be repaired by persons skilled in the care of trees.
1.09 PRECAUTIONS
A. The Contractor shall take every precaution to guard against any movement or settlement of existing or new construction, utilities, paving, walks, light standards, piping, conduit, etc., and shall provide at his own expense, all sheet piling, bracing or shoring necessary in connection therewith. The Contractor shall be entirely responsible for the design, and adequacy of any sheet piling, bracing and shoring required.

1.10 SHEETING AND SHORING
A. Sheetin and shoring shall be in compliance with all federal, state, and local regulations.

1.11 PROTECTION OF UTILITIES IN FILL AREAS
A. New underground utilities shall not be laid in areas of fill prior to the actual performance of the grading operation, unless the depth of the cover over such utilities below existing ground surface is at least 14 inches for steel or ductile iron pipe and 30 inches for pipes of other materials. Such depth of cover requirements may be reduced provided the pipe is protected by concrete encasement or other manner satisfactory to the Engineer.

PART 2 PRODUCTS

2.01 SUITABLE MATERIAL
A. General Fill

General Fill material shall be deemed as material that classifies in the ASTM D 2487 soil classification groups SC, GC, GW, GP, GM, SW, SP, and SM, or a combination of these group symbols. The maximum particle size shall be three inches largest dimension, except in the uppermost lift of fill, where the maximum particle size shall be two inches largest dimension. Maximum sized particles shall not be in excess of 20 percent of the volume of fill material, and such particles shall be well distributed throughout the mass. General fill shall be used for most utility trenches and non-load bearing areas, such as lawns.

2.02 UNSUITABLE MATERIAL
A. Material not meeting the above requirements, including material such as clay mass, frozen materials, cinders, ashes, refuse, and vegetable or organic material shall be construed as unsuitable fill material.

B. Unsatisfactory Soils: ASTM D 2487 soil classification groups MH, CH, OL, OH, and PT, or a combination of these group symbols.

C. Unsatisfactory soils also include satisfactory soils not maintained within 3 percent of optimum moisture content at time of compaction.
2.03 APPROVED GRANULAR MATERIAL
   A. Approved granular material shall be well graded crushed stone conforming to Size No. 57 as specified in Section 203 of the VDOT Road and Bridge Specifications.

2.04 APPROVED AGGREGATE BACKFILL MATERIAL
   A. Aggregate backfill material shall be VDOT No. 21B as specified in Section 208 of the VDOT Road and Bridge Specifications.

2.05 CLASSIFICATION OF EXCAVATED MATERIALS
   A. Unless otherwise specified in the Bidding and Contract Documents, all excavated materials shall be unclassified, and shall be included in the lump sum price or unit price.

PART 3 EXECUTION

3.01 DEMOLITION, CLEARING, AND PREPARATION
   A. The existing structures shall be carefully demolished as required and removed from the site. The demolition work shall be done carefully so as to not disrupt the Owner's operations, and so as to not endanger or harm adjacent property, structures or the public.
   B. The entire area within the limit of earthwork shall be cleared and grubbed and shall be cleaned of all debris. Under the structures, paved, and fill areas; stumps, roots, logs, matted roots and other debris not suitable for foundation purposes shall be removed to a minimum depth of eighteen (18) inches below any subgrade. The resulting hole shall be backfilled with suitable material and compacted as specified hereinafter for general fill, whichever applies. Cleared material shall be completely removed from the site, and disposed of by the Contractor, at his expense.
   C. Topsoil shall be carefully stripped to its full depth from all areas indicated to be graded, or to be built upon. Stripped topsoil shall be stored and protected for reuse later.
   D. All areas to receive fill shall be stripped of rootmat five feet beyond toe of anticipated fills. Topsoil, all vegetation, such as roots, brush, heavy sods, heavy growth of grass, and all decayed vegetable matter, rubbish and other debris within the area upon which fill is to be placed, shall be stripped or otherwise removed before the fill is started. In no case will such objectionable material be allowed to remain in or under the fill area.
   E. Sloped ground surfaces steeper than one vertical to four horizontal on which fill is to be placed shall be plowed, stepped, benched, or broken up in such manner that fill material will bond with the existing surface, as directed. Before starting the fill, the area shall be proofrolled and approved by the Engineer’s quality control
representative. Any soft, pumping, or rutting spots that are discovered shall have the soft material excavated and the void filled with suitable material, compacted as hereinafter specified.

3.02 EXCAVATION

A. GENERAL

All excavations of every description and of whatever substances encountered within the grading limits shall be performed to the grades, slopes, and elevations indicated. All excavated materials which are not considered suitable for fill and any surplus of excavated material which is not required for fill shall be disposed of by the Contractor. Excavations shall extend a sufficient distance away from excavation walls to permit erection and removal of forms and installation of drains and other permanent work. Excavations shall be carefully made to the depths indicated, with the bottoms level, free of loose material, and free of all loam, organic material and other unsuitable material as hereinafter specified. All excavations shall be approved by the Engineer prior to the placing of any concrete.

B. ROCK EXCAVATION

1. Unless otherwise specified in the Bidding and Contract Documents, all excavation is unclassified. Where rock is encountered as indicated by the Engineer or the Engineer’s representative, it shall be excavated, undercut and backfilled in accordance with the following paragraphs. No additional payment will be allowed for undercut or placement of approved granular material.

2. For structures, rock shall be removed to a depth of at least 12 inches below the indicated bottom of the structure foundation, unless the entire foundation rests on the same rock ledge. If the foundation rests on rock, the rock shall be leveled to a hard, clean surface. If rock is excavated below the foundation, the resulting void shall be filled with approved granular material as previously specified. The excavation shall allow 18 inches, horizontally, outside structure walls or outside concrete work for which forms are required.

3. For utility trenches, rock shall be removed to a depth of six inches below the bottom of the pipe, pipe bells, and fittings, and all undercut trench excavation shall be backfilled with approved granular material.

C. UTILITY EXCAVATION

1. General: The Contractor shall excavate all materials encountered in the trenches and ditches, detailed on the Drawings along the alignments shown on the drawings. Trenches shall be graded to avoid local high points. Trenches shall be graded either level or on a continuous upslope to the high points designated on the drawings. Trenches shall be such a
depth to provide the minimum cover shown on the Drawings, as measured from the top of the pipe to the existing ground surface or the final grade, whichever is lower.

2. Excavated Material: Excavated suitable material to be utilized for backfilling shall be piled alongside the trench at a distance sufficient to avoid overloading the trench walls and causing cave-ins, and located to prevent obstruction of driveways, roads and hydrants. All excavated material not suitable for or not required for backfilling, including that from the trenches and the ditches, shall be removed and disposed of by the Contractor at his expense.

3. Dewatering: The Contractor shall utilize means necessary to prevent surface water from washing into the trench. Grading or construction of berms shall be performed as required to prevent surface water from flowing into trenches or other excavations. Any water that accumulates in the trench shall be promptly removed. Where conditions are such that running or standing water occurs in the trench bottom or the soil in the trench bottom displays a "quick" tendency, the water should be removed by pumps and suitable means such as well points or pervious underdrain bedding until the pipe has been installed and the backfill has been placed to a sufficient height to prevent pipe flotation.

4. Trench Width: Trench width at the ground surface may vary with and depend upon depth, type of soils, and position of surface structures. The minimum clear width of the trench, sheeted or unsheeted, measured at the springline of the pipe should be one foot greater than the outside diameter of the pipe. The maximum clear width of the trench at the top of the pipe should not exceed a width equal to the pipe outside diameter plus two feet. If the above defined trench widths must be exceeded or if the pipe is installed in a compacted embankment, pipe embedment should be compacted to a point of at least 2.5 pipe diameters from the pipe on both sides of the pipe or the trench walls, whichever is less. Excavation at manholes and similar structures shall be sufficient to provide 12 inches in the clear between the outside of the structure and the embankment or sheeting.

5. Trench Bottom, General: The trench shall be excavated to the depth required as specified in the bedding section (Sec. 3.04) and shall provide a firm, stable, and uniform support for the full length of pipe on solid or undisturbed soil, or as otherwise specified for pipelines. If necessary, bell holes and depressions shall be provided to permit proper joint assembly and pipe support. Any part of the trench bottom excavated below the established pipe grade shall be backfilled and compacted as required to provide firm pipe support. Ledge rock, boulders, and large stones shall be removed to provide six (6) inches of soil cushion on all sides of the pipe, including the bottom, and on all sides of accessories.
6. Unsuitable Subgrade: When an unstable subgrade condition is encountered, which will not provide adequate pipe support, additional trench depth shall be excavated to a stable foundation under the supervision of the Engineer’s quality control representative and backfilled with approved granular material. Backfill, removal, and disposal of unsuitable material shall be at the Contractor’s expense.

D. DITCH EXCAVATION

Cut ditch, gutter, and channel changes to cross sections and grades indicated on the Drawings. Remove, trim, or dress all roots, stumps, rock and foreign matter in the sides and bottom of each ditch, gutter, and channel to conform to the slope, grade and shape of the section indicated. No excavated material shall be deposited closer than 3 feet to the edge of ditches, unless otherwise indicated. Care shall be taken not to excavate ditches and gutters below the grades indicated. If over-excavation occurs, backfill to grade with suitable (general or engineered fill) material in 9-inch lifts and compact to 95% Standard Proctor as deemed by ASTM D698.

E. EXCESS MATERIAL

Excess material, including but not limited to, excess cut material, unsuitable fill material, and rock or other unsuitable material resulting from excavation or blasting operations, shall be disposed of by the Contractor off-site. Where designated on the drawings or directed by the Owner, excess material may be disposed of on-site. On-site excess materials shall be compacted to minimum 85% maximum dry density (ASTM D698 Standard Proctor). All removal and hauling for disposal of excess material shall be performed at no additional cost to the Owner.

3.03 BLASTING

A. REFERENCE


B. PERSONNEL

When explosives are used, work shall be executed by experienced powder men who are licensed by governing authorities to use explosives.

C. STORAGE, HANDLING, AND USE

1. Blasting shall be performed as directed or approved as to number, length, placing and direction and loading of holes. The charges used shall not make the excavation unduly large or irregular, not shatter the rock upon or against which masonry is to be built, nor injure masonry or existing structures at the site or in the vicinity thereof. Each blast shall be covered
with rubber tire or steel mats. Blasting will not be permitted within 25 feet of completed pipes or structures except where directed by the Engineer.

2. Whenever the Engineer determines that further blasting may injure or damage adjacent rock, masonry or other structures, blasting shall be discontinued. In such case, the remaining rock shall be excavated by baring, wedging or other approved method.

3. Where sewers, gas, water, steam or other utility ducts or lines, busing connections or other structures have been exposed during excavation, such structures shall be adequately protected from damage before proceeding with the blasting. Any structure, pipe line or conduit damaged by blasting shall be promptly repaired at no cost to the Owner.

4. Blasting shall not be carried on within 300 feet of any radio transmitter or radio frequency emission equipment such as high frequency welders, and blasting caps shall be kept in tightly closed, all metal cans when in the vicinity of such equipment.

5. A sufficient quantity of explosives to avoid delay to the work shall be kept on the site, but at no time shall there be a quantity in excess of that which will be required for use within the following twelve hours. Explosives shall be stored, handled and used in accordance with State and local regulations and the "Manual of Accident Prevention in Construction" of the Associated General Contractors of America, Inc. The magazine keeper shall keep an accurate daily record and account of each piece of explosive, detonator, and equipment from the time of delivery of the magazine until used or removed from the site.

D. PERMITS AND BONDS

The Contractor shall take out permits and execute a bond, as required by the ordinances of the jurisdiction, in which the work is being done, relating to permits and bonds for blasting. Any damage to foundations or other work caused by use of explosives shall be corrected at the Contractor's expense.

E. NOTICE

Advise owners of adjacent buildings or structures in writing two (2) weeks prior to blasting. Describe blasting and seismic operations as required. Prior to firing blasts, the Contractor shall have a competent man, carrying a red flag, stationed at a reasonable distance from the blast at each avenue of approach to give warning of the blast. Blasting in the vicinity of any existing utilities shall be done carefully and with the knowledge and approval of the owner of the utility.

F. LIABILITY

The Contractor shall hold the Owner harmless for any injuries and for all damage caused by the explosives and shall satisfactorily correct and pay for all injuries and damage resulting from his use of explosives. The Contractor shall conduct a
preblasting inspection and monitoring of nearby facilities and structures as necessary for protection against claims.

3.04 BEDDING

A. Bedding for PVC water and sewer pipelines shall be compacted approved granular material to provide uniform support.

1. Bedding for PVC gravity pipe shall extend from four (4) inches under pipe invert and bell to four (4) inches over the crown of the pipe.

2. Unless otherwise indicated on the plans, bedding for PVC pressure pipe shall extend from four (4) inches under pipe invert and bell to the pipe springline.

B. Bedding for Ductile Iron gravity pipe shall extend to the pipe springline.

C. Bedding for Ductile Iron pressure pipe shall be suitable material.

D. Bedding for storm sewers and culverts shall be in accordance with VDOT Road and Bridge Specifications, and Standards.

3.05 FILLING, BACKFILLING, AND COMPACTING

A. GENERAL

1. Suitable material (as described in Part 2 Products) shall be used for fill, backfill and subgrade preparation. Frozen material shall not be used as fill or backfill. Any additional material necessary for establishing the indicated grades shall be furnished by the Contractor and approved by the Engineer as part of this contract. The maximum particle size shall be three inches largest dimension, except in the uppermost lift, where the maximum particle size shall be two inches largest dimension. Fill material shall be placed in successive horizontal layers not to exceed one (1) foot of loose material, and then thoroughly compacted as hereinafter specified.

2. Fill or backfill adjacent to foundation and retaining walls shall be placed in nine (9) inch horizontal layers, each layer being moistened or dried and compacted as hereinafter specified. Special care shall be taken to prevent wedging action as the backfill proceeds.

3. Embankment slopes shall be constructed by filling one (1) foot beyond the proposed finished slope surface for each lift. Compaction equipment shall work to the edge of each lift. After the entire fill is placed and compacted, the outside foot of the slope shall be trimmed to the design slope with a dozer. No slopes shall be steeper than 2 horizontal to 1.

B. OFF-SITE MATERIAL

1. Where off-site material is required to provide an adequate suitable material for fill, this material shall be approved by the Engineer prior to use. Off-
site material shall be free of large roots, stumps, debris, and all other deleterious materials which may affect the integrity of any fills. In addition, off-site borrow material shall meet the following requirements:

a. Maximum % finer than a No. 200 sieve: .......................... 50%
b. Maximum Liquid Limit: .................................................. 80
c. Maximum Plastic Limit: .................................................. 50
d. Minimum Plasticity Index ................................................. 5

2. Provision, hauling, and placement of off-site materials shall be performed at no additional cost to the Owner.

C. COMPACTION– STRUCTURES AND ROADWAYS

1. Compaction shall be performed by approved compaction equipment adjacent to or underlying the structures. The compaction in grassed areas shall be 90 percent of the maximum density as determined by ASTM D698 (Standard Proctor). The compaction under the building, adjacent to foundation walls, and within ten (10) feet of structures, under walks and under pavement shall be 95 percent of maximum density as determined by ASTM D698 (Standard Proctor). The materials shall be aerated or moistened, as required to provide a moisture content that falls within three (3) percentage points of either side of optimum, unless otherwise approved by the Engineer.

D. UTILITY BACKFILLING, COMPACTION

1. Initial Backfill: Initial backfill shall begin at the top of the bedding and shall be placed in six (6) inch layers up to a level at least one (1) foot above the crown of the pipe. Initial backfill shall be compacted to a minimum 95 percent of the maximum density as determined by ASTM D698 (Standard Proctor). No lumps greater than one (1) inch in diameter shall be allowed in initial backfill material. Backfill under roadways, driveways, and sidewalks shall be aggregate backfill material, unless otherwise required by VDOT. Each layer shall be thoroughly tamped and compacted by approved equipment. Special care shall be taken in using a mechanical tamper directly over the pipe.

2. Final Backfill: Backfill for trenches not subjected to vehicular traffic shall be placed in layers no greater than one (1) foot thick and compacted to at least 90 percent maximum density as determined by ASTM D698 (Standard Proctor). No lumps greater than five (5) inches in diameter shall be allowed in final backfill material. Each layer shall be moistened or dried as necessary to provide a moisture content that falls within three (3) percentage points of either side of optimum moisture unless otherwise approved in writing by the Engineer. Backfill compaction shall be accomplished by use of equipment designed and suitable for the materials being compacted and their specific location or situation. Compaction by “puddling”, either natural or man-induced, shall not be allowed. Topsoil
(in grassed areas) shall be deposited in the final layer of backfill to guarantee the areas will be returned to original or better conditions. Final backfill in grassed areas shall be mounded three (3) inches above surrounding ground to allow for settlement.

3. Final Backfill Under Roadways, Driveways, and Sidewalks: Where excavation has been made through pavement, subgrades of roadways under construction, curbs, driveways, sidewalks, or where structures are undercut by excavation, the backfilling is to be made of the approved aggregate backfill material, or as otherwise specified, in layers not greater than six (6) inches thick, with each layer thoroughly compacted to subgrade. Backfill shall be deposited for the full width of the trench and compacted to 95 percent of the maximum density as determined by ASTM D698 (Standard Proctor). Work within VDOT rights-of-way shall meet all requirements of the VDOT. The trench in paved areas shall be maintained daily, as required, to provide a smooth crossing for vehicles until such time as the final pavement is placed.

E. PLACING OF TOPSOIL

Immediately before placing the topsoil, the areas on which it is to be placed shall be deeply and thoroughly raked so as to disturb the surface and provide means for bonding of the topsoil. Spread topsoil over the prescribed area in a uniform layer yielding a settled thickness of four (4) inches.

3.06 PIPE OR STRUCTURES TO BE ABANDONED OR REMOVED

A. Pipe indicated on the plans to be abandoned shall be plugged, capped or sealed with concrete.

B. Pipe indicated on the plans to be removed shall be completely removed then backfilled with general fill material and compacted, in accordance with related backfill work specified elsewhere. Removed pipe not required for the completion of the work shall be taken from the site and disposed of by the Contractor at his expense.

C. Structures indicated on the plans to be abandoned shall be cut off or removed to a minimum depth of 24 inches below finished grade then backfilled with suitable material and thoroughly compacted, in accordance with related backfill work specified elsewhere. Existing frames and covers shall be returned to the respective owner if not reused on this project.

D. Structures indicated on the plans to be removed shall be demolished and completely removed, then backfilled with suitable material and thoroughly compacted, in accordance with related backfill work specified elsewhere. Existing frames and covers shall be returned to the respective owner, if not reused on this project.

3.07 RESTORATION
A. GENERAL

Physical conditions disturbed by the Work shall be restored to conditions equal to or better than those existing prior to the Work. Repair of damages to structures and utilities shall be the responsibility of the Contractor. Restoration includes, but is not limited to, fine grading, seeding, pavement replacement, concrete replacement, and drainage structures. Contractor shall install no more than 1000 linear feet of pipe before completing backfill and restoration of previously laid pipe. In no case shall restoration be delayed more than seven (7) days after laying pipe.

B. LANDSCAPE

Grass plots, sod, shrubbery, ornamental trees, signs, or fences and mail boxes shall be restored to the conditions equal or better than those existing prior to making the excavation. All disturbed areas not covered by pavement or structure and all areas disturbed by the construction activity shall be fertilized, limed, seeded with the type of seed that produces a stand of grass similar to the existing and mulched.

