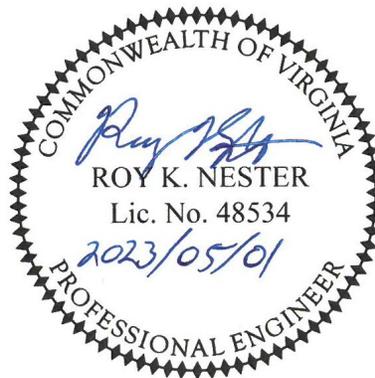


CITY OF CHARLOTTESVILLE, VA



POTABLE WATER AND SANITARY SEWER STANDARD SPECIFICATIONS AND DETAILS

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May 1, 2023

APPENDIX F

POTABLE WATER and SANITARY SEWER STANDARD SPECIFICATIONS

CITY OF CHARLOTTESVILLE, VIRGINIA

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GENERAL PROVISIONS

GENERAL PROVISIONS

REVISIONS

- A. 07/14/2013 – Section 02220 has been updated to require that all building demolitions include abandonment of the water and sewer service lines all the way to the public main unless otherwise approved by the Utilities Engineer. This change is an effort to protect purchasers of new homes or buildings from inheriting existing problems with water and sanitary laterals.
- B. 08/15/2013 – Design Requirements – Sanitary Sewer, Section D has been updated to require demolition of existing sanitary service laterals and more clearly define ownership of existing and new sanitary service laterals.
- C. 03/19/2014 – Section 15280 “Temporary By-pass Pumping” has been added to these specifications.
- D. 03/19/2014 – Section 15052 now requires that two bacterial test be taken for every 1200 linear feet of new water pipe install and that the disinfection procedures must be repeated on new water main following a failed bacterial test. These changes reflect forthcoming changes to VDH Waterworks Regulations.
- E. 04/29/2014 – Section 15253 now includes additional information on Mandrel Testing requirements for PVC pipe.
- F. 05/01/2023 – Design Requirements – Water, Section D horned services removed and detail W5.0 updated to reflect this. Minimum horizontal clearance and depth of cover also clarified.
- G. 05/01/2023 – Design Requirements – Sanitary Sewer, Section D has been updated to more clearly define ownership of existing and new sanitary service laterals. Section 14 also updated for horizontal clearance.
- H. 05/01/2023 – Design Requirements – Water, Section E added, which requires designers to submit fixture count calculations for meters 1” and larger.
- I. 05/01/2023 – Section 15052 requires 3.0 fps flushing velocity and discharge into sanitary sewer for chlorinated water.
- J. 05/01/2023 – Section 15104 updated for current water meter boxes.
- K. 05/01/2023 – Details W1.0 and W1.1 have been updated to require that all waterline be backfilled with VDOT #68 stone to top of the pipe.

PART 1. ABBREVIATIONS AND DEFINITION OF TERMS

1.01 ABBREVIATIONS

AIA – American Institute of Architects
AASHTO – American Association of State Highway and Transportation Officials
ACI – American Concrete Institute
ACSA – Albemarle County Service Authority
AMR – Automatic Meter Reading
ANSI – American National Standards Institute
AREA – American Railway Engineering Association
ARV – Air Relief Valve or Combination Air-Vacuum Relief Valve
ASA – American Standards Association
ASME – American Society of Mechanical Engineers
ASTM – The American Society for Testing Materials
AWG – American Wire Gauge
AWS – American Welding Society
AWWA – American Water Works Association
BOCA – Building Officials and Code Administrators
CAD – Computer-Aided Drafting
C.I. – Cast Iron
CMU – Concrete Masonry Unit
CSI – Construction Specifications Institute
DEQ – Virginia Department of Environmental Quality
D.I. – Ductile Iron
ERT – Electronic Radio Transmitter
F – Fahrenheit
fps – Feet per second
Galv. – Galvanized
gpd – Gallons per day
gpm – Gallons per minute
H:V – Horizontal to Vertical
I.D. – Inside Diameter
IBC – International Building Code
IPC – International Plumbing Code
ksi – Thousand pounds per square inch
M.H. – Manhole
No. – Number
NSF – National Sanitation Foundation
O.D. – Outside Diameter
OSHA – Occupational Safety and Health Administration
pcf – Pounds per Cubic Foot
PE – Polyethylene
PI – Plasticity Index
psi – Pounds per Square Inch
psig – Pounds per Square Inch Gage

PVC – Polyvinyl Chloride
R.C. – Reinforced Concrete
RWSA – Rivanna Water & Sewer Authority
Spec. – Specifications
Std. – Standard
SDR – Standard Dimensional Ratio
Typ. – Typical
USDA – United States Department of Agriculture
USGS – United States Geological Survey
V.C. – Vitrified Clay
VDH – Virginia Department of Health
VDOT – Virginia Department of Transportation
VDPOR – Virginia Department of Professional and Occupational Regulation
VMRC – Virginia Marine Resources Commission
VTM – Virginia Test Methods
VUSBC – Virginia Uniform Statewide Building Code
WWF – Welded wire fabric

Whenever the specifications of the ASTM, ANSI, AASHTO, AWWA and/or VUSBC, are referred to in these Standards, it shall be taken to mean the latest revised edition of such specifications, unless otherwise noted.

1.02 DEFINITIONS

- Agreement – The written contract between Owner and Contractor covering the Work to be performed; other contract Documents are attached to the Agreement and made a part thereof as provided therein.
- As-built – Construction plans and details that have been edited after construction to reflect accurate locations and features of all appurtenant utilities.
- Bedding – A layer of granular material, gravel, or crushed rock immediately below and supporting a conduit or fully or partially encasing a conduit. Material existing in a trench, ditch, or tunnel, upon which conduit is placed directly, is considered to be bedding.
- Bid – The offer or proposal of the Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.
- Building Sewer – In plumbing, the extensions from the building drain to the public sewer or other place of disposal. Also called a building connection.
- Change Order – A written order issued by the City to the Contractor directing certain changes, additions, or reductions in the Work or in the materials used.
- City – The City of Charlottesville, Virginia, referred to as Owner.
- Construction approval – A letter issued by the City of Charlottesville to a developer that authorizes him to construct facilities for which the design plans and specifications have been approved by the City of Charlottesville.

Contract Documents – The Contract, Contract Bond, General Conditions, Special Conditions, Specifications, and Plans, together with all Addenda, Change Orders, and Supplemental Agreements covering the project.

Contractor – The person, firm, or corporation with whom Owner has entered into the Agreement, or performing the work on the water or waste water system belonging to the City of Charlottesville.

Department of Public Works – The Department of Public Works of the City of Charlottesville, Virginia, its designated employ in charge of the project, or contracted representative.

Developer – Any person, firm, corporation or association having an interest in constructing improvements to alter the use of land. Of particular interest to the City are developers constructing facilities to be dedicated to public use within the jurisdictional area of the City.

Drainage Ditch – A natural or artificially constructed open depression for the purpose of carrying off surface water.

Drawings – The drawings which show the character and scope of the Work to be performed by the Contractor and which have been prepared or approved by the City and are referred to in the Contract Documents.

Easement – A grant of a right of use of the property of an owner for a certain purpose at the will of the grantee.

Engineer – An individual, firm, association, properly qualified person, or the legally authorized representative(s), designated by the Owner, experienced in and legally qualified to practice the profession involved. The term shall apply to the Owner when the Owner is acting as its own Architect or Engineer.

Guarantee Period – One year following the date of final acceptance of the work by the Owner unless otherwise specified.

Infiltration – groundwater entering sewers through defective joints and cracks in pipes and manholes.

Inflow – water discharged into sewers from foundation and roof drains, outdoor paved areas, cooling water from air conditioners, and unpolluted discharges from businesses and industries.

Inspector – The person appointed by the City, whose duty it is to inspect the materials used, and see that the work is performed in accordance with the Contract documents; and carry out such instructions as given him by the Engineer.

Interceptor – a sewer that receives sewage flow from a number of gravity mains, trunk sewers, sewage force mains, etc. On June 23, 2006 the City of Charlottesville defines interceptors as continuous sections of 24” diameter and greater sanitary sewer lines that continue to increase in diameter as they approach the RWSA interceptor.

Invert – The lowest point in the internal cross-section of a pipe.

Lateral – a sewer that has no other common sewers discharging into it.

Laws and (or) Regulations – Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

Main or trunk – a sewer that receives sewage flow from one or more sub main sewers. Sewer mains are generally 8” and 10” diameter. Sewer trunks are hereby defined as 12”, 15”, 16”, 18”, 21” diameter.

Owner – The party that will own and maintain the utilities upon completion of the work. Unless specified otherwise - The City of Charlottesville

Plans – The drawings which show the character and scope of the Work to be performed by the Contractor and which have been prepared or approved by the City and are referred to in the Contract Documents.

Potable Water – Water suitable for human consumption and domestic use.

Right-of-Way – A general term denoting land, property, or interest therein, usually in a strip, that is acquired or devoted to transportation or other public facilities, but is not meant to denote the legal nature of ownership.

Roadway – That portion of the street intended for use of vehicular traffic.

Sanitary Sewer – A pipe or conduit that carries wastewater.

Service Lateral – a sewer that has no other common sewers discharging into it. These lines are generally 4” diameter.

Sewer Service – See “Service Lateral”

Shop Drawings – All drawings, diagrams, illustrations, brochures, schedules, and other data that are prepared by the Contractor, a Subcontractor, manufacturer, supplier, or distributor that illustrate the equipment, material, or some portion of the Work.

Specifications – Those portions of the Contract Documents consisting of written technical descriptions of materials, equipment, construction systems, standards, and workmanship as applied to the Work and certain administrative details applicable thereto.

Storm Sewer – A sewer that carries storm water and surface water, street wash and other wash waters, or drainage, but excludes domestic wastewater and industrial wastes. Also called a storm drain.

Street – The whole right-of-way included between property lines, reserved for the accommodation of the traveling public, and its appertaining structures and slopes, and all ditches, channels, waterways, etc., necessary to its correct drainage.

Subcontractor – An individual, firm, or corporation having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the site.

Sub main – a sewer that receives flow from one or more lateral sewers. These sewers are generally 6” and 8” diameter.

Superintendent – The executive representative of the Contractor authorized to receive and fulfill instructions from the City and supervise and direct the construction.

Wastewater – The spent water of a community. From the standpoint of source, it may be a combination of the liquid and water-carried wastes from residences, commercial buildings, industrial plants, and institutions, together with any groundwater, surface water, and storm water that may be present.

Water Service – Water supply pipeline to a customer's building service line.

Work – The entire completed construction or the various separately identifiable parts thereof required to be furnished under the Contract Documents. Work includes and is the result of performing or furnishing labor and furnishing and incorporating materials and equipment into the construction, and performing or furnishing services and furnishing documents, all as required by the Contract Documents.

PART 2. GENERAL CONDITIONS

2.01 ENGINEERING AND ARCHITECTURAL GENERAL CONDITIONS

A. General.

1. The design of all potable water systems and sanitary sewer systems shall be performed under the direction of a registered professional engineer with a current registration in the Commonwealth of Virginia in accordance with Title 54.1, Chapter 3 of the Code of Virginia, 1950, as amended. Where applicable and in accordance with DPOR Regulations, design may be performed under the direction of a certified land surveyor in accordance with Section 54.1-408 of the above-cited Code.
2. The design of all potable water systems shall conform to the Virginia Department of Health Waterworks Regulations and to the requirements of other state and federal agencies having jurisdiction. The design of all sanitary sewer systems shall conform to the Virginia Department of Environmental Quality Sewage Collection and Treatment Regulations and to the requirements of other state and federal agencies having jurisdiction.
3. All properties within City limits shall be served by the City water distribution and the City wastewater collection systems. No new private wells (except for geothermal use) and no new private septic systems will be approved for construction and use.
4. All designs shall conform to the requirements of the City of Charlottesville. Where the requirements of the state and city are in conflict, the more restrictive requirements shall govern.
5. The designer shall be responsible for obtaining the review and necessary approvals of all drawings and specifications by applicable agencies having jurisdiction. Copies of such approvals shall be submitted to the City prior

to final review.

6. Water lines for developments or subdivisions are to be designed for maximum build-out of the area of which the subdivision or development is a part. Sanitary sewer lines for development or subdivisions are to be designed to serve the entire watershed of which the subdivision or development is a part. This necessitates consideration of property beyond the development or subdivision in question. The designer is required to design and construct the system, properly sized and at an appropriate location, to permit future extensions to be made at the limits of the subdivision or development in question. Elevation of the proposed sewer system lines and structures must be designed such that future extensions can serve the entire area that naturally drains towards the existing system.

B. Engineering report.

1. An engineering report shall be submitted to and approved by the City before approval of drawings and specifications, with the exception of lateral connections. The engineering report shall include a preliminary system design and an overall system layout plan. The report shall demonstrate that the water lines are designed to serve the entire subdivision or development. Where phased development is contemplated, the extent of each phase shall be clearly delineated.
2. Capacity studies for water lines will be required on an as-need basis as deemed necessary by the City Engineer for developments exceeding 40,000 gallons per day average flow based on VDH Water Works Regulations.
3. Capacity Study Requirements for Sanitary Sewer
 - a. Estimate of flow rate of sewage from a development
 - 1) The estimated flow rate shall be based on Table 3 in VDH Sewage Collection and Treatment Regulations (SCAT) 9VAC25-790-460. These figures may need to be adjusted to include infiltration and inflow.
 - 2) Additional provisions for inflow, infiltration and appropriate peaking factors shall be provided by the City of Charlottesville in consultation with the designer.
 - 3) The basis of design shall, in general, be that the sewer systems be designed for the estimated ultimate tributary population with an upper limit consisting of the 50-year population growth projection, except when considering parts of the systems that can be readily increased in capacity. Consideration shall be given too land use plans and to other planning documents and to the maximum anticipated capacity of institutions, industrial parks, apartment developments, etc. as required by SCAT Regulations 9VAC 25-790-310.B.

- 4) The minimum peak design capacity for lateral and submain sewers should be 400% of the average design flow SCAT Regulations 9VAC 25-790-310.D. This includes the effect of infiltration.
 - 5) The minimum peak design capacity of main and trunk sewers should be 250% of the average design flow and minimum peak design for interceptor sewers shall be 200% of the average design flow SCAT Regulations 9VAC 25-790-310.D. This includes the effect of infiltration.
- b. Guidance for determining sewer system adequacy
- 1) Sewage collection system downstream of the development shall be evaluated on an as-needed basis determined by the City of Charlottesville. In general, developments generating 4000 gallons per day (average daily flow) or more sewage shall comply with the following.
4. The designer shall:
- a. provide sewage quantity estimates from the development
 - b. provide capacity of receiving line at tie-in point and downstream at any critical points (as determined in consultation with the City) to where the line connects with a trunk line (as defined above)
 - c. provide a plan indicating the sanitary sewershed that the proposed development will impact. Label manholes with the city manhole ID numbers. Indicate MH top elevations, invert elevations, slope of line, and diameter of pipes. Include this information in a table as well, and
 - d. provide a table indicating the proposed additional load on the sewage collection system, the current capacity of the downstream lines analyzed, and a determination if there is available capacity to handle the proposed additional load.
 - e. Perform an evaluation of capacity of the existing system that shall include flow monitoring at a minimum of one location and may include additional locations as determined by the City of Charlottesville after consultation with the designer. Flow monitoring device(s) shall be in place so as to obtain 30 days flow data. The City requires analysis to a point where the sanitary sewer becomes a trunk line (i.e. is a continuous 12-inch diameter or greater).
 - f. Sharing of data
 - 1) All data submitted to the City shall be made available to any and all interested parties.

- C. Preliminary system design.
 - a. An analysis shall be prepared that tabulates the number of people being served or proposed to be served. The tabulation shall be by incremental areas for evaluation purposes.
 - b. Average and maximum flows shall be developed for areas and sub-areas and tabulated in the report as deemed necessary or appropriate.
 - c. The design documentation shall address total current and projected future flows and system capacities of existing and proposed utilities and shall provide the proposed line sizes.
 - d. Facility sizing shall be based on ultimate development (complete build-out of the area) and shall present all information necessary for a sound evaluation of the factors used in development of the report.
 - e. If proposed, an alternate design incorporating interim or staged construction shall be included.
 - f. The system layout plan shall delineate service area boundaries and clearly define the areas pertinent to interim and ultimate development of the service area. The system layout plan shall show present and future development, proposed interim and future utilities, and existing utilities that will be affected by or have an effect on the proposed utilities. Existing and proposed ground elevations shall be shown at contour intervals not exceeding two (2) feet unless otherwise approved by the City. Proposed utilities necessary to serve adjacent properties and associated easements shall be shown.
- D. Contacting property owners: Prior to performing any survey and design work on private property, the engineer/surveyor shall notify the affected landowner of the proposed project. Notification shall be made in the form of a letter to be sent to the property owner 7 to 10 days before commencing work. Copies of such letter shall be provided to the City along with the initial plan submittal.
- E. City review of construction drawings
 - 1. Prior to construction of potable water facilities and/or new sanitary sewer facilities, construction drawings for the proposed facilities must be submitted for review to the City. The construction drawings must be in a form acceptable to the City. Five (5) copies shall be submitted for review.
 - 2. Easements
 - a. Off-site easements shall be recorded and the deed book and page numbers of the recordation included on the utilities plans before

receiving approval of the plans for construction.

- b. Easements shall be required except where installed within a public right-of-way of the City of Charlottesville or the Virginia Department of Transportation. If the utility is placed within the outer 10 feet of the VDOT right-of-way, additional private easements shall be provided to allow 10 feet from the center of the pipeline. Easements shall not be less than 20 feet in width centered on the main. Combined sewer and water easements shall not be less than 30 feet in width with both mains 10 feet from the edges of the easement. The City reserves the right to require additional easement width if construction and maintenance activities require it.
- c. All easements shall have the right of ingress and egress fully provided for in the recorded deed. Where deemed necessary, easements shall extend to adjacent property for orderly extensions of service. No trees, shrubs, structures, fences, or obstacles shall be placed within an easement that would render the easement inaccessible by equipment. Any person who constructs a structure within the utility easement shall be liable for the cost of removal and any damage to the pipeline.

2.02 CONSTRUCTION DRAWING ORGANIZATION AND FORMAT

A. Drawing organization.

1. Drawings shall consist of the following types of sheets arranged in the order listed.
 - a. Cover sheet.
 - b. Index sheet (if necessary).
 - c. Plan and profile sheets.
 - d. Standard sheets and special details.
 - e. Erosion and sediment control details.

B. Sheet format.

1. All construction drawings shall be on sheets 24 inches by 36 inches.
2. The cover sheet shall contain the City's name and project description in large, distinctive letters, a vicinity map drawn on a scale of 1 inch = 2000 feet to indicate the general vicinity of the contemplated construction, an index to the plan sheets, and a seal of the design engineer or person responsible for the design (i.e. consistent with DPOR regulations). The vicinity map shall include a North arrow and a scale.

3. A plan index map shall be prepared for all pipeline projects. The index map shall be to a scale of not less than 1 inch = 600 feet, and shall show all proposed utilities with tie-ins to existing utilities. The lines of the proposed construction, together with proposed utility structures, shall be indexed to the drawings to indicate the extent of coverage on each drawing.
4. Plan sheets, as well as plan and profile sheets, shall show horizontal, vertical, and topographical data.
5. All plans shall bear a suitable title showing the City's name and project title. The plans shall also show the scale in feet, the North arrow, the date, and the name of licensed professional responsible for preparation of the plans. Each plan sheet shall bear the same general title identifying the overall project, and shall be numbered.

C. Drafting conventions.

1. Industry standard symbols should be used for drawings where applicable. When standard symbols are not used, a symbol key shall be included in the drawing set. Existing facilities shall be differentiated from new facilities.
2. Standard symbols — proposed facilities: Symbols shall be as noted above except that solid lines shall be used for pipes, line weight shall be no lighter than 0.024 inches and no heavier than 0.031 inches.
3. Text, dimensions and notes: Lettering shall be consistent and clear with a minimum height of 0.125 inches (1/8 inch). The larger size lettering type shall have proportionately wider line widths. When drawings are prepared using computer-aided drafting (CAD), the minimum text height shall be 0.10 inches.

D. Drawing standards.

1. All plans shall comply with the format and quality control requirements of the City. Plans that do not meet these criteria will not be acceptable for review.
2. Plans submitted for review shall be direct blue line or black line prints. Photocopies or facsimile reproductions will only be accepted for information or preliminary review purposes.
3. Drawings shall be clear and legible. Text shall be readable when drawings are reduced to half size.
4. The contrast of the printed material shall be high, with blank areas being as white as possible, and all information being as dark as practicable,

while remaining clear and distinct.

5. Shading, such as on plan views for paving, shall not be used on the drawings where it will hide any information when the drawing is photocopied or scanned. For areas that need to be identified or highlighted, stippling or cross-hatching may be used, provided no other information is hidden.

E. Additional information.

1. Horizontal scale in plan and profile sheets shall be no smaller than 1 inch = 50 feet.
2. Vertical profile scale shall be no smaller than 1 inch = 10 feet.
3. A bar scale shall be included on each sheet.
4. All known existing structures and utilities, both above and below ground, which might interfere with the proposed construction, particularly water mains, sewer mains, gas mains, storm drains, utility service lines, etc., shall be shown in plan and profile. Approximate locations shall be noted as such.
5. Benchmarks shall be set no more than 500 feet apart along the lines of construction but outside the limits of construction. Datum for elevations shown shall be North American Vertical Datum 1988 (NAVD88).
6. Drawings shall show existing and off-site easements required and identify deed book and page number.
7. Drawings shall show all property lines bordering the proposed work area. Property owners and tax map parcels shall be identified.
8. Project specifications shall be in the Construction Specifications Institute (CSI) 16-Division format. Specification sections contained herein shall be incorporated into the project specifications.
9. All sub-surface investigations, including test bores, reports, etc., utilized in the design shall be incorporated into the project specifications.
10. "As built" drawings shall be prepared and delivered to the City of Charlottesville by the designer, based on information provided by the Contractor, if so required in the contractual agreement between City and designer or developer.

2.03 CONTRACTOR GENERAL CONDITIONS

- A. General Conditions of the Contract entitled, General Provisions, published by

City of Charlottesville and as amended by Supplemental Conditions shall be made a part of the Contract documents and shall apply to all Contractors and Subcontractors.

- B. All Contractors and Subcontractors will be held to have examined and made themselves familiar with the articles of the General Conditions and the modifications and Supplemental Conditions thereof.
- C. Unless otherwise indicated, in cases where a water service lateral or sewer service lateral is permanently taken out of service or abandoned (aka demolished) such as in the case of the demolition of a building, the contractor is responsible for removing the service line to the main. In the case of a water service abandonment, the contractor shall remove all service lines to the corporation stop, where practicable and shut off the corporation stop. In the case of sanitary sewer service abandonment, the contractor shall remove all service line to the main where practicable and plug the tap and/or repair the main to the satisfaction of the City of Charlottesville. The contractor is responsible for any and all permits required to perform the work and repairing the paved surfaces as per these standards.
- D. All new construction shall have new water and sewer services. The contractor shall be responsible for any demolition of old utilities that served the property, as well as the installation of the new utilities for the property to be served.

END OF SECTION

DESIGN REQUIREMENTS

DESIGN REQUIREMENTS - POTABLE WATER

3.01 GENERAL REQUIREMENTS

A. Introduction.

1. The potable water distribution system currently in place consists of a network of interconnecting pipe with minimal dead-end lines. The designer shall make every effort possible to minimize the use of dead-end lines in the replacement of existing water lines and in the design of new extensions of the distribution system.

B. Basis.

1. All distribution system extensions and modifications shall be designed to adequately serve the ultimate needs of the area in which located. The design flow shall be based on acreage density with proper allowances for fire flows and future expected maximum growth per the Comprehensive Plan, latest edition, future land use map.
2. In the absence of information on population densities or unit flows, the designer shall supply sufficient information, substantiated by sound engineering judgment, to verify the design flow rates. The information shall be subject to approval by the City.

C. Design

1. All water lines shall be located in:
 - a. Legally established road rights-of-way; or
 - b. Legally established permanent easements for such purpose, either existing or as proposed by the designer.
2. Alignment shall be along the centerline of rights-of-way or easements except when this location has been previously used by any other utility. Exception to this specified location will be allowed only when it can be established that it is not practical to adhere to the standard location.
3. **Dead-ends should be minimized by looping of all mains.** Where dead-end lines occur, they shall be provided with a fire hydrant, flushing hydrant, or blowoff for flushing purposes. No flushing device shall be directly connected to any sewer. However, where dead-end lines are unavoidable, they shall be designed subject to the approval of the Utilities Engineer.
4. The use of fittings shall be minimized where possible by the use of pipe-joint deflections.

5. Provide thrust restraint at all fittings and as shown and called out on the Plans as necessary to conduct final pressure test of the completed line.
 - a. Retainer Glands may be used in lieu of restrained joint pipe. See Section 15050 for specifications.
 - b. Thrust restraints shall be used at all fittings. The designer shall confirm the adequacy of thrust blocks, if used, as shown on Detail Drawings W 2.0, W 2.1, W 2.2, and W 2.3 for each application.
6. Water lines with less than 10 feet of bury depth shall be located a minimum of 10 feet horizontally from any part of a building, structure, or its foundation. Waterline with 10 feet or greater bury depth shall be located a minimum of 15 feet horizontally from any part of a building, structure, or its foundation.
7. The designer shall consider the following factors in preparing layout:
 - a. Topography of the area.
 - b. Location of other utilities.
 - c. Groundwater elevations.
 - d. Sub-surface conditions.
 - e. Possible future structure locations.
 - f. Future maintenance by the Owner
8. All new construction will require new water service laterals be installed to the main line and demolition of any existing water service laterals.

3.02 TECHNICAL DESIGN - WATER

A. Design capacity.

1. The water distribution system and any extensions thereof shall have adequate capacity to supply the peak hour demands of all customers - domestic, public, commercial and industrial -while maintaining a pressure of not less than 30 pounds per square inch at all points of delivery. In addition, the system shall be capable of delivering maximum hour customer demand plus flows required for fire protection as determined by the City's Fire Marshal while maintaining a residual pressure of not less than 20 pounds per square inch at each service connection.

B. Customer demand.

1. The following criteria will be used in estimating customer water demands for hydraulic design computations.

- a. Residential demand (including single-family homes, townhouses, apartments).
 - 1) Maximum hour demand: 2 gpm per connection.
 - 2) Peak hour demand: 3 gpm per connection.
 - 3) Where the number of residential units is less than 1,000, the greater of the following equation or 2 gpm (for max hour demand, use 3 gpm for peak hour demand) per connection shall be used to estimate maximum hour demand:

$$Q = 11.4 * N^{0.544}$$

where Q = total demand (gpm)
 N = total number of residential units

- b. Commercial, industrial, and institutional water demand.
 - 1) Maximum hour demand: Use Tables A and B for estimation of water demand. Maximum hour demand shall be at least 300% of average hour demand computed from average daily flows. Note: In cases where VUSBC (Virginia Uniform Statewide Building Code) requirements are more stringent, the VUSBC requirements govern.
 - 2) Peak hour demand: Calculate peak hour demand by applying a 1.5 factor to maximum hour demand.
 - 3) Industrial flows shall be estimated from flow records or from similar large water users.
 - 4) Maximum hour demand and peak hour demand per connection shall not be less than 2 gpm and 3 gpm, respectively.
 - c. Applicable design flows shall be selected through coordination with the City Engineer, Department of Utilities, City Fire Marshal, and other local offices, as required.
2. When water distribution system extensions are to be made, the designer shall first determine the quantity of water required and then obtain from the City the hydraulic gradient for the point of connection to the City's system while providing said demands. Distribution piping design will be based upon providing capacities and service pressures in accordance with these standards from the supply design gradient furnished by the City.

3. Hydraulic design of distribution piping will be based on pipe carrying capacities consistent with head losses determined in accordance with the following Hazen-Williams Coefficients.

Pipe Diameter	Coefficient “C”
6”	100
8”	110
10”	115
12” and greater	120

C. Distribution system layout criteria

1. Secondary loops and cross mains with diameters less than 12" shall be spaced not more than 1,000 feet apart with no dead-end length exceeding 500 feet for any 8-inch main.
 - a. Dead ends should be minimized by looping all mains where possible.
 - b. The minimum size pipe for looped water distribution systems shall be 8 inches in diameter.
 - c. Any departure in minimum sizing shall be justified by hydraulic analysis and future water use and shall be considered only in special circumstances.
 - d. Water mains not sized for fire flows shall not be connected to fire hydrants.
2. Maximum velocity within water lines at peak demand shall be less than 5.0 fps.
3. All mains, branches, and dead-ends shall be equipped with blow-offs and/or hydrants of adequate size and number to develop a velocity in the main of at least 2.5 feet per second. Blow-offs will be required at low points of lines 8-inches I.D. and larger where practical.
4. Separation of water lines and sanitary sewers.
 - a. The following factors shall be considered in providing adequate separation.
 - 1) Materials and types of joints for water and sewer pipes.
 - 2) Soil conditions.
 - 3) Service branch connections into the water line and sewer lines.
 - 4) Compensating variations on the horizontal and vertical separations.
 - 5) Space for maintenance, repairs, and alterations of water and sewer pipes.

- 6) Offsetting of pipes around manholes.
 - 7) Standards and recommendations by Virginia Department of Health and DEQ.
- b. Parallel installation.
- 1) Potable water lines (including all appurtenances) and sanitary sewers (including all appurtenances) shall be separated horizontally by a clear distance of not less than 10 feet edge-to-edge wherever possible.
 - 2) If local conditions preclude a clear horizontal separation of 10 feet, the installation will be permitted provided the potable water line is in a separate trench and at such elevation that bottom of the potable water main is at least 18 inches above the top of the sewer.
 - 3) Where this separation cannot be obtained, the sewer shall be constructed of AWWA specified water pipe and pressure tested in place without leakage prior to backfilling. Sewer manholes shall be of watertight construction and tested in place.
- c. Crossings.
- 1) Provide a minimum vertical separation of 18 inches between the outside of the potable water line and the outside of the sewer when a potable water line must cross over a sewer line.
 - 2) Where this vertical separation cannot be obtained, the sewer shall be constructed of AWWA specified water pipe and pressure tested in place without leakage prior to backfilling.
 - 3) Sewers passing over potable water lines shall be constructed of AWWA specified water pipe. Minimum vertical separation of potable water line and sewer shall be 18 inches.
 - a) Center 1 full-length section of pipe so that the sewer joints will be equidistant from the potable water main joints.
 - b) Provide adequate structural support for the sewer so as to maintain line and grade.
- d. Potable water lines (and appurtenances) and sanitary sewers (and appurtenances) shall be separated horizontally by a clear distance of not less than 10 feet edge-to-edge wherever possible. No water lines shall pass through or come in contact with any part of a sanitary sewer or manhole.
5. Separation of water lines and other utilities.