C. PAVEMENT REPLACEMENT

Existing pavement which has been cut, damaged, or removed during construction shall be replaced in accordance with the VDOT Road and Bridge Specifications.

D. SIDEWALK, CURB, AND GUTTER REPLACEMENT

All damaged brick, concrete or built-up asphalt sidewalk or curb and gutter shall be replaced of like material in a manner and condition equal to or better than that existing at the time of removal or damage. Materials and method of replacing State Highway sidewalks or curbs shall conform to VDOT specifications.

E. DRAINAGE STRUCTURES

Ditches, culverts, and other drainage structures which are damaged shall be restored promptly. All drainage structures shall be kept open and functional at all times.

3.08 FINISH GRADING AND CLEAN-UP

A. Finish grading shall be done as required to establish the slopes indicated. The grades shall be formed to easy contours sloping toward inlets and ditches. The grading shall eliminate low spots and pockets that do not drain. Ditches shall be excavated to the sections and elevations shown and shall be excavated on smooth slopes to avoid low spots and pockets that do not drain.

B. The surface of all excavations and fill and all disturbed areas shall be finished to a smooth surface, with the grades sloping away from the buildings. Swales and ditches shall be finished so that effective drainage results. Proper allowance shall be made for topsoil and for pavement thickness. Any settling or washing prior to
acceptance of the work shall be repaired at no additional expense to the Owner. Topsoil and seeding of all disturbed areas shall be performed in accordance with Section 02920.

C. All lumber, earth clods or rocks larger than four inches and other undesirable materials shall be removed from the site at the completion of construction. If in a tended lawn or crop area, all stones or material which are unsightly or which could damage moving or other equipment, shall be removed. Clean up shall be performed as promptly as practicable and/or at least once a week. Ditches which are disturbed shall be restored as promptly as practical and/or at least once a week. Establish and maintain sediment and erosion control measures as stipulated in Section 02370.

3.09 MAINTENANCE OF UTILITY TRENCHES

A. The Contractor shall maintain the surface over the trench or excavation for a period of one (1) year after final completion and acceptance of the work, both in public right of way and private property, and shall fill in any settled areas with suitable fill and reseed or with pavement as the location warrants.

END OF SECTION
SECTION 02370
EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED
All measures required to control erosion and sediment on the project site and on areas beyond the project limits, affected by the project.

1.02 REFERENCES

PART 2 PRODUCTS

2.01 MATERIALS
Materials shall be in accordance with the Virginia Erosion and Sediment Control Handbook, local ordinances, and Virginia Department of Transportation Standards where indicated.

PART 3 EXECUTION

3.01 GENERAL
A. The erosion and sediment control measures shall protect adjacent properties, shall be in accordance with the Virginia Erosion and Sediment Control Handbook and local ordinances, and shall be approved by the Engineer. All measures shall be sized and designed in accordance with the criteria specified in the handbook. All erosion control measures shall be placed prior to commencement of grading.

B. Temporary measures shall be applied throughout the construction of the project to control erosion and to minimize siltation of drainage ditches, storm drains and waterways. The Contractor, as a minimum, shall employ all erosion control measures indicated on the drawings and specified herein.

C. Limit grading to areas of workable size so as to limit the duration of exposure of disturbed and unprotected area. All appropriate conservation practices should be applied in sequence of work. Disturbed areas that are to be left unfinished for more than 30 days shall be seeded temporarily.

D. Protect stockpiling material with mulch, temporary vegetation, or sediment barrier at base. Slopes of stockpiled material shall not exceed 2 to 1.
E. Stabilize all streets and parking areas, within 15 days of final grading, with base coarse-crushed stone.

F. Allow no water to enter the storm drainage system prior to settlement or screening of excess siltation.

G. No more than 200 feet of trench shall be open at any one time.

H. Synthetic filter fabric fencing shall be used for sediment control when land disturbing activities are within 25 feet of a live creek or stream.

I. No excavated material shall be placed in stream beds.

3.02 MAINTENANCE
Inspection of all control measures following each storm event, and at least weekly, to ensure maximum effectiveness. Clean as required. Repair any damage or deteriorated condition immediately.

3.03 REMOVAL
Remove all temporary control measures at the completion of the work and restore site as required by the Division.

3.04 FAILURE TO EXECUTE
In the event the Contractor repeatedly fails to satisfactorily control erosion and siltation, the Owner reserves the right to employ outside assistance or to use his own forces to provide the erosion control measures indicated and specified.

END OF SECTION
SECTION 02400
BORING, AND JACKING

PART 1  GENERAL

1.01 WORK INCLUDED
   A. Installation of pipelines using horizontal earth boring and pipe jacking.

1.02 RELATED SECTIONS
   A. Section 01410; Regulatory Requirements
   B. Section 02300; Earthwork

1.03 REGULATIONS AND PERMITS
   A. Comply with all codes, laws, ordinances, regulations, and permits of governmental and other authorities having jurisdiction over this part of the work.

1.04 REFERENCES
   A. Virginia Department of Transportation (VDOT) Road and Bridge Specifications, latest edition.

1.05 PRECAUTIONS
   A. The Contractor shall take every precaution to guard against any movement or settlement of existing or new construction, railways, utilities, paving, walks, light standards, piping, conduit, etc., and shall provide at his own expense, all sheet piling, bracing or shoring necessary in connection therewith. The Contractor shall be entirely responsible for the design, and adequacy of any sheet piling, bracing and shoring required.

   B. For all boring and jacking work performed within railway right-of-way, Contractor shall reference individual railway’s requirements.

1.06 SUBMITTALS
   A. Product data for steel casing pipe, including evidence that pipe complies with the Specifications.

PART 2  PRODUCTS

2.01 STEEL CASING PIPE
   Steel casing pipe shall conform to ASTM A139, Grade B (No Hydro) with a minimum yield strength of 35,000 psi. All joints shall be butt welded, watertight in accordance with the American Welding Society’s recommended procedures. Casing pipe diameter
and wall thickness shall be as indicated on the Drawings. No protective coating or lining is required.

2.02 CASING SPACERS

A. Casing spacers shall be installed between the carrier pipe and casing pipe. Casing spacers shall be Model No. C8G-2 as manufactured by PSI, Inc. or approved equal. The spacers shall be sized to fasten securely onto the carrier pipe barrel O.D. and specified with a minimum runner height to keep the pipe from resting or sliding on its joint during installation. Unless otherwise noted, carrier pipe shall be centered and restrained in the casing pipe.

B. Casing spacers shall be bolt on style with a shell made in two sections of 14 gauge (0.074") mild steel or 304 stainless steel. Connecting flanges shall be ribbed for extra strength. The shell shall be lined with a PVC liner 0.090" thick with 85-90 Durometer or neoprene rubber. All nuts and bolts are to be 18-8 stainless steel. Runners shall be made of ultra high molecular weight polymer (UHMW) or glass reinforced plaster. Runners shall be supported by risers made of heavy 304 stainless steel or 10 gauge welded steel. The supports shall be meg welded to the shell and all welds shall be passivated or 3/8" diameter stud welded to band and locked with a locking fastener. The height of the supports and runners combined shall be sufficient to keep the carrier pipe at least 0.75" from the casing pipe wall at all times.

PART 3 EXECUTION

3.01 ROAD CROSSING

A. Pipeline crossing shall be installed in a steel casing installed by the “dry case as you go” boring and jacking method. The pipeline crossing shall be installed as shown on the Drawings.

B. If the Contractor determines that boring and jacking of the highway crossing is not possible due to rock, the Contractor shall make application to VDOT to allow open cutting of the crossing. Contractor shall make every effort to bore and jack before abandoning this method, including use of a rock head. If the trench is allowed to be open cut, casing pipe shall be provided and the trench shall be backfilled entirely to the bottom of the pavement base course and the pavement restored in accordance with VDOT requirements.

C. 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 bracing, bulkheads, and shields to ensure complete safety to all traffic at all times. The Contractor shall arrange for and pay for all flagmen, signs and other measures required by VDOT.

3.02 RAILROAD CROSSING
A. For all boring and jacking work performed within railway right-of-way, Contractor shall reference individual railway’s specifications and requirements.

3.03 DRY JACKED BORING

A. The jacking operation shall be performed in such a manner that settlement of the ground, railway, or the highway above the pipeline will not occur. The use of water or other fluids in connection with the boring and jacking operation shall not be allowed. Excavation shall not precede the jacking operation more than is necessary. Lengths of steel pipe shall be welded to the preceding length installed. Excavation shall be made by auger or manual methods at the Contractor’s option to suit conditions encountered. The Contractor shall repair or replace, as directed by the Engineer, at his own expense, casing pipe which is damaged during the jacking operation.

B. Casing excavation shall not be more than one (1) inch greater than the casing pipe’s outside diameter. Should casing excavation become more than one (1) inch larger than the outside diameter of the casing pipe, the void area shall be pressure grouted at the Contractor’s expense.

3.04 REQUIRED ACCURACY

A. Bores for water line or force main installations shall not be off line more than one (1) percent of the total length, not to exceed two (2) feet or off grade more than one (1) percent of the total length, not to exceed 0.5 feet.

B. Bores for sanitary sewer installations shall not be off line more than one (1) percent of the total length, not to exceed one (1) foot or off grade more than one (1) percent of the total length, not to exceed 0.25 feet.

3.05 CARRIER PIPE INSTALLATION

A. After installation of the casing pipe, the carrier pipe shall be installed. The carrier pipe shall be secured to casing spacers as shown on the plans and inserted in the casing pipe. Casing spacers shall be installed in accordance with the manufacturer’s instructions. Spacers shall be installed within one foot on each side of the bell and in the center of pipe sections.

B. The ends of the casing pipe shall be closed off by wraparound end seals or by concrete or masonry block wall prior to backfilling. Where concrete or masonry block is used, the carrier pipe shall be wrapped with tar paper at the masonry plug.

C. Carrier pipe joints for water lines and sewage force mains shall be restrained a minimum of one (1) joint outside each end of the casing pipe.

END OF SECTION
SECTION 02510
WATER DISTRIBUTION SYSTEMS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED
   A. Provide personnel, materials, equipment and supplies to install the water system as shown on the Drawings, including all piping, fittings, valves, and related appurtenances.
   B. Provide all personnel, materials, and equipment necessary to perform pressure testing and leakage testing of newly laid water lines.
   C. Provide certificates that all lines meet pressure and leakage requirements.

1.02 RELATED REQUIREMENTS
   A. Section 02300; Earthwork
   B. Section 02512; Valves and Specialties
   C. Section 02514; Disinfection of Water Distribution
   D. Section 02520; Pipe and Pipe Fittings

1.03 QUALITY ASSURANCE
   Comply with all applicable codes and regulations as required by regulatory agencies having jurisdiction over this Work. Comply with the pertinent sections of the American Water Works Association (AWWA) Standards.

1.04 SUBMITTALS
   A. Shop drawings and product data for pipe and appurtenances.
   B. Submit test logs with location of lines, date tested, length of line tested, pressure at beginning of test, pressure at end of test, time period, amount of leakage allowable, amount of leakage, signature of person responsible for test and any other pertinent data with Quality Control Report.

PART 2 PRODUCTS

Materials, equipment, and water source shall be suitable for the purpose of pressure and leakage testing.
PART 3    EXECUTION

3.01  GENERAL

Water lines shall be laid to lines and grades shown on the drawings with appurtenances and service connections at required locations. Installation of all materials shall be in strict conformance with manufacturer's recommendations.

3.02  CLEARANCE

A. Where water mains are near sewers, the water main shall be laid at least 10 feet, horizontally, from any existing or proposed sewer line. Should local conditions prevent a lateral separation of 10 feet, a water main may be laid closer than 10 feet to a storm or sanitary sewer, provided that the main is laid in a separate trench at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer.

B. Whenever water mains must cross over a sewer, the water main shall be laid at such an elevation that the bottom of the water main is 18 inches above the top of the sewer.

C. Where a water main must cross under a sewer, a vertical separation of 18 inches between the bottom of the sewer and the top of the water main shall be maintained, with adequate support for the larger sized sewer lines to prevent them from settling on and breaking the water main. This vertical separation should be maintained for that portion of the water main located within 10 feet horizontally of any sewer it crosses, said 10 feet to be measured as the normal distance from the water main to the sewer. In making such a crossing, it is preferable to center a length of water main pipe under the sewer to be crossed, so that the joints will be equidistant from the sewer and as remote therefrom as possible.

D. Where it is impossible to obtain proper horizontal and/or vertical separation as stipulated above, the sewer shall be constructed of AWWA approved water pipe, and pressure tested to a minimum of 30 psi in place without leakage prior to backfilling. County engineer shall approve the construction method to be followed when the required 10 feet horizontal and/or 18 inch vertical separation between water and sewer pipes is not possible.

E. No water pipe shall pass through, or come into contact with any part of a sewer manhole. Water mains shall be installed so as to have a minimum earth cover of 36 inches, except where otherwise shown or specified.

3.03  LOCATING EXISTING UTILITIES

A. The location of existing utilities, including underground utilities, is indicated on the drawings insofar as their existence and location were known at the time of preparation of the drawings. However, nothing in these Contract Documents shall be construed as a guarantee that such utilities are in the location indicated or that they actually exist, or that other utilities are not within the area of operations. The Contractor shall make all necessary investigations to determine the existence and
locations of such utilities far enough in advance of pipelaying to allow for adjustments due to conflicts in the horizontal and vertical location of the pipe line.

B. The Contractor may obtain field utility locations by calling "Miss Utility" (1-800-552-7001). Utility owners are given forty-eight (48) hours from 7 am the day following placement of the call to mark utilities. If a utility has not responded, a late notice is issued and Miss Utility shall be called to notify of the situation. Said utility has 3 hours to respond following the second call prior to commencement of work on site.

C. Based on the location and the elevation of the existing utilities, the horizontal and vertical alignment of the new pipe shall be adjusted to avoid sharp changes in direction or localized high points.

D. The Contractor shall pay for any damage to and for maintenance and protection of existing utilities and structures.

3.04 CONNECTIONS TO EXISTING SYSTEM

A. Before the start of the construction, the Contractor shall dig test pits at all crossings of and as proposed connections to the existing system, as applicable, to determine the existing system location, size, and piping material. If the location, size, and piping material differs from that shown on the Drawings, the contractor shall notify Engineer immediately.

B. The Contractor shall make connections to the existing system under a pressure or non-pressure condition, as indicated, complying with the system owner’s requirements for the time of day such work can be done. The Contractor shall pay all costs associated with the connections unless otherwise indicated. If the system owner performs the work, the Contractor shall arrange for the work to be done.

3.05 PIPE INSTALLATION

A. All potable water pipe shall be buried with a minimum of 3 feet of cover.

B. Proper implements, tools, and facilities shall be provided and used for the safe and convenient performance of the work. All pipes, fittings, valves, and hydrants shall be lowered carefully into the trench by means of a derrick, ropes, or other suitable tools or equipment, in such a manner as to prevent damage to water main materials and protective coatings and linings. Under no circumstances shall water main materials be dropped or dumped into the trench. The trench should be dewatered prior to installation of the pipe. Installation of the pipe shall be in accordance with AWWA C600.

C. All pipes, fittings, valves, hydrants and other appurtenances shall be examined carefully for damage and other defects immediately before installation. Defective materials shall be marked and held for inspection by the Owner, who may prescribe corrective repairs or reject materials.

D. All lumps, blisters, and excess coating shall be removed from the socket and plain ends of each pipe, and the outside of the plain end and the inside of the bell shall
be wiped clean and dry and be free from dirt, sand, grit, or any other foreign material before the pipe is laid.

E. Foreign material shall be prevented from entering the pipe while it is being placed in the trench. During laying operations, no debris, tools, clothing, or other materials shall be placed in the pipe.

F. Laying of the pipe shall commence immediately after the excavation is started, and every means must be used to keep pipe lying closely behind the trenching. The Engineer may stop the trenching when, in his opinion, the trench is open too far in advance of the pipe laying operation. Pipe may be laid in the best manner adapted to securing speed and good results. It shall, however, be in accordance with the manufacturer’s instructions and recommendations. As each length of pipe is placed in the trench, the joint shall be assembled and the pipe brought to correct line and grade. Before joints are made the pipe shall be well bedded on a firm foundation and no pipe shall be brought into position until the preceding length has been thoroughly embedded and secured in place. Any defects due to settlement shall be rectified by the Contractor at his expense. Bell holes shall be dug sufficiently large to insure the making of proper joints.

G. Plastic encased aluminum foil tape shall be installed above all non-metallic pipe such that pipe can be located in the future with a metal locating device. Tape shall be color coded and permanently imprinted with identification message. Tape shall be LINEGUARD Detectable Underground Marking Tape, or equal.

H. At times when pipe laying is not in progress, the open ends of the pipe shall be closed by a water tight plug or other means approved by the Engineer. This provision shall apply during breaks as well as overnight. If water is in the trench, the plug shall remain in place until the trench is pumped completely dry. Care must be taken to prevent pipe flotation should the trench fill with water.

I. Specified laying conditions for water main shall be completed in strict accordance with the water main manufacturer's recommendations.

J. When it is necessary to deflect pipe from a straight line in either the vertical or horizontal plane, the amount of deflection shall not exceed 2/3 of the deflection limits recommended by the manufacturer. The trench may be curved to change direction or to avoid obstructions within the limits of the curvature of the pipe as recommended by the pipe manufacturer. Required curvature shall be maintained using full joints and/or fittings. Short sections of pipe shall not be used without approval of Engineer.

K. Cutting pipe for insertion of valves, fittings, or closure pieces shall be done in a neat, workmanlike manner without creating damage to the pipe or lining. Pipe shall be cut so as to leave a smooth end at right angles to axis of the pipe.

3.06 VALVE AND FITTING INSTALLATION

A. Valve and fitting installation shall be in accordance with AWWA C600.
B. Prior to installation, valves shall be inspected for direction of opening, freedom of operation, tightness of pressure-containing bolting, cleanliness of valve ports and, especially, seating surfaces, handling damage, and cracks. Defective valves shall be corrected or replaced at manufacturers/contractors expense.

C. Valves shall be located where shown on the Drawings and shall be supported so that no load transfers to the pipe. Valves, fittings, plugs, and caps shall be set and joined to the pipe in the manner specified in Part 3.05.

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

E. All dead ends on new mains shall be closed with plugs or caps that are suitably restrained to prevent blowing off under test pressure.

3.07 HYDRANT INSTALLATION

A. Hydrant location, position, and drainage shall be in accordance with AWWA Standard C600.

B. Prior to installation, inspect all hydrants for direction of opening, nozzle threading, operating-nut and cap-nut dimensions, tightness of pressure-containing bolting, cleanliness of inlet elbow, handling damage, and cracks. Defective hydrants shall be corrected or replaced at manufacturers/contractors expense.

C. All hydrants shall stand plumb and shall have their nozzles parallel with or at right angles to the curb or street line, with the pumper nozzle facing the curb or street. Centerline of lowest nozzle shall be at least 18 inches above the ground. The hydrant shall be supported so that no load transfers to the pipe. Each hydrant shall be connected to the main with a 6-inch branch controlled by an independent 6-inch valve. If hydrant drain will be below groundwater, drain shall be plugged and Owner notified so hydrant can be marked for manual dewatering.

D. Fire hydrant extensions shall be provided, where required, at no additional cost to the Owner.

3.08 THRUST RESTRAINT

A. All tees, bends, plugs and abrupt changes in direction of the water piping shall be provided with thrust blocks, except hydrants. Hydrants and their isolation gate valves shall be harnessed to the main water pipe with assemblies, not thrust blocks.

B. Hydrants and their related valves shall be harnessed to the main pipe as shown on the Drawings. Hydrants shall be harnessed such that hydrant can be removed while leaving the isolation valve still harnessed to the main pipe. Tie rods, clamps, or other components of dissimilar metal shall be protected against corrosion by hand application of a bituminous coating or by encasement of the entire assembly with 8-mil thick, loose polyethylene film in accordance with AWWA C105.
C. Thrust blocking shall be in accordance with the standard detail, bearing on undisturbed earth. Thrust blocking shall be made of concrete having a compressive strength of not less than 3000 psi after 28 days. The system shall not be pressure tested for 14 days after the thrust blocks are poured.

3.09 HYDROSTATIC TESTING

A. Hydrostatic testing shall be performed in accordance with AWWA C600, Section 4. Testing shall be performed in the presence of the Owner’s Representative.

B. Water mains to be tested with taps and service laterals installed.

C. After placing the pipe, all thrust restraint, and valve support, and before placement of permanent surface, all newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure of at least 1.5x the working pressure at the point of testing or 150 psi (whichever is greater). Allow seven days after thrust restraint blocks have been poured before testing. Hydrostatic test shall be made between all valved sections of waterline so that test pressure is applied to one side of each valve in the system at a minimum.

D. Test Pressure Restrictions

Test pressures shall:

1. Not be less than 1.25 times the working pressure at the highest point along the test section.

2. Not exceed pipe or thrust restraint design pressures.

3. Be of at least 2-hour duration.

4. Not vary by more than ±5 psi for the duration of the test.

5. Not exceed twice the rated pressure of the valves or hydrants when the pressure boundary of the test section includes closed gate valves or hydrants.

6. Not exceed the rated pressure of the valves when the pressure boundary of the test section includes closed resilient-seated gate valves or butterfly valves.

7. Contractor shall assure that water from new piping does not enter existing system prior to approved bacteriological test.

E. Pressurization

Each valved section of pipe shall be filled with water slowly and the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Owner's Representative.

F. Air Removal
Before applying the specified test pressure, air shall be expelled completely from the pipe, valves and hydrants. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall remain closed and left in place.

G. Examination

All exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings, valves, or hydrants that are discovered following the pressure test shall be repaired or replaced with sound material and the test shall be repeated until it is satisfactory.

3.10 LEAKAGE TESTING

A leakage test shall be conducted concurrently with the pressure test.

A. Leakage defined

Leakage shall be defined as the quantity of water in gallons per hour that must be supplied into the newly laid pipe, or any valved section thereof, to maintain pressure within 5 psi of the specified test pressure after the air in the pipeline has been expelled and the pipe has been filled with water. Leakage shall not be measured by a drop in pressure in a test section over a period of time.

B. Allowable leakage

No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

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

in which \( L \) is the allowable leakage, in gallons per hour; \( S \) is the length of pipeline tested, in feet; \( D \) is the nominal diameter of the pipe, in inches; and \( P \) is the average test pressure during the leakage test, in pounds per square inch gauge.

1. Allowable leakage shall not exceed the amount given by the leakage formula found in the most current AWWA Standard C-600.

2. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gallons/hour/inch of nominal valve size shall be allowed.

C. Acceptance of Installation

Acceptance shall be determined on the basis of allowable leakage. If any test of pipe laid discloses leakage greater than that specified above, the Contractor shall, at his own expense, locate and make repairs as necessary until the leakage is
within the specified allowance. All visible leaks are to be repaired regardless of the amount of leakage.

3.11 DISINFECTION
All piping, fittings, valves, and related appurtenances shall be disinfected in accordance with Section 02514.

3.12 COORDINATION
All work in this section shall be coordinated with the plumbing and mechanical work so that the connections and minor adjustments can be made.

END OF SECTION
SECTION 02514
DISINFECTION OF WATER DISTRIBUTION SYSTEMS

PART 1  GENERAL

1.01  REQUIREMENTS INCLUDED

All new water mains shall be disinfected before they are placed in service. All existing water mains which are cut into or repaired shall be disinfected before they are returned to service. Disinfection of water mains shall be performed in accordance with AWWA C651, and the requirements of the Virginia Department of Health.

1.02  SUBMITTALS

A. Method of disinfection to be utilized, for approval.

B. Two copies of the bacteriological test results.

PART 2  PRODUCTS

2.01  FORMS OF CHLORINE FOR DISINFECTION

The following forms of chlorine may be used in the disinfection operations after approval by the Engineer:

A. Liquid Chlorine

Liquid chlorine shall be used only:

1. In combination with appropriate gas-flow chlorinators and ejectors to provide a controlled high concentration solution feed to the water to be chlorinated.

2. Under the direct supervision of a person who is familiar with the biological, chemical and physical properties of liquid chlorine, and who is trained and equipped to handle any emergency that may arise.

3. When appropriate safety practices are observed to protect working personnel and the public.

B. Sodium Hypochlorite

Care must be used in control of conditions and length of storage to minimize its deterioration.

C. Calcium Hypochlorite

The material shall be stored in a cool, dry, and dark environment to minimize its deterioration.
PART 3 EXECUTION

3.01 PREVENTIVE MEASURES

Precautions shall be taken to prevent contaminating materials from entering the water main during storage, installation, or repair.

3.02 PRELIMINARY FLUSHING

Prior to disinfection all water mains shall be flushed unless the tablet method of disinfection is used. All valves and hydrants shall be operated during this operation. Flushing velocities should not be less than 2.5 feet per second (fps). Table 1 shows the rates of flow required to produce a velocity of 2.5 fps in pipes of various sizes.

<table>
<thead>
<tr>
<th>Pipe Diam. (in)</th>
<th>Flow Required to Produce 2.5 fps Velocity in Main (gpm)</th>
<th>Size of Tap (in.)</th>
<th>Number of 2 1/2-in. Hydrant Outlets</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>100</td>
<td>1 1 1/2 2</td>
<td>Number of Taps on Pipe* Number</td>
</tr>
<tr>
<td>6</td>
<td>200</td>
<td>- 1 - 1</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>400</td>
<td>- 2 1 1</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>600</td>
<td>- 3 2</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>900</td>
<td>- - 2</td>
<td>2</td>
</tr>
<tr>
<td>16</td>
<td>1600</td>
<td>- - 4</td>
<td>2</td>
</tr>
</tbody>
</table>

* Number of taps on pipe based on discharge through 5 ft. of galvanized iron pipe with one 90° elbow.

3.03 METHODS OF CHLORINE APPLICATION

Three methods of chlorination are given. The Engineer shall approve the particular method to be used.

A. Continuous Feed Method

Potable water shall be introduced into the pipe line at a constant flow rate at a point not more than 10 ft. downstream from the beginning of the new main. Chlorine shall be added at a constant rate to this flow so that the chlorine concentration in the water in the pipe is at least 25 milligrams per liter (mg/L). The chlorinated water shall remain in the pipe line at least 24 hours, after which, the chlorine concentration in the water shall be at least 10 mg/L. All valves and
appurtenances shall be operated while the chlorinated water remains in the pipe line. Table 2 gives the amount of chlorine required for each 100 feet of pipe of various diameters. Solutions of one percent chlorine may be prepared by adding one pound of calcium hypochlorite to eight gallons of water.

**TABLE 2**

**CHLORINE REQUIRED TO PRODUCE 25 mg/L CONCENTRATION IN 100 FT. OF PIPE - BY DIAMETER**

<table>
<thead>
<tr>
<th>Pipe Diameter (in.)</th>
<th>100 Percent Chlorine (lb.)</th>
<th>1 Percent Chlorine Solutions (gal.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>0.013</td>
<td>0.16</td>
</tr>
<tr>
<td>6</td>
<td>0.030</td>
<td>0.36</td>
</tr>
<tr>
<td>8</td>
<td>0.054</td>
<td>0.65</td>
</tr>
<tr>
<td>10</td>
<td>0.085</td>
<td>1.02</td>
</tr>
<tr>
<td>12</td>
<td>0.12</td>
<td>1.44</td>
</tr>
<tr>
<td>16</td>
<td>0.217</td>
<td>2.60</td>
</tr>
</tbody>
</table>

B. Slug Method

Potable water shall be introduced into the pipe line at a constant flow rate at a point not more than 10 ft. downstream from the beginning of the new main. This water shall receive a chlorine dosage which will result in a chlorine concentration of 100 mg/L in a "slug" of the water. The chlorine shall be added long enough to insure that all portions of the pipe are exposed to the 100 mg/L chlorine solution for at least 3 hours. The chlorine residual shall be checked at regular intervals not to exceed 2000 feet to insure that adequate residual is maintained. As the chlorinated water passes valves and appurtenances, they shall be operated to insure disinfection of these appurtenances. The amount of chlorine required for each 100 feet of pipe line may be obtained by quadrupling the amounts shown in Table 2.

3.04 INTRODUCTION OF POTABLE WATER

If potable water from an existing water main is introduced into a proposed water main to be disinfected the Contractor shall tightly close the gate valve separating the proposed main from the existing main immediately after introduction of water, so that the heavily chlorinated water can not enter the existing system.

3.05 FINAL FLUSHING

A. Clearing the Main of Heavily Chlorinated Water

After the applicable retention period, the heavily chlorinated water shall be
flushed from the main until chlorine measurements show that the concentration in the water leaving the main is no higher than that generally prevailing in the system or is acceptable for domestic use.

B. Disposing of Heavily Chlorinated Water

The environment to which the chlorinated water is to be discharged shall be inspected and if there is any question that the chlorinated discharge will cause damage to the environment, then a reducing agent shall be applied to the water to be wasted to neutralize thoroughly the chlorine residual remaining in the water. Where necessary, federal, state, and local regulatory agencies should be contacted to determine special provisions for the disposal of heavily chlorinated water.

3.06 BACTERIOLOGICAL TESTS

After the mains have been flushed, water samples shall be collected at regular intervals, not exceeding 1200 feet throughout the length of the pipe line. Samples shall include one set from the end of the line and at least one set from each branch. No fire hydrant or hose shall be used in the collection of samples. Taking samples from blow-offs is acceptable. The Contractor shall install sample taps if required. Two water samples for bacteriological analysis must be collected 24 hours apart and analyzed by a certified laboratory. The results of these samples must indicate no coliform contamination before water mains are to be placed in service.

3.07 REDISINFECTION

If contamination is indicated by the bacteriological tests, the main shall be rechlorinated by the continuous-feed or slug method and resampled until satisfactory results are obtained.

END OF SECTION
SECTION 02518
PRECAST CONCRETE STRUCTURES FOR WATER DISTRIBUTION

PART 1    GENERAL

1.01 WORK INCLUDED
   A. Furnish all labor, materials, equipment, and services required to construct and install precast concrete structures, related items and accessories as indicated on the Drawings.

1.02 RELATED REQUIREMENTS
   A. Section 02300; Earthwork
   B. Section 02520; Pipe and Pipe Fittings

1.03 SUBMITTALS
   A. The Contractor shall submit shop drawings showing all dimensions, reinforcement, opening details, inserts, and other details necessary for the fabrication and installation of all precast concrete structures and items.
   B. The manufacturer shall prepare design analysis and calculations indicating that allowable stresses will not be exceeded during any and all phases of manufacture, shipping and handling, and installation. This analysis must also include calculations to verify that all units have been designed to withstand all loadings at the burial depths indicated on the plans. This analysis shall be sealed by a professional engineer licensed in the Commonwealth of Virginia and shall be submitted with the shop drawings.

1.04 QUALITY ASSURANCE
   A. The materials and methods of construction for precast concrete shall comply with the latest revisions of the applicable ASTM and VDOT standards. Precast structures shall conform to the details on the Drawings and herein.
   B. At the request of the Engineer, the manufacturer shall submit test reports indicating the concrete 28-day compression strength results for every day production of material was performed for this work.

1.05 REFERENCES
   A. Virginia Department of Transportation (VDOT) - Road and Bridge Specifications and Standard Details - Latest Revisions
   B. American Society for Testing Materials (ASTM):
      1. C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections
2. C890 - Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures
3. C891 - Standard Practice for Installation of Underground Precast Concrete Utility Structures
4. C913 - Standard Practice for Installation of Underground Precast Concrete Water and Wastewater Structures

C. American Concrete Institute (ACI):
   1. ACI 318 - Building Code Requirement for Reinforced Concrete
   2. ACI 318.1 - Building Code Requirement for Structural Plain Concrete

PART 2 PRODUCTS

2.01 PRESSURE REDUCING VALVE VAULTS
   A. Precast concrete structures shall be constructed of reinforced concrete with a minimum 28-day compressive strength of 5000 psi as determined by ASTM test procedures. All structures shall be fabricated of monolithic precast concrete sections of dense, watertight concrete, designed for the installation indicated on the drawings. Cement shall be Type II per ASTM C150. Aggregates shall meet the requirements of ASTM C33. Coarse aggregates shall be sound, crushed, angular granitic stone only. Honeycombed or retempered concrete will not be acceptable. Precast concrete structures shall be as manufactured by Permatile, or approved equal.
   B. Reinforcing shall be as required from design by ACI 318 and ASTM C913 for rectangular components and as specified in ASTM C478 for round components. Reinforcing shall meet the requirements of ASTM A615 and reinforcing bar shall be certified Grade 60.
   C. Joints between precast sections shall be sealed with a continuous, one inch minimum thick, flexible butyl resin sealant conforming to Federal specification number SS-S-00210-A and AASHTO-198. Material shall be ConSeal CS-202 manufactured by Concrete Sealants, Inc., or approved equal. Asphaltic or petrochemical based materials shall not be used.

2.02 AIR RELEASE VALVE VAULTS
   A. Units shall be precast reinforced concrete manufactured in accordance with ASTM C478 and VDOT Section 302, with O-ring joints conforming to ASTM C443 or with flexible butyl gasket, CS-302 by Concrete Sealants, Inc., E-Z Stik by Concrete Products Supply or approved equal.
   B. Each unit shall have no more than two (2) holes for installation and/or handling. All holes shall be plugged with mortar or rubber stoppers upon completion of manhole installation.
C. Top units shall be flat top as indicated on the Drawings.

D. Units shall be constructed to the required height to ensure that the top of the frame and cover will be set at the finished grade, unless specified or indicated otherwise. Maximum wall thickness shall be five (5) inches. Concrete shall be minimum compressive strength of 4000 psi at 28 days.

2.03 PIPE CONNECTIONS

A. Pipe connections to precast concrete structures shall be made utilizing rubber gaskets cast integrally in the structure at the time of manufacture. Rubber gaskets shall conform to ASTM C923 and shall meet the performance and test requirements of ASTM C425. Flexible connections shall be A-LOK Manhole Pipe Seal, manufactured by A-LOK Corp., or equal.

B. As an alternate, connections may be made utilizing field installed positive seal gasketing systems. Field installed connections shall be PRESS-BOOT, manufactured by Press Seal Gasket Corporation: KOR-N-SEAL, manufactured by NPC, or equal.

2.04 MANHOLE STEPS

A. Steps shall be steel encapsulated in corrosion resistant rubber or copolymer polypropylene plastic, as manufactured by Delta Pipe Products (WEDG-LOK), Model #PS1-PF as manufactured by M. A. Industries, or equal.

B. Steps shall be in accordance with the dimensions and capable of withstanding the loads specified in ASTM C478.

C. Steps shall be vertically aligned and uniformly spaced for the entire depth of the structure. Steps shall be vertically spaced 12 inches on center. Step width shall be 16 inches. Steps shall protrude from the wall of the structure a minimum of five (5) inches and a maximum of seven (7) inches and shall have a drop front and a grooved step surface.

2.05 GROUT

A. Aggregate shall be clean, washed natural sand, free from dirt and foreign material, in accordance with ASTM C144. Portland Cement shall be Type II, in accordance with ASTM C150. Water shall be clean and free from injurious amounts of oil, acid, alkali, organic, or other deleterious mater.

2.06 ACCESS LADDERS

A. Ladders shall be constructed entirely of aluminum. The rails shall be 3/8 inch X 2 1/2 inch flat bar and shall be spaced 16 inches apart. The wall mounted standoffs shall be 3/8 inch X 2-1/8 inch flat bar and welded to the rails at a maximum of 60 inches on center. The standoffs shall be a minimum of seven (7) inches and manufactured to fit flush with the wall. 1-3/8 inch diameter slip resistant ribbed rungs shall be spaced 12 inches on center and shall be welded to the inside of each rail. Ladders shall be L1B Series Ladder as manufactured by Halliday Products, Inc. of Orlando, Florida, or equal.
2.07 ACCESS FRAMES AND COVERS

A. Access frame and cover shall have a ¼ inch thick one-piece, mill finish, extruded aluminum frame, incorporating a continuous concrete anchor. A bituminous coating shall be applied to the frame exterior where it will come in contact with concrete. Door panel shall be ¼ inch aluminum diamond plate, reinforced to withstand a live load of 300 psf. Door shall open to 90° and automatically lock with stainless steel hold open arm with aluminum release handle. Door shall close flush with the frame and rest on a built-in neoprene cushion/gasket. Hinges and all fastening hardware shall be stainless steel. Unit shall lock with a stainless steel slam lock with removable key and have a non-corrosive handle. Unit shall be guaranteed against defects in material and/or workmanship for a period of 10 years.

B. Access frame and cover shall be as manufactured by Halliday Products, Inc. of Orlando, Florida, or equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Precast concrete structures shall be handled by lifting devices furnished by the manufacturer, under the supervision of factory trained personnel. The Contractor shall provide a suitable sized crane and qualified operator to set the precast structural sections.

B. The precast concrete structures shall be installed level and plumb by the Contractor on a crushed stone bed as indicated on the Drawings.

C. All items shall be installed in accordance with the manufacturer’s recommendations.

END OF SECTION
SECTION 02520
PIPE AND PIPE FITTINGS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED
Furnish all piping, fittings, and appurtenances as shown and as specified and required.

1.02 RELATED REQUIREMENTS
A. Section 02200 – Earthwork
B. Section 02510 – Water Distribution Systems
C. Section 02530 – Sanitary Sewer System
D. Section 02522 – Valves and Specialties

1.03 QUALITY ASSURANCE
Comply with all applicable codes and regulations as required by regulatory agencies having jurisdiction over this Work. Comply with the pertinent sections of the following Standards:
A. AWWA - American Water Works Association
B. ANSI - American National Standards Institute
C. ASTM - American Society of Testing and Materials
D. NSF - National Sanitation Foundation

1.04 SUBMITTALS
Shop drawings and product data for pipe and fittings, including detailed drawings on pipe, fittings, gaskets, and appurtenances, and evidence that pipe and fittings comply with Contract Specifications and Reference Standards.

PART 2 PRODUCTS

2.01 DUCTILE IRON PIPE
A. GENERAL: Ductile iron pipe shall be in accordance with AWWA C151/ANSI A21.51. Pipe thickness shall conform with AWWA C150/ANSI 21.50. All pipe shall conform to AWWA C104 (mortar lining), C116 (fusion-bonded epoxy coating), C602 (cement-mortar lining), or C620 (spray applied in-place epoxy lining). Maximum size of ductile iron pipe covered by these Specifications is 12 inches.
B. EXPOSED PIPE: Ductile iron pipe, installed inside buildings or underground vaults, shall have flanged joints. Pipe shall be a minimum Class 53 in accordance with AWWA C115/ANSI A21.15. Flanges shall conform to Class 125, ANSI B16.1 unless otherwise noted on the Drawings. Outside coating shall be as specified in Division 9 of these Specifications.