- a. Potable water lines (and appurtenances) shall have a minimum parallel separation of 5 feet from gas lines and all other utilities. If not practical, provide the maximum separation possible with approval of Utilities Engineer.
 - b. At all crossings, provide a minimum vertical separation of 12 inches between potable water lines and gas mains or "wire-type" utilities with the water crossing above gas mains or "wire-type" utilities.
 - c. No water lines shall pass through or come in contact with any part of a storm sewer or manhole.
6. Depth of cover.
- a. Water pipe shall be laid with a minimum cover of 42-inches, measured from established finished grade to the top of the pipe. Depth of cover shall increase at high points where doing so will result in the elimination of air relief valves. Where air relief valves are to be installed, the designer shall ensure adequate cover exists to satisfactorily install the air relief valve assembly and vault.
 - b. In general, when designing public utilities, the water system shall be the shallowest utility and storm, sanitary sewer, and all dry utilities shall be deeper, where possible.
7. Automatic combination air-vacuum release valves shall be installed at the high points of water mains 10-inches I.D. and larger, where accumulation of air may interfere with flow. Automatic air release valves shall be installed in all other main sizes as required.
8. Valves shall be installed at the intersections of all water lines. Generally, three (3) valves will be used at crosses and two (2) valves at tees. A valve shall also be installed every 1000 feet on distribution mains. Additional valves may be required at the discretion of the City.
9. Fire hydrants shall be located on the distribution system as follows:
- a. In water systems and extensions serving 1- or 2-family residential areas, fire hydrants shall be located and installed so that there will be at least one hydrant within 300 feet of any building (existing or proposed in ultimate development) serviced by said system or extension.
 - b. Hydrants along streets or roads on which 1- or 2-family residences front shall be spaced not more than 600 feet apart.
 - c. In commercial, industrial, apartment, and townhouse areas, fire hydrants shall be provided as required to meet the fire protection standards of the American Insurance Association. In no case shall more than 300 feet of fire hose be required to reach any point at the base of any exterior building wall from the

nearest fire hydrant or from each of the hydrants required to supply the stipulated fire flow.

- d. Not more than one fire hydrant shall be located on any 6-inch I.D. dead-end main and said fire hydrant shall be located not more than 300 feet from a looped main.
- e. Hydrants shall be located directly behind sidewalks and be placed where practical to meet ADA requirements.
- f. Any deviation from the above requirements shall be approved by the City Fire Marshal.

10. Surface water crossings.

- a. Water lines intended to cross streams, rivers, or other surface waters, with either continuous or intermittent flows, present special problems and should be discussed with the City, VDH and VMRC before final plans are prepared. Only under extraordinary conditions will the City approve aboveground crossings.
- b. The water line is to be installed a minimum of three (3) feet under the stream or river bed and be of special construction having flexible watertight joints.
- c. Valves shall be provided at both ends of the water crossing so that the section can be isolated for tests or repairs; the valves shall be easily accessible and not subject to flooding.
- d. Permanent 1-inch taps shall be made at each end of the crossing for testing and locating leaks. Taps shall be located within manhole-type vaults with watertight frames and covers.
- e. The designer is reminded that specific requirements of the Army Corp of Engineers, DEQ, and/or VMRC may apply to any stream crossing. A joint permit application may be filed with VMRC for review by these agencies.

11. Roadway crossings.

- a. All roadway crossings are subject to the approval and requirements of the governing authority having jurisdiction. Where approved, roadway crossings are to be by "open cut." Encasement in a steel casing pipe shall be done only at the direction of the governing authority. Where encasement is required, it shall be in compliance with the requirements of the governing authority and Detail Drawing W 9.0.
- b. Where crossings are required to be tunneled, bored, or jacked, said crossings are to be in compliance with the requirements of the governing authority and Detail Drawing W 9.0.

- c. Valves shall be provided at both ends of the crossing so that the pipe section can be isolated for testing or repairs. Valves are to be located a minimum of 40 feet from the ends of the crossing, easily accessible and not subject to flooding. No service connections shall be located between valves unless approved otherwise by the City.

12. Railroad crossings.

- a. Railroad crossings are subject to the approval and requirements of the operating railway company. Crossings are to be by tunneling, boring, or jacking, and are to comply with the requirements of the railway and Detail Drawing W 9.1.
- b. Valves shall be provided at both ends of the crossing so that the pipe section can be isolated for testing or repairs. Valves are to be located a minimum of 40 feet from the ends of the encasement, easily accessible, and not subject to flooding. No service connections shall be located between valves unless approved otherwise by the City.

D. Water service laterals

- 1. Service laterals shall be sized for maximum anticipated peak flow demand for the building being serviced in accordance with the requirements of the Virginia Uniform Statewide Building Code. Service lateral shall not be less than 3/4-inch diameter.

Table C is provided to assist in selecting appropriate service lateral pipe size. Maximum allowable water velocity for cold water service is 8 feet per second. Note: In cases where VUSBC requirements are more stringent, VUSBC governs.

- 2. All service laterals are to be installed with 36 inches minimum cover on the City side of the meter. Minimum cover may be reduced to 24 inches with written permission of the Utilities Engineer.
- 3. The service lateral shall run perpendicular to the main straight to the meter box or vault. The meter shall be located on the property that it is intended to service.
- 4. Where a service lateral must cross a sanitary sewer, the bottom of the service lateral within 10 feet of the point of crossing shall be at least 12 inches above the top of the sewer.
- 5. Service laterals shall be provided by the Contractor complete per details W 6.0, W 6.1, W 6.2, W 6.3, or W 6.4 with the exception of the meter and associated automatic meter reading components.
- 6. Meter boxes or vaults are to be located a minimum of 12 inches and a maximum of 36 inches directly behind the curb where possible or as directed by the Utilities Engineer. Where no curb exists, meter boxes and vaults shall be installed in

readily accessible locations beyond the limits of the street surfacing and driveways as directed by the City.

7. Metallic warning tape shall be installed with each service lateral.
8. Water laterals may not connect to fire lines or hydrant lines. Each water lateral must have its own connection to a public main line with a corporation stop or valve located adjacent to the main line.

E. Water Meters

1. Meter and associated automatic meter reading components will be provided and installed by the City. Table D is provided to assist in meter selection. Note: In cases where VUSBC requirements are more stringent, VUSBC governs.
2. For all proposed meters 1” and larger, the designer shall provide estimated domestic water demand calculations based on fixture counts or other means acceptable to the Utilities Engineer.

F. Piping materials.

1. All pipe for water main construction shall be cement-lined ductile iron pressure pipe of the push-on joint or mechanical joint or restrained joint variety, conforming to ANSI 21-51 (AWWA C151, latest revision). Thickness class shall be a minimum Class 52 for all pipe diameters.

Fittings for ductile iron pipe shall be mechanical joint ductile iron in accordance with AWWA Specifications C111, latest revision, with a minimum pressure rating of 250 pounds per square inch.

2. Service lines 2 inches and smaller shall be soft copper tubing, Type K, conforming to ASTM B88 and ANSI/AWWA C800. Service lines four (4) inches and larger shall be ductile iron pipe as noted in paragraph E.1 above. Three (3) inch service line is not allowed without written approval of the Utilities Engineer.
3. The City may approve alternate piping material at its discretion.

Table A.

AVERAGE FLOW QUANTITIES

	Gallons/Day/Acre	Equivalent Persons/Acre
Residential		
Low (R-25, R-40)	500	5
Medium (R-9, R-12, R-15)	1000	10
High (RTH, RMF)	2500	25
Other (Agriculture/ Undeveloped Land)	1000	10
Commercial		
Retail	2000	20
Office	1500	15
Industrial		
Light (M-1)	2000	20
Medium (M-2, M-3), Heavy	3500	35

Note: R-9, R-12, R-15, R-25, R-40, RTH, RMF, M-1, M-2 and M-3 are defined in BOCA National Building Code, latest edition.

TABLE B.
AVERAGE FACILITY FLOW RATES

Discharge Facility	Design Units	Flow (gpd)
Single family units (includes townhouses, individual house trailers, etc.)	3.5 people/dwelling	400
Apartments and condominiums	4 people/3 bedroom apt.	400
	3 people/2 bedroom apt.	300
	2 people/1 bedroom apt.	200
Schools with showers and cafeteria	Per person – elementary	16
	Per person – high school	25
Motels and hotels at 65 gals./person (rooms only)	Per room	130
Trailer courts at 4 persons/trailer	Per trailer	400
Restaurants	Per seat	50
Service stations	Per vehicle services	10
Factories	Per person per 8 hr. shift	25
Shopping centers	Per 1000 sq. ft.	250
Hospitals	Per bed	300
Nursing homes	Per bed	200
Homes for the aged	Per bed	100
Doctor's office in medical center	Per 1000 sq. ft.	500
Laundromats, 9 to 12 machines	Per machine	500
Theaters (auditorium type)	Per seat	5
Bowling alleys	Per lane	75
Office buildings	Per 1000 sq. ft. of ultimate floor space	200

Note: Other classifications may be found in the BOCA National Plumbing Code, latest edition; the Virginia Department of Health Waterworks Regulations, latest edition, and the Virginia Department of Environmental Quality Sewage Collection and Treatment Regulations (SCAT Regs), latest edition.

TABLE C.
SIZING BASED ON VELOCITY LIMITATIONS COPPER WATER TUBE -
TYPE K (ASTM B88)

Nominal Size (in.)	Actual I.D. (in.)	Velocity - 4 feet per second		Velocity - 6 feet per second		Velocity - 8 feet per second	
		Maximum Probable Flow (gpm)	Friction (psi/100 ft.)	Maximum Probable Flow (gpm)	Friction (psi/100 ft.)	Maximum Probable Flow (gpm)	Friction (psi/100 ft.)
1/2	.527	2.72	8.55	4.08	18.0	5.44	30.4
3/4	.745	5.43	5.70	8.15	12.0	10.9	20.3
1	.995	9.69	4.06	14.5	8.53	19.4	14.5
1-1/4	1.245	15.2	3.12	22.8	6.56	30.3	11.1
1-1/2	1.481	21.5	2.55	32.2	5.35	42.9	9.07
2	1.959	37.6	1.84	56.4	3.86	75.1	6.53
2-1/2	2.435	58.0	1.42	87.1	2.99	116	5.06
3	2.907	82.7	1.16	124	2.43	165	4.11
4	3.857	146	0.83	218	1.74	291	2.95

Excerpt from The BOCA National Plumbing Code

TABLE D.

OPERATING CHARACTERISTICS FOR WATER METERS

Displacement type (AWWA Standard C700-77, cold water meters - displacement type)			
Meter size (in.)	Safe maximum operating capacity (gpm)	Maximum pressure loss at safe maximum operating capacity (psi)	Recommended maximum rate for continuous operations (gpm)
5/8	20	13	10
5/8 x 3/4	20	13	10
3/4	30	13	15
1	50	13	25
1-1/2	100	15	50
2	160	15	80
3	300	15	150
4	500	15	250
Compound type (AWWA Standard C-702-78, cold water meters - compound type)			
Meter size (in.)	Safe maximum operating capacity (gpm)	Maximum rate for continuous duty (gpm)	Maximum allowable loss of head at safe maximum operating capacity (psi)
2	160	80	20
3	320	160	20
4	500	250	20
Turbine type (AWWA Standard C-701-78, cold water meters - turbine type for customer service) Class I -- Vertical shaft and low velocity horizontal type			
Meter size (in.)	Safe maximum operating capacity (gpm)	Maximum rate for continuous duty (gpm)	Maximum loss of head at safe maximum operating capacity (psi)
1-1/2	100	50	15
2	160	80	15
3	350	175	15
4	600	300	15
Turbine type (AWWA Standard C-701-78, cold water meters - turbine type for customer service) Class II -- In line (high velocity type)			
Meter size (in.)	Safe maximum operating capacity (gpm)	Maximum rate for continuous duty (gpm)	Maximum loss of head at safe maximum operating capacity (psi)
2	160	100	7
3	350	240	7
4	630	420	7

From The BOCA National Plumbing Code

END OF SECTION

DESIGN REQUIREMENTS - SANITARY SEWER

4.01 GENERAL REQUIREMENTS

A. Introduction

1. Sewage collection systems shall be designed and constructed to achieve total containment of the predicted sewage flows contributed from the established service area and population. Sewers shall be designed and constructed to prevent the discharge of inadequately treated wastes or corrosion of facilities not only within the new systems but in the downstream receiving systems as well. Any projected overflows within receiving systems shall be addressed.

B. Basis

1. Sewer systems should be designed for the estimated ultimate tributary population with an upper limit consisting of the 50-year population growth projection. Proper allowance for peak flow shall be included as per the State Sewage Collection and Treatment Regulations. Consideration shall be given to land use plans, to the Comprehensive Plan of the City of Charlottesville, and to other relevant planning documents and to the maximum anticipated capacity of institutions, industrial parks, apartment developments, etc.

C. Factors

1. In determining the required capacities of sanitary sewers, the following factors shall be considered.
 - a. Maximum hourly sewage flow / Daily peaking factors
 - b. Additional maximum sewage or wastewater flows from industrial sources.
 - c. Preventing Groundwater infiltration
 - d. Topography of area
 - e. Location of existing sewers
 - f. Minimizing Depth of excavation
 - g. Pumping requirements
 - h. Occupancy rates

D. Sanitary sewer service laterals.

1. All new construction will require new sanitary sewer service laterals be installed to the main line and demolition of any existing sanitary sewer service laterals.

2. Service laterals shall be minimum 4-inch inside diameter. Slope shall be a minimum of 2% (1/4"/ft.) unless otherwise approved in writing by Utilities Engineer.
3. Ownership of service laterals.
 - a. Existing service laterals not previously accepted by Utilities shall be the responsibility of the owner of the property served by the service lateral from the building to the connection with the public main.
 - b. All new service laterals shall be owned and maintained by the property owner from the building to the connection with the public main.
4. Each individual dwelling shall have its own separate service lateral service line and connection in cases where each dwelling has its own tax map and parcel number.
5. No sewer lateral connection to the main line in the street or right of way shall be located at a distance greater than fifteen (15) feet from the nearest property corner of the lot to be served.

E. Private Septic Systems

1. No private sanitary sewer septic systems shall be constructed within the limits of the City of Charlottesville where a connection to the public sewer system is possible by extension of an existing sewer main.

4.02 TECHNICAL DESIGN – SANITARY SEWER

A. Capacity

1. New sewer system capacity shall be designed on the basis of an average daily per capita flow of sewage of not less than that set forth in Table A herein. These figures are assumed to include infiltration but do not address inflow from surface water. When deviations from the foregoing per capita rates and established peak flow factors are proposed, a description of the procedure used to establish those design flows shall be provided to the City for approval.
2. The minimum peak design capacity for lateral and sub-main sewers shall be 400 percent of the average design flow.
3. Minimum peak design capacity of main and trunk sewers shall be 250 percent of the average design flow.
4. Minimum peak design for interceptor sewers shall be 200 percent of the average design flow.

B. Pipe sizing

1. Gravity sewers shall be sized to serve the estimated ultimate tributary population and maximum anticipated flows for commercial, industrial, and institutional users consistent with the 50-year growth and land use projections for the City of Charlottesville. Hydraulic computations and other design data should clearly establish the capacity of proposed sewers.
2. Sewer size shall not be less than 8 inches in diameter, except under the following conditions.
 - a. Calculations and justifications indicating that reduced line size of six (6) inch diameter is adequate shall be provided for review and approval prior to inclusion within the system design.
 - b. This exception will only be allowed for laterals serving six or fewer connections.
3. Generally, the size of pipes shall be continually increasing in direction of flow with addition of tributary areas. However, when steep grades are available and length is such that significant cost savings will result without jeopardizing the system, the size of pipe may be reduced to no more than one nominal diameter, but not below 10 inches. Proper hydraulic allowances must be made for resulting head losses.
4. The following table represents the minimum slopes to be provided for gravity sewers; however, slopes greater than those listed are desirable:

Table A

Sewer Size	Minimum Slope in Feet/100 Feet Non-Settled Sewage	Maximum Allowable Capacity (MGD) (n=0.013)
8"	0.50	0.54
10"	0.28	0.75
12"	0.22	1.07
14"	0.17	1.45
15"	0.15	1.6
16"	0.14	1.8
18"	0.12	2.4
21"	0.10	3.1
24"	0.08	4.2
27"	0.067	5.2
30"	0.058	6.3

- a. Sewers shall be installed with uniform slope between manholes.
 - b. Sewers constructed on 20 percent slope or greater shall be anchored securely with concrete anchors or equal. Minimum anchorage is as follows:
 - 1) Slopes 20% to 35%: Not over 36 feet center-to-center
 - 2) Slopes 35% to 50%: Not over 24 feet center-to-center
 - 3) Slopes over 50%: Not over 16 feet center-to-center.
5. All sewer lines shall be designed for a minimum mean velocity of 2.0 fps when flowing full. Computations for velocity of flows shall be based upon the following values of “n” as used in the Manning formula for velocity of flow in pipes flowing full.
- a. Sizes 8 inches through 21 inches: “n” equals 0.014
 - b. Sizes 24 inches and above: “n” equals 0.014 unless justification is provided for an alternate value.

Manning Formula:
$$v = \left(\frac{1.49}{n} \right) R^{2/3} S^{1/2}$$

Where: R = Hydraulic radius
S = Slope
n = Manning’s roughness coefficient

The maximum permissible velocity shall not exceed 15 feet per second. Suitable provisions shall be provided to break steep slopes to limit the velocities in the connecting sewer pipes between manholes. Where velocities greater than 15 feet per second are unavoidable, special provisions shall be made to protect against internal erosion by high velocity. The pipe shall conform to applicable ASTM, AWWA, ANSI, or other appropriate standards or specifications, which provide protection against internal erosion.

C. Layout criteria

1. All sanitary sewers shall be located in:
 - a. Legally established road rights-of-way; or
 - b. Legally established permanent easements for such purpose, either existing or as proposed by the designer.
2. Construction shall be along the centerline of rights-of-way or easements except when this location has been previously used by another utility. Exception to this

specified location will be allowed only when it can be established that it is not practical to adhere to the standard location.

3. Sewers shall be installed at a sufficient depth of 24-inches of cover (minimum) to prevent ice formation due to cooling of the wastewater flows that results in blockage of the flow channel and to allow subaqueous crossings of creeks.
 - a. Exceptions to the above requirements will be considered only if it is impractical to provide required depths, in which case special approval must be secured, in writing, from the City. In the special case of less than minimal cover, ductile iron pipe of adequate thickness shall be provided.
4. All sewers shall be designed to prevent damage from superimposed loads. Proper allowance shall be made for loads on the sewer as a result of the width and depth of the trench.
5. Full access to sewers will be required following installation. This includes properly graded easements, gates in fences, culverts, trees over ditches, etc.
6. Where sewer depth is 10 feet or less, sewer lines and manholes shall be located a minimum of 10 feet horizontally from any part of a building, structure, or its foundation. Where the depth of sewer is greater than 10 feet, the sewer lines and manholes shall be located a minimum of 15 feet from any part of a building, structure, or its foundation.
7. All sewers shall be installed with a straight alignment between manholes. No curved sewers are allowed.
8. Sewer size and pipe material shall remain constant between manholes.
9. Sewers should intersect in manholes at deflection angles no less than 90 degrees.
10. Only ductile iron or SDR-26 PVC will be considered acceptable material for sewers. Sewers having more than 15' of cover shall be ductile iron. The material selected shall be adapted to local conditions such as character of industrial waste, possibility of septicity, soil characteristics, exceptionally heavy internal-external loadings, abrasions, and similar problems. The pipe material shall conform to applicable ASTM, AWWA, ANSI, or other appropriate standards..
11. The design engineer shall certify that all existing and proposed sites will be served by gravity with sewer service connections installed at a slope of 1/4 inch per 1 foot (2%) except where shown otherwise and noted on the Plans.
12. Separation of sewers and potable water lines
 - a. Parallel installations

- 1) Sewers shall be laid at least ten (10) feet horizontally from a water main. The distance shall be measured edge-to-edge.
- 2) When the minimum 10-foot separation between manholes and water lines cannot be attained, manholes must be both of watertight construction and tested in place.
- 3) When local conditions prohibit horizontal separation, the sewer may be laid closer provided that the water main is in a separate trench or an undisturbed earth shelf located on one side of the sewer and the bottom of the water main is at least 18 inches above the top of the sewer.
- 4) Where this vertical separation cannot be obtained, the sewer shall be constructed of water pipe material in accordance with AWWA specifications and pressure tested in place without leakage prior to backfilling. The hydrostatic test shall be conducted in accordance with the most recent edition of the AWWA standard (ANSI/AWWA C600-82) for the pipe material with the minimum test pressure of 30 psi. Sewer manholes shall be of watertight construction.

b. Crossings

- 1) A minimum vertical separation of 18 inches shall be provided between the bottom of the potable water main and the top of the sewer when a sewer line passes under the water line.
- 2) Where this vertical separation cannot be obtained, the sewer shall be constructed of AWWA specified water pipe and pressure tested in place without leakage prior to backfilling in accordance with State SCAT regulations.
- 3) Sewers passing over potable water lines shall be constructed of AWWA specified water pipe and pressure tested in place without leakage prior to backfilling in accordance with State SCAT regulations. Minimum vertical separation of potable water line and sewer shall be 18 inches.
- 4) For all crossings:
 - a) Center one (1) full-length section of pipe so that the sewer joints will be equidistant from the potable water line joints.
 - b) Provide adequate structural support for the sewer so as to maintain line and grade. Provide adequate structural support for water mains to prevent settlement.

13. Separation of Water and Sewer Service lines

- a. All sewer service lines shall be laid a minimum of five (5) feet from any water line.

14. Separation of sewers and other utilities

- a. A minimum horizontal separation of five (5) feet shall be maintained between parallel sewers and gas lines. Should this horizontal separation not be obtainable, this may be reduced to three (3) feet with approval of the City Gas Engineer.
- b. A minimum horizontal separation of five (5) feet shall be maintained between parallel sanitary and storm sewers lines. Should this horizontal separation not be obtainable, this may be reduced with approval of the City Engineer.
- c. Sanitary sewers crossing under storm sewers shall maintain a minimum separation of 12 inches. Where this separation is not possible, the sanitary sewer shall be constructed of AWWA specified ductile iron pipe. Concrete supports may be required for the storm sewer.
- d. Sewers shall have a minimum edge-to-edge separation of five (5) feet from all other utilities.
- e. At all crossings, provide a minimum vertical separation of 12 inches between sewers and other utilities.

15. No sewer line shall pass within 50 feet of a drinking water supply well, source, or structure unless special construction and pipe materials are used to obtain adequate protection. The proposed design shall identify and adequately address the protection of all drinking water supply wells, sources, and structures up to a distance of 100 feet of the sewer line installation.

D. Surface water crossings

1. Sewer lines intended to cross streams, rivers, or other surface waters, with either continuous or intermittent flows, present special problems and should be discussed with the City before final plans are prepared. Only under extraordinary conditions will above ground crossings be approved by the City.
2. The tops of all sewers entering or crossing streams shall be at a sufficient depth below the natural bottom of the streambed to protect the sewer line. In general, one (1)-foot minimum of suitable cover shall be provided. All proposed sewer stream crossings shall be ductile iron pipe encased in concrete. Stream crossings should also take future streambed improvements into consideration.
3. Sewers shall remain fully operational during the 25-year flood. Sewers and their appurtenances located along streams shall be protected against the normal range of high and low water conditions, including the 100-year flood. Sewers located

along streams shall be located outside of the streambed and should be sufficiently removed therefrom to provide for future possible channel widening.

4. Sewers entering or crossing streams shall be constructed of watertight pipe. Sewers laid on piers across ravines or streams shall be allowed only when it can be demonstrated that no other practical alternative exists. Such sewers on piers shall be constructed of ductile iron pipe and in accordance with the requirements for sewers entering or crossing under streams. Construction methods and materials of construction shall be such that sewers will remain watertight and free from change in alignment or grade due to anticipated hydraulic and physical loads, erosion, and impact. Consideration shall be given to using long-span ductile iron pipe or steel.
5. Depressed sewers or siphons, where approved by the City, shall have not less than 2 barrels, with a minimum pipe size of 6 inches and shall be provided with necessary appurtenances for convenient flushing and maintenance. The inlet and outlet chambers shall be designed to facilitate cleaning. Sufficient head shall be provided and pipe sizes selected to secure velocities of at least 3 feet per second for average flows. The inlet and outlet details shall be arranged so that normal flow is diverted to 1 barrel so that either barrel may be removed for service or cleaning.
6. The designer is reminded that specific requirements of the Army Corp of Engineers, DEQ, and/or VMRC may apply to any stream crossing. A joint permit application may be filed with VMRC for review by these agencies.

E. Roadway crossings

1. All roadway crossings are subject to the approval and requirements of the governing authority having jurisdiction. Where approved, roadway crossings are to be by "open cut." Encasement in a steel casing pipe shall be done only at the direction of the governing authority. Where encasement is required, it shall be in compliance with the requirements of the governing authority and Detail Drawing WW 3.0.
2. Where crossings are required to be tunneled, bored, or jacked, said crossings are to be in compliance with the requirements of the governing authority and Detail Drawing WW 3.0.
3. Manholes shall be provided at both ends of the crossing when casing is required to be installed. Manholes shall be located a maximum of 60 feet from the end of the casing and shall be easily accessible and not subject to flooding.

F. Railroad crossings

1. Railroad crossings are subject to the approval and requirements of the operational railway company. Crossings are to be by tunneling, boring, or jacking, and are to comply with the requirements of the railway and Detail Drawing WW 3.1.

2. Manholes shall be provided at both ends of the crossing a maximum of 60 feet from the end of the casing. Manholes shall be easily accessible and not subject to flooding.

G. Manholes

1. Manholes shall be installed at the end of each line, at all grade, size, or alignment changes, and at all sewer line intersections.
2. When manholes are located in areas accessible to vehicular traffic, they shall be spaced at distances no greater than 400 feet. When located in inaccessible areas, spacing of manholes on sewer lines shall not exceed 300 feet.
3. Sewer lines shall be protected from a 100-year flood by either raising manhole tops one (1) foot above base flood elevation of 100-year flood plain or by the use of watertight frames and covers. Where watertight frames and covers are used, unventilated length of sewer shall not exceed 1,000 feet. In addition, watertight frames and covers shall be used whenever manhole tops may be flooded for several hours.
4. Manhole top elevations shall be a minimum of 24” above grade in un-landscaped areas. In all other areas, the manhole top shall be flush with the surrounding grade.
5. Manholes shall be constructed of pre-cast concrete sections sized in accordance with Appendix E and Table B, whichever is larger.

Table B

Pipe Size	Manhole Size
8” – 15”	48”
16” – 27”	60”
30” – 45”	72”
48” or larger	84”

6. The use of drop manholes shall be avoided if possible. Where the use of a drop manhole is necessary the following requirements shall apply.
 - a. A drop pipe should be provided for an upstream sewer entering a manhole at an elevation of 24 inches or more above the manhole invert.
 - 1) Internal pipe drops shall only be used at existing manholes and only with the approval of the City. Where approved, the number of internal pipe drops at a manhole shall be limited to one.

- b. Sewer lines entering a manhole less than twenty-four (24) inches above the manhole invert shall not enter the manhole greater than twelve (12) inches above the manhole invert and shall be incorporated into a smooth transition by filleting the invert.

Miscellaneous head losses at manholes shall be computed in accordance with Table C. Junctions of more than 2 pipes will require special consideration.

Table C

Nominal Pipe Size	Drop Through Manhole (feet)
≤ 16"	0.2
≥ 16"	0.1

- c. Manholes where radius of turn is less than 2 pipe diameters:

$$H = (0.50) \left(\sqrt{\frac{angle}{90}} \right) \left(\frac{V^2}{2g} \right)$$

- Where: "angle" = horizontal deflection angle
 $V^2/2g$ = velocity head of effluent pipe
 V = velocity in ft./sec.
 g = earth gravity acceleration

- d. Manholes where radius of turn is greater than 2 pipe diameters:

$$H = (0.25) \left(\sqrt{\frac{angle}{90}} \right) \left(\frac{V^2}{2g} \right)$$

- Where: "angle" = horizontal deflection angle
 $V^2/2g$ = velocity head of effluent pipe
 V = velocity in ft./sec.
 g = earth gravity acceleration

- e. Head loss for straight run manhole shall be 0.05 feet. In no case shall loss less than 0.05 feet be allowed.

- f. Where pipe diameters increase at manholes, in direction of flow, effluent invert shall match crowns or be lowered below influent invert as follows:

$$\text{Change} = 0.8 (D1 - D2)$$

- Where: D1 = downstream pipe diameter
 D2 = upstream pipe diameter

This adjustment shall be in addition to computed miscellaneous head loss.

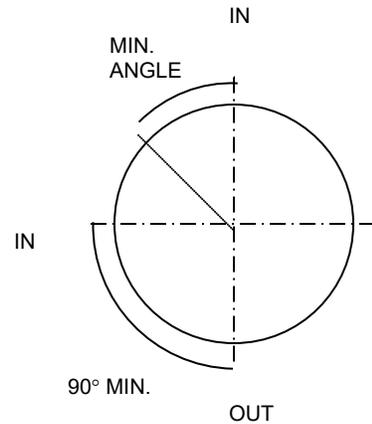
- g. Special consideration shall be given to cases where pipe diameters decrease in direction of flow.

7. Where velocities greater than 15 feet per second are expected, special provisions shall be made to protect against internal erosion by high velocity.
8. A monitoring manhole shall be required on all new construction or renovations or modifications to existing facilities, where the discharge originating in the new, renovated, or modified facility is, or will have the potential to be, non-domestic in nature. All wastewater from the facility shall flow through the monitoring manhole.
 - a. These facilities include but are not limited to industrial facilities, food preparation establishments, grocery stores, bakeries, automobile service stations, gasoline stations, hospitals, animal hospitals, cleaners, machine shops, photographic finishers, printing shops, laboratories, funeral homes, etc.
 - b. For multi-use buildings such as shopping centers, the sewer should be an adequate distance from the building to allow installation of a monitoring manhole and grease trap on each sewer lateral when the tenant spaces are upgraded.
 - c. A sewer lateral is required for each individually metered facility. Adequate space to accommodate installation of monitoring manhole and/or grease trap should be provided.
 - d. If the facility is master metered, a monitoring plan is required for the entire facility. A grease trap and monitoring manhole is required for each individual unit meeting the above definition.
9. Oil and grease interceptors and separators (traps)

Oil and grease traps shall be provided for all commercial and industrial facilities connected to the public sewer in accordance with the Virginia Uniform Statewide Building Code (reference International Plumbing Code Section 1003). Traps shall be maintained in an operation condition by periodic removal of accumulated deposits.

APPENDIX E. MANHOLE SIZING AND MINIMUM ANGLE TABLE

		PIPE SIZE (IN)													
		8	10	12	15	18	21	24	27	30	33	36	42	48	
48" MH	8	38°	40°												
	10	40°	43°												
	12	43°	45°	48°											
	15	47°	49°	51°	55°										
	18	55°	57°	59°	63°	71°									
	21	59°	61°	64°	67°	76°	80°								
	24	63°	65°	68°	71°	80°	84°	88°							
60" MH	12	34°	36°	38°	41°										
	15	37°	39°	41°	44°										
	18	44°	46°	48°	51°	57°									
	21	47°	49°	51°	54°	61°	64°								
	24	51°	53°	54°	57°	64°	67°	71°							
	27	54°	56°	58°	61°	67°	71°	74°	77°						
	30	57°	59°	61°	64°	71°	74°	77°	81°	84°					
33	61°	63°	64°	67°	74°	77°	81°	84°	87°	90°					
72" MH	15				37°	42°									
	18				42°	48°									
	21				45°	50°	53°								
	24				48°	53°	56°	59°							
	27				50°	56°	59°	62°	64°						
	30				53°	59°	62°	64°	67°	70°					
	33				56°	62°	64°	67°	70°	73°	76°				
36				59°	64°	67°	70°	73°	76°	78°	81°	87°			
84" MH	18					41°	43°								
	21					43°	46°								
	24					46°	48°	50°							
	27					48°	50°	53°	55°						
	30					50°	53°	55°	58°	60°					
	33					53°	55°	58°	60°	62°	65°				
	36					55°	58°	60°	62°	65°	67°	70°			
	42					60°	62°	65°	67°	70°	72°	74°	79°		
	48					65°	67°	70°	72°	74°	77°	79°	84°	89°	



END OF SECTION

DIVISION 2 – SITE WORK

SECTION 02100

CLEARING AND GRUBBING

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Contractor shall provide all labor, equipment, materials, and incidentals necessary to perform all clearing and grubbing within the limits of work as shown on the Drawings and specified herein.