C. BURIED PIPE: Buried ductile iron pipe shall have push-on joints, with mechanical (stuffing box type) joints at fittings and valves. Pipe shall be Class 350 for diameters less than 12 inches, unless otherwise specified. Joints shall be rubber gasket joints in accordance with AWWA C111/ANSI A21.11. Outside coating shall be asphaltic coating.

2.02 FITTINGS FOR DUCTILE IRON PIPE

A. GENERAL: Fittings for ductile iron pipe shall be ductile iron or grey iron in accordance with AWWA C110/ANSI A21.10. Ductile iron compact fittings, in accordance with AWWA C153/ANSI A21.53, may be used if approved by the Engineer. Fittings shall have a minimum pressure rating of 250 psi. All fittings shall be cement mortar lined in accordance with AWWA C104/ANSI 21.4. Fittings shall be HARCO or equal.

B. FITTINGS FOR EXPOSED PIPE: Fittings for exposed pipe shall have flanged joints. Flanges shall conform to Class 125, ANSI B16.1 unless otherwise noted on the Drawings. Outside coating shall be as specified in Division 9 of these Specifications.

C. FITTINGS FOR BURIED PIPE: Fittings for buried pipe shall have rubber gasket mechanical joints in accordance with AWWA C111/ANSI A21.11, unless otherwise noted on the Drawings. Fittings shall have a minimum pressure rating of 350 psi. Outside coating shall be asphaltic coating.

2.03 STEEL

Steel potable water pipe shall be Schedule 40 (for size 3 inches or less) and Schedule 20 (for size above 3 inches.) Grade B black steel pipe meeting the requirements of ASTM A53. All steel potable water pipe, linings and fittings shall meet appropriate AWWA standards. Steel fittings shall be malleable iron or steel meeting ASTM A106, Grade B. Steel pipe joints shall be welded with flanges at equipment and valves. Harness compression sleeve couplings shall be provided where indicated on the Drawings. For exposed service, steel pipe shall be coated in accordance with the Drawings. For buried service, steel pipe shall be provided with 5 mils of asphalt coating. For pipe less than 4 inches in diameter, NSF-PW pipe shall be used.

2.04 STAINLESS STEEL

Stainless steel shall meet the requirements of AWWA C220. The stainless steel joints shall be butt welded with unions at equipment and valves. Harness compression sleeve couplings where indicated on the Drawings.

2.05 COPPER TUBING
Copper tubing shall be seamless, annealed copper tubing Type K, in conformance with ASTM B88. Exposed tubing shall be hard-temper and buried tubing shall be soft-temper. Fittings shall be wrought copper or cast bronze. Exposed joints shall be solder joints except where threaded or flanged fittings are required. Solder joint type fittings shall conform to ANSI B16.22 or ANSI B16.18. Solder used shall be a 95-5 Tin-Antimony alloy in conformance with ASTM B32.

2.06 BRASS PIPE
Brass pipe shall be seamless red brass pipe in accordance with ASTM B43.

2.07 BRONZE FITTINGS
Bronze fittings shall conform to the requirements of ANSI B16.15.

2.08 PVC PIPE
A. PVC gravity sewer pipe and fittings shall be in accordance with ASTM D3034. The walls shall have a minimum thickness of DR-35. The pipe shall have integral bell and spigot joints. Bell and spigot joints shall be supplied with a rubber o-ring to provide for contraction and expansion to ensure water tightness. All fittings and accessories shall have identical bell and spigot configurations as the pipe. All fittings shall be supplied by the same manufacturer as the pipe.

B. ASTM PVC pressure pipe shall be in accordance with the latest NSF standards, AWWA standards, and ASTM D2241. The pipe shall be pressure rated at 200 psi. The walls shall have a minimum thickness of SDR-21. The pipe shall have integral bell and spigot joints. The joints shall be supplied with rubber o-ring gaskets to ensure water tightness. All fittings shall meet ASTM D3139, latest edition.

C. AWWA PVC pipe shall conform to AWWA C900 and shall have a wall thickness dimension ratio of 14 unless indicated otherwise on the drawings. The pipe shall have an outside diameter conforming to the dimensions of cast iron pipe. The pipe shall be listed by Underwriters Laboratory and shall be Factory Mutual approved. The pipe shall have a factory installed coupling or gasket bell end. Fittings shall be as specified for ductile iron pipe.

D. Schedule 80 PVC pipe shall conform to ASTM D 1785, and threaded fittings shall conform to ASTM D 2466. Joints shall be threaded and lubricated before assembly with Teflon tape. Where indicated, flanges shall be provided for joints.

E. Schedule 40 PVC pipe shall conform to ASTM D 1785 and socket welded fittings shall conform to ASTM D 2466, D 2564 and D 2855.

F. All PVC potable water pipe less than 4-inches in diameter shall be NSF-PW pipe. Maximum size of PVC pipe covered by these Specifications is 12 inches.

2.09 CPVC PIPE
A. CPVC material for pipe and fittings shall conform to ASTM D1784, Class 23447-B. Pipe and fittings shall be in accordance with ASTM F441. Neoprene gaskets with push-on joints shall conform to ASTM F477.

B. Schedule 80 CPVC socket type fittings shall conform to ASTM F439. Schedule 40 CPVC socket type fittings shall conform to ASTM F438. CPVC solvent weld cement for socket connections shall meet the requirements of ASTM F493. Schedule 80 CPVC threaded type fittings shall conform to ASTM F437.

2.10 POLYETHYLENE PIPE

A. Polyethylene pipe (PE) shall be in conformance with AWWA C901 with a minimum Pressure Class rating of 200 psi. Joints for polyethylene pipe shall be fusion type in accordance with AWWA C901. Maximum size of polyethylene pipe covered by these Specifications is 12 inches.

2.11 FLANGE ADAPTERS

A. Flange adapters for ductile iron pipe shall be ductile iron slip-on type retained by set screws. Set screws shall be manufactured from AISI 4140 steel, case and core hardened, unplatted. Drilling for set screws shall be on a 10° angle. Flange adapters shall conform to ANSI B16.1 and AWWA specifications. Flange adapters for ductile iron pipe shall be ductile iron conforming to ASTM A536, conforming to AWWA dimensions. Bolt circles and bolt holes shall conform to ANSI/AWWA C110/A21.10. Flange adapters for ductile iron pipe shall be Series 2100 Megaflange, Series 400 Star Pipe Products, or equal.

2.12 PIPE FITTINGS

A. If specified on the plans, ductile iron pipe fittings shall be restrained using Megalug Series 1100 retainer glands by EBAA Iron (or approved equal). Glands shall be manufactured of ductile iron conforming to ASTM A 536. Restraining devices shall be of ductile iron heat treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee-head bolts. Restraining devices shall conform to ANSI/AWWA A21.11 and C153/A21.53. Twist-off nuts shall be used to insure proper actuating of the restraining devices. The mechanical joint restraint device working pressure rating of at least 350 psi for 3-16-inch pipe and at least 250 psi for 18-48-inch pipe. A minimum safety factor of 2 to 1 shall be included for all sizes.

B. If specified on the plans, PVC pipe fittings 4"-12" shall be restrained using Megalug Series 2000 PV retainer glands by EBAA Iron (or approved equal). Glands shall be manufactured of ductile iron conforming to ASTM A 536. The restraint shall meet the requirements of ASTM F 1674-96. Twist-off nuts shall be used to insure proper actuating of the restraining devices. The mechanical joint restraint device shall have the same working pressure requirements as the pipe itself.
2.13 **WALL PIPES AND SLEEVES**

Pipes through concrete walls and slabs shall be provided with wall pipes or penetration seals. Wall pipes shall comply with cast iron fittings specification and shall have flanged joint connections unless otherwise noted on the drawings. Penetration seals shall be Link-Seal as manufactured by Thunderline Corporation of Wayne, Michigan, or equal, and shall include the Link-Seal wall sleeve, and shall be suitable for the pipe material passing through the wall.

2.14 **PIPE SUPPORTS**

A. **Hangers**

1. Pipe shall be supported by steel pipe hangers, clamps, brackets or rods and inserts, sized to support the imposed pipe load. Hangers shall be manufactured by ITT Grinnell Corporation or approved equal. Hangers shall be new, manufactured of clean carbon steel and suitable for painting with the pipe. Hangers shall be spaced and sized in accordance with the following schedule:

<table>
<thead>
<tr>
<th>Pipe Size (Inches)</th>
<th>0 to ¾</th>
<th>1 to 1¼</th>
<th>1½ to 2</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Spacing (feet)</td>
<td>6</td>
<td>8</td>
<td>10</td>
<td>12</td>
</tr>
</tbody>
</table>

2. Where concentrations of valves, fittings and equipment occur, closer hanger spacing may be required. In such case, the total hanger load shall not exceed the following. Where flexible couplings occur, additional hangers shall be installed one foot each side of coupling.

<table>
<thead>
<tr>
<th>Hanger Rod Diameter (Inches)</th>
<th>⅜</th>
<th>½</th>
<th>⅝</th>
<th>¾</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Safe Load (Pounds)</td>
<td>600</td>
<td>1,100</td>
<td>1,800</td>
<td>1,700</td>
</tr>
</tbody>
</table>

B. **Floor Pipe Supports**

1. Cast iron adjustable pipe saddle supports, ITT Grinnel Fig. 264, or equal, shall be furnished where indicated on the drawings, complete with support pipe and base flange drilled for anchor bolting to floor.

2. Concrete pipe supports shall be provided where indicated on the drawings. Pipe supports shall be in accordance with the detail.

C. **Wall Mounted Supports**

1. Wall mounted support systems shall consist of channels with necessary framing fittings and pipe clamps, as manufactured by Unistrut Building Systems.

2.15 **COMPRESSION SLEEVE COUPLING:**

Compression sleeve couplings for steel to steel and ductile iron to ductile iron shall be of
a gasketed, sleeve-type design with diameter to properly fit the pipe. Couplings for steel to steel and ductile iron to ductile iron shall be Dresser Style 38, Dresser Style 138, or equal. Coating shall be fusion-bonded epoxy. Provide field coating for buried application per AWWA C203.

2.16 CAST-IRON SOIL PIPE

Cast-iron soil pipe and fittings shall be in accordance with ASTM A74. Pipe shall be provided with bituminous coating and joints shall be hub and spigot type. Pipe joints at floor drain connections shall be no hub.

2.17 PIPE INSULATION

A. Piping insulation shall be tubular type with a minimum thickness of 1-inch. Pipe insulation shall be cellular glass or fiberglass type and shall be provided with aluminum jackets. Complete installation shall be weathertight. Cellular glass type insulation shall conform to the requirements of ASTM C552, Type II. Fiberglass type insulation shall conform to the requirements of FEDSPEC HH-I-558B. Aluminum jackets shall be constructed of smooth finish aluminum sheet conforming to ASTM B209, alloy 5005, temper H16, with integral vapor barrier. Jackets shall be 0.016 inch thick. Sheet metal screws shall be aluminum or stainless steel. Jackets shall be secured with 0.020 by 3/4 inch type 304 stainless steel expansion bands. Aluminum covers shall be constructed of smooth finish aluminum sheet conforming to ASTM B209, alloy 5005, temper H16, with integral vapor barrier. Covers shall be 0.016 inch thick.

B. Insulation for fittings, connections, flanges and valves shall be cellular glass or fiberglass type and shall be provided with rigid aluminum covers. Complete installation shall be weathertight. Insulation shall be segmented sections, molded, or blanket type coverings with the same thickness as pipe insulation.

PART 3 EXECUTION

3.01 PIPE INSTALLATION

A. Piping shall be installed in accordance with appropriate installation specifications.

B. Piping materials required for specific applications shall be as indicated on the piping schedule included in this specification. Pipe shall be cut accurately to dimensions established at the job site and worked into place without springing or forcing, properly clearing all openings and other conflicts. Open ends of pipe lines or equipment shall be properly capped or plugged during installation to prevent entry of dirt or other foreign material into the system. Exposed piping shall be installed in practical alignment with the building. All cast iron pipe and fittings shall be carefully checked and tested on job for correct dimensions and coating before placing pipe.
C. Changes in direction of piping shall be made with fittings except bending will be permitted in copper tubing providing a mechanical or hydraulic pipe bender is used, wide sweep bends are formed, and no kinks or wrinkles are evident in bends. Changes in direction in piping shall be made by the appropriate use of long sweep 1/4 bends, 1/6, 1/8 or 1/16 bends; 45 degree wyes, 1/2 wyes or a combination of these fittings, except that changes in direction of flow from the horizontal to the vertical may be made with short 1/4 bends.

D. Interior flanged pipe shall be properly supported, aligned flange to flange, gaskets installed, lubricant applied, if required, bolts inserted and drawn up until tight. Torque wrenches shall be used to assure tightness of bolts.

E. Interior, small diameter pipe shall be carefully aligned and connected together. Pipe joints shall be made up with an approved joint compound applied to male threads only. Valves and fittings shall be made up to ensure no distortion or damage to these parts. Threaded ends shall be protected against damage and shall not be used if damaged. All valves shall be installed with a union on one side to permit easy removal for repair.

F. Piping systems shall be well supported in accordance with ANSI B31.1 so as to maintain required pitch of lines, prevent vibration and provide for expansion and contraction movement. Pipes shall be supported from the building structure in a neat and workmanlike manner.

G. Pipe shall be installed in strict accordance with manufacturer’s instructions.

END OF SECTION
SECTION 02522
VALVES AND SPECIALTIES

PART 1  GENERAL

1.01  REQUIREMENTS INCLUDED
Furnish all valves, specialties, and appurtenances as shown and as specified and required.

1.02  RELATED REQUIREMENTS
A.  Section 02200 – Earthwork
B.  Section 02510 – Water Distribution Systems
C.  Section 02530 – Sanitary Sewer System
D.  Section 2520 – Pipe and Pipe Fittings

1.03  QUALITY ASSURANCE
Comply with all applicable codes and regulations as required by regulatory agencies having jurisdiction over this Work. Comply with the pertinent sections of the following Standards:
A.  AWWA - American Water Works Association
B.  ANSI - American National Standards Institute
C.  ASTM - American Society of Testing and Materials

1.04  SUBMITTALS
Shop drawings and product data for valves and specialties.

PART 2  PRODUCTS

2.01  GATE VALVES
A.  GENERAL
1.  Gate valves shall be resilient seated valves conforming to AWWA C509. The valve shall be designed so that no sliding or shear on the resilient seating surface is present when compressed to a drop tight shut off. Valve shall seal equally well in either direction. Interior shall be epoxy coated. Valve shall be permanently lubricated. Direction of opening shall be counterclockwise. Valve shall have permanent designation of the direction of opening on the valve. All gate valves four (4) inches in
Valves And Specialties

2.02 BALL VALVES

A. Ball valves shall comply with Federal Specifications WW-V-35B Type II, Class A. Valve body shall be bronze; stem and stem gland nut shall be brass. Valve ball shall be chrome plated brass seats; stuffing box ring and thrust washer shall be reinforced teflon. Handle shall be vinyl coated, zinc-plated steel or cadmium-plated steel. Design working pressure shall be 200 psi. Valve stuffing boxes shall be capable of being repacked under pressure and adjustable for wear. Stems shall be provided with reinforced Teflon stuffing box ring and with blowout-proof design. The ball design shall not allow media contact with the stem. Actuator shall be integral part of valve.

B. Ball valves shall be as manufactured by Apollo, Jamesbury, Watts, Stockham, or equal.

2.03 VALVE BOXES

Each buried valve shall be provided with a valve box. Valve boxes shall be approved standard Buffalo-type, cast iron, slip-type adjustable shaft boxes, with a minimum shaft diameter of 5 1/4 inches, unless otherwise specified on the Drawings. Valve box size shall suit depth of bury and valve size at each location. Valve box covers shall have the word "SEWER" or "WATER" cast into them. Valve boxes shall be Sigma Municipal Corporation, or equal.

2.04 FIRE HYDRANTS

Fire hydrants shall be post type, dry-barrel, compression type main valve in accordance with AWWA Standard C502. Hydrants shall be designed for a working pressure of 150 psi. Hydrants shall have a six (6) inch mechanical joint connection to the water main,
two 2½ inch hose outlets, and one (1) 4½ inch pumper outlet. The diameters of the main valve opening and pumper outlet shall be as specified on the Drawings. Connection caps shall be fitted with chains. Hydrants shall be equipped with a national standard 1½ inch pentagon operating nut, opening counter-clockwise. All hose threads shall conform to the National Standard. Hydrants shall be equipped with safety flange, breakaway top type, and stem. Packing shall be of the O-ring type. Hydrants shall be painted with one coat of zinc paint matching the color of chromed yellow. Hydrants shall be American Darling 5 ¼ B-84-B-5 red in color or equal.

2.05 COUPLINGS & EXPANSION JOINTS

Standard couplings shall be Dresser Style 38 or approved equal. Transition couplings shall be Dresser Style 162 or approved equal. Flanged adapters shall be Dresser Style 127 or approved equal. Expansion joints shall be Red Valve J-1, or approved equal. All couplings, adapters and expansion joints shall be restrained unless otherwise indicated.

2.06 TAPPING SLEEVES

Tapping sleeves shall meet requirements of AWWA C110 for pressure ratings shown on the drawings. Sleeves shall be built in two sections and shall be mechanical joint type with flanged outlet. Two part steel, bolted tapping sleeves shall be 304 stainless and furnished with stainless steel bolts and nuts as manufactured by ROMAC Industries. The tapping sleeve shall be for the size and type of pipe shown on the Drawings.

2.07 SWING-CHECK VALVES

A. Cushioned swing-check valves, 2 ½ inches through 8 inches, shall be iron body and bronze mounted in accordance with AWWA C508. The minimum rated working pressure shall be 175 psi. All cushioned swing-check valves shall be lever and weight operated unless otherwise shown on the Drawings. Seat ring material shall be bronze and end types shall be flanged. Check valves shall be Mueller A-2604-6-01, APCO Service 6000, Golden Anderson Figure 250 – D, or equal.

B. Swing-check valves, 2 inches in diameter and smaller, shall be bronze body, suitable for service required. Valves shall be rated for 150 psi working pressure. Valves shall comply with Federal Specification MSS SP-80. Valves shall be Stockham B-319, Nibco 413B, or equal.

2.08 REDUCED PRESSURE ZONE BACKFLOW PREVENTER

A reduced pressure zone backflow preventer shall be installed at each noted potential health hazard location to prevent backflow due to backsiphonage and/or backpressure. The assembly shall consist of an internal pressure differential relief valve located in a zone between two positive seating check modules with captured springs and silicone seat discs. Service of all internal components shall be through a single access cover secured with stainless steel bolts. The assembly shall also include two resilient seated isolation valves, four resilient seated test cocks, a protective bronze wye strainer with a 20 mesh screen and an air gap drain fitting. The assembly shall meet the requirements of ASSE
Std. 1012; AWWA Std. C511; USC-FCC&HR and shall be a Watts Regulator Co. Series 009S-QT.

2.09 ALTITUDE VALVES

Altitude valve shall be a two-way (double acting) valve as manufactured by Cla-Val, Ross Valve, or approved equal. The maximum allowable head loss across the valve shall be 10 psi at a flow of 5,000 gpm. The valve is to be a non-throttling, hydraulically operated, and pilot controlled type valve that remains fully open until the shut off point is reached. The valve shall close at a high water level and open for return flow when the pressure at the valve inlet is less than the tank pressure. The valve shall be equipped with a strainer in the pilot system which can be cleaned without shutting down the valve. Isolation valves are to be provided on the pilot system. The shutoff head of the valve shall be adjustable between 100 and 150 feet at a minimum. The valve shall be equipped with 125 lbs. flanges.

2.10 AIR RELEASE VALVES

A. Sewage combination air release valves shall be Val-Matic or approved equal. Valve shall be provided with inlet and blow off valves. Air release valves shall be rated for 150 psi working pressure. Air release orifice shall be equipped with a screened gooseneck attachment. Air release valves shall be single body.

B. Water combination air release valves shall be Val-Matic, ARI, or approved equal. Valve shall be provided with inlet and blow off valves. Blow off shall be Kupferle Mainguard #78 in plastic meter box model Carson 1220 or equal. Air release valves shall be rated for 150 psi working pressure. Air release orifice shall be equipped with a screened gooseneck attachment.

C. Air release valves on all potable water mains shall meet AWWA C512.

2.11 VALVE ACTUATORS

A. Actuators shall be as shown on Plans or as specified. Actuators shall have a counterclockwise opening as viewed from the top. The direction of opening and the word open shall be cast on handwheel or valve bonnet. The actuator shall be sized to produce the required torque with a maximum pull of 80 pounds and withstand without damage a pull of 200 pounds.

B. Buried valve actuators shall be provided with a screw or slide type adjustable cast iron box, 5 inches minimum diameter, and an identifying cover. The box base shall enclose the buried valve gear box or bonnet. Buried valves shall have a 2 inch AWWA standard valve actuator nut. Provide stem extension to grade with guide bushing to center extension.

C. All gate valves shall be provided with handwheels, sized in accordance with AWWA C500. Plug valves, butterfly valves, ball valves 3 inches in diameter and smaller shall be provided with lever actuators. Lever actuators for butterfly valves shall have a minimum of five (5) intermediate lock positions between full open and full close. Gear actuators are required for plug valves, butterfly valves,
and ball valves 4 inches in diameter and larger. Gear actuators shall be totally enclosed, permanently lubricated and with sealed bearings. Chain actuators shall be provided for valves 6 feet or higher from finished floor. Equip chain wheels with chain guide to permit rapid operation with reasonable side pull without jamming the wheel.

D. Electric actuators shall be Limitorque LY2001, 115 volt, single phase, 60 cycle open/close service electric actuator. Valve actuator shall include a compartment heater. Valves shall include a manual override with limit switch feedback to the micro-processor in both the open and closed positions. Field wiring and junction/box disconnect shall be provided by the Installing contractor. Valve stem extensions shall be provided as indicated on the Plans.

2.12 HOSE BIBBS

A. Hose bibbs shall be ¾ inch, wheel operated brass hose bibb, each provided with a vacuum breaker. Hose bibb shall be Chicago 13LK with Watts No. BAC vacuum 6 breaker. Provide wall-mounted hose reel hose at all bib locations. Hose reel shall be Northern Tool and Equipment #520-13208, or equal.

2.13 PRESSURE GAUGES

A. Pressure gauges shall have 4 1/2-inch diameter cases. Gauges shall have white faces with black numerals, acrylic windows, stainless steel bourdon tubes and phenol cases. Accuracy of measurement shall be provided with a Type 316 stainless steel porous metal disc type pressure snubber having 0.0013 - to 0.0025 inch pore openings, and an isolation valve. Gauges shall be graduated in psi to meet system design requirements with normal operating pressure being indicated mid-range of dial. 4 1/2-inch pressure gauges shall be Ashcroft, Duragauge, Weksler, Regal, or equal.

PART 3 EXECUTION

NOT USED

END OF SECTION
SECTION 02530
SANITARY SEWERAGE SYSTEMS

PART 1  GENERAL

1.01 REQUIREMENTS INCLUDED

A. Provide personnel, materials, equipment, and supplies to install sanitary sewerage system as shown on the Drawings, including all piping, fittings, valves, manholes, cleanouts, and appurtenances.

B. Provide all personnel, materials, and equipment necessary to perform testing of newly laid sewerage force mains, gravity sewers, manholes, and wetwells.

C. Provide certificates that all lines meet testing requirements.

1.02 RELATED REQUIREMENTS

A. Section 02300; Earthwork

B. Section 02520; Pipe and Pipe Fittings

C. Section 02522; Valves and Specialties

D. Section 02532; Sanitary Sewer Manholes and Cleanouts

1.03 QUALITY ASSURANCE

Comply with all applicable codes and regulations as required by regulatory agencies having jurisdiction over this Work. Comply with the pertinent sections of the Virginia Department of Health's "Sewage Collection and Treatment Regulations". Comply with all pertinent requirements of the Virginia Department of Transportation "Road and Bridge Specifications", and "Standard Details", latest editions.

1.04 SUBMITTALS

A. Shop drawings and product data for pipe and appurtenances.

B. Submit test logs with location of lines, date tested, length of line tested, pressure at beginning of test, pressure at end of test, time period, amount of leakage allowable, amount of leakage, signature of person responsible for test and any other pertinent data with Quality Control Report.

PART 2  PRODUCTS

Materials, equipment, and water source shall be suitable for the purpose of test.

PART 3  EXECUTION

3.01 GENERAL
Gravity sewer lines shall be laid to lines and grades shown on the drawings with manholes and service connections at required locations. Installation of all materials shall be in strict conformance with manufacturer's recommendations.

### 3.02 CLEARANCE

A. Wherever gravity sewer lines are within 10 feet of water mains, the top of the sewer line shall be not less than 18 inches below the bottom of the water main. This vertical separation should be maintained for that portion of the sewer line located within 10 feet horizontally of the waterline, said feet to be measured as the normal distance from the water main to the sewer.

B. Wherever possible, sewer lines shall be laid at least 10 feet, horizontally, from any existing or proposed waterline. Should local conditions prevent a lateral separation of 10 feet, a sewer line may be laid closer than 10 feet to a waterline provided that the line is laid in a separate trench and the top of the sewer line is maintained at 18 inches below the bottom of the waterline. The Contractor shall obtain approval from the Engineer before laying any sewer line closer than 10 feet, horizontally to a waterline.

C. Whenever a sewer line passes over a water line, a vertical separation of at least 18 inches between the bottom of the sewer and the top of the waterline shall be maintained. Whenever a sewer line passes over a waterline, the sewer shall be constructed of AWWA approved water pipe and shall be pressure tested in place without leakage prior to backfilling.

D. Where it is impossible to obtain proper horizontal and vertical separation as stipulated above, the sewer shall be constructed of AWWA approved water pipe and shall be pressure tested in place without leakage prior to backfilling.

### 3.03 LOCATING EXISTING UTILITIES

A. The location of existing utilities, including underground utilities, is indicated on the drawings insofar as their existence and location were known at the time of preparation of the drawings. However, nothing in these Contract Documents shall be construed as a guarantee that such utilities are in the location indicated or that they actually exist, or that other utilities are not within the area of operations. The Contractor shall make all necessary investigations to determine the existence and locations of such utilities far enough in advance of pipelaying to allow for adjustments due to conflicts in the horizontal and vertical location of the pipe line.

B. The Contractor shall obtain field utility locations by calling “Miss Utility” (1-800-552-7001) forty-eight (48) hours prior to working in the vicinity of existing utilities. If the utilities fail to locate, a second call shall be made providing an additional three (3) hour notice.

C. The Contractor shall pay for any damage to and for maintenance and protection of existing utilities and structures.

### 3.04 LAYING PIPE AND PLACING MANHOLES
A. Proper implements, tools, and facilities shall be provided and used for the safe and convenient performance of the work. All pipes, fittings, valves, and manholes shall be lowered carefully into the trench by means of a derrick, ropes, or other suitable tools or equipment, in such a manner as to prevent damage to sewer pipe and appurtenances. Under no circumstances shall materials be dropped or dumped into the trench. The excavation shall be dewatered prior to installation of the pipe and manholes. Installation of sewage force main shall be in accordance with AWWA C600.

B. All materials shall be examined carefully for damage and other defects immediately before installation. Defective materials shall be marked and held for inspection by the Engineer, who may prescribe corrective repairs or reject materials.

C. All lumps, blisters, and excess coating shall be removed from the socket and plain ends of each pipe, and the outside of the plain end and the inside of the bell shall be wiped clean and dry and be free from dirt, sand, grit, or any other foreign material before the pipe is laid.

D. Foreign material shall be prevented from entering the pipe and manholes while being placed in the trench. During laying operations, no debris, tools, clothing, or other materials shall be placed in the pipe. Each pipe shall be swabbed or brushed out as necessary to assure that no debris gets into the finished line.

E. Any required field pipe cutting shall be done so in a neat and workmanlike manner, so as to leave a smooth end at right angles to the axis of the pipe. Care shall be taken to avoid damaging the pipe and any coatings or linings. Ductile iron pipe shall not be cut with an oxyacetylene torch.

F. Pipe and fittings shall be strung out along the route of construction where it will cause the least interference with traffic. Construction of gravity sewer shall commence at the lowest point in the system. The downstream sections shall be completed, tested, and approved prior to allowing sanitary sewage to enter the system.

G. Laying of pipe shall be commenced immediately after excavation is started and every measure must be used to keep pipe laying closely behind trenching. No more than 10 linear feet of trench shall remain open at the end of each working day.

H. The Contractor shall maintain existing sewage flows at all times by pumping, diversion, or other means approved by the Engineer. The Contractor shall at no time allow sewage to be diverted into a natural watercourse or back up into any service connections. The Contractor shall pay for all damages which may occur as a result of failing to maintain the sewage flow in the system.

I. The Contractor shall make provisions at all times to allow natural drainage to flow through the work area with minimal damage to the new construction and/or existing downstream storm drain system. The Contractor shall at no time allow
drainage to back up or be diverted onto private property. The Contractor shall pay for all damages which may result by failing to maintain drainage flow.

J. Gravity sewer pipe shall be laid in true straight lines with the bell ends upstream and with the invert of the pipe being the true elevation and grade of the system. The Contractor shall establish and maintain the horizontal alignment and vertical elevation and grade of the system in accordance with the survey information indicated on the Drawings.

K. The horizontal alignment of gravity sewer pipe shall be maintained by a transit or theodolite plumbed over the center of the downstream manhole. The vertical elevation and grade shall be maintained by an adjustable laser level mounted at the invert of the downstream manhole with target(s) placed in the bell end of the pipe being laid.

L. Connections to existing sewers shall be made in accordance with local standards and requirements. Contractor shall verify invert elevations of existing sewers to which connections are to be made and inform the Engineer immediately of any discrepancies on the Drawings.

M. For force mains, the trench may be curved to change direction or to avoid obstructions within 2/3 of the limits of the curvature of the pipe as recommended by the manufacturer. Where necessary to maintain the required curvature, short sections of the pipe or fittings shall be provided. Harnessing shall be provided for these short sections of pipe or where fittings are provided for the force main.

N. When work is not in progress, the Contractor shall plug the open ends of the pipe to prevent trench water or other substances from entering the pipe. The plug shall be watertight and shall remain in place until any required dewatering has been completed.

3.05 JOINTING

A. The sanitary sewer system shall be laid and joined complete-in-place in order that each length and section of pipe between the manholes shall have a smooth and uniform invert. The previous joint shall have been completed and the entire length of pipe shall be well bedded and firmly backfilled before jointing another length of pipe. Bell holes shall be dug of sufficient size to insure proper jointing.

B. The Contractor shall not use excavation equipment to push the pipe into the home position, unless approved by the Engineer, and then only for one length of pipe at a time.

C. Joints for pipes of different materials shall either be made at manholes or with standard adapter fittings.

D. The Contractor shall join the pipe as recommended by the manufacturer to obtain the degree of watertightness required. The use of lubricants, primers, adhesives and similar materials shall be as recommended by the manufacturers.
E. The pipe shall be connected to manholes utilizing rubber gaskets as specified in Section 02532.

3.06 FORCE MAIN VALVE AND FITTING INSTALLATION

A. Valve and fitting installation shall be in accordance with AWWA C600.

B. Prior to installation, valves shall be inspected for direction of opening, freedom of operation, tightness of pressure-containing bolting, cleanliness of valve ports and, especially, seating surfaces, handling damage, and cracks. Defective valves shall be corrected or replaced.

C. Valves shall be located where shown on the Drawings and shall be supported so that no load transfers to the pipe. Valves, fittings, plugs, and caps shall be set and joined to the as recommended by individual manufacturers.

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

E. PLUGS AND CAPS: All dead ends on new mains shall be closed with plugs or caps that are suitably restrained to prevent blowing off under test pressure.

3.07 FORCE MAIN THRUST RESTRAINT

A. All tees, bends, plugs and abrupt changes in direction of the force main piping shall be either harnessed or provided with thrust blocks.

B. Thrust blocking shall be in accordance with the standard detail, bearing on undisturbed earth. Thrust blocking shall be made of concrete having a compressive strength of not less than 3000 psi after 28 days. The system shall not be pressure tested for 14 days after the thrust blocks are poured.

3.08 LOCATION TAPE

A. Plastic encased aluminum foil tape shall be installed above all non-metallic force main such that pipe can be located in the future with a metal locating device. Tape shall be color coded and permanently imprinted with identification message. Tape shall be LINEGUARD Detectable Underground Marking Tape, or equal.

3.09 SERVICE CONNECTIONS

A. Service lines shall be connected to the sewer by means of wye fittings with a branch as shown on the Drawings. The branch of the wye fitting will be elevated as directed depending upon the depth of the sewer. The service line shall be connected to the wye fitting with a 45° bend. Reducers shall be used to connect 4-inch service lines as shown on the Drawings. Service lines shall be a minimum of four inches in diameter.

B. Service lines shall extend from the sewer line to the property line as indicated, unless otherwise specified. Ends shall be plugged and marked. The Contractor
shall verify that the elevation of the service line will allow gravity flow from the unit served. Cleanouts shall be installed on the upstream end of all horizontal deflections in the service lateral.

3.10 HYDROSTATIC TESTING OF FORCE MAINS

A. Hydrostatic testing shall be performed in accordance with AWWA C600, Section 4. Testing shall be performed in the presence of the Owner’s Representative.

B. After placing the pipe, all thrust restraint, and valve support, and before placement of permanent surface, all newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure of at least 1.5 x the working pressure at the point of testing or 150 psi (whichever is greater). Allow seven days after thrust restraint blocks have been poured before testing. Hydrostatic test shall be made between all valved sections of force main so that test pressure is applied to one side of each valve in the system at a minimum.

C. Test Pressure Restrictions

Test pressures shall:

1. Not be less than 1.25 times the working pressure at the highest point along the test section.

2. Not exceed pipe or thrust restraint design pressures.

3. Be of at least 2-hour duration.

4. Not vary by more than ±5 psi for the duration of the test.

5. Not exceed twice the rated pressure of the valves when the pressure boundary of the test section includes closed gate or plug valves.

6. Not exceed the rated pressure of the valves when the pressure boundary of the test section includes closed gate or plug valves.

D. Pressurization

Each valved section of pipe shall be filled with water slowly and the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Owner's Representative.

E. Air Removal

Before applying the specified test pressure, air shall be expelled completely from the pipe, valves and hydrants. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall remain closed and left in place.
F. Examination

All exposed pipe, fittings, valves, and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings, or valves that are discovered shall be repaired or replaced with sound material following the pressure test and the test shall be repeated until it is satisfactory.

3.11 LEAKAGE TESTING OF FORCE MAIN

A leakage test shall be conducted concurrently with the pressure test.

A. Leakage defined

Leakage shall be defined as the quantity of water in gallons per hour that must be supplied into the newly laid pipe, or any valved section thereof, to maintain pressure within 5 psi of the specified test pressure after the air in the pipeline has been expelled and the pipe has been filled with water. Leakage shall not be measured by a drop in pressure in a test section over a period of time.

B. Allowable leakage

No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

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

in which \(L\) is the allowable leakage, in gallons per hour; \(S\) is the length of pipeline tested, in feet; \(D\) is the nominal diameter of the pipe, in inches; and \(P\) is the average test pressure during the leakage test, in pounds per square inch gauge.

1. Allowable leakage shall not exceed the amount given by the leakage formula found in the most current AWWA Standard C-600.

2. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gallons/hour/inch of nominal valve size shall be allowed.

C. Acceptance of Installation

Acceptance shall be determined on the basis of allowable leakage. If any test of pipe laid discloses leakage greater than that specified above, the Contractor shall, at his own expense, locate and make repairs as necessary until the leakage is within the specified allowance. All visible leaks are to be repaired regardless of the amount of leakage.

3.12 TESTING OF GRAVITY SEWER LINE

A. Prior to final inspection, the required tests shall be completed in the presence of the Engineer, the Owner, or the Owner’s authorized representative. The Contractor shall prove the watertightness of the sewer system or portions thereof
by a low pressure air test as specified in Section 3.12.B. The Contractor might utilize an infiltration or exfiltration test in special circumstances, but only after receiving written approval from the Engineer. All testing expenses shall be borne by the Contractor, and shall be bid as a part of the price of the sanitary sewer.

B. AIR TEST: A low pressure air test may be employed on pipes of 18" diameter or less. The testing equipment, procedure, and results will all be subject to the strict approval of the Engineer. Results of the air test will be reviewed for compliance with ASTM C828 and C924. The air test is to be conducted between two (2) consecutive manholes. The test equipment shall consist of two (2) plugs (one tapped and equipped for air inlet connection), a shut-off valve, a pressure regulating valve, a pressure reduction valve, and a monitoring pressure gauge having a pressure range from 0 to 5 psi, graduated in 0.10 psi with an accuracy of ± .04 psi. Contractor shall provide certification of accuracy of test equipment to the Engineer. The test equipment shall be set up outside the manhole for easy access and reading. Air shall be supplied to the test slowly and shall be regulated to prevent the pressure inside the pipe from exceeding 5.0 psig. The pipeline shall be filled until a constant internal pressure of 3.5 psig is maintained. The internal pressure shall be maintained at 3.5 psig or slightly above for a five (5) minute stabilization period, after which time the internal pressure will be adjusted to 3.5 psig, the air supply shut off and the test begun. No person shall remain in the manhole while pipe is being pressurized or throughout the test for safety purposes. A pressure drop of 1.0 psi from 3.5 to 2.5 psig shall be allowed for the test times specified in the following table, based upon the designated pipe size and test segment length. Should the 1.0 psi drop occur in less time than that specified in the table the sewer segment shall have failed. If the time required for the pressure to drop 1.0 psi is greater than that shown in the table, the sewer segment shall have passed. For a more detailed description of the air test method refer to ASTM C828, current revision. An air pressure correction shall be required when the prevailing ground water is above the sewer line being tested and shall be calculated as follows:

Ground Water Depth (ft.)/2.31 + 3.5 = Starting Test Pressure

Ending Test Pressure = Starting Pressure - 1.0 psi

<table>
<thead>
<tr>
<th>AIR TEST TABLE</th>
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<tbody>
<tr>
<td>BASED ON EQUATIONS FROM ASTM C828 LATEST REVISION</td>
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<tr>
<td>SPECIFICATIONS TIME (MIN:SEC)</td>
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<tr>
<td>REQUIRED FOR PRESSURE DROP FROM 3.5 TO 2.5 PSI</td>
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<tr>
<td>WHEN TESTING ONE PIPE DIAMETER ONLY</td>
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<tr>
<td>Length of Test Segment</td>
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<td>------------------------</td>
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<td>25</td>
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<td>50</td>
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</table>
There is no change from time requirements established for the basic air test.