1.02 RELATED WORK

- A. Excavation and Backfill.
- B. Section 02270, Erosion and Sediment Control.
- C. Section 02280, Seeding, Topsoiling, Fertilizing, and Mulching.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.01 CLEARING

- A. Area to be cleared and grubbed shall be completely cleared of all timber, brush, stumps, roots, grass, weeds, rubbish, and all other objectionable obstructions resting on or protruding through the surface of the ground. Clearing operations shall be conducted so as to:
 - 1. prevent damage to existing structures and installations, and to those under construction, and
 - 2. provide for the safety of employees and others.
- B. Minimize damage to trees outside construction limits and preserve as specified hereinafter.

3.02 GRUBBING

- A. Grubbing shall consist of the complete removal of all stumps, roots larger than 1-1/2 inches in diameter, matted roots, brush, timber, logs, concrete rubble, and all other debris encountered. All depressions excavated below the original ground surface for or by the removal of such objects shall be refilled with suitable materials and compacted to a density conforming to the surrounding ground surface.

3.03 DISPOSAL OF CLEARED AND GRUBBED MATERIAL

- A. The Contractor shall dispose of all material and debris from the clearing and grubbing operation by hauling such material and debris away to an approved dump. Disposal by burning or burial will not be permitted. Chipped material may be spread evenly across the easement or right-of-way with prior approval of the City.

3.04 PRESERVATION OF TREES

- A. Trees beyond construction limits shall be carefully protected from damage. The Contractor shall erect such barricades, guards, and enclosures he may consider necessary for the protection of the trees during all construction operations. Materials and equipment shall be maintained beyond the drip lines of such trees to the extent practicable. Where required, cut back limbs and branches to preserve trees and paint with an approved tree wound paint.

3.05 PRESERVATION OF DEVELOPED PRIVATE PROPERTY

- A. The Contractor shall exercise extreme care to avoid unnecessary disturbance of adjacent private property. Trees, shrubbery, gardens, lawn, and other landscaping damaged by the Contractor beyond the construction limits shall be restored to pre-construction conditions.
- B. All soil preparation procedures and replanting operations shall be performed under the supervision of a licensed nurseryman approved by the City or its representative.

END OF SECTION

**SECTION 02140
DEWATERING AND DRAINAGE**

PART 1 - GENERAL

1.01 STATUTORY REQUIREMENTS

- A. Obtain and pay for all permits required for temporary dewatering and drainage systems.
- B. Original permits shall be prominently displayed on the site prior to constructing dewatering and drainage systems.

1.02 SCOPE OF WORK

- A. Furnish, install, operate, monitor, maintain, and remove temporary dewatering and drainage systems as required to lower and maintain groundwater levels below sub-grades of excavations and trenches. Prevent surface water runoff from entering or accumulating in excavations and trenches.
- B. Furnish the services of a licensed professional engineer, registered in the Commonwealth of Virginia, to prepare dewatering and drainage system designs and submittals.
- C. Collect and properly dispose of all discharge water from dewatering and drainage systems in accordance with state and local requirements and permits.
- D. Repair damage caused by dewatering and drainage system operations.
- E. Remove temporary dewatering and drainage systems when no longer needed. Restore all disturbed areas.

1.03 RELATED WORK

- A. Section 02200, Excavation and Backfill.
- B. Section 02270, Erosion and Sediment Control.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 GENERAL

- A. Control surface water and groundwater such that excavation to final grade is made in-the-dry, and bearing soils are maintained undisturbed. Prevent softening, or instability of, or disturbance to, the sub-grade due to water seepage.
- B. Provide adequate protection against flotation for all work.
- C. The anticipated subsurface soil/water conditions shall be considered when selecting methods of excavation and temporary dewatering and drainage systems. Where groundwater levels are above the proposed bottoms of excavations, a pumped dewatering system shall be evaluated for pre-drainage of the soils prior to excavation to final grade and for maintenance of the lowered groundwater level until construction has been completed to such an extent that the foundation, structure, pipe, or fill will not be floated or otherwise damaged. Type of dewatering system, spacing of dewatering units, and other details of the work are expected to vary with soil/water conditions at a particular location. Excavation support system designs shall be prepared by a licensed professional engineer registered in the Commonwealth of Virginia.

3.02 SURFACE WATER CONTROL

- A. Control surface water runoff to prevent flow into excavations. Provide temporary measures such as dikes, ditches, and sumps.

3.03 EXCAVATION DEWATERING

- A. Provide and maintain adequate equipment and facilities to promptly remove and properly dispose of all water entering excavations. Excavations shall be kept in-the-dry, so as to maintain an undisturbed sub-grade condition throughout construction below grade, including backfill and fill placement.
- B. Pipe shall not be installed in water or be allowed to be submerged prior to backfilling. Pipe that becomes submerged shall be removed and the excavation dewatered and restored to proper conditions prior to reinstalling the pipe.
- C. Excavations for foundations and structures shall be maintained in-the-dry for a minimum of 4 days after concrete placement. In no event shall water be allowed to enter an excavation and rise to cause unbalanced pressure on foundations and structures until the concrete or mortar has set at least 24 hours.

- D. Dewatering and drainage operations shall at all times be conducted in such a manner as to preserve the natural, undisturbed bearing capacity of the sub-grade at the bottom of the excavation. If the sub-grade becomes disturbed for any reason, the unsuitable sub-grade material shall be removed and replaced with compacted granular fill to restore the bearing capacity of the sub-grade to its original undisturbed condition. Costs of such removal and restoration shall be the responsibility of the Contractor.
- E. Dewatering and drainage operations shall be conducted in a manner that does not cause loss of ground or disturbance to the pipe bedding or soil that supports overlying or adjacent structures.
- F. Provide diesel or gasoline powered standby pumping units ready for immediate use to serve the system in case of failure of normal pumping units.
- G. The Contractor shall prevent flotation by maintaining a positive and continuous operation of the dewatering system. The Contractor shall be fully responsible and liable for all damages that may result in failure of this system.
- H. The Contractor shall take all necessary precautions to preclude the accidental discharge of fuel, oil, etc., in order to prevent adverse effects on groundwater or surface water quality.
- I. If for any reason the dewatering system is found to be inadequate to meet the requirements set forth herein, the Contractor shall at his own expense make such additions, changes and/or replacements as necessary to provide a satisfactory dewatering system.
- J. Removal of dewatering equipment shall be accomplished after the system is no longer required. The Contractor shall remove the material and equipment constituting the system.

3.04 DISPOSAL OF DRAINAGE

- A. All water discharged from temporary dewatering and drainage systems shall be disposed of in accordance with the sediment and erosion control plan as specified in Section 02270.

END OF SECTION

**SECTION 02200
EXCAVATION AND BACKFILL**

PART 1 - GENERAL

1.01 STATUTORY REQUIREMENTS

- A. All excavation, trenching, sheeting, bracing, etc., shall comply with the requirements of OSHA excavation safety standards (29 CFR Part 1926.650 Subpart P) and any state and local requirements. Where conflict between OSHA, state, and local regulations exists, the most stringent requirements shall apply.

1.02 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required and perform all excavation work and grading; place and compact backfill and fill; and dispose of unsuitable waste and surplus materials as shown on the Drawings and as specified herein.
- B. Provide the services of a licensed professional engineer, registered in the Commonwealth of Virginia, to prepare temporary excavation support system designs and to inspect the installed temporary support systems.
- C. Furnish and install temporary excavation support systems, including sheeting, shoring, and bracing, to insure the safety of personnel and protect adjacent structures, piping, etc., in accordance with federal, state and local laws, regulations, and requirements.
- D. No classification of excavated materials will be made. Excavation includes all materials regardless of type, character, composition, moisture, or condition thereof.

1.03 RELATED WORK

- A. Section 02100, Clearing and Grubbing.
- B. Section 02140, Dewatering and Drainage.
- C. Section 02230, Fill and Granular Fill Materials.
- D. Section 02270, Erosion and Sediment Control.
- E. Section 02280, Seeding, Topsoiling, Fertilizing, and Mulching.
- F. Section 02575, Asphaltic Concrete Pavement and Appurtenances.

1.04 SUBMITTALS

- A. Test reports of compaction testing on embankment, fill, and backfill materials shall be submitted directly to the City with copies to Contractor.

1.05 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM).
 - 1. ASTM A36 - Specification for Carbon Structural Steel.
 - 2. ASTM A328 - Specification for Steel Sheet Piling.
 - 3. ASTM D698 - Test Method for Laboratory Compaction Characteristics of Soils Using Standard Efforts.
 - 4. ASTM D1557 - Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort.
- B. Virginia Department of Transportation (VDOT).
 - 1. Road and Bridge Specifications.
- C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.06 QUALITY ASSURANCE

- A. Excavation support system designs shall be prepared by a licensed professional engineer registered in the Commonwealth of Virginia.
- B. Materials will be tested and observed as described in the following paragraphs. Free access to the work for selection of test materials and observations shall be granted to the testing agency.
 - 1. Materials to be used in the work shall be tested by a certified independent testing laboratory engaged by the Contractor and acceptable to the City to demonstrate conformance with the requirements of these Specifications.
 - 2. Testing methods shall comply with the latest applicable ASTM or VDOT Standards specified.
 - 3. During the placement of bedding, backfill, and fill, the soils testing laboratory shall perform in-place soil density testing to confirm that fill material has been compacted in accordance with the requirements of this Section. The City may designate areas where soil density testing will not be required.

- a. At least 1 density and moisture content test for each 1,000 square feet of surface area for each compacted lift of fill at construction areas.
- b. At least 1 density and moisture content test for each 400 linear feet of installed pipe.
- c. Materials that have been previously tested may be subjected to further testing from time to time and may be rejected if it is determined that they do not conform to the requirements of these Specifications. Rejected materials shall be removed from the Work immediately when so directed by the City, notwithstanding the results of previous testing.

1.07 PROJECT/SITE CONDITIONS

- A. Boring locations and logs, if available, are included in the Contract documents. The data and recommendations presented are based on observations at specific boring locations as designated therein. Conditions between or away from the borings may vary from the conditions reported. No warranty of subsurface conditions, expressed or implied, is intended or made to any reviewer of the report.
- B. Existing structures. The Drawings may show certain surface and underground structures adjacent to the Work. This information has been obtained from existing records. It is not guaranteed to be correct or complete and is shown for the convenience of the Contractor. Contractor shall explore ahead of the required excavation to determine the exact location of all structures. They shall be supported and protected from damage by Contractor. If they are broken or damaged by Contractor, Contractor shall restore them immediately at his expense.
- C. Existing utilities.
 1. It shall be the responsibility of the Contractor to conduct the Work in such a manner as to avoid damage to, or interference with, any utility services. The Contractor is responsible for providing temporary supports for any utility that may be affected by its work. If any damage, interference, or interruption of service occurs as a result of its work, it shall be the Contractor's responsibility to promptly notify the City and utility owner of the occurrence and to repair, or cause to be repaired, the damage immediately, at Contractor's expense, and to the satisfaction of the City and the owner of the utility.
 2. It shall be the Contractor's responsibility to uncover and expose the location of all service connections to avoid damage or interruption of service. If damage occurs, the Contractor shall make the necessary repairs in accordance with the above requirements.

3. It is the responsibility of the Contractor to determine in advance of beginning the construction effort the exact location of all utilities, and the affect they will have on the Work. Contractor shall contact "Miss Utility" 48 hours prior to starting work. All costs related to identification of utility location shall be the responsibility of the Contractor.
 4. Do not interrupt existing utilities serving facilities occupied and used by the City or others, except when permitted in writing by the City and then only after acceptable temporary utility services have been provided.
 5. Demolish and completely remove from site the existing underground utilities indicated to be removed. Coordinate with utility companies for shut-off of services if lines are active.
- D. If conditions at variance with those described in the Contract Documents or Supplemental Project Information are encountered during construction, immediately notify the City in accordance with the requirements of the General Conditions.

1.08 DEFINITIONS

- A. Where the phrase "in-the-dry" is used in this Section, it shall be defined to mean a soil sub-grade that is stable with no ponded water, mud, or muck, and is able to support construction equipment without rutting or disturbance.
- B. Where used in this Section, "structures" refers to all buildings, wet wells, manholes, and below- grade vaults.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Fill materials designated for use in this Section are specified in Section 02230.
- B. Filter fabric.
 1. Filter fabric shall conform to the following requirements.
 - a. Minimum grab strength of 120 lbs. per ASTM D1682.
 - b. Apparent opening size to be equal to or greater than the U.S. Standard Sieve No. 100 (0.210 mm) per ASTM D4751.

- c. Percent open area not to exceed 30 percent. The “percent open area” is defined as the ratio of the sum of 20 or more individual open areas (times 100) to the sum of the corresponding 20 or more individual total areas.
 - d. Coefficient of permeability shall not be less than 0.2 cm/sec.
 - e. Filter fabric shall be Mirafi Type 140N; Dupont Type PAR, Style 3401; or approved equal.
- C. High strength geotextile fabric.
- 1. Geotextile fabric shall conform to the following requirements.
 - a. Minimum tensile strength of 360 lbs. per ASTM D4632.
 - b. Minimum puncture strength of 150 lbs. per ASTM D4833.
 - c. Apparent opening size to be equal to or greater than the U.S. Standard Sieve No. 40 per ASTM D4751.
 - d. Fabric material shall be woven polypropylene or polyester.
 - e. High strength geotextile fabric shall be LINQ Industrial Fabrics, Inc., GTF 375N, or approved equal.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Contact “Miss Utility” before beginning excavations and allow required time for marking. Before excavating within 20 feet of utility poles and after pipeline stake out, coordinate construction with the appropriate utility company. Immediately notify the City of any conflict of new Work with existing utilities that may require relocation of new Work or of existing utilities. All necessary support of utility poles shall be the sole responsibility of the Contractor at no additional expense to the owner or City.
- B. Prior to excavation, other utilities and underground facilities shall be located to confirm location, proper depth, and clearances. Care shall be taken in excavating to prevent damage to underground structures, utilities, and adjacent properties. When approaching and crossing such installations, a combination of installation methods may be used. Trenching equipment shall not be used within 2 feet of existing utilities.

C. Test holes.

1. Perform exploratory excavation work (test holes) for the purpose of verifying the location of underground utilities and structures and to check for unknown utilities and structures, prior to commencing excavation work. Contractor shall immediately notify the City if such exploratory work yields information that may alter the design or installation of the pipeline.
2. Test holes shall be backfilled as soon as the desired information has been obtained. Backfilled surfaces shall be stabilized in accordance with approved erosion and sediment control plans. Test holes in asphalt pavement shall be patched with a thickness equal to existing adjacent areas.

D. Dewatering and drainage systems.

1. Temporary dewatering and drainage systems shall be in place and operational prior to beginning excavation work.

3.02 EXCAVATION SUPPORT

- A. Furnish, install, monitor, and maintain excavation support (e.g., shoring, sheeting, bracing, trench boxes, etc.) as required by federal, state, or local laws, ordinances, regulations, and safety requirements. Support the sides of excavation to prevent any movement which could in any way reduce the width of the excavation below that necessary for proper construction and protect adjacent structures from undermining, settlement, or other damage. Take care to prevent the formation of voids outside of sheeting. If voids occur behind sheeting, immediately backfill and compact the voids with common fill material. Voids in locations that cannot be properly compacted upon backfilling shall be filled with 2000 psi concrete or flowable fill.
- B. Install excavation supports outside the neat lines of foundations. Supports shall be plumb and securely braced and tied in position. Excavation support shall be adequate to withstand all pressures to which the supports will be subjected. Any movement or bulging of supports shall be corrected to provide the necessary clearances, dimensions, and structural integrity.
- C. Excavation supports left in place.
 1. Excavation supports are required to remain in place if installed below the foundation and within a zone extending from the edge of the foundation and then outward and downward at 1H:1V below the pipe springline, or as specified on the Drawings.

2. The City may direct that certain excavation supports remain in place, or be cut off at any specific elevation. If the Contractor believes that such a directive increases Contractor's cost and would thereby entitle Contractor to a change in contract cost, Contractor shall notify the City in accordance with the applicable article(s) in the Contract General Conditions pertaining to changes in the Work.
 3. The right of the City to direct that certain excavation supports remain in place shall not be construed as creating any obligation to give such direction, nor shall failure to give such direction relieve the Contractor from liability for damages to persons or property occurring from or upon the work occasioned by negligence, or otherwise growing out of a failure on the part of the Contractor to leave in place sufficient excavation supports to prevent any movement of the ground or damage to adjacent structures.
- D. Excavation supports shall be carefully removed in such manner so as not to endanger the Work or other adjacent structures, utilities, or property. All voids left or caused by withdrawal of supports shall be immediately filled with sand and compacted.
- E. Excavation support systems shall be inspected during and after installation and monthly thereafter by the support system design engineer. The support system design engineer shall submit a written report to the Contractor for each inspection describing recommendations, if any.

3.03 EXCAVATION BELOW GRADE

- A. If the bottom of any excavation is taken out below the limits shown on the Drawings, specified, or directed by the City, it shall be refilled at the Contractor's expense with 4-inch layers of compacted granular fill or other material approved by the City.
- B. If the sub-grade is damaged by water, remove the unsuitable material and replace it with compacted granular fill or other approved material at Contractor's own expense so that the condition of the sub-grade meets with the approval of the City before any work is placed thereon.
- C. If, in the opinion of the City, the material, in its undisturbed natural condition at or below the normal grade of the excavation as indicated on the Drawings, is unsuitable for the work being performed, it shall be removed to such depth and width as directed and be replaced with suitable material for which compensation will be made at the unit prices established in the Contract.

3.04 STRUCURE EXCAVATION

- A. Excavation shall be made to the grades shown on the Drawings and to such widths as will give suitable room for construction of the structures for bracing, shoring, and dewatering. The bottom of the excavations shall be rendered firm and dry and in all respects acceptable to the City.
- B. Excavation and dewatering shall be accomplished by methods that preserve the undisturbed state of sub-grade soils. Exposed soil and rock sub-grades shall be proof rolled with at least two coverages of the compaction equipment. Sub-grade soils that become soft, loose, "quick," or otherwise unsatisfactory for support of structures as a result of inadequate excavation dewatering, proof rolling, or other construction methods shall be removed and replaced by granular fill at the Contractor's expense.
- C. Dewatering shall be such as to prevent boiling or detrimental under-seepage at the base of the excavation as specified herein.
- D. Excavation equipment shall be satisfactory for carrying out the Work in accordance with the requirements specified. In no case shall the earth be plowed, scraped, or dug with machinery so near to the finished sub-grade as to result in excavation of or disturbance of material below grade. Equipment used for excavation to final sub-grade shall furnish an undisturbed sub-grade surface.
- E. During final excavation to sub-grade level, take whatever precautions are required to prevent disturbance and remolding. Material that has become softened and mixed with water shall be removed. Hand excavation of the final 3 to 6 inches may be required to obtain a satisfactory undisturbed bottom. The City will be the sole judge as to whether the work has been accomplished satisfactorily.

3.05 EXCAVATION AND BACKFILLING FOR UNDERSLAB TRENCHES

- A. Excavation for all pipelines beneath structures shall be carried out with the excavating equipment operating from above the sub-grade for the structure. The excavation shall be carried out in-the-dry and in a manner that will preserve the undisturbed state of the sub-grade soils. The excavations may be completed with shoring and bracing at the Contractor's option with no additional cost to the City.

3.06 TRENCH EXCAVATION AND BACKFILLING

- A. Excavation for all trenches required for the installation of pipes shall be made to the depths indicated on the Drawings and in such a manner and to such widths as will give suitable room for laying the pipe within the

trench, for bracing and shoring, and dewatering. Render the bottom of the excavations firm and dry and in all respects acceptable to the City.

- B. Pavement, when encountered, shall be cut along straight lines before excavating. All excavations in concrete shall be precut in neat straight lines with a pavement breaker or saw. In sidewalks the excavation shall be a minimum of one “block” in size. If the sidewalk is combined with the curb, the curbing shall also be removed.
- C. Rock shall be removed to a minimum 6-inch clearance around the bottom and 12-inch minimum clearance on the sides of all pipe being laid.
- D. Excavation of earth material below the bottom of a trench shield shall not exceed the limits established by ordinances, codes, laws, and regulations.
 - 1. When using a trench shield for installing rigid pipe, any portion of the shield extending below mid-diameter shall be raised above this point prior to moving the shield ahead to install the next pipe.
 - 2. When using a trench shield for installing flexible pipe (PVC, PE, etc.), the bottom of the shield shall not extend below mid-diameter at any time.
 - 3. When a shield is removed or moved ahead, extreme care shall be taken to prevent the movement of pipe or the disturbance of the pipe bedding. Pipe that has been disturbed shall be removed and reinstalled at Contractor’s own expense.
- E. Where pipelines are to be constructed in fill areas, all fill material to a level 2 feet above the “top of pipe” elevation shall be placed and compacted to 95 percent dry density as determined by ASTM D698 prior to excavating pipe trench.
- F. Backfill excavations as promptly as work permits, removing bracing and shoring as backfilling progresses.
- G. In rock excavations, granular fill as noted on the Detail Drawings shall be placed and compacted in 6-inch lifts to a minimum depth of 12 inches above top of pipe. Compaction shall be to 95 percent of maximum dry density as determined by ASTM D698.
- H. In earth excavations, backfill as noted on the Detail Drawings shall be placed and compacted in 6-inch lifts to a minimum depth of 12 inches above top of pipe. Compaction shall be to 95 percent of maximum dry density as determined by ASTM D698. Pipe bedding shall be as shown on the Detail Drawings.

- I. Where the pipes are laid in unpaved areas, the remainder of the trench shall be filled with common fill in lifts not to exceed 1 foot and thoroughly compacted by rolling or tamping to prevent subsequent settling. The top 1-foot lift shall be select common fill. The backfill shall be mounded 3 inches above the existing grade or as directed. Wherever a loam or gravel surface exists prior to excavation, it shall be removed, conserved, and replaced to the full original depth as part of the Work. In some areas it may be necessary to remove excess material during the clean-up process so that the ground may be restored to its original level and condition. If storage of loam, gravel, or topsoil is not preferred, replace it with material of equal quality and in equal quantity at Contractor's own expense.
- J. Where the pipes are laid in streets or other paved areas, the remainder of the trench shall be backfilled with VDOT #21A crushed stone in 1-foot layers thoroughly compacted by rolling or tamping. The top 1-foot lift below the bottom of the specified paving shall be compacted in 6-inch layers.
- K. Along the length of all pipeline, construct impervious dams or bulkheads of clay or concrete in the trench bottom at 300-foot intervals or at manholes and structures, whichever is less, to obstruct the free flow of groundwater after construction is completed. Install impervious dams at all points where a pipe trench enters an excavated area where a permanent under-drain system is installed.

3.07 MISCELLANEOUS EXCAVATION

- A. Perform all miscellaneous excavations as required to complete the Work. Make all excavations necessary to permit the placing of loam and plants, for constructing roadways, and any other miscellaneous earth excavation required under the Contract.

3.08 ROCK AND BOULDER EXCAVATION AND DISPOSAL

- A. Rock excavation may be performed by jack hammering, expansive chemical splitting, or other similar processes. Blasting will not be permitted without written authorization by the City. The City must approve all rock excavation processes prior to any rock excavation.
 - 1. All blasting operations required for the purpose of rock excavation, including but not limited to permit acquisition, employee training/certification, explosives handling/storage and charge detonation, shall be performed in accordance with 29 CFR 1926, Subpart U – Blasting and the Use of Explosives.
 - 2. The Contractor shall be responsible for securing any and all required permits and for providing trained and certified blasting personnel. Prior to blasting, the Contractor shall submit to the City for approval a

written blasting procedure that includes addressing the protection of existing subsurface utilities and structures.

3. Blasting mats shall be required for all blasting operations. Blasting operations shall not be performed within 15 feet, or a distance otherwise determined by the City, of any existing water, gas, fuel, and/or sanitary sewer lines or drainage structures. The Contractor shall provide the City with charge specifications and soil type in the area adjacent to these utilities for review and approval prior to initiating any blasting operations.
 4. Any and all damage resulting from blasting operations shall be the responsibility of the Contractor, and shall be promptly repaired to the satisfaction of the City and at no cost to the City, utility, or property owner.
 5. EXCAVATION IS UNCLASSIFIED. NO ADDITIONAL PAYMENT WILL BE MADE FOR ROCK EXCAVATION.
- B. Fragmented rock with dimensions not exceeding 4 inches in any direction may be mixed with common fill and used as common fill in accordance with Section 02230.
- C. Unused rock and boulders shall be removed and disposed off site.

3.09 BACKFILLING - COMMON FILL

- A. Common fill may be used as trench backfill, as embankment fill, or in other areas as designated by the City. Material conforming to the requirements of common fill shall be placed in lifts having a maximum thickness of 1 foot measured before compaction.
- B. Common fill shall be compacted to at least 95 percent of maximum density as determined by ASTM D698.
- C. Materials placed in fill areas shall be deposited to the lines and grades shown on the Drawings making due allowance for settlement of the material and for the placing of loam thereon.
- D. The surfaces of filled areas shall be graded to smooth true lines, strictly conforming to grades indicated on the Plans. No soft spots or uncompacted areas will be allowed in the Work.
- E. No compacting shall be done when the material is too wet either from rain or from excess application of water. At such times, work shall be suspended until the previously placed and new materials have dried sufficiently to permit proper compaction.

3.10 BACKFILLING - STRUCTURAL FILL

- A. Structural fill shall be placed in lifts having a maximum thickness of 6 inches in open areas and 4 inches in confined areas including points where piping joins structures, measured before compaction. Each lift of fill shall be compacted to at least 95 percent of maximum dry density determined by ASTM D698 using methods approved by the City. The limits of structural fill adjacent to structures shall extend as shown on the Drawings.
- B. Structural fill shall not be placed on a frozen surface or one covered by snow or ice, nor shall snow, ice, or frozen earth be incorporated in the compacted fill.
- C. Structural fill shall be compacted by at least 4 coverages of all portions of the surface of each lift by compaction equipment. "One coverage" is defined as the condition obtained when all portions of the surface of the fill material have been subjected to the direct contact of the compactor.

3.11 BACKFILLING - GRANULAR FILL

- A. Place granular fill within pipe trenches and under structures as shown on the Drawings.
- B. Granular fill shall be placed in lifts having a maximum thickness of 1 foot measured before compaction. Each lift shall be compacted to at least 95 percent of maximum dry density determined by ASTM D698.
- C. Granular fill shall be compacted by at least 4 coverages of each lift with vibratory compaction equipment acceptable to the City.

3.12 EARTH EMBANKMENTS

- A. Prior to placing embankment fill materials, all organic materials (including peat and loam) and loose inorganic silt material (loess) shall be removed from areas beneath the embankments. If the sub-grade slopes are excessive, the sub-grade shall be stepped to produce a stable, horizontal surface for the placement of embankment materials. The existing sub-grade shall then be scarified to a depth of at least 6 inches. Adjust the moisture content of the scarified zone to slightly above optimum, and compact the sub-grade.
- B. Embankment fill shall consist of common fill material and shall be placed and compacted in even lifts of 12 inches (compacted thickness) and compacted to at least 90 percent of maximum dry density as determined by ASTM D698.
- C. Rock may not be used in embankment fill.

3.13 IMPERVIOUS FILL

- A. Impervious fill shall be placed in controlled, even lifts having a maximum thickness (measured before compaction) of 6 inches. Compaction shall be sufficient to attain a permeability of less than 1×10^{-7} cm/sec.
- B. Moisture content of impervious fill to be compacted shall be maintained at or near its optimum moisture content (-2 to +3 percent).

3.14 DISPOSAL OF SURPLUS MATERIAL

- A. Excess excavated materials shall be removed from the site and disposed of in accordance with local, state, and federal regulations. Materials shall be neatly piled so as to inconvenience as little as possible the public and adjoining property owners until used or otherwise disposed of as specified below.
- B. Erosion and sediment control measures shall be installed in accordance with Section 02270 as appropriate.
- C. Suitable excavated material meeting the requirements of Section 02230 may be used for fill embankments or backfill on the different parts of the Work as required.
- D. Surplus materials shall become the property of the Contractor and shall be removed and disposed off site.

3.15 GRADING

- A. Grading in preparation for placing of loam, planting areas, paved walks and drives, and appurtenances shall be performed in all places that are indicated on the Drawings, to the lines, grades, and elevations shown, and shall be performed in such a manner that the requirements for formation of embankments can be followed. All material encountered, of whatever nature within the limits indicated, shall be removed and disposed of in accordance with these specifications. During the process of grading, the sub-grade shall be maintained in such condition that it will be well drained at all times.
- B. If at the time of grading it is not possible to place any material in its final location, it shall be stockpiled in approved areas for later use. No extra payment will be made for the stockpiling or double handling of excavated material.
- C. The City reserves the right to make minor adjustments or revisions in lines or grades if found necessary as the Work progresses.

- D. Stones or rock fragments larger than 4 inches in their greatest dimension will not be permitted in the top 12 inches of the finished sub-grade of all fills or embankments.
- E. In cuts, all loose or protruding rocks on the bank slopes shall be barred loose or otherwise removed to line or finished grade of slope. All cut and fill slopes shall be uniformly dressed to the slope, cross section, and alignment shown on the Drawings.

3.16 RIPRAP FOR SLOPE STABILIZATION

- A. Prepare sub-grade for riprap. Remove vegetation, brush, tree stumps, or other objectionable material. Cut or fill to the required lines and grades. Any fills required shall be of the same type as and compacted to a density approximating that of the surrounding undisturbed material.
- B. Before installing riprap, install geotextile filter fabric as shown on the Drawings and in accordance with the geotextile manufacturer's instructions.
- C. Place riprap as soon as practicable after embankment construction. Limit lag between placement of embankment and riprap protection to the least time possible, and prevent mixture of soil with riprap material.
- D. Place riprap as shown on the Drawings and in conformance to the requirements of VDOT Road and Bridge Specifications Section 418 – Riprap. Place stones so that the weight of the stones is carried by the underlying material and not by the adjacent stones. Place large stones at the bottom of the slope. Fill spaces between stones with spalls of suitable size to construct a solid, stable slope, free from large voids and defects.

END OF SECTION

SECTION 02220 DEMOLITIONS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope

1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required for demolition, removal, and disposal Work.
2. Included, but not limited to, are demolition and removal of existing materials, equipment, or work necessary to install the new Work as shown, specified, and required. Demolition may include structural concrete, foundations, attachments, appurtenances, piping, paving, curbs, walks, fencing, and similar existing facilities. The owner/contractor performing demolition is obligated to remove water and sewer service lines back to the main and is obligated to obtain permits and repair pavement.