C. VISUAL TEST: All sewer lines shall be inspected visually to verify accuracy of alignment and freedom from debris and obstructions. The full diameter of the pipe for straight alignments shall be visible when viewed between consecutive manholes. The method of test shall be visually lamping with mirrors and lights.

D. DEFLECTION TEST: The maximum allowable pipe deflection (reduction in inside diameter) shall be 7%. The Engineer reserves the right to require the Contractor to perform random deflection tests of pipe before final acceptance. The device for testing shall be a properly sized go - no go mandrel.

E. WATER CROSSINGS: All sewers crossing streams, estuaries, lakes, reservoirs, and/or stormwater detention ponds shall be tested in place and shall exhibit zero infiltration and leakage.

F. INFILTRATION TEST (ONLY IF APPROVED): This test will only be allowed when the hydrostatic head outside the pipe is a minimum of 4 feet above the crown of the entire length of the pipe being tested. The Contractor shall verify the level of the hydrostatic head during testing. Measurement of the infiltration shall be made before sewage flows are allowed in the sewer, and shall be made by means of a V-notch weir or by measuring the direct volume at the nearest downgrade manhole. Allowable leakage shall not exceed 100 gallons per inch of nominal pipe diameter per day per mile for any section of the system, including manholes. This test shall be conducted in accordance with ASTM Standard C654.

G. EXFILTRATION TEST (ONLY IF APPROVED): This test shall be accomplished by bulkheading the sewer at the end of lower grade and filling the upstream manhole to a minimum of 4 feet of head above the crown of the pipe, or to the top of the manhole, whichever is less. Leakage shall be computed by measuring the volume of water which left the manhole during the test period. Allowable leakage shall be the same as that specified for the Infiltration test.
Vented cleanouts will need to be sealed for the exfiltration test. A watertight cap may be utilized for this purpose.

3.13 TESTING OF PRECAST MANHOLES, WET WELLS, VALVE VAULTS, ETC

A. Precast structures shall be tested by vacuum test, after assembly, but prior to backfilling. Alternate methods of testing might be utilized in special circumstances but only after receiving written approval from the Engineer.

B. The procedure for the vacuum test shall be as follows:

1. Test shall comply with ASTM standards or Division of Water Programs Working Memo #550 dated November 4, 1987. This test method is only applicable to precast concrete manholes. Testing shall include the joint between the concrete cone or spacer rings and the manhole frame.

2. Stubouts, manhole boots and pipe plugs shall be secured to prevent movement while the vacuum is drawn.

3. Installation and operation of vacuum equipment and indicating devices shall be in accordance with equipment specifications for which performance information has been provided by the manufacturer and approved by the Virginia Department of Health.

4. A measured vacuum of 10 inches of mercury shall be established in the manhole. The time for the vacuum to drop to nine inches of mercury shall be recorded.

5. Acceptance standards for leakage shall be established from the elapsed time for a negative pressure change from 10 inches to nine inches of mercury. The maximum allowable leakage rate shall be in accordance with the following:

<table>
<thead>
<tr>
<th>TIME (SECONDS) FOR VACUUM TO DROP FROM 10&quot; HG TO 9&quot; HG</th>
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<tbody>
<tr>
<td>Depth (ft)</td>
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6. If the structure fails the test, necessary repairs shall be made and the vacuum test and repairs shall be repeated until the manhole passes the test or the manhole shall be tested in accordance with the standard exfiltration test and rated accordingly.

7. If a structure’s joint mastic is completely pulled out during the vacuum test, the structure shall be disassembled and the mastic replaced.

C. If approved by Engineer completed precast structure may be tested by exfiltration. Inflatable stoppers shall be used to plug all lines entering and exiting the subject structures. The stopper shall be positioned far enough into the lines to ensure testing of that section of line not air tested. The manhole shall then be filled with water and allowed to soak for 12 hours. Allowable leakage during that period shall not exceed 0.25 gallons per hour.

3.14 COORDINATION

All work in this section shall be coordinated with the plumbing and mechanical work so that connections and minor adjustments can be made.

END OF SECTION
SECTION 02532
SANITARY SEWER MANHOLES AND CLEANOUTS

PART 1  GENERAL

1.01  WORK INCLUDED

A.  The work shall include providing all equipment, materials, labor, and services required to construct and install manholes and cleanouts as indicated on the Drawings.

1.02  RELATED WORK

A.  Section 02300; Earthwork
B.  Section 02530; Sanitary Sewerage System

1.03  QUALITY ASSURANCE

Comply with all applicable codes and regulations as required by regulatory agencies having jurisdiction over this Work. Comply with the pertinent sections of the following standards:

A.  ASTM - American Society of Testing and Materials
B.  VDOT - Virginia Department of Transportation
C.  AASHTO - American Association of State Highway & Transportation Officials
D.  ACI - American Concrete Institute

1.04  SUBMITTALS

Shop drawings and product data for manholes and cleanouts, and related accessories.

PART 2  PRODUCTS

2.01  MANHOLES

A.  Manholes shall be constructed of precast reinforced concrete with cast iron frames and covers as shown on the Drawings. Precast manholes shall conform to ASTM C478. All reinforcing steel shall conform to ASTM A615. Joints between concrete riser sections shall be sealed with flexible butyl resin sealant conforming to Federal Specification SS-S-210A and AASHTO M198 – RAM – NEK or equal.

B.  Each unit shall have no more than two (2) holes for installation and/or handling. All holes shall be plugged with rubber stoppers and mortared upon completion of setting manhole.
C. Base units shall be tub or monolithic type with walls that extend above the top of the largest inlet or outlet pipe. Sanitary sewer manholes shall have an inside diameter of four (4) feet unless otherwise shown on the Drawings. Minimum wall thickness shall be five (5) inches. Concrete shall be minimum compressive strength of 4000 psi at 28 days.

D. Manhole top units shall be eccentric taper type, at least three (3) feet in height, or flat top where indicated.

E. Manholes shall be constructed to the required height to insure that the top of the frame and cover will be set at finished grade, unless specified or indicated otherwise. Spacer rings or other means shall be provided to allow up to eight (8) inches adjustment to final pavement.

2.02 MANHOLE CONNECTIONS

A. Sanitary sewer pipe connections to manholes shall be made utilizing rubber gaskets cast integrally in the manhole base at the time of manufacture. Rubber gaskets shall conform to ASTM C923 and shall meet the performance and test requirements of ASTM C425. Flexible connections shall be A-LOK Manhole Pipe Seal, manufactured by A-LOK Corp., or equal.

B. As an alternate, connections may be made utilizing field installed positive seal gasketing systems. Field installed connections shall be PRESS-BOOT, manufactured by Press Seal Gasket Corporation; KOR-N-SEAL, manufactured by National Pollution Control Systems, Inc. (Trelleborg); or equal.

2.03 MANHOLE FRAMES AND COVERS

A. Manhole frames and covers shall be (cast/ductile) iron in accordance with the dimensions shown on the Drawings. Minimum opening diameter shall be 24 inches. The words "SANITARY SEWER" shall be cast or stamped in the cover so as to be plainly visible. Casting shall be manufactured true to pattern with component parts fitted together in a satisfactory manner. Frames and covers shall have machined bearing surfaces to prevent rocking or rattling. Castings shall be uniform in quality, without defects.

B. Manhole frames and covers shall be MAP Rexel D400 hinged or equal. Anchor bolts shall be supplied by manufacturer.

2.04 MANHOLE STEPS

A. Steps shall be steel encapsulated in corrosion resistant rubber or copolymer polypropylene plastic.

B. Steps shall be in accordance with the dimensions and capable of withstanding the loads specified in ASTM C478, and shall be designed for installation in a sanitary sewer.

C. Steps shall be required in all structures with a depth greater than four (4) feet. Steps shall be vertically aligned and uniformly spaced for the entire depth of the structure. Steps shall be located in the structures so as to land upon a bench.
D. Steps shall be vertically spaced twelve (12) inches on center. Step width shall be sixteen (16) inches. Steps shall protrude from the wall of the structure a minimum of five (5) inches and a maximum of seven (7) inches and shall have a drop front and a grooved step surface.

2.05 INVERT SHAPING

A. The invert channels of manholes shall be smooth and semi-circular in shape sized to match the inlet and outlet pipes and sloped to provide a smooth transition between the inlet and outlet pipes. Changes in direction of flow shall be made with a smooth curve channel with a radius as large as the base will permit.

B. The invert channels and benches may be formed directly in the concrete base unit of the manhole. The benches shall slope a minimum of two (2) inches per foot toward the invert channel. The surface of the channels and benches shall be concrete.

C. Modified shaping, defined as a channel two-thirds the height of the largest pipe, shall be acceptable.

2.06 GROUT

A. Aggregate shall be clean, washed natural sand, free from dirt and foreign material, in accordance with ASTM C144.

B. Portland Cement shall be Type II, in accordance with ASTM C150.

C. Water shall be clean and free from injurious amounts of oil, acid, alkali, organic or other deleterious matter.

D. Grout used for shaping invert channels and filling connection openings shall be composed of two (2) parts aggregate and one (1) part Portland Cement, mixed in accordance with ASTM C270.

2.07 CLEANOUTS - MAINLINE

A. Sewer cleanouts shall be constructed of SDR-35 PVC pipe, unless otherwise indicated, which is the same diameter as the sewer main it is servicing. Cleanouts shall be threaded to accept pipe plug. Cleanout covers shall be cast iron Sigma P107 or equal installed within a 20”x20”x12” thick concrete pad.

PART 3 EXECUTION

3.01 INSTALLATION

A. Items shall be installed in accordance with manufacturer's recommendations, the Drawings, and related Specification Sections.

END OF SECTION
PART 1  GENERAL

1.01  REQUIREMENTS INCLUDED

A. Provide personnel, materials, equipment and supplies to install the sewage force main system as shown on the Drawings, including all piping, fittings, valves, and related appurtenances.

B. Provide all personnel, materials, and equipment necessary to perform pressure testing and leakage testing of newly laid force mains.

C. Provide certificates that all lines meet pressure and leakage requirements.

1.02  RELATED REQUIREMENTS

A. Section 01410; Regulatory Requirements

B. Section 01450; Quality Control

C. Section 02300; Earthwork

D. Section 15060; Pipe and Pipe Fittings

E. Section 15100; Valves and Specialties

1.03  QUALITY ASSURANCE

Comply with all applicable codes and regulations as required by regulatory agencies having jurisdiction over this Work. Comply with the pertinent sections of the American Water Works Association (AWWA) Standards.

1.04  SUBMITTALS

A. Shop drawings and product data for pipe and appurtenances.

B. Submit test logs with location of lines, date tested, length of line tested, pressure at beginning of test, pressure at end of test, time period, amount of leakage allowable, amount of leakage, signature of person responsible for test and any other pertinent data with Quality Control Report.

PART 2  PRODUCTS

Materials, equipment, and water source shall be suitable for the purpose of pressure and leakage testing.
PART 3 EXECUTION

3.01 GENERAL

Force mains shall be laid to lines and grades shown on the drawings with appurtenances and service connections at required locations. Installation of all materials shall be in strict conformance with manufacturer's recommendations.

3.02 CLEARANCE

A. Where force mains are near water mains, the force main shall be laid at least 10 feet, horizontally, from any existing or proposed water main. Should local conditions prevent a lateral separation of 10 feet, a force main may be laid closer than 10 feet to a water main, provided that the main is laid in a separate trench at such an elevation that the bottom of the water main is at least 18 inches above the top of the force main.

B. Whenever force mains must cross water mains, the force main shall be laid at such an elevation that the bottom of the water main is 18 inches above the top of the force main. This vertical separation should be maintained for that portion of the force main located within 10 feet horizontally of any water main it crosses, said 10 feet to be measured as the normal distance from the water main to the force main. In making such crossing, it is preferable to center a length of force main pipe under the water main to be crossed, so that the joints will be equidistant from the water main and as remote therefrom as possible.

C. Where a force main must cross over a water main, a vertical separation of 18 inches between the bottom of the force main and the top of the water main shall be maintained, with adequate support for the force main to prevent it from settling on and breaking the water main. In making such crossing, it is preferable to center a length of force main pipe over the water main to be crossed, so that the joints will be equidistant from the water main and as remote therefrom as possible.

3.03 EXISTING UTILITIES

A. The location of existing utilities, including underground utilities, is indicated on the drawings insofar as their existence and location were known at the time of preparation of the drawings. However, nothing in these Contract Documents shall be construed as a guarantee that such utilities are in the location indicated or that they actually exist, or that other utilities are not within the area of operations. The Contractor shall make all necessary investigations to determine the existence and locations of such utilities far enough in advance of pipelaying to allow for adjustments due to conflicts in the horizontal and vertical location of the pipe line.

B. The Contractor may obtain field utility locations by calling "Miss Utility" (1-800-552-7001) forty-eight (48) hours prior to working in the vicinity of existing facilities if calls have been responded to by Utility Owners and an additional twenty-four (24) hours if they have not responded. If the utilities fail to locate
and evidence of other facilities is present, a second call shall be made providing an additional three (3) hour notice.

C. Based on the location and the elevation of the existing utilities, the horizontal and vertical alignment of the new pipe shall be adjusted to avoid sharp changes in direction or localized high points.

D. The Contractor shall pay for any damage to and for maintenance and protection of existing utilities and structures.

3.04 CONNECTIONS TO EXISTING SYSTEM

A. Before the start of the construction, the Contractor shall dig test pits at all crossings of and at proposed connections to the existing system, as applicable, to determine the existing system location, size, and piping material. If the location, size, and piping material differs from that shown on the Drawings, the contractor shall notify Engineer immediately.

B. The Contractor shall make connections to the existing system under a pressure or non-pressure condition, as indicated, complying with the system owner’s requirements for the time of day such work can be done. The Contractor shall pay all costs associated with the connections unless otherwise indicated. If the system owner performs the work, the Contractor shall arrange for the work to be done.

3.05 PIPE INSTALLATION

A. Proper implements, tools, and facilities shall be provided and used for the safe and convenient performance of the work. All pipes, fittings, valves, and hydrants shall be lowered carefully into the trench by means of a derrick, ropes, or other suitable tools or equipment, in such a manner as to prevent damage to force main materials and protective coatings and linings. Under no circumstances shall force main materials be dropped or dumped into the trench. The trench should be dewatered prior to installation of the pipe. Installation of the pipe shall be in accordance with AWWA C600.

B. All pipes, fittings, valves and other appurtenances shall be examined carefully for damage and other defects immediately before installation. Defective materials shall be marked and held for inspection by the Owner, who may prescribe corrective repairs or reject materials.

C. All lumps, blisters, and excess coating shall be removed from the socket and plain ends of each pipe, and the outside of the plain end and the inside of the bell shall be wiped clean and dry and be free from dirt, sand, grit, or any other foreign material before the pipe is laid.

D. Foreign material shall be prevented from entering the pipe while it is being placed in the trench. During laying operations, no debris, tools, clothing, or other materials shall be placed in the pipe.

E. Laying of the pipe shall commence immediately after the excavation is started, and every means must be used to keep pipe lying closely behind the trenching.
The Engineer may stop the trenching when, in his opinion, the trench is open too far in advance of the pipe laying operation. Pipe may be laid in the best manner adapted to securing speed and good results. It shall, however, be in accordance with the manufacturer’s instructions and recommendations. As each length of pipe is placed in the trench, the joint shall be assembled and the pipe brought to correct line and grade. Before joints are made the pipe shall be well bedded on a firm foundation and no pipe shall be brought into position until the preceding length has been thoroughly embedded and secured in place. Any defects due to settlement shall be made good by the Contractor at his expense. Bell holes shall be dug sufficiently large to insure the making of proper joints.

F. Plastic encased aluminum foil tape shall be installed above all non-metallic pipe such that pipe can be located in the future with a metal locating device. Tape shall be color coded and permanently imprinted with identification message. Tape shall be LINEGUARD Detectable Underground Marking Tape, or equal.

G. At times when pipe laying is not in progress, the open ends of the pipe shall be closed by a water tight plug or other means approved by the Engineer. This provision shall apply during breaks as well as overnight. If water is in the trench, the plug shall remain in place until the trench is pumped completely dry. Care must be taken to prevent pipe flotation should the trench fill with water.

H. Specified laying conditions for force main shall be completed in strict accordance with the force main manufacturer’s recommendations.

I. When it is necessary to deflect pipe from a straight line in either the vertical or horizontal plane, the amount of deflection shall not exceed 2/3 of the deflection limits recommended by the manufacturer. The trench may be curved to change direction or to avoid obstructions within the limits of the curvature of the pipe as recommended by the pipe manufacturer. Required curvature shall be maintained using full joints and/or fittings. Short sections of pipe shall not be used without approval of Engineer.

J. Cutting pipe for insertion of valves, fittings, or closure pieces shall be done in a neat, workmanlike manner without creating damage to the pipe or lining. Pipe shall be cut so as to leave a smooth end at right angles to axis of the pipe.

### 3.06 VALVE AND FITTING INSTALLATION

A. Valve and fitting installation shall be in accordance with AWWA C600.

B. Prior to installation, valves shall be inspected for direction of opening, freedom of operation, tightness of pressure-containing bolting, cleanliness of valve ports and, especially, seating surfaces, handling damage, and cracks. Defective valves shall be corrected or replaced at Manufacturer’s/ Contractor’s expense.

C. Valves shall be located where shown on the Drawings and shall be supported so that no load transfers to the pipe. Valves, fittings, plugs, and caps shall be set and joined to the pipe in the manner specified in Part 3.05.
D. Valve boxes shall be provided for all buried valves. The valve box shall not transmit shock or stress to the valve and shall be plumb and centered over the operating nut of the valve, with the box cover flush with the finished grade.

E. All dead ends on new mains shall be closed with plugs or caps that are suitably restrained to prevent blowing off under test pressure.

3.07 THRUST RESTRAINT

A. All tees, bends, plugs and abrupt changes in direction of the force main piping shall be either harnessed or provided with thrust blocks.

B. Thrust blocking shall be in accordance with the standard detail, bearing on undisturbed earth. Thrust blocking shall be made of concrete having a compressive strength of not less than 3000 psi after 28 days. The system shall not be pressure tested for 14 days after the thrust blocks are poured.

C. If specified on the plans, fittings shall be restrained using Megalug Series 1100 retainer glands by EBAA Iron (or approved equal). Glands shall be manufactured of ductile iron conforming to ASTM A 536. Restraining devices shall be of ductile iron heat treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee-head bolts conforming to ANSI/AWWA A21.11 and C153/A21.53. Twist-off nuts shall be used to insure proper actuating of the restraining devices. The mechanical joint restraint device shall have a working pressure rating of at least 350 PSA for 3-16 inch pipe and of at least 250 psi. A minimum safety factor of 2 (to be included for all sizes).

D. If specified on the plans, fittings 4"-12" shall be restrained using Megalug Series 2000 PV retainer glands by EBAA Iron (or approved equal), and fittings 14"-36" shall be restrained using Megalug Series 2800 retainer glands by EBAA Iron (or approved equal). Glands shall be manufactured of ductile iron conforming to ASTM A 536. The restraint shall meet the requirements of ASTM F 1674-96. Twist-off nuts shall be used to insure proper actuating of the restraining devices. The mechanical joint restraint device shall have the same working pressure requirements as the pipe itself.