B. Related sections

1. Section 02100, Clearing and Grubbing
2. Section 02200, Excavation and Backfill
3. Section 02270, Erosion and Sediment Control

1.02 SUBMITTALS

- ##### **A. Schedule: Submit for approval proposed methods, equipment, and operating sequences. Include coordination for shut-off, capping, temporary services, continuation of utility services, and other applicable items to ensure no interruption of the City's or other's operations.**

1.03 PERMITS

- ##### **A. No demolition will be allowed without a permit issued from neighborhood development services indicating that all gas services have been properly abandoned and that other utilities have been located.**

1.04 JOB CONDITIONS

A. Protection

1. Perform all demolition and removal Work to prevent damage or injury to persons, structures, and adjacent features which might result from falling

debris or other causes, and so as not to interfere with the use and free and safe passage to and from adjacent structures.

2. Closing or obstructing of roadways, sidewalks, and passageways adjacent to the Work by the placement or storage of materials will not be permitted. All operations shall be conducted with a minimum interference to vehicular and pedestrian traffic on these ways.
 3. Erect and maintain barriers, lights, sidewalk sheds, and other necessary protective devices in accordance with the approval of authorities having jurisdiction. Road, sidewalk, or other access way closure will only be allowed with approval of authorities having jurisdiction.
- B. Notification: At least 48 hours prior to commencement of a demolition or removal, notify the City in writing of the proposed schedule. The City will inspect the existing equipment and mark for identification those items that are to remain the property of the City.
- C. Explosives
1. Do not bring explosives on site or use explosives without written consent of the City and authorities having jurisdiction. Such written consent will not relieve Contractor of total responsibility for injury or damage caused by blasting operations.
 2. Perform all blasting, if permitted, in compliance with applicable governing regulations.

PART 2 - PRODUCTS

2.01 Mechanical Plugs

- A. Mechanical plugs furnished for water main and sanitary sewer service abandonment shall consist of an adjustable plug with an extra large wing nut and a natural rubber o-ring.
- B. Mechanical plug shall be "Gripper Plug" by Cherne Industries, Inc. of Minneapolis, MN or approved equal.

2.02 Low Pressure Repair Clamp (gravity sanitary sewer)

- A. Low pressure repair clamp band shall be stainless steel Type 304. Lugs shall be high strength ductile iron ASTM A536. Gasket shall be nitrile (Buna N). The bridge plate shall be stainless steel recessed flush and bonded into gasket. Bolts shall be high strength low alloy ASTM A325 or A242 with heavy semi-finished hexagon nuts ASTM A563.
- B. Low pressure repair clamps shall be Smith-Blair 226 Full Circle Single Band

style manufactured by Smith-Blair, Inc. of Texarkana, AR or approved equal.

2.03 High Pressure Repair Clamp (water main)

- A. High pressure repair clamp band shall be stainless steel Type 304. Gasket shall be tapered with a gridded design.
- B. High pressure repair clamps shall be Dresser 360 repair clamp manufactured by Dresser Piping Specialties DMD-ROOTS Division of Bradford, PA or approved equal.

2.04 Flowable Fill

- A. Flowable fill shall be used as a fill material for abandoned pipelines or backfill material, only as directed by the City.
- B. Flowable fill shall be furnished and placed in accordance with the VDOT Special Provision for Flowable Backfill.
- C. Mix design for flowable backfill shall be provided by the Contractor. When used as backfill material for plugging designated abandoned pipes and culverts flowable backfill shall have a design compressive strength of 30 to 1200 pounds per square inch. The design compressive strength requirement shall be at 28 days when tested in accordance with ASTM D 4832. Mix design shall result in a fluid product having no less than an 8-inch slump at time of placement. The Contractor shall submit a mix design for approval supported by laboratory test data verifying compliance with 28 day compressive strength requirements. Mix design shall be approved by the Engineer prior to placement.
- D. Temperature of flowable backfill shall be at least 50 degrees F at time of placement. Material shall be protected from freezing for 24 hours after placement.
- E. When used to fill the voids in abandoned pipes and culverts, they shall be plugged and backfilled in accordance with the plan details or as directed by the Engineer. The plugs shall be in accordance with the plan details. The backfill material shall be flowable backfill placed into the abandoned pipe or culvert without voids. When deemed necessary by the Engineer, the Contractor shall submit a plan of operations for acceptance showing how the flowable backfill will be placed without voids. The opening for culvert backfill installation shall be sealed with masonry or Class A-3 concrete at completion of backfilling.

PART 3 - EXECUTION

3.01 GENERAL

- A. All materials and equipment removed from existing work shall become the property of Contractor, except for those that the City has identified and marked for their use. All cobblestones, paving bricks, and other materials and equipment marked by the City to remain theirs shall be carefully removed by the Contractor, so as not to be damaged, and shall be cleaned and stored on or adjacent to the site in a protected place specified by the City or loaded onto trucks provided by the City.
- B. Contractor shall dispose of all demolition materials, equipment, debris, and all other items not marked by the City to remain as property of the City, off the site and in conformance with all existing applicable laws and regulations.
- C. Pollution controls: Use water sprinkling, temporary enclosures, and other suitable methods to limit the amount of dust and dirt rising and scattering in the air to the lowest practical level. Comply with governing regulations pertaining to environmental protection.
 - 1. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.
 - 2. Clean adjacent structures, facilities, and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to conditions existing prior to the start of the Work.
- D. When underground piping is to be altered or removed, the remaining piping shall be properly capped. Abandoned underground piping may be left in place unless it interferes with new Work or is shown or specified to be removed. For water lines, saw cut ends and fill ends with foam to provide watertight seal or as directed by City representative.
- E. Any changes to potable water piping shall be made in conformance with all applicable codes and under the same requirements as other underground piping. All portions of the potable water system that have been altered or opened shall be pressure tested and disinfected in accordance with local codes and Section 15052.

3.02 SANITARY SEWER AND MANHOLE ABANDONMENT

- A. Sanitary sewers
 - 1. Sanitary sewers designated to be abandoned, but not removed, shall be excavated at the main, cut and properly capped or plugged at all open ends.

2. Grout plugs shall use ordinary cement-sand grout.
3. When required by the City, Contractor shall fill the abandoned sanitary sewer with a cement-sand grout slurry or flowable fill. Lines to be filled shall be capped or plugged at the downstream end, filled with the approved mixture, and capped or plugged at the upstream end.

B. Manhole and/or clean-out abandonment

1. Contractor shall remove the top 2 feet of the structure including frame and cover. Frames and covers shall be returned to the City.
2. Contractor shall fill the manhole or clean-out with No. 57 stone or other suitable approved material.
3. Sewer lines entering or exiting the manhole or clean-out shall be capped or plugged in accordance with Paragraph 3.02.A above.
4. Contractor shall restore the area above the manhole or clean-out to match the surrounding area. Where manholes or clean-outs are located in a roadway, roadway shall be restored in accordance with all City of Charlottesville paving requirements.

C. Sanitary Sewer Services

1. Demolition of buildings shall include demolition of the sanitary lateral all the way to the public main line or manhole.
2. Sanitary sewer services designated to be abandoned shall be abandoned in their entirety in the public right-of-way including removal to the tap fitting at the sanitary sewer main.
3. In cases where the tap is in a terra cotta main using a tapping tee and the tapping tee bell is in good condition, install a twist type plug manufactured by Cherne Industries, Inc. or approved equal. Condition assessment shall be made by a designated inspector from Public Utilities.
4. In cases where the tap is in a terra cotta main using a tapping tee and the tapping tee bell is not in good condition, install a replacement section of sanitary sewer main with two Fernco adapters with strong back steel bands.
5. In cases where the tap is in a terra cotta main using a cemented-on wye, remove the wye and install a repair clamp consisting of a rubber gasket and steel band at least ten (10) inches wide. Use Smith-Blair 226 Full Circle Low Pressure Repair Clamp Single Band or approved equal.
6. In cases where the tap is in PVC pipe, plug the main using a glue-on cap

or plug.

7. In all other cases, contact the City of Charlottesville for instructions on how to seal the main.

3.03 WATER MAIN AND LATERAL ABANDONMENT

A. Water mains

1. Water mains designated to be abandoned, but not removed, shall be excavated at the main, cut and properly capped or plugged at all open ends. Cap or plug shall result in a permanent and watertight seal. Install a mechanical cap or plug, foam plug, a combination of a mechanical plug and foam plug or other method to the satisfaction of the City of Charlottesville.

B. Water service laterals

1. Demolition of buildings shall include demolition of the existing lateral all the way to the public main line, and any valves, meters or other appurtenances located on the service or fire line.
2. Water services designated to be abandoned shall be removed in their entirety in the public right-of-way. The existing water service line shall be cut and removed from the corporation stop at the main. The corporation stop in the main line shall be left in place and closed.
3. If the corporation stop is found to be leaking, it shall be removed and the main repaired with a full circle repair clamp per Section 15050.

C. Asbestos-Cement Pipe

1. The Contractor shall assume that any pipe designated by the City as asbestos-cement pipe does contain asbestos in a quantity sufficient to be a health hazard.
2. Modifications for connections to and removal of asbestos-cement pipe shall be performed in accordance with all applicable U.S. Environmental Protection Agency and Federal and State Occupational, Safety and Health Administration regulations.
3. The Contractor shall ensure that all asbestos-cement pipe is saturated and continually sprayed with water prior to and while disturbing the pipe. Pipe shall not be ground, broken, crushed, sawed, or abraded which would cause asbestos material to become friable or airborne.
4. The Contractor shall appropriately dispose of the asbestos-cement pipe at an authorized disposal site in accordance with Federal, State and local

regulations. The Contractor shall provide the City with a signed manifest documenting the appropriate disposal of the asbestos-cement pipe.

3.04 VALVE ABANDONMENT

- A. All valves to be abandoned shall have the valve boxes completely removed. The excavation caused by the removal shall be backfilled, compacted and restored with seeding and mulch or pavement as required.
- B. The Contractor shall coordinate with the City prior to abandoning any valves so as to insure the proper open or closed position of the valve.

3.05 CLEAN-UP

- A. Contractor shall remove from the site all debris resulting from the demolition operations as it accumulates. Upon completion of the Work, all materials, equipment waste, and debris of every sort shall be removed and premises shall be left clean, neat, and orderly.

END OF SECTION

**SECTION 02230
FILL AND GRANULAR FILL MATERIALS**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Granular fill materials are specified in this Section, but their use for bedding pipe, replacement of unsuitable materials, cushion in ledge excavation, pavement base, foundation support, fill and backfill, and similar uses are specified in detail elsewhere.

1.02 RELATED WORK

- A. Section 02200, Excavation and Backfill.

1.03 SUBMITTALS

- A. At least five (5) working days prior to the date of anticipated use of any backfill or fill material, submit a representative sample of the proposed material weighing at least 50 pounds to the soils testing laboratory (retained by the Contractor and acceptable to the City) for analyses.
- B. Test reports.
 - 1. For each fill material proposed for incorporation into the Work or reuse, submit the following test results. Indicate the testing standard and method used for each material.
 - a. Gradation test in accordance with ASTM D422, AASHTO T27, or VTM-25 as noted.
 - b. Moisture-density test in accordance with ASTM D698 or ASTM D1557.
 - c. Atterberg limits (liquid limit, plastic limit, and plasticity index) in accordance with ASTM D4318 or VTM-7 as noted.
 - d. Unified Soil Classification System identity in accordance with ASTM D2487.
 - 2. At the discretion of the City, the Contractor may furnish a certification of conformity to VDOT Road and Bridge Specifications requirements from the material manufacturer in lieu of testing. Confirm acceptability of such a certification for each material before submitting.

1.04 REFERENCE STANDARDS

- A. American Association of State Highway & Transportation Officials (AASHTO).
 - 1. Standard Specifications for Transportation Materials and Methods of Sampling and Testing.
- B. American Society for Testing and Materials (ASTM).
 - 1. Standard Specifications as referenced.
- C. Virginia Department of Transportation (VDOT).
 - 1. Road and Bridge Specifications.
 - 2. Materials Division, Virginia Test Methods (VTM).

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Riprap shall conform to VDOT Road and Bridge Specifications Section 204.02b and shall be sound, durable stone of igneous or metamorphic origin, and shall be free from seals, cracks, or structural defects.
- B. Gravel or crushed stone shall be open-graded coarse aggregate with clean, hard, tough, and durable pieces free from adherent coatings and deleterious amounts of friable, thin, elongated, or laminated pieces, soluble salts, or organic materials. Coarse aggregate shall conform to VDOT Road and Bridge Specifications Section 203 and the following requirements.
 - 1. VDOT No. 57: Grade B or better stone conforming to the following gradation when tested in accordance with AASHTO T27.

Sieve	% Passing by Weight
1-1/2"	Min. 100
1"	95-100
1/2"	25-60
No. 4	Max. 10
No. 8	Max. 5

2. VDOT No. 68: Grade B or better stone conforming to the following gradation when tested in accordance with AASHTO T27.

Sieve	% Passing by Weight
1"	Min. 100
3/4"	90-100
3/8"	30-65
No. 4	5-25
No. 8	Max. 10
No. 16	Max. 5

3. VDOT No. 1: Grade B or better stone conforming to the following gradation when tested in accordance with AASHTO T27.

Sieve	% Passing by Weight
4"	Min. 100
3-1/2"	90-100
2-1/2"	25-60
1-1/2"	Max. 15
3/4"	Max. 5

4. VDOT No. 25: Crusher run aggregate shall be crushed from stone, slag or gravel, and shall contain all of the sizes produced when the original aggregate is reduced through a series of crushers to the maximum size specified. The material shall conform to the following gradation when tested in accordance with AASHTO T27.

Sieve	% Passing by Weight
1-1/2"	Min. 100
3/4"	95 ± 5
No. 4	32 ± 18

5. VDOT 10 (“Fine aggregate”): Rock Dust shall be crushed from Grade A stone or gravel and shall conform to the requirements of VDOT Road and Bridge Specifications Section 203. The material shall conform to the following gradations when tested in accordance with AASHTO T27.

Sieve	% Passing by Weight
3/8”	Min. 100
No. 4	85-100
No. 100	10-30

6. VDOT 21A: Structural fill shall consist of gravel stone or slag screenings; fine aggregate and crushed coarse aggregate; sand-clay-gravel mixtures; or combinations of these materials. It shall be free of organic material, loam, wood, trash, snow, ice, frozen soil, and other objectionable material and shall conform to the following requirements:

Sieve	% Passing by Weight
2”	100
1”	94 - 100
3/8”	63 - 72
No. 10	32 - 41
No. 40	14 - 24
No. 200	6 - 12

7. Screened gravel shall be hard, durable, rounded, or sub-angular particles of proper size and gradation and shall be free from sand, loam, clay, excess fines, and other deleterious materials. Screened gravel shall be graded within the following limits:

Sieve Size	% Finer by Weight
5/8”	100
1/2”	40 to 100
3/8”	15 to 45
No. 10	0 to 5

- C. Common fill shall consist of uniformly graded mineral soil, substantially free of clay, organic material, loam, wood, trash, snow, ice, frozen soil, and other objectionable material which may be compressible, or which cannot be compacted properly. Common fill shall not contain rocks larger

than 4 inches in any dimension, broken concrete, masonry, rubble, asphalt pavement, or other similar materials.

1. Common fill shall have a maximum 75 percent passing the No. 40 sieve and a maximum of 20 percent passing the 200 sieve.
 2. Soft, wet, plastic soils that may be expansive, and clay soils having natural in-place water content in excess of 30 percent, shall not be used.
 3. Soils containing more than 5 percent (by weight) fibrous organic materials or having a plasticity index (PI) greater than 30 shall not be used.
 4. Rocks larger than 2 inches in any dimension shall not be permitted within 12 inches of finished grade.
- D. Select fill shall be as specified for common fill, except that the material shall contain no stones and shall have a plasticity index less than 20. Select fill used immediately above/around the pipe may contain no stones greater than 1 inch.
- E. Sand shall conform to VDOT Road and Bridge Specifications Section 202, Grade A for fine aggregate.
- F. Impervious fill shall consist of on-site clayey sandy silt or imported material with a permeability coefficient (K-value) less than 1×10^{-7} that can be readily spread and compacted. Low permeability fill shall not be placed under sidewalks or paved areas.

END OF SECTION

**SECTION 02270
EROSION AND SEDIMENT CONTROL**

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals necessary to perform all installation, maintenance, removal, and area cleanup related to sedimentation control work as specified, shown, and required by the City, local sediment control inspectors, and any other regulatory agency that has control or jurisdiction in the area in which the project is located. The Work shall include, but not necessarily be limited to, installation of temporary access ways and staging areas, silt fences, block and gravel filters, sediment traps, diversion dikes, splash aprons, sediment removal and disposal, device maintenance, removal of temporary devices, temporary mulching, erosion control matting installation, and final cleanup.

1.02 RELATED WORK

- A. Section 02100, Clearing and Grubbing.
- B. Section 02140, Dewatering and Drainage.
- C. Section 02200, Excavation and Backfill.
- D. Section 02280, Seeding, Topsoiling, Fertilizing, and Mulching.

1.03 SUBMITTALS

- A. Contractor shall submit to the City an Erosion and Sediment Control Plan showing details of erosion and sediment control devices and locations, and technical product literature for all commercial products to be used for sedimentation and erosion control.
- B. Contractor shall submit copies of approved Erosion and Sediment Control Permits from appropriate governing agencies.

1.04 REFERENCE SPECIFICATIONS

- A. The materials and method of construction shall be in accordance with the latest edition of the Virginia Erosion and Sediment Control Handbook.

1.05 PERFORMANCE REQUIREMENTS

- A. Contractor shall be responsible for obtaining all erosion and sediment control permits required prior to any land-disturbing operations.

- B. Contractor shall be responsible for the timely installation and maintenance of all sedimentation control devices necessary to prevent the movement of sediment from the construction site to off-site areas or into the stream system via surface runoff or underground drainage systems. Measures in addition to those shown on the Erosion and Sediment Plan necessary to prevent the movement of sediment off-site shall be installed, maintained, removed, and cleaned up at no additional cost to the City. Should the Contractor fail to control the movement of sediment from the construction area into the storm sewer system, the City may at its discretion require the Contractor to clean the sediment from the affected reaches of the storm sewer system at the Contractor's expense.
- C. Sedimentation and erosion control measures shall conform to the requirements of the Virginia Sediment and Erosion Control Regulations.
- D. Where Contractors' efforts to control erosion have been demonstrated to be ineffective or potentially ineffective in the opinion of the City, the City may order that the Erosion Control Plan be amended and that additional erosion control measures be constructed at no additional cost to the City.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Coarse aggregate shall conform to Section 02230.
- B. Silt fence.
 - 1. Steel posts shall be a minimum of 5 feet in length, 2-1/2-inch by 2-1/2-inch by 1/4-inch angle post with self-fastening tabs and a 5-inch by 4-inch (nominal) steel anchor plate at bottom.
 - 2. Welded wire fabric shall be 6-inch by 6-inch mesh of 14.5 gauge by 14.5 gauge steel wire.
 - 3. Silt fence fabric shall be extra strength filter cloth fabric.
 - 4. Tie wires for securing silt fence fabric to wire mesh shall be light gauge metal clips (hog rings), or 1/32-inch diameter soft aluminum wire.
 - 5. Commercially available silt fence assemblies (2-inch by 2-inch wooden posts with attached filter fabric) may be substituted in lieu of separate steel posts and filter fabric.
- C. One quarter (1/4) inch woven wire mesh shall be galvanized steel or hardware cloth.

- D. Straw mulch shall be utilized on all newly graded areas to protect against washouts and erosion. Straw mulch shall be comprised of threshed straw of oats, wheat, barley, or rye that is free from noxious weeds, mold, or other objectionable material. The straw mulch shall contain at least 50 percent by weight of material to be 10 inches or longer. Straw shall be in an air-dry condition and suitable for placement with blower equipment.
- E. Latex acrylic copolymer, such as Soil Sealant with coalescing agent as manufactured by Soil Stabilization Co., Merced, CA, or approved equivalent shall be used as straw mulch tackifier.
- F. An asphalt tackifier shall only be used when temperatures are too low to allow the use of a latex acrylic copolymer, and only with prior written approval from the City.
- G. Erosion control matting shall be installed in all seeded drainage swales and ditches as directed by the City. Erosion control matting shall be from the Virginia Department of Transportation's approved products list for the use specified, or equal.
- H. CMU units for block and gravel curb inlet sediment filter shall conform to ASTM DC90, lightweight Grade N, Type 1, hollow units of 8 inch by 16-inch nominal face size.
- I. Pipe for slope drains shall be flexible, corrugated polyethylene pipe, non-perforated, as manufactured by Advanced Drainage Systems, Inc., Columbus, OH, or equal.
- J. Other materials shall be as specified by the Virginia Erosion and Sediment Control Handbook (VESCH) latest edition.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Silt fence installation.
 - 1. Silt fences shall be positioned as necessary to prevent off-site movement of sediment produced by construction activities.
 - 2. Dig trench approximately 6 inches wide and 4 inches deep along proposed fence lines.
 - 3. Drive steel posts 10 feet on center (maximum) at back edge of trenches. Posts shall be driven 2 feet (minimum) into ground.
 - 4. Hang 6-inch by 6-inch woven wire mesh on posts, setting bottom of wire in bottom of trench. Secure wire to posts with self-fastening tabs.

5. Hang filter fabric on wire carrying to bottom of trench with about 8 inches of fabric laid across bottom of trench. Stretch fabric fairly taut along fence length and secure with tie wires 12 inches on center both directions.
 6. Backfill trench with excavated material and tamp.
- B. Construct block and gravel curb inlet sediment filters from 1/4-inch woven wire mesh, CMU, and crushed gravel. Lower course of CMU shall be laid with openings facing to the side. Top course shall be placed with openings facing up. Cover lower course of CMU openings with woven wire mesh and crushed stone.
- C. Staging areas and access ways shall be surfaced with a minimum depth of 4 inches of crusher run aggregate.
- D. Installation of other items shall be as per the VESCH latest edition.

3.02 INSPECTIONS AND MAINTENANCE

- A. Inspections.
1. Contractor shall make a visual inspection of all sedimentation control devices once per week and promptly after every rainstorm. If such inspection reveals that additional measures are needed to prevent movement of sediment to off-site areas, Contractor shall promptly install additional devices as needed. Sediment controls in need of maintenance shall be repaired promptly.
- B. Device maintenance.
1. Silt fences.
 - a. Remove accumulated sediment once it builds up to 1/2 of the height of the fabric.
 - b. Replace damaged fabric, or patch with a 2-foot minimum overlap.
 - c. Make other repairs as necessary to ensure that the fence is filtering all runoff directed to the fence.
 2. Block and gravel curb inlet sediment filters: Replace crushed stone when it becomes saturated with silt.
 3. Rock check dams.
 - a. Sediment must be removed when the level of deposition reaches approximately 1/2 the height of the barrier.

- b. Erosion caused by high flows around the edges of the dam should be corrected immediately.
- 4. Add crushed stone to access ways and staging areas as necessary to maintain a firm surface free of ruts and mud holes.

3.03 TEMPORARY MULCHING

- A. Apply temporary mulch to areas where rough grading has been completed but final grading is not anticipated to begin within 30 days of the completion of rough grading.
- B. Straw mulch shall be applied at rate of 100 lbs./1000 ft.² and tackified with latex acrylic copolymer at a rate of 1 gal./1000 ft.² diluted in a ratio of 30 parts water to 1 part latex acrylic copolymer mix.

3.04 EROSION CONTROL MATTING

- A. Erosion control matting shall be installed in all seeded drainage swales, ditches, and slopes greater than 2 to 1 as directed by the City in accordance with manufacturer's instructions. The area to be covered shall be properly prepared, fertilized, and seeded with permanent vegetation before the blanket is applied. When the blanket is unrolled, the netting shall be on top and the fibers in contact with the soil over the entire area. The blankets shall be applied in the direction of water flow, and stapled. Blankets shall be placed a minimum of 3 rows (of 4 foot) wide (total approximately 12 foot width) within the drainage swale/ditch and stapled together in accordance with manufacturer's instructions. Side overlaps shall be a minimum of 4 inches. The staples shall be made of wire, .091 inch in diameter or greater, U-shaped with legs 10 inches in length and a 1-1/2-inch crown.
- B. Upper and lower ends of the matting shall be buried to a depth of 4 inches in a trench. Erosion stops shall be created every 25 feet by making a fold in the fabric and carrying the fold into a silt trench across the full width of the blanket. The bottom of the fold shall be 4 inches below the ground surface. Staple on both sides of fold. Where the matting must be cut or more than 1 roll length is required in the swale, turn down upper end of downstream roll into a slit trench to a depth of 4 inches. Overlap lower end of upstream roll 4 inches past edge of downstream roll, and staple.
- C. To ensure full contact with soil surface, roll matting with a roller weighing 100 pounds per foot of width perpendicular to flow direction after seeding, placing matting, and stapling. Thoroughly inspect channel after completion. Correct any areas where matting does not present a smooth surface in full contact with the soil below.

3.05 REMOVAL AND FINAL CLEANUP

- A. Once the site has been fully stabilized against erosion, remove sediment control devices and all accumulated silt. Dispose of silt and waste materials in proper manner. Re-grade all areas disturbed during this process and stabilize against erosion with surfacing materials as specified herein.

END OF SECTION

**SECTION 02280
SEEDING, TOPSOILING, FERTILIZING AND MULCHING**

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required to place topsoil, finish grade, and apply lime, fertilizer, seed, and mulch. Maintain all seeded areas as specified herein, including all areas disturbed by the Contractor.

1.02 RELATED WORK

- A. Section 02100, Clearing and Grubbing.
- B. Section 02200, Excavation and Backfill.
- C. Section 02270, Erosion and Sediment Control.

1.03 SAMPLES AND APPROVAL OF MATERIAL

- A. Samples of all materials shall be submitted for inspection and acceptance upon request.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Topsoil shall be fertile, friable, natural topsoil typical of topsoil of the locality, and shall be obtained from a well-drained site that is free of flooding. It shall be without admixture of subsoil or slag and free of stones, lumps, plants or their roots, sticks, clay, peat, and other extraneous matter. Topsoil shall not be placed while in a frozen or muddy condition. Topsoil delivered to the site shall have pH between 6.0 and 7.0 and shall contain not less than 3 percent organic matter as determined by loss of ignition of moisture-free samples dried at 100 degrees Celsius.
- B. Fertilizer shall be commercially mixed free flowing granules or pelleted fertilizer, 10-10-10 (N-P205-K2O) grade for lawn and naturalized areas. Fertilizer shall be delivered to the site in original unopened containers each showing the manufacturer's guaranteed analysis conforming to applicable state fertilizer laws. At least 40 percent of the nitrogen in the fertilizer used shall be in slowly available (organic) form.
- C. Seed shall be labeled in accordance with USDA Rules and Regulations under the Federal Seed Act and shall comply with the requirements of the Virginia Erosion and Sediment Control Handbook standard. Seed shall be

furnished in sealed bags or containers bearing the date of the last germination, which date shall be within a period of 6 months prior to commencement of planting operations. Seed shall be from same or previous year's crop; each variety of seed shall have a purity of not less than 85 percent, a percentage of germination not less than 90 percent, shall have a weed content of not more than 1 percent and contain no noxious weeds. The seed mixtures shall consist of seed proportioned by weight as follows.

1. Acceptable permanent seeding mix for use in all areas:

Common Name	Ingredients
Kentucky 31	70%
Perennial Rye	30%

2. Seed mix for permanent seeding shall be as above or in strict accordance with the VESCH. All temporary seeding shall be as per VESCH. Seed shall be accompanied by an affidavit for seed conforming to Section 244.02 (c) of Virginia Department of Transportation Road and Bridge Specifications, latest edition.
- D. The seed shall be furnished and delivered pre-mixed in the proportions specified above. The manufacturers for each seed type shall submit a manufacturer's certificate of compliance to the specified mixes. These certificates shall include the guaranteed percentages of purity, weed content and germination of the seed, and also the net weight and date of shipment. No seed may be sown until the Contractor has submitted the certificates.
- E. Seed shall be delivered in sealed containers bearing the dealer's guaranteed analysis.
- F. Straw mulch shall be as specified in Section 02270.
- G. Mulch for hydroseeding operations shall be a specially processed cellulose fiber containing no growth or germination inhibiting factors. It shall be manufactured in such a manner that after addition and agitation in slurry tanks with water, the fibers in the material become uniformly suspended to form an homogeneous slurry. When sprayed on the ground, the material shall allow absorption and percolation of moisture. Each package of the cellulose fiber shall not contain in excess of 10 percent moisture and shall be marked by the manufacturer to show the air-dry weight content.
- H. Mulch tacking agent shall be as specified in Section 02270.

PART 3 - EXECUTION

3.01 APPLICATION

- A. Acceptable topsoil shall be placed to a minimum compacted depth of 6 inches on all disturbed areas.
- B. For all areas to be seeded:
 - 1. Fertilizer (10-10-10) shall be applied at the rate of 40 pounds per 1,000 square feet and lightly worked in by approved methods.
 - 2. Seed mix shall be applied at a rate of 20 pounds per 1,000 square feet.
 - 3. Mulch shall be applied at the rate of 40 pounds per 1,000 square feet.
- C. The application of fertilizer may be performed hydraulically in one operation with hydro-seeding and fiber mulching. The Contractor is responsible for cleaning all structures and paved areas of unwanted deposits of the hydroseeded mixture.

3.02 INSTALLATION

- A. Previously established grades as shown on Drawings shall be maintained in a true and even condition.
- B. The topsoil shall be carefully prepared by scarifying or harrowing and hand raking after it has been spread. All stiff clods, lumps, roots, litter, and other foreign material shall be removed from the loamed area and disposed of by the Contractor. The areas shall also be free of smaller stones in excessive quantities as determined by the City. The whole surface shall then be rolled with a hand roller weighing not more than 100 pounds per foot of width. During the rolling, all depressions caused by settlement of rolling shall be filled with additional loam and the surface shall be re-graded and rolled until a smooth and even finished grade is created.
- C. Seeding, mulching, and conditioning shall only be performed during those periods within the seasons that are normal for such work as determined by the weather and locally accepted practice.
- D. Schedules for seeding and fertilizing must be submitted to the City for approval prior to the work. Seeding as specified herein shall be accomplished between the period of April 1 to May 31 or August 16 to October 15. Seeding during the periods from October 16 to March 31 and from June 1 to August 15 shall only be undertaken upon approval of the City.

- E. Seeding shall be done within 5 days following soil preparation. Seed shall be applied at the rates and percentages indicated.
- F. Slopes whose vertical height is less than 20 feet but more than 5 feet shall be seeded in 2 equal increments. Slopes whose vertical height is 5 feet or less may be seeded in one operation. Slopes greater than 2H:1V shall be protected by erosion control matting acceptable to the City.
- G. In order to prevent unnecessary erosion of newly topsoiled and graded slopes and unnecessary siltation of drainage ways, the Contractor shall carry out seeding and mulching as soon as he has satisfactorily completed a unit or portion of the project or when 1,000 square feet of ground surface has been disturbed. When protection of newly topsoiled and graded areas is necessary at a time which is outside of the normal seeding season, the Contractor shall protect those areas by whatever means necessary as approved by the City and shall be responsible for prevention of siltation in the areas beyond the limit of Work.
- H. When newly graded sub-grade areas cannot be topsoiled and seeded because of season or weather conditions and will remain exposed for more than 30 days, the Contractor shall protect those areas against erosion and washouts by whatever means necessary such as straw applied with a tar tack, wood chips, or by other approved measures. Prior to application of topsoil, any such materials applied for erosion control shall be thoroughly incorporated into the sub-grade by disking. Fertilizer shall be applied prior to spreading of topsoil.
- I. On slopes, the Contractor shall provide against washouts by an approved method. Any washout that occurs shall be re-graded and re-seeded at the Contractor's expense until a good sod is established.