3.08 HYDROSTATIC TESTING

A. Hydrostatic testing shall be performed in accordance with AWWA C600, Section 4.

B. After placing the pipe, all thrust restraint, and valve support, and before placement of permanent surface, all newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure of at least 1.5 x the working pressure at the point of testing or 150 psi (whichever is greater). Allow seven days after thrust restraint blocks have been poured before testing. Hydrostatic test shall be made between all valved sections of force main so that test pressure is applied to one side of each valve in the system at a minimum.
C. Test Pressure Restrictions

Test pressures shall:

1. Not be less than 1.25 times the working pressure at the highest point along the test section.
2. Not exceed pipe or thrust restraint design pressures.
3. Be of at least 2-hour duration.
4. Not vary by more than ±5 psi for the duration of the test.
5. Not exceed twice the rated pressure of the valves or hydrants when the pressure boundary of the test section includes closed gate valves or hydrants.
6. Not exceed the rated pressure of the valves when the pressure boundary of the test section includes closed resilient-seated gate valves or butterfly valves.

D. Pressurization

Each valved section of pipe shall be filled with water in gallons per hour slowly and the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Owner's Representative.

E. Air Removal

Before applying the specified test pressure, air shall be expelled completely from the pipe, valves and hydrants. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall remain closed and left in place.

F. Examination

All exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings, valves, or hydrants that are discovered following the pressure test shall be repaired or replaced with sound material and the test shall be repeated until it is satisfactory.

3.09 LEAKAGE TESTING

A leakage test shall be conducted concurrently with the pressure test.

A. Leakage defined

Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, or any valved section thereof, to maintain pressure within 5 psi of
the specified test pressure after the air in the pipeline has been expelled and the pipe has been filled with water. Leakage shall not be measured by a drop in pressure in a test section over a period of time.

B. Allowable leakage

No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

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

in which \( L \) is the allowable leakage, in gallons per hour; \( S \) is the length of pipeline tested, in feet; \( D \) is the nominal diameter of the pipe, in inches; and \( P \) is the average test pressure during the leakage test, in pounds per square inch gauge.

1. Allowable leakage shall not exceed the amount given by the leakage formula found in the most current AWWA Standard C-600.

2. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gallons/hour/inch of nominal valve size shall be allowed.

C. Acceptance of Installation

Acceptance shall be determined on the basis of allowable leakage. If any test of pipe laid discloses leakage greater than that specified above, the Contractor shall, at his own expense, locate and make repairs as necessary until the leakage is within the specified allowance. All visible leaks are to be repaired regardless of the amount of leakage.

3.10 COORDINATION

All work in this section shall be coordinated with the plumbing and mechanical work so that connections and minor adjustments can be made.

END OF SECTION
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PART 1  GENERAL

1.01  WORK INCLUDED
   A. Provide all equipment, materials, labor, and services required to establish a permanent vegetative cover over all areas disturbed or altered by construction.

1.02  RELATED WORK
   A. Section 02300; Earthwork

1.03  SUBMITTALS
   A. Product Data: Submittals on seed and fertilizer shall include a test report from the Virginia Department of Agriculture and Consumer Services (VDACS) or a comparable testing lab. The test report shall bear the specific lot number of the product as well as the date sampled, the purity, and germination, the percent weed seed, the analysis, date tested as well as other pertinent data about the product.
   B. Guarantee: Written guarantee for a period of one growing season (minimum six months). Replacement shall be at no cost to the Owner.

1.04  REFERENCES
   A. The materials and method of construction for protective covering and erosion control shall be in accordance with the latest revisions of the Virginia Department of Transportation (VDOT) Standards, Road and Bridge Specifications.

1.05  JOB CONDITIONS
   A. Topsoil shall be stockpiled, on the project site, for reuse on all disturbed areas in the grading and landscape work.
   B. Seeding shall not begin until all site work has been completed, except utility trenches shall be seeded so that no more than 2000 lineal feet remain unseeded at any one time.
   C. Seeding shall only be performed between March 1 and May 31 or between August 15 and September 30. At other times, sodding or seeding with annual rye for temporary cover shall be completed until the desired spring or later summer seeding time.
   D. Seeding shall not be performed on frozen or muddy grounds or when prevailing winds exceed five (5) miles per hour.
PART 2  PRODUCTS

2.01  GENERAL

A. Materials shall be delivered in unbroken containers, clearly marked by the manufacturer as to contents. Limes, Fertilizer and Seed shall be labeled as to proportions, analysis and quality. Store all materials in a manner affording protection from damage by weather or vandalism.

2.02  LIME

A. Lime shall be ground or pulverized agricultural grade limestone containing not less than 85 percent total carbonates and shall be ground to such a fineness that at least 50% will pass a No.100 sieve and at least 90% will pass a No.20 sieve.

2.03  FERTILIZER

A. The fertilizer shall be an agricultural grade 10-20-10 or any equivalent 1-2-1 ratio fertilizer. Fertilizer shall be commercial/agricultural grade, free flowing, uniform in composition and shall conform to State and Federal regulations. Fertilizer shall bear the manufacturer's guaranteed statement of analysis.

2.04  SEED

A. Grass seed for lawns and open fields shall be 100 percent by weight Kentucky 31 Tall Fescue. Grass seed for drainage channels shall be 67 percent by weight Kentucky 31 Tall Fescue and 33 percent by weight Red Creeping Fescue. In restored areas, species and mixture shall match existing vegetation.

B. Grass seed shall be clean, fresh stock, and labeled in accordance with the Federal Seed Act and shall be produced by a recognized manufacturer and guaranteed by the dealer. The seed shall have the State of Virginia certification.

2.05  MULCH

A. Mulch shall be straw or grain mulch as described, or wood cellulose fiber.

B. Straw mulch shall be from oats wheat and or barley and shall be free of noxious weeds and noxious weed seeds. The straw will not contain sticks, rocks, or other objectionable material and will not be wet, moldy, or otherwise undesirable.

C. Wood cellulose fiber used for hydraulic mulching shall consist of specially manufactured commercially available products containing wood cellulose fiber, recycled newsprint fibers, or a combination of these materials. The wood cellulose fiber or newsprint fiber will contain no growth or germination inhibiting factor and shall contain a dye for color. The dye shall allow the operator to monitor the amount of mulch being applied to the area to insure proper coverage.
PART 3  EXECUTION

3.01  SUBGRADE PREPARATION

A.  All subgrade for finished lawn areas and drainage channels shall be raked to remove all debris and stones over two (2) inches in diameter.  All subgrade for open field areas and shoulders shall be raked to remove all debris and stone over three (3) inches in diameter.

B.  Prior to spreading topsoil, the subgrade shall be loosened to a minimum of four (4) inches by tilling, diskimg or harrowing.

3.02  TOPSOIL PREPARATION

A.  Topsoil shall be spread over the prepared subgrade in all lawn areas to a minimum depth of four (4) inches.  Bond topsoil to subgrade by tilling, diskimg or harrowing.  Topsoil shall not be spread over the subgrade when either the topsoil or subgrade are frozen or excessively wet.

B.  Where topsoil is not applied, the surface of finished grade shall also be prepared as specified for topsoil hereinafter.

C.  Prior to seeding finished lawn areas and drainage channels, topsoil surface shall be raked to remove all debris and stones over two (2) inches in diameter and to smooth any surface irregularities.  Prior to seeding open field areas and shoulders, topsoil shall be raked to remove all debris and stones over three (3) inches in diameter and to smooth any surface irregularities.

D.  Topsoil finish grade of lawn areas and open fields shall be slightly higher than existing grade and rounded off to avoid abrupt changes in grade.

3.03  PREPARATION OF AREAS TO BE SEEDED

A.  Slopes 3:1 or steeper

1.  On slopes, use the walking or tracking method with a dozer or other tracked equipment.  Vertically "walk" the slope so as to leave track marks perpendicular to the toe of the slope.  Remove large rocks, stones and roots over two inches in diameter.

2.  Where this tracking of slope areas is not possible or practical, the use of a slope chain may be used to loosen the top two inches of soil for proper seedbed preparation.  The chain shall be dragged across the top of the slope.  The spikes on the chain shall produce puncture marks in the slope as well as serve to loosen the soil surface.

3.  Where the sloped areas are smoothly graded and are unable to be loosened satisfactorily for seedbed preparation, cutting horizontal grooves into the slope may be required with the use of grading equipment or by other means.
4. If the slope is freshly graded and the surface is friable without disturbing, the Contractor may be allowed to seed the slope without further slope preparation.

B. Areas Flatter Than 3:1
1. Use a disk or harrow to loosen the top 4 inches of soil. Where this is not possible backdrag the area with the toothed bucket or dozer type equipment to loosen the soil surface.
2. Rake the area smooth and remove roots, rocks and other debris that may interfere with the seeding operation. Debris larger than two inches in diameter should be raked from the surface with the use of a York Rock Rake, hand rake or other comparable equipment.
3. In the final preparation of the surface, care should be taken to insure that low areas or depressions do not occur which could later cause ponding or settling out areas.

C. Ditchlines, Waterways, Channel Change Areas
1. Care should be taken to insure that a minimum of disturbance occurs in all areas that are to carry water through the site. Preparation for seeding in these areas consists of removing large stones, rocks, roots and other debris that may interfere with the germination of seed.
2. In ditchlines that will receive erosion control treatment, the ditch shall be free of all obstructions that may prevent the erosion control from being attached securely to the bottom and sides of the ditch.

3.04 LIME APPLICATION
A. Lime shall be applied at the rate of 90 lb./1000 sq. ft.
B. Lime may be applied with the use of a bulk spreader, drop type spreader, Hydroseeder or any other equipment approved for application by the Engineer. The application shall result in an even spreading of the lime over the entire area to be seeded.
C. In areas 3:1 or flatter the lime shall be applied after the diskling operation and before raking the soil. Lime shall be applied before any application of fertilizer except when the seeding equipment used is a hydroseeder. On slopes 3:1 or steeper or where a hydroseeder is used in the seeding operation, the application of lime can be made in connection with the fertilizer seed and mulch in the slurry mix in the hydroseeder.

3.05 FERTILIZER APPLICATION
A. The rate of application shall be the equivalent of 23 lbs./1000 sq ft. except where otherwise directed.
B. Fertilizer may be applied with the use of a bulk spreader, cyclone spreader, Hydroseeder or other equipment approved for application by the Engineer. The application shall result in an even spreading of the fertilizer over the entire area to be seeded.

C. The Contractor shall take care as to not spill large amounts of the fertilizer in the areas to be seeded during the loading and spreading of fertilizer.

D. The fertilizer shall be worked into the topsoil to a depth of 3 inches.

3.06 SEEDING

A. Prior to seeding, scarify the topsoil surface with a rake to a minimum depth of 1/4 inch. The application of seed shall be by broadcast, cyclone type, drill type, hydroseeder, or other equipment approved for application by the Engineer. The application of the seed over the area shall be even and at the rates specified.

B. Sow Seed by Mechanical Seeder as Follows:
   1. Mix seed thoroughly with clean dry sawdust and broadcast at rate of 200 lbs. of seed per acre for permanent seeding or as specified elsewhere for temporary seeding.
   2. Apply mulch uniformly to depth of approximately 1-1/4 inches.
   3. Anchor mulch by the following methods.
      a. Apply light tack coat of asphalt emulsion or synthetic mulch binder.
      b. On slopes steeper than 3 horizontal to 1 vertical, anchor with EC-2 (jute mesh) matting fastened to wooden stakes.

C. Sow Seed by Hydraulic Seeder as Follows:
   1. Prepare homogeneous slurry equal to the seed mixture used for mechanical seeding as specified in this Section.
   2. Distribute slurry uniformly at rate equal to the rate specified for mechanical seeding.
   3. Apply mulch as specified for sowing by mechanical seeder.

D. The Contractor shall take great care to insure that the seed is not sown into areas that are to receive landscaping or other treatment such as asphalt and or concrete pavement. This includes bed areas, landscaped berms, parking and drive areas as well as sidewalks, etc.

E. After sowing, seed shall be rolled with a cultipacker and immediately mulched with straw or wood cellulose fiber.

3.07 MULCHING
A. Straw mulch will be applied at the rate of 45 lbs./1000 sq. ft. Wood cellulose fiber mulch shall be applied at the rate of 35 lbs. dry weight/1000 sq. ft.

B. The application of straw mulch will be through a blower or other approved equipment capable of shredding the material from the bale and distributing it evenly over the seeded areas. The application of mulch will take place no more than 24 hours after the seeding operation of the area.

C. The application of wood cellulose fiber mulch shall be in a slurry mix through a hydroseeder. The slurry mixture shall be constantly agitated from the initial mixing point until the material is discharged onto the ground. The material shall then be applied over the seeded area in a manner not disruptive to the placement of seed.

D. The Contractor will take all necessary precautions to prevent the application of the wood cellulose fiber mulch, straw or binders onto landscaped areas, fixtures, fences and signs in the area to be mulched.

**3.08 MULCH TACKIFIER**

A. Straw mulch will be tacked to the seeded area by the use of one of the following methods. A crimping device may be used that will punch the straw into the soil to prevent wind disturbance. The use of a chemical binder manufactured for the purpose of securing mulch may also be used when applied with a hydroseeder. The use of wood cellulose is also allowed for tacking straw mulch.

B. When a chemical binder is used, follow the manufacturer's recommendations as to the rates of material required. The Contractor may also elect the use of an application of wood cellulose fiber at the rate of 750 pounds to the acre as a tackifier in lieu of the above methods.

C. The tacking or securing of the straw mulch shall be completed immediately after the mulching is complete.

**3.09 PROTECTION AND MAINTENANCE OF SEEDED AREAS**

A. After the seeding is completed in a particular area, the area shall be protected from vehicular, and or foot traffic by erecting, barricades, signs, ropes or other such devices to prevent traffic where necessary.

B. Surfaces gullied or otherwise damaged following seeding shall be repaired and re-graded as required and re-seeded as directed by the Engineer.

C. In utility installation and erosion control areas, the maintenance period shall be the amount of time required to establish the desired species or its companion crop over 90% of the seeded area or 90 calendar days from the last seeding date.

D. In industrial lawn and shoulder areas, the maintenance period will extend through the time necessary to establish a healthy, uniform, two (2) inch high close stand of grass, free of weeds, bare spots, and surface irregularities.
3.10 ACCEPTANCE OF SEEDED AREAS

A. The acceptance of seeded areas shall be at the end of the establishment period mentioned above. Final acceptance shall be made when the specified vegetation is successfully established in the area to be accepted.

END OF SECTION
NOTE: COMPLETE FIRE HYDRANT ASSEMBLY INCLUDES HYDRANT, BRANCH PIPE, TEE, FITTINGS, GATE VALVE AND BOX, AND THRUST RESTRAINT.

AWWA C502 HYDRANT, SAFETY TYPE, TWO 2 1/2" HOSE CONNECTIONS, ONE 4 1/2" PUMPER CONNECTION, 5 1/4" MAIN VALVE OPENING, MECHANICAL JOINT INLET.

PUMPER NOZZLE SHALL FACE STREET

VARIABLE

2'x2' CONCRETE PAD (TYP.)

GRADE

18" MIN.
24" MAX.
2" MIN.

TWO LAYERS OF 15 LB. BUILDER'S FELT

12" MIN.

36" MIN.

VALVE BOX

6" GATE VALVE, M.J.

CONCRETE THRUST BLOCK (NO SUBSTITUTIONS)

TEE

6" DUCTILE IRON WATER MAIN ONLY

ENTIRE BRANCH SHALL BE RESTRAINED WITH MECHANICAL JOINT RESTRAINTS OR FOUR STAINLESS STEEL TIE RODS (3/4"

9 CU. FT. CLEAN STONE FOR DRAINAGE (VDOT 6B)
NOTE:

1. CORPORATION STOP SHALL BE SAME SIZE AS AIR RELEASE VALVE.

2. PLACE CONCRETE BLOCK, ASTM C–139, OR POUR 12"x8" CONCRETE RING FOOTING TO SUPPORT CHAMBER, BUT LEAVE OPENING BELOW PIPE. FILL SPACE INSIDE RING WITH CLEAN GRAVEL FOR DRAINAGE.

3. CONNECT PIPE OR COPPER TUBING TO OUTLET AND EXTEND UP 12". USE FITTINGS AS REQUIRED. PROVIDE SCREENED, DOWNWARD–FACING ELBOW & PIPE.
NOTES:

1. POST HYDRANT SHALL BE NON-FREEZING, SELF-DRAINING, FURNISHED WITH 2" FIP INLET, NON-TURNING OPERATING ROD (OPENING COUNTER-CLOCKWISE). OUTLET SHALL BE 2 1/2" NST.

2. DETAIL ALSO APPLIES TO DEAD END LINE EXCEPT TAPPED TEE IS RESTRAINED TAPPED PLUG/CAP.

3. PLASTIC METER BOX SHALL BE CARSON 1220 OR EQUAL.
TYPICAL 5/8" x 3/4" METER SETTING DETAIL
STANDARD DETAIL
Smyth County, Virginia

NOTES
1. PRESSURE REGULATOR SHALL BE 3/4" WILKINS 600LUSC OR APPROVED EQUAL

TANDEM COPPERSETTER-A.Y. MCDONALD 51-212QFGG33x995 OR FORD TVHC72-12W-44-33

COVER LABELED "WATER METER"
ADAPTOR RING AND LID COVER

HERSEY MODEL 430 5/8" x 3/4" WITH 6 WHEEL (10 GAL) TRANSLATOR REGISTER AND HOT ROD RADIO TRANSMITTER

ANGLE VALVE METER

24" DIA. METER BOX

30" MIN.

45" MAIN

3' MIN.

STABILIZATION ROD OR PIPE

CORPORATION STOP

NO. 57 STONE

3/4" SERVICE LINE

SCALE: NTS

SHEET WD-5
SECTION VIEW

NOTES:
1. RESTRAINED JOINTS SHALL BE REQUIRED WITHIN 20 FEET OF THE END OF CASING PIPE ON BOTH SIDES OF THE ROAD CROSSING.
2. SIZE, NUMBER AND PLACEMENT OF SPACERS SHALL BE IN ACCORDANCE WITH MANUFACTURER’S RECOMMENDATIONS.

<table>
<thead>
<tr>
<th>CASING PIPE SIZE</th>
<th>CARRIER PIPE</th>
<th>STEEL CASING PIPE</th>
<th>WALL THICKNESS (FOR ROADS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4&quot;</td>
<td>12&quot;</td>
<td>0.250&quot;</td>
<td></td>
</tr>
<tr>
<td>6&quot;</td>
<td>16&quot;</td>
<td>0.250&quot;</td>
<td></td>
</tr>
<tr>
<td>8&quot;</td>
<td>18&quot;</td>
<td>0.312&quot;</td>
<td></td>
</tr>
<tr>
<td>12&quot;</td>
<td>24&quot;</td>
<td>0.375&quot;</td>
<td></td>
</tr>
</tbody>
</table>

STEEL CASING PIPE SHALL CONFORM TO ASTM A139, GRADE B (NO HYDRO) WITH A MINIMUM YIELD STRENGTH OF 35,000 PSI.
TYPICAL CROSS SECTION

BEDDING PER SPECIFICATIONS

WATER PIPE

AGGREGATE BACKFILL MATERIAL (VDOT #21A) IN 8" LAYERS, EACH LAYER COMPACTED TO 95% DENSITY

2" VDOT SM-9.5 SAME THICKNESS AS EXIST. SURFACE, MIN. 2"
3/4" BARS, THREADED 8" MIN. BOTH ENDS. BARS TO BE SYMMETRICALLY PLACED.