3.03 MAINTENANCE AND PROVISIONAL ACCEPTANCE

- A. The Contractor shall maintain seeded areas, re-seeding if and when necessary, until a good, healthy, uniform growth is established over the entire area seeded.
- B. The City will inspect all work for provisional acceptance at the end of a 10-week maintenance period upon receiving written request from the Contractor at least 10 days prior to the anticipated date of inspection.
- C. A satisfactory stand will be defined as a section of turf of 1,000 square feet or larger that has:
 - 1. No bare spots larger than three square feet.
 - 2. No more than 10 percent of total area with bare spots larger than 1 square foot.

3. Not more than 15 percent of total area with bare spots larger than 6 square inches.
- D. After all necessary corrective work and clean up has been completed, certification of provisional acceptance will be issued. The Contractor's responsibility for maintenance of lawns, or parts of lawns, shall cease on receipt of provisional acceptance.

3.04 GUARANTEE PERIOD AND FINAL ACCEPTANCE

- A. The Contractor shall guarantee all seeded areas for not less than 1 full year from the time of provisional acceptance.
- B. At the end of the guarantee period, the City will make an inspection upon written request submitted by the Contractor at least 10 days before the anticipated inspection date. Seeded areas not demonstrating satisfactory stands as outlined above shall be scarified, re-seeded, fertilized, and mulched, meeting all requirements as specified herein.
- C. After all necessary corrective work has been completed, the City shall certify in writing the final acceptance of the seeded areas.

END OF SECTION

SECTION 02300

CROSSINGS BY JACKING, BORING, AND TUNNELING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope

1. Contractor shall provide all labor, materials, equipment, supervision, and incidentals required to furnish and install casing pipe and carrier pipe as shown on the Details and as required to complete the Work.
2. The Details indicate the smallest diameter casing that is acceptable for the installations. The Contractor may elect to use a larger diameter casing. If the Contractor elects to utilize the casing diameter called for on the Details, and the installation must be abandoned due to the inability of the Contractor to hand mine the casing, the installation will be abandoned at the Contractor's expense.

B. Related sections.

1. Section 02100, Clearing and Grubbing.
2. Section 02200, Excavation and Backfill.
3. Section 03300, Concrete.
4. Division 15, Mechanical.

1.02 QUALITY ASSURANCE

A. Installer's qualifications and experience.

1. Installer shall be a specialist in the construction of casing pipes by jacking, boring, or by installation of tunnel liner plates, and shall have at least 5 years of experience in this specialty. Installer shall have satisfactorily constructed, during the past 5 years, not less than 10 similar installations that are comparable in diameter and length to that shown and specified herein.
2. Use only personnel thoroughly trained and experienced in the skills required. The field supervisor of boring operations and the boring machine operator shall have not less than 12 months' experience in the operations of the equipment being used.
3. Welds shall be made only by welders, tackers, and welding operators who

have been previously qualified by tests to perform the type of work required, as prescribed in American Welding Society, AWS D.1.1.

B. Permits. The Contractor shall be responsible to obtain and pay for all permits, insurance, and bonds required to complete the Work.

C. Requirements of regulatory agencies.

1. The Contractor shall comply with all provisions of all permits required by the governing authorities at his own expense. The Contractor's responsibility under this paragraph may include, but is not limited to the following:

- a. Constructing and removing temporary facilities or structures.
- b. Providing details of construction methods.
- c. Providing detailed construction schedules.
- d. Reimbursing the applicable authority for all expenses incurred by them in connection with the Work.
- e. Traffic maintenance.
- f. Coordination of scheduling with the authority.
- g. Necessary clean up and restoration.

2. Materials and methods of construction used on railroad company property shall be subject to the approval of the railroad company. Contractor shall at all times conduct his work and operations fully within the railroad company's rules, regulations, and requirements. The Contractor must ascertain from the railroad company its rules, regulations, and requirements, and what, if any, delays may be encountered. If required by the railroad company, the Contractor must submit for approval specific details of the methods of construction he intends to utilize together with any sketches or drawings.

D. Tolerances. The casing pipes shall be installed as shown on the Details and within tolerances required to allow the carrier pipe to be properly installed to the lines and grades shown on the Plans.

E. Reference standards.

1. ASTM A139, Electric-Fusion (ARC Welded) Steel Pipe.
2. ASTM A153, Zinc-Coating (Hot Dip) on Iron and Steel Hardware.
3. ASTM A307, Low-Carbon Steel Externally and Internally Threaded

Standard Fasteners.

4. ASTM A569, Hot-Rolled Carbon Steel Sheets and Strip, Commercial Quality.
5. ASTM S252, Welded and Seamless Steel Pipe Piles.
6. AASHTO, Interim Specification for Steel Tunnel Liner Plates.
7. American Railway Engineering Association (AREA) Chapter 1, Part 4, "Jacking Culvert Pipe Through Fills."
8. AREA Chapter 1, Part 5, "Specification for Pipelines Conveying Non-Flammable Substances."
9. AWS D1.1, Structural Welding Code.
10. Virginia Work Area Protection Manual.
11. OSHA.

1.03 SUBMITTALS

- A. Installation methods. The Contractor shall submit drawings and descriptions showing methods and equipment for the installation of the casing and carrier pipe for approval by the City. The description shall include subsurface information, dewatering methods, jacking pit elevations, and profile of proposed bore.
- B. Welder's certification to perform required work.
- C. Casing pipe certificates from manufacturer.
 1. Certificate of conformance in accordance with paragraph 20.2 of ASTM A139-90.
 2. Hydrostatic test report in accordance with paragraph 12 of ASTM A139-90.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery.
 1. Exercise special care during delivery not to damage the casing pipe and carrier pipe.
 2. Damaged materials will be replaced by the Contractor at his expense.
 3. The City will not accept shipments of any kind for the Contractor.

B. Storage.

1. Store casing pipe and carrier pipe on approved blocking for protection from corrosion until incorporation into the Work in accordance with manufacturer's recommendation.
2. The City shall be permitted access to inspect the materials in storage areas.

C. Handling.

1. Handle materials in a manner so as to avoid damage.
2. Materials damaged during handling shall be repaired or replaced as ordered by the City.

1.05 JOB CONDITIONS

- A. Protection. Guardrail, fences, signs, lights, barricades, barrels, and all other protective items necessary shall be provided in accordance with the requirements of all applicable permits, laws, regulations, and ordinances, including the Virginia Work Area Protection Manual, and as necessary to prevent damage or injury to private or public property or to workmen or the general public.
- B. Adequately support and protect utilities and facilities that are encountered in, or may be affected by, the Work.
- C. If the railroad company requires the installation of track supports, the Contractor shall install such supports. If the railroad company does not furnish the supports, the Contractor shall be responsible for fabricating the track supports in accordance with the requirements of the railroad company's chief engineer. It should be noted, however, that railroad companies usually require that any work involving rails, ties, or other track material be performed by their own forces. The cost of such work, even though carried out by the railroad company, is at the expense of the Contractor.
- D. The Contractor must observe all necessary and appropriate safety precautions when working on railroad rights-of-way or property. At the discretion of the railroad, the Contractor shall provide a qualified watchman or pay for a watchman supplied by the railroad to warn workmen of the approach of any train or other moving equipment upon the tracks of the railroad, and to keep all workmen or other persons, equipment, and materials from the tracks including any power, communication, and signal wires, so that there will be no contacts with trains, rolling equipment, or wires. Contractor shall comply with all railroad requirements.
- E. All excavations shall be sheeted, shored, and braced as required to prevent subsurface subsidence.

- F. Boring pits shall be kept dewatered, and pumps shall be attended on a 24-hour basis, if conditions so require. Close observation shall be maintained to detect any settlement or displacement of facilities during dewatering operations. Dewater into a sediment trap and comply with applicable environmental protection criteria specified in Section 02270.
- G. Maintain the air quality in the pipe or tunnel, when hand excavating, in a condition suitable for the health of workmen at all times in accordance with OSHA requirements.

PART 2 - PART 2 PRODUCTS

2.01 MATERIALS

A. Steel casing pipe.

1. Casing pipe shall be new steel casing pipe meeting the requirements of ASTM A139, Grade B, leakproof construction. Minimum impact factor shall be 1.0. Pipe shall be seamless or have not more than one (1) longitudinal weld.
2. Minimum wall thickness shall be as shown on the Details.
3. Casing pipe shall be designed for earth cover shown on the Plans and live load including impact equal to Cooper E-80 railroad loading for railroad crossings and HS-20 wheel loading for roadway crossings.
4. If the casing pipe is furnished in sections to be field welded, then casing pipe shall be supplied with plain ends, mill beveled for field butt welding. Field welded joints shall be performed by AWS D.1.1 certified welders and be full penetration single-vee groove, butt type welds around the entire circumference of the pipe. All welding shall receive non-destructive testing. Copies of test reports shall be submitted to the City.
5. Coatings. The exterior and interior surfaces of the casing pipe shall receive surface preparation conforming to SSPC-SP6. Provide Tnemec, TnemeTar, 2 coats, 8.3 dry mils per coat, or approved equal.
6. For casing pipe 30-inches in diameter and larger, provide an adequate number of 1-1/2-inch or 2-inch holes drilled 3 feet on center alternating 30 degrees with a vertical plane through the casing pipe. The holes shall be tapped for plugs. Plugs shall be furnished and installed by the Contractor. Cost for installation of holes and plugs shall have been included in the Contract price bid.

B. Tunnel liner plate

1. Tunnel liner plates, bolts, and nuts shall conform to the requirements of

the Specification for Steel Tunnel Liner Plates as developed by the American Association of State Highway and Transportation Officials, Committee on Bridges and Structures, latest revision.

2. Liner plate tunnel shall be designed for earth cover shown on the Drawings and live load, including impact, equal to Cooper E80 railroad loading for railroad crossings or HS-20 wheel loading for roadway crossings.
3. Minimum liner plate thickness shall be 0.1345 inch.
4. Minimum moment of inertia shall be 0.0549 inch⁴/inch.
5. Liner plates shall be galvanized in accordance with ASTM A123 and coated with a bituminous coating.
6. Liner plates may be “2-flanged” or “4-flanged,” but must not be mixed on any specific tunnel.
7. Nuts and bolts shall be hot dipped galvanized in accordance with ASTM A153, latest revision.
8. Shape plates such that erection can be completely and readily effected from within the tunnel.
9. Provide plate dimensions of such size and with such tolerances that plates of similar curvature are interchangeable.
10. Punch all plates for bolting on both longitudinal and circumferential joints.
11. Fabricate each plate from one piece of metal, including circumferential and longitudinal flanges.
12. Provide all plates with circumferential flanged joints.
13. Provide either flanged or offset lap seam type longitudinal joints.
14. Circumferential bolt-hole spacing
 - a. Space in accordance with manufacturer’s recommended standard spacing
 - b. Space as a multiple of plate length so that plates having the same curvature are interchangeable and permit staggering of the longitudinal joints.
15. Longitudinal bolt-hole spacing. Space in accordance with manufacturer’s recommended standard spacing

16. Provide tapped grout holes consisting of welded half-couplings with pipe plugs 2 inches minimum in diameter. Number, size, type, and location of grout holes shall be shown on the (shop drawing) details of the liner plates; but shall not occur in less than 10 percent of plates. Additional holes shall be inserted in the field if necessary to make sure all voids are filled.
- C. Cement grout. Uniform mixture of cement and sand, in accordance with Section 03600.
- D. Casing spacers.
1. Provide bolt-on style casing spacers for positioning carrier pipe within tunnel or casing pipe and for electrically isolating the carrier pipe from the tunnel or casing pipe.
 2. The casing spacers shall support the carrier pipe in the center of the tunnel or casing pipe.
 3. Materials.
 - a. Shell. Type 304 stainless steel with PVC liner.
 - b. Runners. Ultra high molecular weight polymer supported by Type 304 stainless steel risers welded to the shell or high density polyethylene. All welds shall be passivated.
 - c. Bolts and nuts. Type 304 stainless steel.
 4. Spacer width. Follow manufacturers' recommendations.
 5. Extent. Refer to Drawings.
 6. Manufacturer. Cascade Waterworks Manufacturing Co., Advance Product Systems, Inc., Raci Spacer North America, Inc. or approved equal.
- E. End seals.
1. End seals shall be 1/8 inch thick neoprene rubber secured with 1/2 inch wide T-304 stainless steel banding straps with a 100% non-magnetic worm gear mechanism. Edge seals shall be pressure sensitive butyl mastic strips.
 2. Manufacturer. Advance Products & Systems, Inc. Model AC, AM and AW or approved equal.

PART 3 - EXECUTION

3.01 GENERAL

- A. Installation of the crossings shall be by jacking, boring, micro-tunneling, or tunnel with liner plate and shall conform in all respects to the requirements contained herein and other applicable standards.
- B. Lines and grades. The Contractor is responsible for establishing and maintaining proper line and grade at each crossing.
 - 1. The Contractor shall periodically check his line and grade to assure conformance with line and grade within the tolerances indicated in this Section.
 - 2. Extra work required because of the Contractor's failure to maintain the proper line and grade as shown on the Plans shall be performed by the Contractor at no additional cost to the City.

3.02 INSPECTION

- A. As required by the City, VDOT, railroad, or other regulatory authority.
- B. Contractor shall check for voids around casing pipes 30 inches or larger in diameter.

3.03 PREPARATION

- A. Work pits at each end of the crossings shall be sufficiently large to permit satisfactory installation of the casing pipe or tunnel liner plates. All excavation, backfill, sheeting, shoring, bracing, and dewatering shall comply with the applicable requirements of these Specifications and the requirements of the applicable authorities.
- B. The Contractor shall dispose of excess excavated material or drilling mud/cuttings in an approved disposal site at the expense of the Contractor.

3.04 INSTALLATION

- A. Installation of steel casing pipe by jacking.
 - 1. Install in accordance with current American Railroad Engineering Association Specifications for railroad crossings and VDOT Road and Bridge Standards for roadway crossings.
 - 2. Design bracing and backstops and use jacks of sufficient rating such that jacking can be accomplished in a continuous manner until the leading edge of the pipe reaches the final positions shown on the Plans.

3. If voids develop around the casing pipe as it is jacked, pump cement grout to fill all such voids, or fill by other means acceptable to the City, the railroad or VDOT, where applicable.
4. Fill all voids as specified hereafter as soon as possible after completion of jacking operation.

B. Installation of steel casing pipe by boring.

1. The boring method shall consist of pushing the pipe into the fill with a boring auger rotating inside the pipe to remove the soil.
2. Provide the front of the casing pipe with suitable mechanical arrangements or devices that will positively prevent the auger and cutting head from leading the pipe so that there will be no unsupported excavation ahead of the pipe.
3. The equipment and mechanical arrangements or devices used to bore and remove the earth shall be removable from within the casing pipe in the event an obstruction is encountered.
4. The face of the cutting edge shall be arranged to provide reasonable obstruction to the free flow of soft or poor soil.
5. Do not use water or other liquids to facilitate casing emplacement or spoil removal.
6. If voids develop around the casing pipe as it is bored, pump cement grout to fill all such voids, or fill by other means acceptable to the City, VDOT, or railroad, where applicable.
7. Fill all voids as specified hereafter as soon as possible after completion of boring operation.

C. Installation of tunnel liner plating.

1. Assemble plates in accordance with the manufacturer's recommendations.
2. Make all circumferential and longitudinal joint connections with specified nuts and bolts.
3. Mine tunnel by approved methods that will prevent loss of material outside the plate section and as follows:
 - a. Excavate for 1 course at a time.
 - b. Place and securely bolt liner plates in sequence immediately following excavation for them, and prior to excavation for the next course.

- c. Where material is lost outside the plate sections, grout to completely fill all voids in a manner acceptable to the City, the railroad or VDOT, where applicable.
- d. Grout all voids full as close to the header as possible, using grout stops behind plates, if necessary.
- e. Provide and maintain a solid, approved bulkhead at the end of work at the end of each day's operations.

D. Grouting.

1. Start at the lowest hole of each section to be grouted, grout holes above to remain open, and proceed upward progressively and, if possible, simultaneously on both sides of the casing or tunnel until all voids are completely filled with 1:4 cement grout as specified in Section 03600, Grout.
2. Provide grout holes in addition to those specified where directed by the City to insure filling of all voids.
3. At any given location, grouting pressures shall not exceed 1/2 psi for each foot of earth overburden.

E. Obstructions. If an obstruction is encountered during installation to stop the forward action of the casing pipe, and it becomes evident that it is impossible to advance the pipe, the Contractor may choose either of the follow procedures.

1. Operations will cease and the casing pipe shall be abandoned in place and filled completely with grout. The pipe location shall be changed to an approved location and the crossing re-bored or re-jacked at the Contractor's expense and at no additional cost to the City.
2. The Contractor may continue the casing pipe by tunneling and installation of tunnel liner plates as described herein. The continuation by the tunneling method shall be at the Contractor's expense and at no additional cost to the City.

F. Installation of the pipe.

1. After completion of the tunnel or steel casing pipe, the carrier pipe shall be installed and pressure tested in accordance with these Specifications.
2. Care shall be taken to prevent undue disturbances of the joints.
3. Carrier pipe shall be blocked in place, using stainless steel casing spacers

to secure it against movement at maximum spacing of 9 feet.

4. The Contractor shall repair, replace, or take whatever action is deemed necessary by the City to correct all disturbed joints at no additional cost to the City.

G. Installation of end seals.

1. Install end seals consistent with manufacturers' recommendations. Installed end seal shall prevent foreign material from entering the space between the carrier pipe and the casing and allow for some movement of the carrier pipe.

H. Bulkheads.

1. After the carrier pipe is installed in the tunnel or steel casing and successfully pressure tested, construct bulkheads as shown in the Details and as specified herein.
2. Prior to the installation of bulkheads, the line shall be properly and sufficiently secured against flotation and against all movement that would disturb joints.
3. On railroad crossings, a vent shall be installed in accordance with AREA recommendations.
4. Masonry bulkheads shall be eight (8) inches wide unless otherwise indicated.

END OF SECTION

SECTION 02575

ASPHALTIC CONCRETE PAVEMENT AND APPURTENANCES

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required to install asphaltic paved roadways, parking areas, temporary paving, markings, tie-ins to existing paving, and appurtenances as shown on the Drawings and as specified herein.
- B. Maintain new pavements for one year after Final Completion. Promptly refill and repave areas that have settled or are otherwise unsatisfactory for traffic.

1.02 RELATED WORK

- A. Section 02100, Clearing and Grubbing.
- B. Section 02200, Excavation and Backfill.
- C. Section 02230, Fill and Granular Fill Materials.

1.03 REFERENCE STANDARDS

- A. Where reference is made to the standards listed below, the revision in effect at the time of bid opening shall apply.
- B. Except as otherwise specified herein, materials and construction shall be in accordance with the Virginia Department of Transportation Road and Bridge Specifications, latest edition.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Asphaltic concrete paving wearing course shall be Type SM-9.5 as specified in Section 211.04 of the above-referenced specifications.
- B. Asphaltic concrete binder course shall be Type BM-25 as specified in Section 211.04 of the above-referenced specifications.
- C. Aggregate base material shall be as specified in the Drawings and Section 02230.
- D. Tack coat shall consist of either emulsified asphalt or cutback asphalt conforming to the requirements of Section 311 of the above-referenced

specifications.

- E. Gravel sub-base shall be as specified in the Drawings.
- F. Unused pavement saw cuts shall be sealed with Bondo Traffic, P-606 Flexible Loop Sealer, or approved equal.

PART 3 - EXECUTION

3.01 GENERAL

- A. Pavements shall be placed at the locations shown on the Drawings and as directed.
- B. The work for new or for repair of existing pavement shall include the placing and compacting of the base course, the priming of the base, the placing and maintaining of the binder and surface treatments, and any special requirements, all as specified herein.
- C. Pavement, at a minimum, shall consist of a 4-inch layer of asphaltic concrete binder course, Type BM-25, placed on a 6-inch compacted stone base course, with a 2-inch asphaltic concrete surface course, Type SM-9.5, placed so that the top layer matches the grade of existing pavement.
- D. The binder course shall be placed as soon as possible after the 6-inch stone base has been prepared, shaped, and compacted.
- E. The binder course shall be placed and compacted by steel-wheeled rollers with a minimum weight of 3 tons. New pavement shall be rolled smooth and even with the existing pavement.
- F. All pavement thicknesses referred to herein are compacted thicknesses. Place sufficient mix to ensure that the specified thickness of pavement is achieved.
- G. Hose clean all road surfaces after backfilling and before any surfacing, but in no case shall pavement be placed until the stone base is dry and compacted to at least 95 percent maximum dry density at optimum moisture content as determined by ASTM D698.
- H. All manhole frames and utility boxes are to be set to the grade of the wearing course. At no time shall the frames or boxes be allowed to protrude above the surface of the wearing course.
- I. The contact surfaces of castings and other structures shall be painted with a tack coat.
- J. After the paving mixture has been properly spread, initial compaction shall be obtained by the use of power rollers weighing not less than 240 pounds per

inch width of tread.

- K. Final compaction of the surface shall be accomplished by rollers weighing not less than 285 pounds per inch width of tread. Along curbs, structures, and all places not accessible with a roller, the mixture shall be thoroughly compacted with tampers. Such tampers shall weigh not less than 25 pounds and shall have a tamping face of not more than 50 square inches. The surface of the mixture after compaction shall be smooth and true to the established line and grade.
- L. When the air temperature falls below 50 degrees F, extra precautions shall be taken in drying the aggregates, controlling the temperatures of the materials, and placing and compacting the mixtures.
- M. No mixtures shall be placed when the air temperature is below 40 degrees F, nor when the material on which the mixtures are to be placed contains frost or has a surface temperature less than 35 degrees F.
- N. No vehicular traffic or loads shall be permitted on the newly completed pavement until adequate stability has been attained and the material has cooled sufficiently to prevent distortion or loss of fines. If climatic or other conditions warrant it, the period of time before opening to traffic may be extended at the discretion of the City.

3.02 CUTTING PAVEMENT

- A. Cut and remove existing pavement as necessary for installing the new pipe lines and appurtenances, for making connections to existing pipe lines, and for making tie-ins between existing and new pavements.
- B. Pavements to be cut shall be marked neatly, paralleling pipe lines and street lines. Asphaltic concrete pavement shall be cut along the markings with a jackhammer, rotary saw, or other suitable tool. Concrete pavement and asphaltic pavement on concrete base shall be scored to a depth approximately 2 inches below the surface of the concrete along the marked cuts. Scoring shall be done by use of a rotary saw, after which the pavement may be broken below the scoring with a jackhammer or other suitable equipment.
- C. No pavement shall be machine pulled until completely broken and separated along the marked cuts.

3.03 PAVEMENT REPAIR AND REPLACEMENT

- A. All existing pavement cut or damaged by construction shall be repaired to match the original surface material and original grade unless otherwise specified or shown on the Drawings. Materials and construction procedures for sub-base, base course, and pavement repair shall conform to VDOT standards.

- B. The width of all repairs shall extend at least 6 inches beyond the excavation or limits of any damaged section. The edge of the pavement to be left in place shall be saw cut to a true edge so as to provide a clean edge to abut the repair. The line of the repair shall be reasonably uniform with no unnecessary irregularities.
- C. After all repair and restoration or paving has been completed, all excess asphalt, dirt, rock, and other debris shall be removed from the roadways. All storm sewers and inlets shall be checked and cleaned of any construction debris.
- D. The pavement adjacent to pipeline trenches shall neither be disturbed nor damaged. If the adjacent pavement is disturbed or damaged, irrespective of cause, the damaged pavement shall be removed and replaced at no expense to the City.

3.04 TRENCH PAVEMENT RESTORATION

- A. Place 6-inch compacted stone base course and 4-inch minimum binder course over trenches cut in existing paved areas no later than 1 week after the trench has been backfilled. The paving shall be maintained until overlaid with a 2-inch wearing course. Contractor may elect to install temporary pavement repair in accordance with the Detail Drawings until such time as permanent repair can be made.
- B. If points of settlement or holes appear in the pavement, repair the same within 3 days of notification by the City. If after due notice Contractor fails to make the repairs, the work will be done by the City and the total cost of such repairs will be charged to the Contractor.

3.05 CUTTING CONCRETE STRUCTURES

- A. Cut and remove concrete sidewalks, curbs, gutters, etc., as necessary for the installation of new piping. Cutting and removal of concrete sidewalk sections shall correspond to existing jointing of the sidewalk. Removal of partial sidewalk sections shall not be permitted.
- B. Cutting of sidewalks, curbs, gutters, etc., shall be performed using appropriate concrete saws and shall be in a neat and workmanlike manner. The Contractor shall only remove sections necessary for the proper installation of the piping or sections damaged as a result of the construction activity.
- C. All concrete sections removed as part of the Work shall be removed from the job site and disposed of in accordance with the requirements of federal, state, and local regulations.

3.06 CONCRETE STRUCTURE REPAIR AND REPLACEMENT

- A. Concrete structures, including but not limited to curbing, gutters, driveways, and sidewalks, damaged during construction shall be promptly and satisfactorily restored to pre-construction condition, or as directed by the City, in accordance with all applicable sections of the Virginia Department of Transportation Road and Bridge Specifications, latest edition.
- B. Sidewalks and driveways shall be repaired or replaced to the thickness of the adjacent undisturbed sections or 4 inches, whichever is greater. The finish shall be floated or broomed to match the existing concrete. Joints shall be tooled to match the spacing of the existing sections. WWF 6 x 6, W 1.4 x 1.4 steel mesh reinforcement shall be required for all installations.
- C. Curbing and gutters shall be rebuilt to original lines, grade, cross-section, and finish. Any curbing or gutters that have settled or shifted as a result of the Work shall be replaced at the Contractor's expense.

3.07 MAINTENANCE AND GUARANTEE

- A. All wearing surfaces shall be maintained in good order and be suitable for traffic at all times for a period of 1 year after Final Completion and acceptance of the Work.
- B. At the end of the maintenance period, a final inspection will be made of the repaired and new surfaces and any settlement or depression shall be repaired as specified above.

END OF SECTION

DIVISION 3 – CONCRETE

SECTION 03300

CONCRETE

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor and materials required and install cast-in-place concrete complete as shown on the Drawings and as specified herein.

1.02 RELATED WORK

- A. Section 03600, Grout.

1.03 SUBMITTALS

- A. Submit to the City shop drawings and product data including the following:

1. Sources of cement, pozzolan, and aggregates.
2. Air-entraining admixture. Product data including catalog cut, technical data, storage requirements, product life, recommended dosage, temperature considerations, and conformity to ASTM standards.
3. Water-reducing admixture. Product data including catalog cut, technical data, storage requirements, product life, recommended dosage, temperature considerations, and conformity to ASTM standards.
4. High-range water-reducing admixture (plasticizer). Product data including catalog cut, technical data, storage requirements, product life, recommended dosage, temperature considerations, retarding effect, slump range, and conformity to ASTM standards.
Concrete mix for each formulation of concrete proposed for use including constituent quantities per cubic yard, water-cementitious materials ratio, concrete slump, type, and manufacturer of cement.

- B. Certifications.

1. Certify admixtures used in the same concrete mix are compatible with each other and the aggregates.
2. Certify mix design meets requirements of the City's standard "City Mix" concrete mix design if applicable.

1.04 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM).

1. ASTM C31 - Standard Practice for Making and Curing, Concrete Test Specimens in the Field.
2. ASTM C33 - Standard Specification for Concrete Aggregates.
3. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
4. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
5. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
6. ASTM C150 - Standard Specification for Portland Cement.
7. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
8. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
9. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
10. ASTM C1017 - Standard Specification for Chemical Admixtures for use in Producing Flowing Concrete.

B. American Concrete Institute (ACI).

1. ACI 304R - Guide for Measuring, Mixing, Transporting and Placing Concrete.
2. ACI 305R - Hot Weather Concreting.
3. ACI 306.1 - Standard Specification for Cold Weather Concreting.
4. ACI 318 - Building Code Requirements for Structural Concrete.
5. ACI 350R - Environmental Engineering Concrete Structures.

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Reinforced concrete shall comply with ACI 318, the recommendations of ACI 350R and other stated requirements, codes, and standards. The most stringent requirement of the codes, standards, and this Section shall apply when conflicts exist.

- B. Only one (1) source of cement and aggregates shall be used on any single structure. Concrete shall be uniform in color and appearance.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The City's standard "City Mix" Portland cement concrete mix design shall be used for all curbs, gutters, sidewalks, and driveways. The color shall be "Canvas."
- B. All other uses of cast-in-place concrete shall meet the design requirements specified herein.

2.02 MATERIALS

- A. Cement: Domestic Portland cement complying with ASTM C150 – Type II. Cement brand shall be subject to approval and one brand shall be used throughout the Work.
- B. Supplemental cementitious material: Ground granulated blast-furnace slag.
 - 1. Meet ASTM C989 (Grade 120).
 - 2. Blend with Portland cement meeting requirements of ASTM C595 Type IS or IS(MS).
 - 3. Supplier: Blue Circle Cement, Inc., Product: NewCem, or approved equal.
- C. Fine aggregate: Washed inert natural sand conforming to the requirements of ASTM C33.
- D. Coarse aggregate: Well-graded crushed stone or washed gravel conforming to the requirements of ASTM C33. Grading requirements shall be as listed in ASTM C33 Table 3 for the specified coarse aggregate size number. Limits of deleterious substances and physical property requirements shall be as listed in ASTM C33 Table 3 for severe weathering regions. Size numbers for the concrete mixes shall be as shown in Table 1 herein.
- E. Water: Potable water, free from injurious amounts of oils, acids, alkalis, salts, organic matter, or other deleterious substances.
- F. Admixtures: Admixtures shall be free of chlorides and alkalis (except for those attributable to water). When it is required to use more than one admixture in a concrete mix, the admixtures shall be from the same manufacturer. Admixtures shall be compatible with the concrete mix including other admixtures.

1. Air-entraining admixture: The admixture shall comply with ASTM C260. Proportioning and mixing shall be in accordance with manufacturer's recommendations.
 2. Water-reducing agent: The admixture shall comply with ASTM C494, Type A. Proportioning and mixing shall be in accordance with manufacturer's recommendations.
 3. High-range water-reducer (plasticizer): The admixture shall comply with ASTM C494, Type F and shall result in non-segregating plasticized concrete with little bleeding and with the physical properties of low water/cement ratio concrete. The treated concrete shall be capable of maintaining its plastic state in excess of 2 hours. Proportioning and mixing shall be in accordance with manufacturer's recommendations.
 4. Admixtures causing retarded or accelerated setting of concrete shall not be used without written approval from the City. When allowed, the admixtures shall be retarding or accelerating water reducing or high range water reducing admixtures.
- G. Sheet curing materials: Waterproof paper, polyethylene film, or white burlap-polyethylene sheeting all complying with ASTM C171.

2.03 MIX

- A. Development of mix design and testing shall be by an independent testing laboratory acceptable to the City engaged by and at the expense of the Contractor.
- B. Select proportions of ingredients to meet the design strength and materials limits specified in Table 1 and to produce concrete having proper placability, durability, strength, appearance, and other required properties. Proportion ingredients to produce a homogenous mixture that will readily work into corners and angles of forms and around reinforcement without permitting materials to segregate or allowing excessive free water to collect on the surface.
- C. The design mix shall be based on standard deviation data of prior mixes with essentially the same proportions of the same constituents or, if such data is not available, be developed by a testing laboratory engaged by and at the expense of the Contractor. Acceptance of mixes based on standard deviation shall be based on the modification factors for standard deviation tests contained in ACI 318. The water content of the concrete mix, determined by laboratory testing, shall be based on a curve showing the relation between water cementitious ratio and 7- and 28-day compressive strengths of concrete made using the proposed materials. Four (4) or more points shall determine the curves, each representing an average value of at least 3 test specimens at each age. The curves shall have a range of values sufficient to yield the desired

data, including the specified design strengths as modified below, without extrapolation. The water content of the concrete mix to be used, as determined from the curve, shall correspond to strengths 16 percent greater than the specified design strength. The resulting mix shall not conflict with the limiting values for maximum water cementitious ratio and net minimum cementitious content as specified in Table 1 below.

- D. Compression tests: Provide testing of the proposed concrete mix to demonstrate compliance with the specified design strength requirement in conformity with the above paragraph.
- E. Entrained air, as measured by ASTM C231, shall be as shown in Table 1 below.
 - 1. If the air-entraining agent proposed for use in the mix requires testing methods other than ASTM C231 to accurately determine air content, make special note of this requirement in the admixture submittal.
- F. Slump of the concrete as measured by ASTM C143, shall be as shown in Table 1 below. If a high-range water-reducer (plasticizer) is used, the slump indicated shall be that measured before plasticizer is added. Plasticized concrete shall have a slump ranging from 7 to 10 inches.
- G. Proportion admixtures according to the manufacturer's recommendations. Two (2) or more admixtures specified may be used in the same mix provided that the admixtures in combination retain full efficiency and have no deleterious effect on the concrete or on the properties of each other.

**TABLE 1
CONCRETE MIX REQUIREMENTS**

Class	Design Strength (1)	Cement (2)	Fine Aggregate (3) (4)	Coarse Aggregate (3) (4)	Water
A3 (10)	3000 psi	588 lb/cu yd	1362 lb/cu yd	1811 lb/cu yd	33.5 gal/cu yd
City Mix (9)	3500 psi	588 lb/cu yd	1245 lb/cu yd	1850 lb/cu yd	33.0 gal/cu yd
A4 (10)	4000 psi	635 lb/cu yd	1219 lb/cu yd	1811 lb/cu yd	33.5 gal/cu yd
Flowable Fill	30 psi	---	---	---	---

Class	W/C Ratio (5)	Fly Ash	AE Range (6)	WR (7)	HRWR (8)
A3	0.56	---	6 +/- 2%	---	1-5"
City Mix (9)	0.25	120	6 +/- 2%	---	1-5"
A4	0.45	---	6 +/- 1%	---	2-4"
Flowable Fill	---	---	---	---	---

NOTES:

- (1) Minimum compressive strength in psi at 28 days.
- (2) Min. amount of Type I or Type II Portland Cement per ASTM C 150
- (3) Saturated surface dry weight
- (4) #57 size manufactured and tested for acceptance by ASTM C33 and The Virginia Department of Transportation Road and Bridge Specifications.
- (5) Max. water-cementitious ratio by weight.
- (6) AE is percent air-entrainment. AE admixtures to meet or exceed requirements of ASTM C-260 and AASHTO M-154.
- (7) WR is water-reducer admixture. WR admixtures to meet or exceed requirements of ASTM C-494 and AASHTO M-194.
- (8) HRWR is high-range water-reducer admixture. HRWR admixtures to meet or exceed requirements of ASTM C-494 Types A & F and AASHTO M-194 Types A & F.
- (9) "City Mix" to be colored "Canvas" using SGS Color #306. "City Mix" shall meet requirements of VDOT A3.5 concrete unless otherwise indicated.
- (10) Use most recently VDOT approved mixture for A3 and A4 mixes.

PART 3 - EXECUTION

3.01 MEASURING MATERIALS

- A. Concrete shall be composed of Portland cement, blast-furnace slag, fine aggregate, coarse aggregate, water, and admixtures as specified and shall be produced by a plant acceptable to the City. All constituents, including admixtures, shall be batched at the plant except a high-range water reducer may also be added in the field.
- B. Measure materials for batching concrete by weighing in conformity with and within the tolerances given in ASTM C94 except as otherwise specified.
- C. Measure the amount of free water in fine aggregates within 0.3 percent with a moisture meter. Compensate for varying moisture contents of fine aggregates. Record the number of gallons of water as batched on printed batching tickets.
- D. Admixtures shall be dispensed either manually using calibrated containers or measuring tanks, or by means of an automatic dispenser approved by the manufacturer of the specific admixture.
 - 1. Charge air-entraining and chemical admixtures into the mixer as a solution using an automatic dispenser or similar metering device.
 - 2. Inject multiple admixtures separately during the batching sequence.

3.02 MIXING AND TRANSPORTING

- A. Concrete shall be ready-mixed concrete produced by equipment acceptable to the City. Hand mixing will not be permitted. Equip each transit-mix truck with a continuous, non-reversible, revolution counter showing the number of revolutions at mixing speeds.
- B. Ready-mix concrete shall be transported to the site in watertight agitator or mixer trucks loaded not in excess of their rated capacities as stated on the nameplate.
- C. The City must direct any addition of water. Added water shall be incorporated by additional mixing of at least 35 revolutions. All added water shall be metered and the amount of water added shall be shown on each delivery ticket.
- D. Re-tempering (mixing with or without additional cement, aggregate, or water) of concrete or mortar that has reached initial set will not be permitted.
- E. Furnish a delivery ticket for ready-mixed concrete batch. Each ticket shall provide a printed record of the weight of cement and each aggregate as batched individually. Clearly indicate the weight of fine and coarse

aggregate, cement and water in each batch, the quantity delivered, and the time any water is added. Show the time of day batched and time of discharge from the truck

F. Temperature control.

1. In cold weather, do not allow the as-mixed temperature of the concrete and concrete temperatures at the time of placement in the forms to drop below 40 degrees F.
2. If water or aggregate has been heated, combine water with aggregate in the mixer before cement is added. Do not add cement to mixtures of water and aggregate when the temperature of the mixture is greater than 90 degrees F.
3. In hot weather, cool ingredients before mixing to maintain temperature of the concrete below the maximum placing temperature of 90 degrees F. If necessary, substitute well-crushed ice for all or part of the mixing water.

3.03 PLACING AND COMPACTING

A. Placing.

1. Verify that all formwork completely encloses concrete to be placed and is securely braced prior to concrete placement. Remove ice, excess water, dirt, and other foreign materials from forms. Confirm that reinforcement and other embedded items are securely in place. Have a competent workman at the location of the placement who can assure that reinforcing steel and embedded items remain in designated locations while concrete is being placed. Sprinkle semi-porous sub-grades or forms to eliminate suction of water from the mix. Seal extremely porous sub-grades in an approved manner.
2. Deposit concrete as near its final position as possible to avoid segregation due to re-handling or flowing. Place concrete continuously at a rate that ensures the concrete is being integrated with fresh plastic concrete. Do not deposit concrete that has partially hardened or has been contaminated by foreign materials or on concrete that has hardened sufficiently to cause formation of seams or planes of weakness within the section. If the section cannot be placed continuously, place construction joints as specified or as approved.
3. Pumping of concrete will be permitted. Use a mix design and aggregate sizes suitable for pumping.

4. Remove temporary spreaders from forms when the spreader is no longer useful. Temporary spreaders may remain embedded in concrete only when made of galvanized metal or concrete and if prior approval has been obtained.
5. Slabs.
 - a. After suitable bulkheads, screeds, and jointing materials have been positioned, the concrete shall be placed continuously between construction joints beginning at a bulkhead, edge form, or corner. Each batch shall be placed into the edge of the previously placed concrete to avoid stone pockets and segregation.
 - b. Avoid delays in casting. If there is a delay in casting, the concrete placed after the delay shall be thoroughly spaded and consolidated at the edge of that previously placed to avoid cold joints. Concrete shall then be brought to correct level and struck off with a straightedge. Bullfloats or darbies shall be used to smooth the surface, leaving it free of humps or hollows.

B. Compacting.

1. Consolidate concrete by vibration, puddling, spading, rodding, or forking so that concrete is thoroughly worked around reinforcement, embedded items, and openings, and into corners of forms. Puddling, spading, etc., shall be continuously performed along with vibration to eliminate air or stone pockets that may cause honeycombing, pitting, or planes of weakness.

3.04 CURING AND PROTECTION

A. Protect all concrete work against injury from the elements and defacements of any nature during construction operations.

B. Curing methods.

1. Curing methods for concrete surfaces: Cure concrete to retain moisture and maintain minimum temperature at the surface for a minimum of 2 days after placement. Curing methods to be used are as follows:
 - a. Sheet material curing: Cover entire surface with sheet material. Securely anchor sheeting to prevent wind and air from lifting the sheeting or entrapping air under the sheet. Place and secure sheet as soon as initial concrete set occurs.
 - b. Liquid membrane curing: Apply over the entire concrete surface except for surfaces to receive additional concrete. Curing compound shall NOT be placed on any concrete surface where additional

concrete is to be placed, or where concrete sealers or surface coatings are to be used. Application shall be in compliance with the manufacturer's recommendations.

C. Finished surfaces and slabs shall be protected from the direct rays of the sun to prevent checking and crazing.

D. Cold weather concreting.

1. "Cold weather" is defined as a period when for more than 3 successive days, the average daily outdoor temperature drops below 40 degrees F. The average daily temperature shall be calculated as the average of the highest and the lowest temperature during the period from midnight to midnight.
2. Discuss a cold weather work plan with the City. The discussion shall encompass the methods and procedures proposed for use during cold weather including the production, transportation, placement, protection, curing, and temperature monitoring of the concrete. The procedures to be implemented upon abrupt changes in weather conditions or equipment failures shall also be discussed. Cold weather concreting shall not begin until the work plan is acceptable to the City.

E. Hot weather concreting.

1. "Hot weather" is defined as any combination of high air temperatures, low relative humidity, and wind velocity that produces a rate of evaporation estimated in accordance with ACI 305R, approaching or exceeding 0.2 lbs./sq.ft./hr.
2. Concrete placed during hot weather, shall be batched, delivered, placed, cured, and protected in compliance with the recommendations of ACI 305R and the additional requirement specified herein.
 - a. Temperature of concrete being placed shall not exceed 90 degrees F. Every effort shall be made to maintain a uniform concrete mix temperature below this level.
3. Discuss with the City a work plan describing the methods and procedures proposed to use for concrete placement and curing during hot weather periods. Hot weather concreting shall not begin until the work plan is acceptable to the City.

3.05 INSPECTION AND FIELD TESTING

A. The batching, mixing, transporting, placing, and curing of concrete may be subject to the inspection of the City at any time.

- B. The City may have cores taken from any questionable area in the concrete work for determination of concrete quality. The results of tests on such cores shall be the basis for acceptance, or rejection of the concrete work.
- C. The Contractor shall cooperate in obtaining cores by allowing free access to the work and permitting the use of incidental equipment as may be required. The Contractor shall also repair all core holes. Cores for testing shall not be taken until concrete has aged a minimum of 60 days. The work of cutting and testing the cores will be at the expense of the City.

3.06 FAILURE TO MEET REQUIREMENTS

- A. When the tests on specimens of concrete fall below the specified strength, the City will permit check tests for strengths to be made by means of typical cores drilled from the structure in compliance with ASTM C42 and C39 at the Contractor's expense. In the case of cores not indicating adequate strength, the City, in addition to other recourses, may require, at the Contractor's expense, the replacement of those portions of the concrete work that fail to develop the required strength.

END OF SECTION

SECTION 03600

GROUT

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required and install grout complete as shown on the Drawings and as specified herein.
- B. Perform all sampling and furnish all testing of materials and products by an independent testing laboratory acceptable to the City but engaged by and at the expense of the Contractor.

1.02 RELATED WORK

- A. Section 02300, Crossings by Jacking, Boring, and Tunneling.
- B. Section 03300, Concrete.

1.03 SUBMITTALS

- A. Submit to the City product data showing materials of construction and details of installation for:
 - 1. Commercially manufactured nonshrink cementitious grout. The submittal shall include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to required ASTM standards, and Material Safety Data Sheet.
 - 2. Commercially manufactured nonshrink epoxy grout. The submittal shall include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to required ASTM standards, and Material Safety Data Sheet.
 - 3. Cement grout. The submittal shall include the type and brand of the cement, the gradation of the fine aggregate, product data on any proposed admixtures, and the proposed mix of the grout.

1.04 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM).
 - 1. ASTM C531 - Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical Resistant Mortars, Grouts and Monolithic Surfacing and Polymer

2. Section 0300 – Concrete.
 3. ASTM C579 - Standard Test Method for Compressive Strength of Chemical Resistant Mortars, Grouts and Monolithic Surfacing and Polymer Concretes.
 4. ASTM C827 - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures.
 5. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
 6. ASTM D695 - Standard Test Method for Compressive Properties of Rigid Plastics.
- B. U.S. Army Corps of Engineers Standard (CRD).
1. CRD C-621 - Corps of Engineers Specification for Nonshrink Grout.
- C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

- A. Qualifications.
1. Grout manufacturer shall have a minimum of 10 years experience in the production and use of the type of grout proposed for the work.
- B. Services of manufacturer's representative.
1. A qualified field technician of the nonshrink grout manufacturer, specifically trained in the installation of the products, shall be available, as required, to assist with correct installation.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the jobsite in original, unopened packages, clearly labeled with the manufacturer's name, product identification, batch numbers, and printed instructions.
- B. Store materials in full compliance with the manufacturer's recommendations. Total storage time from date of manufacture to date of installation shall be limited to 6 months or the manufacturer's recommended storage time, whichever is less.
- C. Material that becomes damp or otherwise unacceptable shall be immediately

removed from the site and replaced with acceptable material at no additional expense to the City.

- D. Nonshrink cement-based grouts shall be delivered as preblended, prepackaged mixes requiring only the addition of water.
- E. Nonshrink epoxy grouts shall be delivered as premeasured, prepackaged, 3-component systems requiring only blending as directed by the manufacturer.

1.07 DEFINITIONS

- A. Nonshrink grout: A commercially manufactured product that does not shrink in either the plastic or hardened state, is dimensionally stable in the hardened state, and bonds to a clean base plate.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The use of a manufacturer's name and product or catalog number is for the purpose of establishing the standard of quality desired.
- B. Like materials shall be the products of one manufacturer or supplier in order to provide standardization of appearance.

2.02 MATERIALS

- A. Nonshrink cementitious grout.
 - 1. Nonshrink cementitious grouts shall meet or exceed the requirements of ASTM C1107, Grades B or C and CRD C-621. Grouts shall be Portland cement based, contain a pre-proportioned blend of selected aggregates and shrinkage compensating agents, and shall require only the addition of water. Nonshrink cementitious grouts shall not contain expansive cement or metallic particles. The grouts shall exhibit no shrinkage when tested in conformity with ASTM C827.
 - a. General purpose nonshrink cementitious grout shall conform to the standards stated above and shall be SikaGrout 212 by Sika Corp.; Set Grout by Master Builders, Inc.; Gilco Construction Grout by Gifford Hill & Co.; Euco NS by The Euclid Chemical Co.; NBEC Grout by U. S. Grout Corp., or equal.
 - b. Flowable (precision) nonshrink cementitious grout shall conform to the standards stated above and shall be Masterflow 928 by Master Builders, Inc.; Hi-Flow Grout by the Euclid Chemical Co.; SikaGrout 212 by Sika Corp.; Supreme Grout by Gifford Hill & Co.; Five Star Grout by U. S. Grout Corp., or equal.

B. Nonshrink epoxy grout.

1. Nonshrink epoxy-based grout shall be a pre-proportioned, 3-component, 100 percent solids system consisting of epoxy resin, hardener, and blended aggregate. It shall have a compressive strength of 14,000 psi in 7 days when tested in conformity with ASTM D695 and have a maximum thermal expansion of 30×10^{-6} when tested in conformity with ASTM C531. The grout shall be Ceilcote 648 CP by Master Builders Inc.; Five Star Epoxy Grout by U.S. Grout Corp.; Sikadur 42 Grout-Pak by Sika Corp.; High Strength Epoxy Grout by the Euclid Chemical Co., or equal.

C. Cement grout – General.

1. Cement grouts shall be a mixture of 1 part Portland cement conforming to ASTM C150, Types I, II, or III and 1 to 2 parts sand conforming to ASTM C33 with sufficient water to place the grout. The water content shall be sufficient to impart workability to the grout but not to the degree that it will allow the grout to flow.

D. Cement grout – Steel casing installations.

1. Cement grout shall be a mixture of 1 part Portland cement conforming to ASTM 150, Type I and 4 parts sand conforming to ASTM C33 with sufficient water to place the grout. The water content shall be sufficient to allow the grout to flow into voids surrounding the steel casing.

E. Water.

1. Potable water, free from injurious amounts of oil, acid, alkali, organic matter, or other deleterious substances.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Grout shall be placed over cured concrete that has attained its full design strength unless otherwise approved by the City.
- B. Concrete surfaces to receive grout shall be clean and sound; free of ice, frost, dirt, grease, oil, curing compounds, laitance, and paints; and free of all loose material or foreign matter which may affect the bond or performance of the grout.
- C. Roughen concrete surfaces by chipping, sandblasting, or other mechanical means to ensure bond of the grout to the concrete. Remove loose or broken concrete. Irregular voids or projecting coarse aggregate need not be removed if they are sound, free of laitance, and firmly embedded into the parent concrete.

1. Air compressors used to clean surfaces in contact with grout shall be the oilless type or equipped with an oil trap in the air line to prevent oil from being blown onto the surface.
- D. Remove all loose rust, oil, or other deleterious substances from metal embedments or bottom of base plates prior to the installation of the grout.
 - E. Concrete surfaces shall be washed clean and then kept moist for at least 24 hours prior to the placement of cementitious or cement grout. Saturation may be achieved by covering the concrete with saturated burlap bags, use of a soaker hose, flooding the surface, or other method acceptable to the City. Upon completion of the 24-hour period, visible water shall be removed from the surface prior to grouting. The use of an adhesive bonding agent in lieu of surface saturation shall only be used when approved for each specific location of grout installation.
 - F. Epoxy-based grouts do not require the saturation of the concrete substrate. Surfaces in contact with epoxy grout shall be completely dry before grouting.
 - G. Construct grout forms or other leak-proof containment as required. Forms shall be lined or coated with release agents recommended by the grout manufacturer. Forms shall be of adequate strength, securely anchored in place and shored to resist the forces imposed by the grout and its placement.
 1. Forms for epoxy grout shall be designed to allow the formation of a hydraulic head and shall have chamfer strips built into forms.
 - H. Level and align the structural or equipment bearing plates in accordance with the structural requirements and the recommendations of the equipment manufacturer.
 - I. Equipment shall be supported during alignment and installation of grout by shims, wedges, blocks, or other approved means. The shims, wedges, and blocking devices shall be prevented from bonding to the grout by appropriate bond-breaking coatings and removed after grouting unless otherwise approved by the City.

3.02 INSTALLATION - GENERAL

- A. Mix, apply, and cure products in strict compliance with the manufacturer's recommendations and this Section.
- B. Have sufficient manpower and equipment available for rapid and continuous mixing and placing. Keep all necessary tools and materials ready and close at hand.
- C. Maintain temperatures of the foundation plate, supporting concrete, and grout between 60 and 90 degrees F during grouting and for at least 24 hours

thereafter or as recommended by the grout manufacturer, whichever is longer. Take precautions to minimize differential heating or cooling of base plates and grout during the curing period.

- D. Take special precautions for hot weather or cold weather grouting as recommended by the manufacturer when ambient temperatures and/or the temperature of the materials in contact with the grout are outside of the 60 and 90 degrees F range.
- E. Install grout in a manner that will preserve the isolation between the elements on either side of the joint where grout is placed in the vicinity of an expansion or control joint.
- F. Reflect all existing underlying, expansion, control, and construction joints through the grout.

3.03 INSTALLATION - CEMENT GROUTS AND NONSHRINK CEMENTITIOUS GROUTS

- A. Mix in accordance with manufacturer's recommendations. Do not add cement, sand, pea gravel, or admixtures without prior approval.
- B. Avoid mixing by hand. Mixing in a mortar mixer (with moving blades) is recommended. Pre-wet the mixer and empty excess water. Add premeasured amount of water for mixing, followed by the grout. Begin with the minimum amount of water recommended by the manufacturer and then add the minimum additional water required to obtain workability. Do not exceed the manufacturer's maximum recommended water content.
- C. Placements greater than 3 inches in depth shall include the addition of clean, washed pea gravel to the grout mix when approved by the manufacturer. Comply with the manufacturer's recommendations for the size and amount of aggregate to be added.
- D. Place grout into the designated areas in a manner that will avoid segregation or entrapment of air. Do not vibrate grout to release air or to consolidate the material. Placement should proceed in a manner that will ensure the filling of all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes as necessary.
- E. Place grout rapidly and continuously to avoid cold joints. Do not place cement grouts in layers. Do not add additional water to the mix (retemper) after initial stiffening.
- F. Just before the grout reaches its final set, cut back the grout to the substrate at a 45-degree angle from the lower edge of bearing plate unless otherwise approved by the City. Finish this surface with a wood float (brush) finish.

- G. Begin curing immediately after form removal, cutback, and finishing. Keep grout moist and within its recommended placement temperature range for at least 24 hours after placement or longer if recommended by the manufacturer. Saturate the grout surface by use of wet burlap, soaker hoses, ponding, or other approved means. Provide sunshades as necessary. If drying winds inhibit the ability of a given curing method to keep grout moist, erect windbreaks until wind is no longer a problem or curing is finished.

3.04 INSTALLATION - NONSHRINK EPOXY GROUTS

- A. Mix in accordance with the procedures recommended by the manufacturer. Do not vary the ratio of components or add solvent to change the consistency of the grout mix. Do not over mix. Mix full batches only to maintain proper proportions of resin, hardener, and aggregate.
- B. Monitor ambient weather conditions and contact the grout manufacturer for special placement procedures to be used for temperatures below 60 or above 90 degrees F.
- C. Place grout into the designated areas in a manner that will avoid trapping air. Placement methods shall ensure the filling of all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes as necessary.
- D. Minimize "shoulder" length (extension of grout horizontally beyond base plate). In no case shall the shoulder length of the grout be greater than the grout thickness.
- E. Finish grout by puddling, to cover all aggregate and provide a smooth finish. Break bubbles and smooth the top surface of the grout in conformity with the manufacturer's recommendations.
- F. Maintain the formed grout within its recommended placement temperature range for at least 24 hours after placing, or longer if recommended by the manufacturer.

END OF SECTION

**DIVISION 15 – MECHANICAL
POTABLE WATER**

SECTION 15050

WATER PIPING INSTALLATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope. This section shall govern all waterline installed within the City of Charlottesville intended for public use including labor, materials, equipment and incidentals as shown, specified, and required to install and test all piping, fittings, and specialties as shown on approved final site plans. The Work includes, but is not limited to, the following:

1. All types and sizes of piping except those specified under other Sections.
2. Supports, restraints, and thrust blocks.
3. Pipe encasements.
4. Work on or affecting existing piping.
5. Testing.
6. Cleaning.
7. Installation of all jointing and gasketing materials, specialties, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, tie rods, and all other Work required to complete the piping installation.

B. Related sections.

1. Section 02200, Excavation and Backfill.
2. Section 02300, Crossings by Jacking, Boring, and Tunneling.
3. Section 03300, Concrete.
4. Section 15072, Ductile Iron Pipe and Fittings.

1.02 QUALITY ASSURANCE

- A. All pipe to be installed shall be inspected at the place of manufacture for compliance with the Specifications by an independent testing laboratory. The Contractor shall require the manufacturer's cooperation in these inspections.
- B. The City reserves the right to inspect the pipe after delivery to the project site. The pipe shall be subject to rejection at any time due to failure to meet any of

the specified requirements herein, even though pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall be removed from the job.

- C. The City shall be contacted to provide final inspection and to witness testing of all pipe intended for public use.
- D. Reference standards. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
 - 1. AWWA C105 - Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids.
 - 2. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.

1.03 SUBMITTALS

- A. Final Site Plan approval is required prior to construction of any public waterline.
- B. Shop drawings. Submit for approval the following:
 - 1. Laying schedules and grade sheets for all pipe.
 - 2. Full details or cut sheets of piping, specialties, joints, and connections to existing piping, structures, equipment, and appurtenances intended for public ownership.
- C. Certificates. Certificates of compliance shall be submitted with referenced standards.
- D. As-built drawings. As-built drawings shall be submitted prior at Substantial Completion.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. All pipe, fittings, specials, and accessories shall be handled carefully with approved handling devices in accordance with the manufacturer's recommendations and to the satisfaction of the City. Materials shall not be dropped or rolled off trucks. Piping shall not be otherwise dropped, rolled, or skidded.
- B. Pipes and fittings shall be stored on heavy wood blocking or platforms so they are not in contact with the ground. Pipe shall not be stacked higher than the limits recommended by the manufacturer and shall conform to the manufacturer's recommendations. Pipe and fittings strung out for installation within five (5) working days may be placed in contact with the ground.

- C. Pipe, fittings, and specials shall be unloaded opposite to or as close to the place where they are to be installed as is practical to avoid unnecessary handling. Pipe interiors shall be kept completely free from dirt and foreign matter.
- D. Pipe shall be inspected upon delivery for cracks, gouges, chips, dents, or other damages. Damaged pipe shall be immediately removed from site.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Per section 1417(a)(1) of the Safe Drinking Water Act, all pipe, plumbing fixture, solder, flux or other materials installed in a residential or non-residential facility providing water for human consumption shall be “lead free”. Lead free is defined as:
 - 1. Less than 8.0% lead for solders and flux
 - 2. Less than 0.25% for pipes, pipe fittings, and components based on a weighted average of wetted surfaces.Additionally, all materials shall bear the NSF 61-G stamp.
- B. Refer to applicable Pipe Sections for material specifications.
- C. Pipe marking.
 - 1. Material, type, and pressure designation shall be cast or painted on each piece of pipe or fitting 4 inches in diameter and larger.
 - 2. Pipe and fittings smaller than 4 inches in diameter shall be clearly marked by manufacturer as to material, type, and rating.
- D. Any plastic or other nonmetallic pressurized conduit installed underground shall have affixed thereto a wire conductive of electricity or some other means of locating the conduit while it is underground. Tracer wire shall be AWG No. 14, single-conductor solid copper with 600-volt insulation designed to meet U.S.E. requirements for buried service.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General.
 - 1. Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe, linings, or coatings. Pipe or fittings shall not be dropped. All pipe and fittings shall be examined before laying and no

piece shall be installed which is found to be defective. Any damage to the pipe linings or coatings shall be repaired as directed. Handling and laying of pipe and fittings shall be in accordance with the manufacturer's instructions and as specified herein.

2. If there is a conflict between manufacturer's recommendations and the Drawings or Specifications, request instructions from the City before proceeding.
3. Prior to excavation, other utilities and underground facilities shall be located to confirm location, proper depth, and clearances. Care shall be taken in excavating to prevent damage to underground structures, utilities, and adjacent properties. When approaching and crossing such installations, a combination of installation methods may be used. Trenching equipment shall not be used within 2 feet of existing utilities.
4. All mains and services shall be installed true to the horizontal and vertical alignment indicated on the Plans, or as otherwise directed by the City. The Contractor shall make no deviations to the proposed horizontal and/or vertical alignment of the mains or services unless otherwise approved by the City. In such cases where the proposed horizontal and/or vertical pipeline alignment will cause conflict with other utilities or structures, or result in less than the specified minimum clearance or cover, the City shall be notified and the pipeline relocated as directed.
5. All pipe shall be sound and clean before laying. When laying is not in progress, including lunchtime, the open ends of the pipe shall be closed by watertight plugs or other approved means.
6. A firm, even bearing throughout the length of the pipe barrel shall be constructed of compacted crushed stone as shown in Detail Drawing W 1.0 or W 1.1. Blocking will not be permitted. If any defective pipe is discovered after it has been laid, it shall be removed and replaced with a sound pipe in a satisfactory manner by the Contractor, at Contractor's expense.
7. The deflection at joints shall not exceed 1/2 that recommended by the pipe manufacturer. Fittings, in addition to those shown on the Drawings, shall be provided, if required, in areas where conflict exists with existing facilities.
8. Where pipe cutting is required, the cutting shall be done by abrasive saw, leaving a smooth cut at right angles to the axis of the pipe. Any damage to the lining shall be repaired to the satisfaction of the City. Field cuts shall only be made in pipe that has been gauged full length. Field cut ends shall be in accordance with the manufacturer's instructions.
9. Pipe and fittings shall be installed in accordance with the requirements of

applicable reference standards. Solid sleeves shall be used only where approved by the City.

10. Rights-of-way and easements.

- a. Construction operations shall be confined to the immediate vicinity of the project location as shown on the Plans, and in no case shall the limits of construction, as shown on the approved final site plans, be encroached upon. Construction tools, equipment, excavated materials, and pipeline facility materials and supplies shall be placed carefully and strategically so as to cause the least possible damage to property and the least interference with traffic. The placing of such tools, equipment, and materials shall be subject to the approval of the City. Any damage resulting from the placement of equipment and materials or construction operation occurring outside of designated work areas shall be the sole responsibility of the offender. Satisfactory settlement shall be made for any damage directly with the property owner involved.
- b. Construction shall be conducted in such a manner to cause the least inconvenience to the citizens of the area, thereby maintaining good public relations. Construction activities shall not unnecessarily interfere with the use of any public or private improvements, including landscaping; nor shall he unnecessarily damage such improvements. Those responsible shall repair any damage to such improvements to pre-construction condition, or as otherwise directed by the City.
- c. Existing property irons and monuments shall be protected in and adjacent to the working area. If a property iron or monument must be removed to install new facilities, the services of a properly registered surveyor shall be retained to immediately replace it after construction of the new facilities.

11. Work within city rights-of-way, VDOT rights-of-way, and railroad property and rights-of-way.

- a. Permits. Those performing the Work shall be responsible for obtaining and paying for all permits, insurance, and bonds required to complete the Work.
- b. Those performing the Work shall comply with all provisions of all permits required by the governing authorities at his own expense. The responsibilities of those performing the Work under this paragraph may include, but is not limited to, the following:
 - 1) Constructing and removing temporary facilities or structures.