<table>
<thead>
<tr>
<th>VALVE SIZE</th>
<th>NUMBER OF 3/4&quot; BARS REQUIRED</th>
<th>MAX. LENGTH OF SPIGOT PIPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>3&quot;</td>
<td>2</td>
<td>24&quot;</td>
</tr>
<tr>
<td>4&quot;</td>
<td>2</td>
<td>24&quot;</td>
</tr>
<tr>
<td>6&quot;</td>
<td>2</td>
<td>27&quot;</td>
</tr>
<tr>
<td>8&quot;</td>
<td>2</td>
<td>27&quot;</td>
</tr>
<tr>
<td>10&quot;</td>
<td>4</td>
<td>27&quot;</td>
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<tr>
<td>12&quot;</td>
<td>6</td>
<td>27&quot;</td>
</tr>
<tr>
<td>16&quot;</td>
<td>8</td>
<td>36&quot;</td>
</tr>
</tbody>
</table>

METHOD OF STRAPPING VALVE TO MAIN
STANDARD DETAIL
Smyth County, Virginia

SCALE: NTS

SHEET
WD-9
NOTE:

INSTALL TWO LAYERS OF 15 LB. BUILDER’S FELT OR TWO LAYERS OF 6 MIL. POLYETHYLENE BETWEEN CONCRETE AND FITTING.

<table>
<thead>
<tr>
<th>PIPE</th>
<th>11 1/4&quot; BEND</th>
<th>22 1/2&quot; BEND</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIA.</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>3&quot;</td>
<td>4&quot;</td>
<td>12&quot;</td>
</tr>
<tr>
<td>4&quot;</td>
<td>4&quot;</td>
<td>12&quot;</td>
</tr>
<tr>
<td>6&quot;</td>
<td>6&quot;</td>
<td>14&quot;</td>
</tr>
<tr>
<td>8&quot;</td>
<td>8&quot;</td>
<td>16&quot;</td>
</tr>
<tr>
<td>10&quot;</td>
<td>9&quot;</td>
<td>18&quot;</td>
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<tr>
<td>12&quot;</td>
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<td>20&quot;</td>
</tr>
<tr>
<td>16&quot;</td>
<td>15&quot;</td>
<td>24&quot;</td>
</tr>
</tbody>
</table>

BASED ON NORMAL OPERATING PRESSURE UP TO 150 PSI
E = ADDITIONAL LENGTH TO BE ADDED TO DIMENSION A FOR EACH ADDITIONAL 50 PSI PRESSURE UP TO 300 PSI

THRU{}ST BLOCK DETAIL
(11 1/4°-22 1/2° HORIZONTAL BENDS)
STANDARD DETAIL
Smyth County, Virginia
NOTE:

INSTALL TWO LAYERS OF 15 LB. BUILDER’S FELT OR TWO LAYERS OF 6 MIL. POLYETHYLENE BETWEEN CONCRETE AND FITTING.

<table>
<thead>
<tr>
<th>PIPE DIA</th>
<th>45° BEND</th>
<th>90° BEND</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
</tr>
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<tr>
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<td>14&quot;</td>
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<td>8&quot;</td>
<td>18&quot;</td>
<td>16&quot;</td>
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<tr>
<td>10&quot;</td>
<td>24&quot;</td>
<td>18&quot;</td>
</tr>
<tr>
<td>12&quot;</td>
<td>30&quot;</td>
<td>20&quot;</td>
</tr>
<tr>
<td>16&quot;</td>
<td>42&quot;</td>
<td>30&quot;</td>
</tr>
</tbody>
</table>

BASED ON NORMAL OPERATING PRESSURE UP TO 150 PSI
E = ADDITIONAL LENGTH TO BE ADDED TO DIMENSION A FOR EACH ADDITIONAL 50 PSI PRESSURE UP TO 300 PSI

SCALE: NATURAL

THRU BLOCK DETAIL (45°-90° HORIZONTAL BENDS)
STANDARD DETAIL
Smyth County, Virginia
UNDISTURBED EARTH OR FIRM SUBGRADE (TYP.)

NOTE:

INSTALL TWO LAYERS OF 15 LB. BUILDER'S FELT OR TWO LAYERS OF 6 MIL. POLYETHYLENE BETWEEN CONCRETE AND FITTING.

<table>
<thead>
<tr>
<th>TEE</th>
<th>BRANCH DIAMETER</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>3&quot;</td>
</tr>
<tr>
<td>A</td>
<td>12&quot;</td>
</tr>
<tr>
<td>B</td>
<td>12&quot;</td>
</tr>
<tr>
<td>C</td>
<td>8&quot;</td>
</tr>
<tr>
<td>D</td>
<td>6&quot;</td>
</tr>
</tbody>
</table>

BASED ON NORMAL OPERATING PRESSURE UP TO 150 PSI

NOTE:

INSTALL TWO LAYERS OF 15 LB. BUILDER'S FELT OR TWO LAYERS OF 6 MIL. POLYETHYLENE BETWEEN CONCRETE AND FITTING.

<table>
<thead>
<tr>
<th>PLUG</th>
<th>PIPE DIAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
<tr>
<td>E</td>
<td>14&quot;</td>
</tr>
<tr>
<td>F</td>
<td>8&quot;</td>
</tr>
</tbody>
</table>

BASED ON NORMAL OPERATING PRESSURE UP TO 150 PSI

SCALE: NTS

THrust Block (Horizontal Tees, Sleeves, Plugs, & Caps)
Standard Detail
Smyth County, Virginia
NOTE:

INSTALL TWO LAYERS OF 15 LB. BUILDER’S FELT OR TWO LAYERS OF 6 MIL. POLYETHYLENE BETWEEN CONCRETE AND FITTING.

<table>
<thead>
<tr>
<th>BEND</th>
<th>PIPE DIAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3&quot; 4&quot; 6&quot; 8&quot; 10&quot; 12&quot; 16&quot;</td>
</tr>
<tr>
<td>11 1/4&quot;</td>
<td>A  6&quot; 6&quot; 6&quot; 8&quot; 8&quot; 8&quot; 13&quot;</td>
</tr>
<tr>
<td></td>
<td>B  12&quot; 12&quot; 14&quot; 16&quot; 18&quot; 24&quot; 28&quot;</td>
</tr>
<tr>
<td></td>
<td>C  8&quot; 8&quot; 8&quot; 8&quot; 8&quot; 8&quot; 9&quot;</td>
</tr>
<tr>
<td>22 1/2&quot;</td>
<td>A  6&quot; 6&quot; 10&quot; 11&quot; 15&quot; 16&quot; 25&quot;</td>
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<tr>
<td></td>
<td>B  12&quot; 12&quot; 14&quot; 16&quot; 18&quot; 24&quot; 28&quot;</td>
</tr>
<tr>
<td></td>
<td>C  8&quot; 8&quot; 8&quot; 8&quot; 9&quot; 9&quot; 12&quot;</td>
</tr>
<tr>
<td>45°</td>
<td>A  10&quot; 12&quot; 14&quot; 21&quot; 19&quot; 32&quot; 48&quot;</td>
</tr>
<tr>
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<td>B  12&quot; 12&quot; 14&quot; 16&quot; 18&quot; 24&quot; 28&quot;</td>
</tr>
<tr>
<td></td>
<td>C  8&quot; 8&quot; 8&quot; 8&quot; 12&quot; 14&quot; 18&quot;</td>
</tr>
</tbody>
</table>

BASED ON NORMAL OPERATING PRESSURE UP TO 150 PSI
NOTE:

1. EMBED REINFORCING BARS MINIMUM OF 36 DIAMETERS INCLUDING HOOK.

2. PAINT EXPOSED BARS WITH TWO COATS OF BITUMINOUS PAINT.

3. WHERE 4 BARS ARE REQUIRED, PLACE 2 BARS SYMMETRICALLY AROUND FITTING.

4. INSTALL TWO LAYERS OF 15 LB. BUILDER'S FELT OR TWO LAYERS OF 6MIL POLYETHYLENE BETWEEN CONCRETE AND FITTING.

C = NUMBER AND SIZE OF REINFORCING BARS
D = DIMENSION OF PIPE DIAMETER

<table>
<thead>
<tr>
<th>BEND</th>
<th>PIPE DIAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>3&quot;</td>
</tr>
<tr>
<td>11 1/4&quot;</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>C</td>
</tr>
<tr>
<td>22 1/2&quot;</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>C</td>
</tr>
<tr>
<td>45°</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>C</td>
</tr>
</tbody>
</table>

BASED ON NORMAL OPERATING PRESSURE UP TO 150 PSI
CONCRETE THRUST BLOCK (SEE TABLE)

MJ VALVE
MJ PLUG

6"

3/4"ø THREADED RODS (SEE TABLE)

SOUND SOIL
UNDISTURBED

PLAN VIEW

TRENCH
WATER MAIN

L1
L2

12"

24"

6"

L1
L2

CONCRETE ANCHOR THRUST BLOCK

MJ VALVE
MJ PLUG

DUC-LUGS

3/4"ø THREADED RODS

SECTION VIEW

<table>
<thead>
<tr>
<th>ø (IN.)</th>
<th>B MIN. (IN.)</th>
<th>L1 MIN. (IN.)</th>
<th>NUMBER OF RODS</th>
<th>L2, MIN. (IN.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4–8</td>
<td>12</td>
<td>18</td>
<td>4</td>
<td>27</td>
</tr>
<tr>
<td>10–12</td>
<td>27</td>
<td>33</td>
<td>4</td>
<td>50</td>
</tr>
<tr>
<td>14–16</td>
<td>44</td>
<td>50</td>
<td>6</td>
<td>75</td>
</tr>
</tbody>
</table>

NOTE: FOR USE WITH TEST OR WORKING PRESSURE 200 PSI OR LESS.
NOTES:
1. MANHOLE TO MEET CURRENT REQUIREMENTS OF ASTM C-478.
2. CONCRETE TO BE 4000 PSI MINIMUM COMPRESSIVE STRENGTH.
3. ALL REINFORCING STEEL TO MEET CURRENT REQUIREMENTS OF ASTM A-615.
4. COLD APPLIED JOINT SEALER (RAM-NEK OR EQUAL) SHALL BE USED IN ADDITION TO THE JOINT SPECIFIED.
5. FLEXIBLE JOINT (RAM-NEK OR EQUAL) REQUIRED ON ALL PIPE CONNECTIONS TO MANHOLES. REFER TO SPECIFICATIONS
STANDARD MANHOLE FRAME AND COVER
STANDARD DETAIL
Smyth County, Virginia

STANDARD FRAME & COVER SHALL BE MAP REXEL D400 HINGED OR EQUAL (WITH VENT SLOTS)

VENTILATED

WATERPROOF FRAME & COVER SHALL BE MAP REXEL D400 HINGED OR EQUAL

UNVENTILATED

NOTE:

1. USE BOLTED LID FRAME AND COVER WHEN FLUSH OR ABOVE GRADE, INNER LID FRAME AND COVER WHEN BURIED.
1" FLYGT BRONZE HDL BALL CHECK VALVE II 2002 WITH FLOATING POLYSTYRENE BALL OR EQUAL

1" SCHEDULE 80 90° BEND

20 MESH BRASS SCREEN

1" SCHEDULE 80 PIPE GROUTED IN PLACE

EXISTING GRADE

PRECAST MANHOLE

WATERTIGHT MANHOLE FRAME & COVER

1" MIN.

9" MAX.

3" MIN.

SHEET
SD-3

STANDARD MANHOLE VENT
STANDARD DETAIL
Smyth County, Virginia
NOTES

1. FOR ALL UTILITY TRENCHES, ROCK SHALL BE REMOVED TO A DEPTH OF SIX INCHES BELOW THE BOTTOM OF THE PIPE, PIPE BELLS, AND FITTINGS, AND ALL UNDERCUT TRENCH EXCAVATION SHALL BE BACKFILLED WITH APPROVED GRANULAR MATERIAL.

2. INITIAL BACKFILL SHALL BE PLACED IN 6” LAYERS TO A MINIMUM OF 1’ ABOVE PIPE CROWN.

3. FOR GRASSED AREAS, FINAL BACKFILL SHALL BE PLACED IN 1’ LAYERS AND MOUNDED 3” ON TOP TO ALLOW FOR SETTLEMENT.

4. FOR NON-VDOT ROADWAY, DRIVEWAYS, AND SIDEWALKS, FINAL BACKFILL SHALL BE PLACED IN 6” LAYERS.
20"x20"x12" THICK CONCRETE PAD

CAST IRON PLUG (THREADED)

CAST IRON SIGMA P107 OR EQUAL FINISHED GRADE

VERT. PIPE U.N.O. TO MATCH MAINLINE PIPE SIZE

PROVIDE REDUCER IF/AS REQUIRED

45° (MJ x PE)

WYE(MJ x PE)
(45° EL. @ END OF LINE)

SEE PLAN FOR MAIN SIZE

MAINLINE PIPE

NOTE: SERVICE LATERALS SHALL BE 4-INCH
PUMP CONTROL PANEL DETAIL
STANDARD DETAIL
Smyth County, Virginia
SLOPED METAL ROOF - PAINTED

STEEL FRAMING & SUPPORTS

PUMP ELECTRICAL PANELS & SWITCHGEAR MOUNTED ON UNISTRUT BACKING

6"x6" STEEL POST - 36" MIN. BURY. EMBED IN CONCRETE. TYP. OF 3

CONCRETE ENCASEMENT

PROP. FIN. GRADE

SCALE: NTS

PUMP CONTROL PANEL ELEVATION DETAIL
STANDARD DETAIL
Smyth County, Virginia
APPENDIX A
UNIT PRICE DESCRIPTIONS

GENERAL

A. **Mobilization**: Mobilization shall consist of the performance of construction preparatory operations, including the movement of personnel and equipment to the project site, placement of project identification signs, payment of applicable fees and cost of insurance, payment of performance and payment bond and other insurance premiums and for the establishment of the field offices, and other facilities necessary to begin work on a substantial phase of the contract. Mobilization shall be paid for at the bid lump sum price, which price shall be full compensation for performing the work specified and the furnishing of all materials, labor, tools, equipment and incidentals necessary to mobilize and subsequently demobilize the construction preparatory operations. Mobilization shall not exceed 5% of the Base Bid.

WATER DISTRIBUTION SYSTEM

A. **Water Line/Service Line**: Payment will be made at the unit price bid per linear foot, measured horizontally along the centerline of the pipe. The unit price shall include all work necessary for a complete installation, including all pipe and fittings, excavation, bedding, backfill, thrust restraint, testing and restoration. Water line included in other items (e.g. road crossings) shall be excluded from this item.

B. **Gate Valve**: Payment will be made at the unit price bid for each size of gate valve indicated, and will include all work necessary for a complete installation as shown on the gate valve detail.

C. **Tapping Sleeve & Gate Valve**: Payment will be made at the unit price bid for each size of tapping sleeve & gate valve indicated, and will include all work necessary for a complete installation, including the tapping sleeve, gate valve and box.

D. **Fire Hydrant Assembly**: Payment will be made at the unit price bid, and will include all work necessary for a complete installation, including the tee, up to five feet of 6-inch pipe, 6-inch gate valve and box, fire hydrant, and restraint system, as shown on the detail.

E. **Bore & Jack Road Crossing**: Payment will be made at the unit price bid per linear foot of boring, measured horizontally along the centerline of the casing. The unit price shall include all work necessary for a complete installation as shown on the road crossing detail, including the carrier pipe. No separate payment will be made for unsuccessful bore attempts.

F. **Open Cut Road Crossing**: Payment will be made at the unit price bid per linear foot, measured horizontally along the centerline of the casing. The unit price shall include all work necessary for a complete installation as shown on the road crossing detail, including the carrier pipe, and all earthwork and restoration.

G. **Stream Crossing**: Payment will be made at the unit price bid, measured horizontally along the centerline of the pipe from one end of the concrete encasement to the other.
The unit price shall include all work necessary for a complete installation as shown on
the drawings and as required by the stream crossing permit, including pipe, fittings, and
concrete encasement.

H. Near Side Service Connection (not requiring a road crossing): Payment will be made at
the unit price bid for each and will include all work necessary for a complete installation
as shown on the water service connection detail, including up to 10 feet of service line.

I. Far Side Service Connection (requiring a road crossing): Payment will be made at the
unit price bid for each and will include all work necessary for a complete installation as
shown on the water service connection detail, including up to 50 feet of service line
(including up to 25 feet of road crossing, i.e., service line and casing).

J. Air Release Valve: Payment will be made at the unit price bid, and will include all work
necessary for a complete installation as shown on the air release valve detail.

K. Blow-off Assembly: Payment will be made at the unit price bid, and will include all work
necessary for a complete installation as shown on the blow-off assembly detail for the
particular type of blow-off assembly identified.

SANITARY SEWER COLLECTION SYSTEM

A. Gravity Sewer: Payment will be made at the unit price bid per linear foot, measured
horizontally from center to center of manholes. The linear foot measurements will be
based on horizontal plane surveying and correspond to the station numbers shown on the
plans. The unit price shall include all work necessary for a complete installation,
including all pipe, excavation, bedding, backfill, testing and restoration. Gravity sewer
included in other items (e.g. road crossings) shall be excluded from this item.

B. Force Main: Payment will be made on a horizontal linear foot unit price basis. The unit
price shall include all work necessary for a complete installation, including all pipe and
fittings, excavation, bedding, backfill, thrust restraint, testing and restoration. Force main
included in other items (e.g. road crossings) shall be excluded from this item.

C. Manhole: Payment will be made at the unit price bid per vertical foot, measured from the
invert of the outlet pipe to the top of the frame. The unit price shall include all work
necessary for a complete installation, including the manhole base and sections, inverts,
channels, pipe connections, drop pipe (for drop manhole), vent, steps, excavation,
backfill, testing and restoration. The manhole frame and cover will be excluded from this
item.

D. Manhole Frame and Cover: Payment will made at the unit price bid for each type of
frame and cover (standard or waterproof), and will include all work necessary for a
complete installation.

E. Bore & Jack Road Crossing: Payment will be made at the unit price bid per linear foot of
boring, measured horizontally along the centerline of the casing. The unit price shall
include all work necessary for a complete installation as shown on the road crossing.
detail, including the carrier pipe. No separate payment will be made for unsuccessful bore attempts.

F. **Open Cut Road Crossing:** Payment will be made at the unit price bid per linear foot, measured horizontally along the centerline of the casing. The unit price shall include all work necessary for a complete installation as shown on the road crossing detail, including the carrier pipe, and all earthwork and restoration.

G. **Stream Crossing:** Payment will be made at the unit price bid, measured horizontally along the centerline of the pipe from one end of the concrete encasement to the other. The unit price shall include all work necessary for a complete installation as shown on the drawings and as required by the stream crossing permit, including pipe, fittings, and concrete encasement.

H. **Near Side Service Connection (not requiring a road crossing):** Payment will be made at the unit price bid for each and will include all work necessary for a complete installation as shown on the sewer service connection detail, including the main line wye, pipe (up to 10 linear feet), fittings, cleanout, excavation, bedding, backfill, testing and restoration.

I. **Far Side Service Connection (requiring a road crossing):** Payment will be made at the unit price bid for each and will include all work necessary for a complete installation as shown on the sewer service connection detail, including the main line wye, up to 50 linear feet of service line (including up to 25 linear feet of road crossing, i.e., service line and casing), fittings, cleanout, excavation, bedding, backfill, testing and restoration.

J. **Cleanout:** Payment will be made at the unit price bid for each, and will include all work required for a complete installation in accordance with cleanout detail.