- 2) Providing details of construction methods.
 - 3) Providing detailed construction schedules.
 - 4) Reimbursing the applicable authority for all expenses incurred by them in connection with the Work.
 - 5) Traffic maintenance.
 - 6) Coordination of scheduling with the authority.
 - 7) Necessary clean up and restoration.
- c. Maintenance of traffic.
- 1) Traffic shall be maintained within the construction area for the duration of the construction period, including during any temporary suspension of Work. Maintenance of traffic shall conform to the current editions of the Manual on Virginia Traffic Control Devices, Virginia Work Area Protection Manual, Virginia Department of Transportation Road and Bridge Specifications, and the Virginia Department of Transportation Guidelines for Temporary Traffic Control.
 - 2) The City may provide a detailed Traffic Maintenance Plan for portions of the Work to be performed in the public Right of Way. If a Traffic Maintenance Plan is provided, the Plan must be followed. The City may require that those performing the Work submit a Traffic Maintenance Plan prior to commencing work on a particular portion of the project. Work must not commence on the portion of the project covered by the plan until approval of the Traffic Maintenance Plan by the City.
 - 3) The amount of roadway closure shall be limited to the immediate work area and shall be in accordance with the above-mentioned manuals and specifications.
 - 4) Use of temporary bridging of an open trench with steel plates shall be requested by the Contractor in writing. The Contractor shall submit for review a plan for use of the steel plates and their removal. The following minimum requirements shall apply; however, additional requirements may be enforced based on the specific situation. Plates shall be designed to support a minimum of AASHTO H 20-44 loading. Plates shall have a minimum bearing length of 18” on solid pavement on at least two sides. Steel spikes with rounded or countersunk heads shall be used to anchor the plate to the roadbed, and shall be spaced adequately to prevent horizontal movement under traffic or other loadings. Upon

removal, spike holes shall be filled with graded fines of asphalt concrete mix and sealed with Bondo® Traffic, P-606 Flexible Loop Sealer, or approved equal. If multiple plates are used, they shall be spliced together by bolting and to prevent movement. Asphalt concrete shall be used to provide a smooth transition between the existing road and the steel plate, as well to fill any voids and provide firm support on an uneven road surface. Signage shall be placed adequately to warn drivers of the steel plates.

- d. Maintenance of ingress and egress. Continuous ingress and egress shall be maintained to all affected parcels and traveled ways. When ingress and egress to affected parcels must be blocked or restricted due to the direct execution of the Work, 24-hours advance notice must be given to the affected property owner. In no case shall the blocking of ingress and egress be allowed for more than 24 consecutive hours.
- e. Construction activities within City rights-of-way are subject to the requirements of the City including Street Cut Permit and Temporary Street Closure. Those performing the Work shall ascertain from the City its rules, regulations, and requirements.
 - 1) Traffic control shall be maintained in a safe and professional manner. All traffic control measures, including signage, shall be in conformance with VDOT Guidelines for Temporary Traffic Control.
 - 2) Barriers, lights, and other necessary protective devices shall be erected and maintained as required by the City. Road, sidewalk, or other access-way closure will only be allowed with prior approval of the City.
 - 3) Required notice for work within City roadways is seven (7) calendar days.
- f. Construction within VDOT rights-of-way shall be subject to the approval and issuance of a construction permit by VDOT. Work and operations shall be conducted in accordance with the issued permit and the Virginia Department of Transportation Road and Bridge Specifications. If required by VDOT, those performing the Work shall submit for approval specific details of construction methods proposed for Work within VDOT rights-of-way.
- g. Materials and methods of construction used on railroad company property or rights-of-way shall be subject to the approval of the railroad company. Work and operations shall, at all times, be conducted fully within the railroad company's rules, regulations, and requirements. Those performing the Work must ascertain from the

railroad company its rules, regulations, and requirements, and what, if any, delays may be encountered. If required by the railroad company, those performing the Work must submit for approval specific details of the methods of construction he intends to utilize together with any sketches or drawings.

- h. All necessary and appropriate safety precautions shall be observed when working on railroad rights-of-way or property. At the discretion of the railroad, those performing the Work shall provide a qualified watchman or pay for a watchman supplied by the railroad to warn workmen of the approach of any train or other moving equipment upon the tracks of the railroad, and to keep all workmen or other persons, equipment, and materials from the tracks including any power, communication, and signal wires, so that there will be no contacts with trains, rolling equipment, or wires. Those performing the Work shall comply with all railroad requirements.

12. Staking of Work

- a. The method of field staking for the construction of the work shall be at the option of the Contractor.
- b. The accuracy of any method of staking shall be the responsibility of the Contractor. All engineering or surveying for vertical and horizontal controls shall be the responsibility of the Contractor.

B. Above-grade pipe installation.

1. All above-grade pipe shall be flanged unless otherwise shown or specified.
2. Flanged joints shall be made using gaskets, bolts, bolt studs with a nut on each end, or studs with nuts where the flange is tapped. The number and size of bolts shall conform to the same ANSI standard as the flanges.
3. Bolts in flanged joints shall be tightened alternately and evenly as per manufacturer's recommendations.
4. Sleeve-type couplings shall be installed in accordance with the procedures recommended by the manufacturer.
5. All pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment. When manufacturers have indicated requirements that piping loads shall not be transmitted to their equipment, submit a certification stating that such requirements have been complied with.
6. Sleeves of proper size shall be installed for all pipes passing through floors or walls. Where indicated on the Drawings or required for liquid or gas-

tightness, the sleeve shall be sealed with a mechanical seal similar to Link-Seal, as manufactured by Thunderline Corporation, or approved equal.

7. Concrete inserts for hangers and supports shall be furnished and installed as recommended by the manufacturer, as shown on the Drawings, or as specified herein. The inserts shall be set in accordance with the requirements of the piping layout and their locations verified from approved piping layout drawings and the structural drawings.

C. Buried piping installation.

1. Separation of potable water lines and sanitary sewers.

- a. Parallel installations.

- 1) Potable water lines and sanitary sewers shall be separated horizontally by a clear distance of not less than 10 feet edge-to-edge wherever possible.
- 2) If local conditions preclude a clear horizontal separation of 10 feet, the installation will be permitted provided the potable water line is in a separate trench and at such elevation that bottom of the potable water main is at least 18 inches above the top of the sewer.
- 3) Where this separation cannot be obtained, the sewer shall be constructed of AWWA specified water pipe, pressure tested in place without leakage prior to backfill and the sewer manhole shall be of watertight construction and tested in place.

- b. Crossings.

- 1) Provide a minimum vertical separation of 18 inches between the bottom of the potable water line and the top of the sewer when a potable water line must cross over a sewer.
- 2) Where this vertical separation cannot be obtained, the sewer shall be constructed of AWWA approved water pipe, pressure tested in place without any leakage prior to backfill and the sewer manhole shall be of watertight construction and tested in place.
- 3) Sewers passing over potable water lines shall be constructed of AWWA specified water pipe, pressure tested in place without leakage. Minimum vertical separation of potable water line and sewer shall be 18 inches.
 - a) Center one (1) full-length section of pipe so that the sewer joints will be equidistant from the potable water line joints.

- b) Provide adequate structural support for the sewer so as to maintain line and grade and prevent excessive deflections of the joints and the settling on and breaking of the water line.
- 4) No water pipe shall pass through or come in contact with any part of a sanitary sewer manhole.
- 2. Separation of potable water lines and other utilities.
 - a. Potable water lines shall have a minimum parallel separation of five (5) feet from gas lines where practical. In special cases this may be dropped to three (3) feet with approval of the Chief Gas Engineer. All other utilities shall have a minimum edge-to-edge separation of twelve (12) inches.
 - b. At all crossings, provide a minimum vertical separation of twelve (12) inches between potable water lines and gas mains or "wire-type" utilities.
 - c. No water lines shall pass through or come in contact with any part of a storm sewer or manhole.
- 3. Pipe bedding.
 - a. Bed pipe as specified below and in accordance with the Details W1.0 and W1.1.
 - b. Trench excavation, backfill, and bedding materials shall conform to the requirements of Section 02200, Excavation and Backfill, and Section 02230, Fill and Granular Fill Materials.
 - c. Excavate trenches below the pipe bottom by the amount specified. Remove all loose and unsuitable material from the trench bottom.
 - d. Rock shall be removed to a minimum 6-inch clearance around the bottom and 12-inch minimum clearance on the sides of all pipe being laid.
 - e. Carefully and thoroughly compact all pipe bedding with hand-held compactors.
 - f. If a conflict exists, obtain clarification from the City before proceeding.
 - g. No pipe shall be brought into position until the preceding length has been bedded and secured in its final position.

4. Laying pipe.
 - a. Conform to manufacturer's instructions and requirements of the reference standards where applicable.
 - b. Install all pipe accurately to line and grade shown on the Drawings unless otherwise approved by the City. Remove and re-lay pipes that are not laid correctly.
 - c. Slope piping uniformly between elevations shown.
 - d. Ensure that ground water level in trench is at least six (6) inches below bottom of pipe before laying piping. Do not lay pipe in water. Maintain dry trench conditions until jointing and backfilling are complete. Protect and keep pipe interiors and fittings clean.
 - e. Start laying pipe at lowest point and proceed towards the higher elevations, unless otherwise approved by the City.
 - f. Place bell and spigot pipe so that bells face the direction of laying, unless otherwise approved by the City.
 - g. Field cut pipe, where required, with a machine specially designed for cutting piping. Make cuts carefully, without damage to pipe or lining, and with a smooth end at right angles to the axis of pipe. Cut ends on push-on joint shall be tapered and sharp edges filed off smooth. Flame cutting will not be allowed.
 - h. Inspect interior of all pipe and fittings and completely clean all dirt, gravel, debris, or other foreign material from pipe interior and joint recesses before it is moved into the trench. Bell and spigot mating surfaces shall be thoroughly wire brushed and wiped clean and dry immediately before the pipe is laid.
 - i. Carefully examine all pipe, fittings, and specials for cracks, damage, or other defects while suspended above the trench before installation. Immediately remove defective materials from site.
 - j. Excavate around joints in bedding and lay pipe so that the barrel bears uniformly on the trench bottom.
 - k. Deflections at joints shall not exceed 1/2 the amount allowed by the pipe manufacturer.
 - l. Blocking under piping will not be permitted unless specifically approved by the City for special conditions. If permitted, conform to requirements of AWWA C600.

- m. Touch up protective coatings in a satisfactory manner prior to backfilling.
 - n. On steep slopes, take measures to prevent movement of the pipe during installation.
 - o. Exercise care to avoid flotation of pipe when placing concrete around pipe during concrete encasement.
5. Polyethylene encasement.
- a. Provide polyethylene encasement for ductile iron piping where shown on the Drawings to prevent contact between the pipe and surrounding bedding material and backfill.
 - b. Polyethylene may be supplied in tubes or in sheet material.
 - c. Polyethylene encasement materials and installation shall be in accordance with the requirements of AWWA C105.
6. Jointing pipe.
- a. Ductile iron mechanical joint pipe.
 - 1) Wipe the socket, plain end, and adjacent areas clean immediately before making joint. Make certain that cut ends are tapered and sharp edges are filed off smooth.
 - 2) Place the gland on the plain end with the lip extension toward the plain end.
 - 3) Lubricate the plain end and gasket with soapy water or an approved pipe lubricant in accordance with AWWA C111, and slip the gasket onto the plain end of the joint assembly with the narrow edge of the gasket toward the plain end.
 - 4) Insert the pipe into the socket and press the gasket firmly and evenly into the gasket recess. Keep the joint straight during assembly.
 - 5) Push gland toward socket and center it around pipe with the gland lip against the gasket.
 - 6) Insert bolts and hand-tighten nuts.
 - 7) Make deflection after joint assembly, if required, but prior to tightening bolts. Alternately tighten bolts 180 degrees apart to seat the gasket evenly.

The bolt torque shall be as follows:

Pipe Size (Inches)	Bolt Size (Inches)	Range of Torque (Ft.lbs.)
4-24	3/4	75-90
30-36	1	100-120
42-48	1-1/4	120-150

- b. Ductile iron push-on joint pipe.
- 1) Prior to assembling the joints, the last 8 inches of the exterior surface of the spigot and the interior surface of the bell shall be thoroughly cleaned with a wire brush, except where joints are lined or coated with a special protective lining or coating.
 - 2) Rubber gaskets shall be wiped clean and flexed until resilient. Refer to manufacturer's instructions for procedures to ensure gasket resiliency when assembling joints in cold weather.
 - 3) Insert gasket into joint recess and smooth out the entire circumference of the gasket to remove bulges and to prevent interference with the proper entry of the spigot of the entering pipe.
 - 4) Immediately prior to joint assembly, apply a thin film of approved lubricant to the surface of the gasket that will come in contact with the entering spigot end of pipe. A thin film of lubricant may be applied to the outside of the spigot of the entering pipe.
 - 5) For assembly, center spigot in the pipe bell and push pipe forward until it just makes contact with the rubber gasket. After gasket is compressed and before pipe is pushed or pulled all the way home, carefully check the gasket for proper position around the full circumference of the joint. Final assembly shall be made by forcing the spigot end of the entering pipe past the rubber gasket until it makes contact with the base of the bell. When more than a reasonable amount of force is required to assemble the joint, the spigot end of the pipe shall be removed to verify the proper positioning of the rubber gasket. Gaskets that have been damaged shall not be reused.
 - 6) Maintain an adequate supply of gaskets and joint lubricant at the site at all times when pipe-jointing operations are in progress.
- c. Proprietary joints. Pipes that use proprietary joints shall be installed in strict accordance with the manufacturer's instructions.

7. All buried pipe fittings shall be ductile iron, mechanical joint type.
 - a. All ductile iron pipe to be cut for insertion into fittings shall be gauged full length.
8. Plugs.
 - a. Install AWWA specified mechanical joint type plugs into all bells at dead ends, tees, or crosses and cap all spigot ends where shown on the Drawings.
 - b. Fully secure and block all plugs and caps installed for pressure testing to withstand the specified test pressure.
 - c. Where plugging is required for phasing of the Work or for subsequent connection of piping, install AWWA specified mechanical joint type plugs.
9. Thrust restraint.
 - a. All fittings or components subject to hydrostatic thrust shall be securely anchored by the use of thrust restraint.
 - b. A concrete thrust block, as shown in the drawings, shall be placed at all connections to existing water mains unless the Contractor uses restrained joint pipe. The dimensions for various blocking are shown in the Detail Drawings. Material for reaction blocking shall be 3000 psi concrete. A minimum 4-mil plastic shall cover the fitting to ensure that no concrete will interfere with removal of the fitting.
 - c. Restrained Joint Pipe, Mechanical Joint Pipe with Mega Lug Retaining Glands, or traditional Push-on Pipe with retainer glands may be used along the pipe alignment in accordance with Detail W 2.4.

Ductile Iron Pipe with Restrained Joints shall meet the applicable provisions of AWWA C-110 and AWWA C-111. The accepted manufacturers are as follows:

- United States Pipe & Foundry Company, “TR FLEX” restrained joint or “Field Lok” gasket restrained joint.”
- American Cast Iron Pipe Company, “Flex –Ring” restrained joint or “Fast-Grip” restrained joint.
- Griffin Pipe Products Co., “SNAP LOK” restrained joint pipe.
- Or Approved Equal

- d. Retainer Glands may be used in lieu of restrained joint pipe and shall be manufactured by EBAA Iron, Inc., Series 1100 “Megalug.” “Or Equals” will be considered but must be approved in advance by the City Engineer. Retainer glands may be used on proposed mains to restrain pipe with mechanical joints in accordance with the manufacturer’s recommendation. All pipe where retainer glands are used shall have a hardness of 180-200 BHN (Brinell Hardness Number) to allow proper activation of the glands.

10. Backfilling.

- a. Conform to the applicable requirements of Section 02200 and applicable Detail Drawings.
- b. Place backfill as construction progresses. Backfill by hand and use power tampers until pipe is covered by at least 1 foot of fill.

D. Water service taps.

1. General.

- a. Individual water services and multiple branch services shall be provided from the main to each water meter in accordance with the Drawings. Typically, such laterals are to be Type K soft copper tubing for all services 2 inches and less, installed at a minimum depth of 36 inches from the main line to a meter setting below finished grade.
- b. Water services 1.5” inches and larger shall extend from the main to a meter installed in a vault in accordance with the Drawings. Such laterals shall be AWWA approved ductile iron pipe (unless approved otherwise by the City), installed at a minimum depth of 36 inches below finished grade.
- c. Water service laterals larger than 1 inch, crossing under existing roadways, shall be installed in sleeves of appropriate size and material, as approved by the City.
- d. All connections shall be made by wet taps unless approved otherwise. Service connections shall be made perpendicular to the main and shall run straight to the meter.
- e. All water meter boxes and vaults shall be located a minimum of 12 inches and a maximum of 36 inches directly behind the curb or as directed by the Public Utilities Manager. Where no curb exists, meter boxes and vaults shall be installed in readily accessible locations beyond the limits of street surfacing, walks, and driveways as directed by the City. Water meter boxes and vaults shall not be placed in streets, parking areas, or obstructed by fencing or buildings.

Exceptions to these conditions will be at the direction of the City.

- f. Warning tape shall be installed with each service lateral. Warning tape shall be installed 12 inches above service piping and shall be continuous over the length of the service lateral.
- 2. The water meter shall be sized based on peak water demand. In cases of private development, meter size selection will be done by the developer and installation shall be done by the City. In cases of City extensions, meter size selection and installation will be by the City. Contractor shall consult with the Department of Public Works--Water Division for proper meter laying length.
- 3. Service taps to existing water lines shall be made by the City. Service taps shall be made to new water mains after the mains have been successfully tested and disinfected in accordance with the Specifications. Service taps greater than 2 inches shall be made on existing and new water mains by those performing the Work. If required, contact the City Utilities Department to make taps. Tapping fees will be charge based on the rates defined by Utility Billing.
- 4. A strainer shall be provided upstream of the meter on connections greater than 2 inches and on 1-1/2-inch and 2-inch connections where a turbine-type meter is to be used.
- 5. Taps in ductile iron water mains.
 - a. The maximum size of direct taps without a fitting, tapping sleeve, or saddle for ductile iron water mains shall be as follows:

Main Size	Maximum Tap Size
4"	3/4"
6"	1"
8"	1-1/4"
10"	1-1/2"
12"	2"

- b. Tapping sleeves and valves shall be used on all 4-inch and larger taps.
- c. The maximum size saddle outlet shall be limited to 1/2 the water main size with a maximum outlet size of 3 inches.
- d. Tapping saddles may be used on exposed ductile iron mains at the discretion of the City. Maximum saddle outlet size shall be limited to 1/2 main line size with a maximum size of 12 inches.

- e. Service taps shall be a minimum of 24 inches apart and located at the 12 o'clock position on the main. No burned taps will be allowed. No taps are allowed on a fire hydrant line. No tapping shall be made where rodding is placed.
 - f. Corporation stops threaded into iron pipes, fittings, or specials shall have their threads wrapped in Teflon tape or approved equal prior to assembly.
6. Where a service lateral must cross a sanitary sewer, the bottom of the service lateral within 10 feet of the point of crossing shall be at least 12 inches above the top of the sewer.
- E. Transitions from one type of pipe to another. Provide all necessary adapters, specials, and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.
- F. Closures. Provide all adapters, sleeves, specials, or other closure pieces shown on the Drawings or required to complete the Work.

3.02 WORK AFFECTING EXISTING PIPING

- A. The nominal size, outside diameter, material, depth and general condition of existing waterline shall be verified prior to beginning any work involving demolition of, relocation of, or connection to existing waterlines. The City takes no responsibility for providing this information.
- B. Location of existing piping.
- 1. Locations of existing piping shown on the Drawings should be considered approximate.
 - 2. The true location of existing piping to which connections are to be made, and location of other facilities which could be disturbed during earthwork operations, or which may be affected by work in any way, shall be determined prior to construction.
- C. Repair of water lines.
- 1. Joint leaks of cast iron pipe and ductile iron pipe shall be repaired by using a bell joint leak repair clamp as manufactured by Rockwell, or approved equal.
 - 2. Line breaks or punctures shall be repaired with a full circle repair clamp as manufactured by Rockwell, Mueller, or approved equal.
 - 3. Line splits or blowouts shall be repaired by replacing the damaged section with like pipe material with pipe couplings at each end. (Damaged cast

iron sections shall be replaced with ductile iron pipe.) Rockwell 431 coupling, or approved equal, shall be used for ductile iron pipe.

4. For old cast iron pipe to ductile iron pipe, use a pipe coupling with different end diameters sized specifically for the pipe material and pipe outside diameter at each end.
5. Disinfect materials used to facilitate water line repairs in accordance with Section 15052.

D. Water service line repairs.

1. A water service line severed between the water main and the water meter shall be repaired using new Type K copper tubing and brass flared joint fittings.
2. A corporation stop pulled out of a ductile iron pipe shall have a full circle repair clamp placed over the old tap hole. A new tap shall be made and a new corporation stop installed on the water main.

3.03 TESTING OF PIPING

- A. Test in accordance with Section 15052.

END OF SECTION

**SECTION 15052
WATER PIPE TESTING**

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. This Section specifies the general requirements for testing the water piping systems shown on the Drawings and specified elsewhere in these Specifications.

1.02 RELATED WORK

- A. Piping materials and systems are included in other Sections of Division 15.
- B. Section 15050, Piping Installation.
- C. Section 15100, Valves, Hydrants, and Appurtenances.

1.03 SUBMITTALS

- A. Test records.
 - 1. Maintain records of all tests performed.
 - 2. Test records shall include:
 - a. Date of testing.
 - b. Identification of piping tested.
 - c. Test fluid.
 - d. Test pressure.
 - e. Signature of contractor.
 - 3. If leaks are found, they shall be noted on the record, and then repaired. After repair, retest as specified for original test.
 - 4. Submit test records to City within 24 hours of testing.

1.04 GENERAL REQUIREMENTS

- A. General.
 - 1. Test all piping except as otherwise authorized by the City.

2. All testing will be performed in accordance with ANSI/AWWA C600.
3. Provide all testing apparatus, including pumps, hoses, gauges, and fittings.
4. Unless otherwise noted, pipelines shall hold specified test pressure for two (2) hours.
5. Repair and retest pipelines that fail to hold specified test pressure or which exceed the allowable leakage rate.
6. Unless otherwise specified, test pressures required are at the lowest elevation of the pipeline section being tested.
7. Conduct all tests in the presence of the Utilities inspector or City's representative. Notify the City (Public Utilities) 48 hours in advance of testing.

1.05 TEST PRESSURE

- A. Hydrostatic test. Test pressure shall be 150 psi unless otherwise specified in the respective piping system section.

PART 2 - PRODUCTS

2.01 TEST FLUIDS

- A. Hydrostatic test. Potable water shall be used as the test fluid for all potable water line testing.

2.02 TEST EQUIPMENT

- A. Hydrostatic test.
 1. Water: Of sufficient capacity to deliver the required test pressure.
 2. Strainer: On inlet side of the pump to prevent foreign matter from entering the system.
 3. Valves: Shall be provided on the suction and discharge side of the pump.
 4. Heater: To allow heating of the test fluid when elevated temperatures are required for test.
 5. Relief valve: Set at a pressure to relieve at 20 to 25 percent above the required test pressure.
 6. Pressure gauge(s): Capable of reaching 50 percent over the test pressure. These should be located at the pump discharge and any other place deemed convenient by the installer.

7. Pressure gauges and relief valves shall be checked for accuracy before use in test procedures.

PART 3 - EXECUTION

3.01 SAFETY

- A. All tests shall be performed under the direct supervision of the pipe installer and in the presence of a representative of the City.
- B. Restrict personnel in the test area to those involved in the test.
- C. Safety glasses must be worn throughout testing.

3.02 HYDROSTATIC TEST

- A. This test specification shall be used to hydrostatically test piping systems for structural integrity and leaks. The test shall be performed at ambient temperature unless otherwise specified.
- B. Hydrostatic pressure test.
 1. All newly installed water lines or any valved section thereof shall be hydrostatically tested. Backfilling and compaction shall be completed before testing unless otherwise required or approved by the City.
 2. Test pressure shall be 150 psi unless otherwise approved by the City.
 3. Each valved section of pipe shall be slowly filled with potable water expelling all air. If necessary, Contractor shall install corporation stops to assist in air removal. Backflow prevention device acceptable to the City shall be used whenever non-disinfected pipelines are being filled from a potable water source or line.
 4. Specified test pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the City. The water and container used in pressurizing the line to be tested shall be properly disinfected.
 5. All exposed pipe, fittings, and appurtenances shall be examined after pressurization of pipeline. Any visible leaks shall be repaired.
 6. The section of pipeline under test will be considered to have successfully completed this test if applied pressure does not vary by more than five (5) psi during the two-hour test duration.
- C. Leakage test.
 1. All newly installed water lines or any valved portion thereof shall be subjected to a leakage test conducted concurrently with the hydrostatic

pressure test.

2. Leakage shall be defined as the quantity of water that must be supplied to a newly installed pipeline, or valved section thereof, to maintain line pressure within five (5) psi of the test pressure specified.
3. Allowable leakage in gallons per hour for ductile iron pipe shall be determined by the most recent AWWA Standard C-600. D. Current formula is as follows:

$$L = \frac{S D P^{1/2}}{148,000}$$

L = Allowable leakage (gal./hr.)

S = Length of pipe being tested (ft.)

D = Nominal pipe diameter (in.)

P = Average test pressure (lbs./in.²)

4. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0075 gal./hr./in. of nominal valve size will be allowed.
5. All hydrants, air relief valves, meters, or other appurtenances within the test section shall be valved-off during testing to prevent possible damage.
6. If any test of installed pipe discloses leakage greater than that allowed, the pipe installer shall, at his own expense, determine the sources of leaks and remedy all deficiencies as necessary. The installed pipe shall be retested in accordance with the test procedures above until leakage is within acceptable limits.

3.03 DISINFECTION OF POTABLE WATER PIPING

A. All newly installed water piping shall be disinfected in accordance with Virginia Department of Health Waterworks Regulations, latest revision. Disinfection method may be either continuous feed or tablet method. The pipe installer shall be responsible for all aspects of disinfection, sampling, and testing at his own expense.

1. Continuous feed method.

- a. Potable water shall be introduced into the pipeline at a constant flow rate protected by an approved backflow prevention device. 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 50 mg/l.
- b. The chlorinated water shall remain in the pipeline at least 24 hours, after which the chlorine concentration in the water shall be at least 10 mg/l.

- c. Pipes shall be flushed prior to the disinfection with a velocity of at least 3 ft/sec and valves, hydrants, and other appurtenances shall be operated during this flushing. Valves and hydrants and other appurtenances need to be operated during the disinfection process to be sure that they are disinfected as well. However, flushing should not be done if the tablet method is used.

2. Tablet method.

- a. Tablets of calcium hypochlorite shall be affixed to the top of each length of pipe and in each appurtenance as installed with a food-grade adhesive-Permatex RTV silicone, silicone adhesive sealant, or approved equal. Tablets shall not be completely covered by the adhesive. Tablets shall be crushed or rubbed into appurtenances in addition to being attached to the pipe walls. Use the appropriate size and number of tablets required to yield a minimum 50 mg/l chlorine concentration upon filling the pipe with potable water.
- b. Take two (2) samples for each 1000 feet of pipe and have tested for chlorine concentrate. Minimum chlorine concentration in the filled pipe shall be 50 mg/l.
- c. Maintain disinfection for 24 hours, after which the residual chlorine concentration in the water shall be at least 10 mg/l.
- d. Tablet method cannot be used if non potable water or foreign materials have gotten into the pipes during installation or if the water is less than 5 degrees Celsius (less than 41 degrees Fahrenheit).

- B. Following the chlorination period, flush the disinfectant from the piping with potable water and in accordance with AWWA C655 Field Dechlorination. All treated water flushed from the pipes shall be dechlorinated and shall be discharged into the sanitary sewer system is possible.

For chlorine concentrations greater than 4 mg/l, the Contractor shall use chemical means of dechlorination. The Contractor shall secure and use manufactured equipment and the manufacturer's recommendations for chemical type and quantity based on the chlorine concentration and discharge rate proposed by the Contractor for each situation.

For chlorine concentrations equal to or less than 4 mg/l, the Contractor may use nonchemical means of dechlorination. Examples of non-chemical means of dechlorination are holding tanks or ponds, releases through hay bales or other natural obstructions, and discharge into storm sewers.

No discharge to any storm sewer will be allowed without first testing and verifying a chlorine residual of 0.1 mg/l or less and discharge shall be managed in such a manner to avoid instream impact.

Regardless of the method used to dechlorinate, the Contractor shall use chlorine detection kits or measurement tools to verify that the chlorine concentration of water discharged into natural water bodies has been reduced to less than 0.01 mg/l.

- A. Following final flushing, two (2) water samples for bacteriological test shall be collected for each 1200 feet of pipe disinfected. Samples shall be taken 24 hours apart. All tested samples must indicate the absence of coliform contamination. Should either test indicate the presence of coliform contamination, the entire disinfection procedure shall be repeated until tests indicate the absence of coliform contamination. All cost for re-disinfection, sampling, and testing will be at pipe installer's expense.
- B. Disinfection shall also include hydrants, fittings, taps, tubing, and all other specials used at connections to existing water mains. These shall be thoroughly disinfected immediately prior to installation by emersion or spraying with a water solution containing 250 mg/l chlorine.

END OF SECTION

SECTION 15062

COPPER PIPE AND TUBING

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. This Section specifies the basic materials and methods of installation for copper pipe and tubing. Specific uses and applications are specified in other Sections and/or on the Drawings.
- B. Refer to Section 15050 for general piping requirements.

1.02 RELATED WORK

- A. Section 02200, Excavation and Backfill.
- B. Section 02575, Asphaltic Concrete Pavement and Appurtenances.
- C. Section 15050, Piping Installation.
- D. Section 15052, Pipe Testing.

1.03 SUBMITTALS

- A. Submit to the City, shop drawings and product data required to establish compliance with this Section.

1.04 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM).
 - 1. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes.
 - 2. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
 - 3. ASTM B75 - Standard Specification for Seamless Copper Tube.
 - 4. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
- B. American Society of Mechanical Engineers (ASME).
 - 1. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.

C. American National Standards Institute (ANSI).

1. ANSI/AWWA C800 - Underground Service Line Valves and Fittings.

PART 2 - PRODUCTS

2.01 TUBING AND PIPE

- A. Soft copper tubing furnished for 3/4-inch through 2-inch diameters for water service piping shall be Type K in accordance with ASTM B88 and ANSI/AWWA C800.

2.02 FITTINGS

- A. Type CF-5, flange fittings, 150 lb., ASME B16.24.
- B. Type CF-6, 125 lb., flared or compression type copper unions, ASME B16.26.

PART 3 - EXECUTION

3.01 JOINING OF PIPE

- A. Screwed connections.
 1. All screwed connections shall have full thread of true taper, accurate to gauge, and conform to ANSI B2.
 2. Reduction in size shall be made using reducing fittings.
 3. The use of bushings or close nipples is prohibited.
 4. Plugs shall be steel or brass with square head.
 5. Screwed joints shall be made with an approved joint compound applied to the male thread only. Caulking of screwed joints will not be allowed.

3.02 WATER SERVICE PIPING

- A. Water service piping and fittings shall be installed in accordance with applicable requirements of AWWA C600.
- B. Copper tubing joints shall be square end cut with all fins and burrs removed. Tubing shall be handled carefully, with all dented, gouged, or otherwise damaged tubing replaced with undamaged tubing. Ends of the tubing and the inside of fittings and couplings shall be cleaned with a wire brush and/or abrasive prior to joining.
- C. The longest commercially available length of service line shall be used with no unions (e.g., for 3/4-inch, only 1 union will be allowed for each 100-foot

section). Unions shall be made with flare-type couplings.

- D. New copper service laterals shall be bedded and covered in rock dust (VDOT M10).

END OF SECTION

SECTION 15072

DUCTILE IRON PIPE AND FITTINGS FOR WATER

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required to install ductile iron pipe and fittings complete as shown on the Drawings and as specified herein.
- B. Installation of piping in accordance with Section 15050, Water Piping Installation.
- C. Where the word "pipe" is used, it shall refer to pipe, fittings, or appurtenances unless otherwise noted.

1.02 RELATED WORK

- A. Section 02200, Erosion and Backfill.
- B. Section 02230, Fill and Granular Fill Materials.
- C. Section 15052, Water Pipe Testing.
- D. Section 15120, Water Piping Specialties.

1.03 SUBMITTALS

- A. Submit to the City shop drawings and product data required to establish compliance with this Section.
- B. Submit tabulated layout drawings showing actual pipe lengths, diameters, fittings, and appurtenances.
- C. Prior to shipment of pipe, submit a certified affidavit of compliance from the pipe manufacturer stating that the pipe, fittings, gaskets, linings, and exterior coatings for this project have been manufactured and tested in accordance AWWA and ASTM standards and requirements specified herein.

1.04 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM).
 - 1. ASTM A377 - Standard Index for Specification for Ductile-Iron Pressure Pipe
 - 2. ASTM C150 - Standard Specification for Portland Cement.

3. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs 60,000 psi Tensile Strength.

B. American National Standards Institute (ANSI).

1. ANSI B1.1 - Unified Inch Screw Threads (UN and UNR Thread Form).
2. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
3. ANSI B18.2 - Square and Hex Bolts and Screws Inch Series Including Hex Cap Screws and Lag Screws.

C. American Water Works Association (AWWA).

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
2. AWWA C110 - Ductile-Iron and Gray-Iron Fittings 3-In. through 48-In. (75MM through 1200 mm) for Water and Other Liquids.
3. AWWA C111- Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
4. AWWA C115 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
5. AWWA C150 - Thickness Design of Ductile-Iron Pipe.
6. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast for Water or Other Liquids.

- D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

- A. All ductile iron pipe and fittings shall be from a single manufacturer, unless otherwise approved by the City.
- B. All ductile-iron pipe and fittings to be installed under this Contract shall be inspected and tested at the foundry as required by the standard specifications to which the material is manufactured. Furnish in duplicate to the City sworn certificates of such tests and their results prior to the shipment of the pipe.
- C. All pipe and fittings to be installed in the City and intended for public ownership may be inspected at the plant for compliance with this Section by an independent testing laboratory selected by the City, at the City's expense.
- D. Inspection of the pipe and fittings will also be made by the City or the City's

representative after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the specified requirements, even though sample pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall be removed from the job.

- E. All pipe and fittings shall be permanently marked with the following information:
 - 1. Manufacturer, date.
 - 2. Size, type, class, or wall thickness.
 - 3. Standard produced to (AWWA, ASTM, etc.).

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Care shall be taken in loading, transporting and unloading to prevent injury to the pipe or coatings. Under no circumstances shall the pipe be dropped or skidded against each other. Slings, hooks, or pipe tongs shall be padded and used in such a manner as to prevent damage to the exterior surface or internal lining of the pipe.
- B. Materials, if stored, shall be kept safe from damage. The interior of all pipes, fittings, and other appurtenances shall be kept free from dirt or foreign matter at all times.
- C. Pipe shall not be stacked higher than the limits recommended by its manufacturer. The bottom tier shall be kept off the ground on timbers, rails, or concrete. Stacking shall conform to manufacturer's recommendations.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Joints shall be as shown on the Drawings and as specified. If not shown or specified, provide push-on or mechanical joints for buried pipe and flanged joints for above-grade pipe.
- B. Conform to AWWA C151 for material, pressure class, dimensions, tolerances, tests, markings, and other requirements.
- C. Use Special Thickness Class 52 for all pipe unless otherwise shown or specified.
- D. Ductile iron pipe and fittings shall have a cement mortar lining and asphaltic seal coat in accordance with AWWA C104 except that twice the standard thickness shall be provided.

- E. Unless otherwise specified, ductile iron pipe and fittings shall receive a shop-applied exterior asphaltic coating. Field repair of damaged pipe coating shall be allowed. However, if, in the opinion of the City, the coating damage is beyond repair, the pipe shall be replaced at no expense to the City. Unless otherwise noted, field applied coating material shall be compatible with or equal to the shop applied material.

2.02 FLANGED DUCTILE IRON PIPE AND FITTINGS

A. Flanged joint pipe.

1. Ductile iron pipe shall conform to AWWA C115. Pipe wall thickness shall be Special Thickness Class 53 minimum.
2. Flange shall be flat face type, unless otherwise noted, conforming to ANSI B16.1, Class 125.
3. Flange gasket shall be full-face rubber per AWWA C111. Thickness shall be 1/8 inch unless otherwise indicated.
4. Assembly bolts shall be square-headed carbon steel machine bolts with hexagon nuts per ANSI B18.2. Thread shall conform to ANSI B1.1. Bolt length shall be such that after joints are assembled, the bolts shall protrude through the nuts, but not more than 1/2 inch.

B. Flanged joint fittings.

1. Flanged joint fittings shall conform to AWWA C110.
2. Pipe fittings shall be ductile iron with a pressure rating of 250 psi.
3. Flanges shall be flat face meeting the requirements of ANSI B16.1, Class 125.
4. Flange gaskets shall be full-face rubber per AWWA C111, 1/8 inch thick unless otherwise indicated.
5. Assembly bolts and nuts shall be as specified for flange joint pipe above.

2.03 MECHANICAL JOINT PIPE AND FITTINGS

A. Mechanical joint pipe.

1. Mechanical joint pipe shall conform to AWWA C151 with joint accessories conforming to AWWA C111.
2. Glands shall be ductile iron.
3. Gaskets shall be plain-tipped rubber.

4. Assembly bolts and nuts shall be high-strength, low alloy steel.

B. Mechanical joint fittings.

1. Mechanical joint fittings shall conform to AWWA C110 or AWWA C153 with accessories conforming to AWWA C111.
2. Pipe fittings shall be ductile iron with a pressure rating of 350 psi.
3. Fitting glands shall be of the same material as the fittings.
4. Gaskets shall be plain-tipped rubber.
5. Assembly bolts and nuts shall be as specified for mechanical joint pipe above.

2.04 PUSH-ON JOINT PIPE AND FITTINGS

A. Push-on joint pipe.

1. Push-on joints shall conform to AWWA C151 and AWWA C111.
2. Gaskets shall be molded rubber.
3. Each plain end shall be painted with a circular stripe to provide a guide for visual check that joint is properly assembled.

B. Push-on joint fittings.

1. Push-on joint fittings are not acceptable.

2.05 PROPRIETARY RESTRAINED JOINT PIPE AND FITTINGS

- A. Restrained joint pipe and fittings shall be ductile iron restrained push-on joint.
- B. Restrained pipe shall conform to applicable requirements of AWWA C151. Restrained fittings shall conform to applicable requirements of AWWA C110 or AWWA C153.
- C. Joints shall be suitable for 250 psi working pressure and be fabricated of heavy ductile iron casting.
- D. Bolts and nuts shall conform to ASTM A307, Grade B.
- E. Restrained joint pipe and fittings shall be "TR Flex" restrained joint pipe by U.S. Pipe and Foundry; "Flex-Ring" and "Fast-Grip" restrained joint pipe by American Cast Iron Pipe Company; "SNAP LOK" restrained joint pipe by Griffin Pipe Products Co., or approved equal.

- F. Retainer Glands may be used in lieu of restrained joint pipe and shall be manufactured by EBAA Iron, Inc., Series 1100 “Megalug.” “Or Equals” will be considered but must be approved in advance by the City Engineer. Retainer glands may be used on proposed mains to restrain pipe with mechanical joints in accordance with the manufacturer’s recommendation. All pipe where retainer glands are used shall have a hardness of 180-200 BHN (Brinell Hardness Number) to allow proper activation of the glands.

PART 3 - EXECUTION

3.01 PIPE INSTALLATION

- A. See Section 15050, Water Piping Installation.

END OF SECTION

SECTION 15100

VALVES, HYDRANTS, AND APPURTENANCES

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required, and install complete and ready for operation, all valves and appurtenances as shown on the Drawings.

1.02 RELATED WORK

- A. Section 02200, Excavation and Backfill.
- B. Section 15072, Ductile Iron Pipe and Fittings.

1.03 DESCRIPTION OF SYSTEMS

- A. All of the equipment and materials specified herein are intended to be standard for use in controlling the flow of water.

1.04 QUALIFICATIONS

- A. All of the types of valves and appurtenances shall be products of well-established firms who are fully experienced, reputable, and qualified in the manufacture of the particular equipment to be furnished. The equipment shall be designed, constructed, and installed in accordance with the best practices and methods and shall comply with these Specifications as applicable.

1.05 SUBMITTALS

- A. Copies of all materials required to establish compliance with these Specifications shall be submitted. Submittals shall include at least the following:
 - 1. Certified drawings showing all important details of construction and dimensions.
 - 2. Descriptive literature, bulletins, and/or catalogs of the equipment.
 - 3. The total weight of each item.
 - 4. A complete bill of materials for each item.

1.06 OPERATING INSTRUCTIONS

- A. Operating and maintenance instructions shall be furnished to the City. The

instructions shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc., that are required to instruct operating and maintenance personnel unfamiliar with such equipment.

1.07 TOOLS

- A. Special tools, if required for normal operation and maintenance, shall be supplied with the equipment.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All valves and appurtenances shall be of the size shown on the Drawings and as far as possible all items of the same type shall be from one manufacturer.
- B. All valves and appurtenances shall have the name of the manufacturer, flow directional arrows, and the working pressure for which they are designed cast in raised letters upon some appropriate part of the body.
- C. All valves shall open left (counterclockwise).
- D. Extension stems for valves shall be made from Type 304 stainless steel. Stem guides shall be provided as necessary to support extension stems.
- E. Interior coatings are to be NSF 61 approved for potable water use.

2.02 GATE VALVES

- A. Double disk gate valves.
 - 1. Gate valves shall be mechanical joint unless otherwise shown and shall meet the requirements of AWWA C500. Gate valves shall be rated for 200 psi minimum working pressure and a 400 psi minimum test pressure. Valves shall be iron body, bronze mounted, double disc, parallel seat, non-rising stem type fitted with O-Ring seals. Valves shall open counterclockwise and shall be equipped with a 2-inch square AWWA operating nut. Valves 20 inches and larger shall be furnished with bevel gearing, by-pass valve, tracks, rollers, and scrapers to permit installation in a horizontal position. All interior ferrous parts shall receive 2 coats of an approved 2-component epoxy coating suitable for potable water. After the valves are assembled and tested, a third coat shall be applied to exterior surfaces.
- B. Resilient seated gate valves.
 - 1. Four- through 12-inch resilient seated gate valves shall comply with

AWWA C509 with a working pressure of 200 psi. The valve shall be iron wedge and the valve seat fully encapsulated with molded rubber. Valves shall have mechanical joint ends in accordance with ANSI/AWWA C111/A21.11, unless otherwise specified or shown on the Plans. Gate valves shall be one make and shall open by a counterclockwise rotation of the valve stem with a two (2) inch square operating nut. The operating nut shall be no greater than three (3) feet below finished ground. Operating nuts placed greater than three (3) feet below finished ground shall be equipped with approved operating nut extensions to meet the minimum depth requirements. The stuffing boxes shall be equipped with O-ring seals. Valves shall have iron bodies, and shall be fully bronze mounted. The interior and exterior coatings shall be NSF 61 approved for potable water use.

- C. Valves shall be Kennedy C-509, Mueller 2360 Series, or approved equal meeting this specification.

2.03 BALL VALVES

- A. Cut-off valves 2 inches and smaller shall be brass or bronze and manufactured in accordance with ANSI/AWWA C800 with a working pressure rating of not less than 200 psi.
- B. Main line ball valves shall be curb-stop style with quarter turn check. Valves shall be Mueller Series 300, Ford FB, McDonald 3148 or approved equal meeting this specification.
- C. Ball valves in Blow-off assemblies or Air Release Valve Assemblies shall be handle style with quarter turn check. Valves shall be Mueller Series 7700, McDonald 2117, or approved equal.
- D. Ball valves connections shall be threaded or flared. Compression fittings are not allowed without prior approval from Utilities Engineer.

2.04 TAPPING SLEEVES AND TAPPING VALVES

- A. Tapping sleeves shall be of stainless steel, split-sleeve type designated for working pressure not less than 200 psi. The seal of the tapping sleeve shall be mechanical joint or low lead 2.5% or less and conforming to current regulations. Flanges shall be stainless steel per AWWA C207 Class D with 150 lb. drilling and recessed for tapping valves per MSS-SP60. Nuts and bolts shall be Type 304 stainless steel. Sleeves shall be as manufactured by Smith-Blair Model 624, Romac Model SST III, or equal.
- B. Tapping valves shall conform to the requirements specified above for gate valves except that one end shall be flanged and one mechanical. Tapping valves shall be provided with an oversized opening to permit the use of full-sized cutters.

2.05 BUTTERFLY VALVES

- A. Butterfly valves and operators shall conform to AWWA C504, except as hereinafter specified. The manufacturer shall submit an affidavit of compliance stating that the valves have been manufactured and tested in accordance with AWWA C504 and specifically listing all exceptions. Valves shall have a minimum 150-psi pressure rating. All valves shall be droptight when subjected to the specified working pressure (differential pressure), and all valves shall be capable of droptight seating under bi-directional flow conditions (maximum working pressure applied as differential pressure from either direction). Valves shall be manufactured by Mueller, Kennedy, or approved equal meeting this specification.
- B. Valve bodies shall be constructed of cast iron ASTM A126, Class B, cast iron ASTM A48 -CL40, ductile iron ASTM A536, alloy cast iron ANSI-ASTM A436-78 Type 1 or 2, or ANSI/ASTM 439-80 Type D2. Buried valves shall be mechanical joint end conforming to ANSI C111. Exposed valves shall be flanged.
- C. Valve discs shall be constructed of cast iron ASTM A126 or A48, or ductile iron ASTM A536. Disc edge shall be either ni-chrome or Type 316 stainless steel. Valve discs shall rotate 90 degrees from full closed to full open.
- D. Rubber valve seats shall be Buna-N. The seat shall be located in the valve body. If seat-retaining hardware such as screws and segments are used, they shall be monel. If screws are used, monel plugs shall be affixed in the valve body and tapped to receive these screws.
- E. Valve shafts shall be Type 304 stainless steel, and shall be of a diameter not less than those listed in AWWA C504, Class 150B.
- F. Shaft seals shall be furnished where the shaft projects thru the valve body. Shaft seals shall be standard split-vee type packing. A sealing element utilizing O-rings shall also be acceptable for up to and including 24-inch valves. Packing shall be suitable for potable water service. Packing shall be held in place by a bolted corrosion resistant retainer plate or gland; retainer clips are not acceptable.
- G. Valves shall be fitted with sleeve type bearings contained in the trunions of the valve body. Bearing material shall be nylon for valves thru 20 inches and fiberglass with Teflon lining for valves 24 inches and larger.
- H. Valve manufacturer shall furnish and mount operator suitable for buried service unless otherwise shown. Operators shall be self-locking and suitable for submergence to 20 feet. A 2-inch square operating nut shall be furnished. Operator stops shall be capable of withstanding an input of 450 ft.-lbs.
- I. Non-buried valves shall have hand-wheel type manual actuators and shall

conform to AWWA C504, insofar as applicable. Actuators shall have permanent indicators with raised or engraved marks to show position of the valve disc.

- J. Valve class shall be AWWA, Class 150B with operators sized for bi-directional flow.

2.06 PLUG VALVES

- A. All plug valves shall be of the non-lubricated, eccentric type with bodies and plugs of semi-steel construction. Valves shall be rated for a minimum working pressure of 150 psig. The area at the valve port shall be at least 80 percent of the full pipe area. All valves shall open by turning counterclockwise.
- B. Valves shall have balanced plugs with a resilient facing of Nitrile (Buna-N) solidly bonded thereto to assure bubble-tight shutoff low torque requirements.
- C. Seats shall have a welded-in overlay of 90 percent pure nickel on all surfaces contacting the plug face.
- D. Valves shall be furnished with bolted bonnets and self-adjusting chevron-type packing. Packing shall be replaceable without disassembling the valve or removing the bonnet from the valve.
- E. Corrosion-resistant, permanently-lubricated bearings shall be provided at both ends of the valve shafts.
- F. All valves shall be supplied with flanged ends conforming to ASNI B16.1, Class 125, unless otherwise shown.
- G. All exterior hardware on valves shall be of Type 304 stainless steel.
- H. Valves shall be manufactured by Mueller, Kennedy, or approved equal meeting this specification.

2.07 AIR RELEASE VALVES

- A. Air release valves shall be constructed with cast-iron bodies, stainless steel floats, bronze trim, and Buna-N seats. Valves shall be of the size, type, and at the locations indicated on the Drawings.
- B. Where specifically shown on the Drawings, combination type air-vacuum valves shall be installed.
- C. Valves shall be for working pressures indicated on the drawings. Air release valves shall be 200 series and combination air-vacuum valves shall be 140 series by APCO/Valve & Primer Corp., or approved equal by American

Darling Valve & Manufacturing, Val-Matic Valve & Manufacturing, Simplex, Clow, or Crispin Co.

2.08 VALVE BOXES, EXTENSION SHAFTS, AND OPERATING NUTS

- A. All buried gate and butterfly valves shall be provided with extension shafts, operating nuts, and valve boxes as follows:
1. Extension shafts shall be Type 304 stainless steel and the operating nut shall be 2 inches square. Shafts shall be designed to provide a factor of safety of not less than 4. Operating nuts shall be pinned to the shafts.
 2. Top of the operating nut shall be located no greater than three (3) feet below finished grade.
 3. Valve boxes shall be as manufactured by Bingham and Taylor Model 4906, or approved equal, and shall be a heavy-pattern cast iron, 3-piece, screw-type adjustable box with dome base suitable for installation on the buried valves. Inside diameter shall be at least 5-1/4 inches. Barrel length shall be adapted to the depth of cover. Covers shall be cast iron with "WATER" integrally cast. Aluminum or plastic are not acceptable. A means of lateral support for the valve extension shafts shall be provided in the top portion of the valve box.
 4. The bottom of the lower section shall enclose the stuffing box and operating nut of the valve and shall be oval, as manufactured by Bingham and Taylor Model 4909-D, or approved equal.

2.09 HYDRANTS

- A. Hydrants shall be designed for 150-psi service and for installation in a trench that will provide 3-1/2 feet minimum cover. Hydrants shall be of the safety flange, breakaway top type, meeting requirements of AWWA C502. Hydrants shall have a barrel diameter no smaller than 6 inches, a hydrant valve opening diameter no smaller than 5-1/4 inches, and shall be equipped with two 2-1/2-inch hose nozzles and one 4-1/2-inch pumper connection. Threads on the 4-1/2-inch pumper connection and the operating nut shall be National Standard threads. Threads on the hose connections shall be "Charlottesville Thread"—3-21/64" female, 3-9/32" male, 8 threads per inch (gauge 8-322). Hydrants shall be Mueller Super Centurion Model A-243, or Kennedy K-81D Guardian.
- B. Hydrant valve opening shall be obstructed only by the valve rod. Each hydrant shall be able to deliver a minimum of 600 gallons per minute through its two 2-1/2-inch hose nozzles when opened together with a loss of not more than 2 psi in the hydrant.
- C. Hydrant shall be of the full compression design, opening against and closing

with the water pressure. The hydrants shall be designed to permit rotary movement of the upper barrel any number of degrees required to effect proper alignment without shutting down service or removing flange bolts and nuts.

- D. Hydrant must open turning a 5/8-inch (point to flat) pentagon operating nut counterclockwise and must be marked with an arrow and word "open" to indicate the direction to turn stem to open hydrant.
- E. All internal parts shall be designed for rapid and simple removal employing a compact lightweight wrench (10 pounds or less) that will withdraw all working parts from the base of the hydrant as a unit. Hydrant must be capable of being extended without removing any operating parts.
- F. The main valve assembly shall have a bronze sub-seat and a bronze seat ring. The threaded bronze sub-seat of the hydrant shall be an integral part of the boot or elbow valve assembly. The seal between the set ring and seat shall consist of 2 O-rings located in machined grooves above and below the drainage channel. There shall be a minimum of 2 exterior drain ports, located 180 degrees apart.
- G. Hydrant operating mechanism shall be housed in a compact seal plate with integral lubrication chamber. An O-ring seal shall be used on the hold down nut to prevent direct condensation or atmospheric contamination entering grease chamber from outside. A travel stop nut at the top of the hydrant shall control downward travel of main valve. Hydrant operating mechanism shall be readily available for inspection without removing seal plate from barrel.
- H. The design and construction of the hydrant operating mechanism located at the top of the hydrant shall be such that no part of the operating threads will be in contact with water in the standpipe when the hydrant is in service, and O-ring seals shall be used to prevent water under pressure from entering the lubricating chamber. A bronze nut and check nut shall be provided to hold the main hydrant valve on its stem.
- I. Hydrant shall be furnished with a steel chain holder, double steel hose cap chain, steel pumper cap chain, and any other hooks and/or appurtenances required for proper use. Each nozzle cap shall be provided with a Buna-N rubber washer.
- J. After being thoroughly cleaned, all iron work to be set below ground shall be painted with two (2) coats of asphalt varnish specified in AWWA C502 and iron work to be left above ground shall be shop painted with two (2) coats of Glid Guard #45 safety red by Glidden or approved equal.
- K. Hydrants shall be hydrostatically tested as specified in AWWA C502.

PART 3 - EXECUTION

3.01 BURIED VALVES INSTALLATION

- A. Buried valves and boxes shall be installed in conformance with AWWA Standards C500 and C504, as applicable, except as specified herein. Valves shall be set with the operating nut vertically aligned in the center. Valves shall be set on a concrete foundation block and supported by tamping select fill material at the sides of the valve.
- B. Valve boxes shall be installed vertically, centered over the operating nut, and the elevation of the top shall be adjusted to conform to the finished surface of roadway or other surface at the completion of the contract. Boxes shall be adequately supported during backfilling to maintain vertical alignment.

3.02 TAPPING VALVES AND SLEEVES

- A. Tapping sleeves shall be installed per manufacturer's instructions.
- B. Installations shall be made under pressure and the flow of water through the existing main shall be maintained at all times. The diameter of the tap shall be a minimum of 1/4-inch less than the inside diameter of the branch line.
- C. The entire operation shall be conducted by workmen thoroughly experienced in the installation of tapping sleeves and valves.
- D. The location and depth of the existing mains to be tapped shall be verified. Confirm that the proposed position for the tapping sleeve will be satisfactory and no interference will be encountered such as the occurrence of existing utilities or of a joint or fitting at the location proposed for the connection. No tap shall be made closer than 5 feet from a pipe joint unless otherwise approved by the City.
- E. Tapping valves shall be supplied with a 2-inch square operating nut set in a vertical position. The valve shall be provided with an oversized seat to permit the use of full-sized cutters.
- F. Tapping sleeves and valves shall be set squarely centered on the main to be tapped. Adequate support shall be provided under the sleeve and valve during the tapping operation. Thrust blocks shall be provided behind all tapping sleeves. Proper compaction of supporting backfill around and under the valve and sleeve is mandatory.

3.03 HYDRANT INSTALLATION

- A. Fire Hydrants shall be installed in accordance with Detail W 3.0. The Contractor shall use restrained joint pipe from the Tee to the fire hydrant.

- B. Hydrants as detailed on the Drawings shall be set at the locations shown on the Plans and shall be bedded on a firm foundation. A drainage pit 2-1/2 feet in diameter and to the limits shown on the Drawings shall be filled with crushed stone and satisfactorily compacted. During backfilling, additional crushed stone shall be brought up around and 6 inches over the drain port. Each hydrant shall be set in true vertical alignment and shall be properly braced. Concrete thrust blocks shall be placed between the back of the hydrant inlet and undisturbed soil at the end of the trench. Minimum bearing area shall be as shown on the Drawings. **CARE MUST BE TAKEN TO ENSURE THAT CONCRETE DOES NOT PLUG THE DRAIN PORTS.** The hydrant shall be moved if high groundwater is encountered at the specified installation site. This is necessary to prevent a cross-connection with the weephole.
- C. Hydrants shall be touched up with paint as required after installation.
- D. All chains shall be removed following installation and testing.

3.04 INSPECTION AND TESTING

- A. Valves and hydrants shall be tested in conjunction with testing of the water mains as specified. Operation shall be satisfactory to the City in all respects.
- B. During testing any defective valve or appurtenance shall be adjusted, removed, and replaced, or otherwise made acceptable to the City.
- C. Various regulating valves and other appurtenances shall be tested to demonstrate their conformance with the specified operational capabilities and any deficiencies shall be corrected, or the device replaced or otherwise made acceptable to the City.

END OF SECTION

SECTION 15104

METER BOXES AND PRECAST CONCRETE METER VAULTS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish and install meter boxes and precast concrete meter vaults as shown on the Drawings, including all anchoring and fastening devices, inserts, and hangers or attachments.
- B. Provide all labor, equipment, and materials.

1.02 RELATED WORK

- A. Section 03300, Concrete.

1.03 QUALITY ASSURANCE

- A. Standards and codes. All concrete, reinforcing steel, and the design and construction of the precast concrete units shall meet the latest edition of the following specifications, standards, and codes and the modifications as specified herein.
 - 1. American Concrete Institute, ACI 318 - Building Code Requirements for Reinforced Concrete.
 - 2. American Association of State Highway and Transportation Officials (AASHTO) Standard Specifications for Highway Bridges, 1983, including all subsequent revisions.
- B. Design live loading. Meter vaults and access doors within street rights-of-way, driveways, and parking lots shall meet HS-20 loading requirements and shall be located outside of travel areas. Design live loading at all other locations shall be 300 psf.

1.04 SUBMITTALS

- A. Meter boxes.
 - 1. Submit copies of manufacturer's specifications, dimensioned diagrams, and installation instructions for review prior to placement of order.
- B. Precast meter vaults
 - 1. Prior to fabrication of any precast concrete units, the Contractor shall submit for approval, detailed and complete shop drawings, setting plans,

design information, and such other data as may be required to confirm compliance with this Section.

- a. The shop drawings shall bear the Contractor's certification that the work has been coordinated with other related items of construction.
 - b. The manufacturer's design calculation for all precast concrete units shall be submitted prior to the fabrication of the units.
 - c. The Contractor shall furnish for the City's reference the manufacturer's printed recommendations and instructions for the storing, handling, protection, and erection of the precast concrete units.
2. Shop drawings shall show the setting plans, exact profile of each unit, openings required, all inserts, and other items which are to be embedded in the units.
- C. Access hatch.
1. Submit shop drawings for the fabrication and installation of all vault access hatches provided for this project. Include design load rating, plan, elevation, and sectional views. Provide installation, anchorage, and maintenance documentation.

PART 2 - PRODUCTS

2.01 METER BOXES

- A. Meter boxes fabricated to the dimensions shown on the Drawings shall be used for all 5/8-inch and 1-inch meters.
- B. All meter boxes and meter covers located in paved areas shall be cast iron with cast iron frame and non-locking cast iron lids. Lids shall be cast with a 6-7/8-inch by 3/16-inch deep relief with a center 2-inch diameter hole for installation of an ITRON, Inc. "ERT" module as used in the City's Automatic Meter Reading (AMR) system. Meter box shall be Capitol Foundry MBX-11 or approved equal.
- C. All meter boxes in unpaved areas shall be Armorcast composite meter box A6001923TAX18, or approved equal. Lids shall be provided with 2-inch diameter hole for installation of an ITRON, Inc. "ERT" module as used in the City's Automatic Meter Reading (AMR) system.

2.02 METER VAULTS

- A. Materials.
 1. Cement shall be Portland cement conforming to ASTM designation: C150,

Type III, high early strength.

2. Aggregate shall conform to ASTM C330 and shall be graded, crushed stone with a resulting unit weight of concrete of up to 155 pounds per cubic foot.
3. Water shall be clean and free of injurious and deleterious substances.
4. Concrete shall have a minimum strength of 5,000 psi at 28 days, and a strength of 3,000 psi at time of form release.
5. All reinforcing bars shall conform to the requirements of ASTM A615, Grade 60.
6. Welded wire fabric shall conform to the requirements of ASTM A185.
7. In addition to all other requirements specified, all precast concrete members shall be adequately designed and fabricated to safely withstand all handling stresses without damage and to adequately and safely support all loads imposed by the work of other trades which might affect construction.
 - a. To avoid damage and stress concentration, lifting devices shall be designed for 100 percent impact loading and shall be sufficiently ductile to insure obvious deformation before failure.

2.03 ACCESS HATCH

- A. Access hatch shall have a single-leaf door and sized as indicated by the Drawings. The door shall be 1/4-inch aluminum diamond pattern plate with welded stiffeners, as necessary, to withstand a live load of 300 lbs./sq. ft. or HS-20 loading, as applicable, with a maximum deflection of 1/150th of the span. Hatches shall have a 1/4-inch aluminum channel frame with a perimeter anchor flange or strap anchors for concrete embedment around the perimeter. Unless otherwise noted on the Drawings, use pivot torsion bars for counterbalance or spring operators for easy operation along with automatic door hold open. Hardware shall be durable and corrosion resistant with Type 316 stainless steel hardware used throughout. Provide removable lock handle. Finish shall be the factory mill finish for aluminum doors and frames with bituminous coating on the exterior of the frames in contact with concrete. Hatches shall be watertight and have a 1-1/2-inch drainage coupling to the channel frame. A 6-7/8-inch by 3/16-inch deep relief with a 2-inch center hole is to be provided for installation of an ITRON, Inc. "ERT" module as used in the City's Automatic Meter Reading (AMR) system. Manufacturer shall be Bilco, Halliday Products, or approved equal.

PART 3 - EXECUTION

3.01 METER BOX INSTALLATION

- A. Meter boxes shall be installed in non-paved areas unless otherwise approved by the City.
- B. Each meter box shall be located and installed so as to prevent entrance of water, dirt, or debris. The box and lid shall conform to the finished grade after installation.
- C. Meter box shall be set on a 4-inch bedding of crushed stone. A minimum clearance of 18 inches shall be maintained between the coppersetter and the top of the box.

3.02 PRECAST METER VAULT

- A. General.
 - 1. All precast concrete units shall be stored, handled, protected, and erected in accordance with the printed recommendations of the manufacturer and in a manner to prevent overstressing, marring, or damage to the units.
 - 2. The work shall be performed by workers experienced in this type of work.
 - 3. Installation shall be true to the lines and grades indicated on the Drawings.
- B. Installation.
 - 1. Preparation.
 - a. All units shall be erected true to line and grade in the proper sequence as outlined on the approved shop drawings.
 - b. No holes shall be cut or drilled in the field without the written approval of the City.
 - 2. Placement.
 - a. The concrete units shall be set on clean and properly prepared foundations free from any conditions that would interfere with the proper setting of the concrete units.
 - b. All anchoring and fastening devices shall be provided for the proper and satisfactory installation of the units.
 - c. No cracked, warped, broken units, or units which, in the opinion of the City, show defects which might adversely affect the serviceability of the units, shall be used in the work. Defective units shall be removed

from the site and shall be replaced with new and sound units at no additional expense to the City.

- d. Joints between precast sections and units shall be made in an approved manner to guarantee a leak-proof, watertight joint.

C. Patching.

1. Where the City permits patching, the patches shall be made using the same materials as used in the unit being patched. Use a 2-part epoxy compound of a type to produce proper bonding of the patch to the unit.
2. Patching shall match the adjacent surfaces in color and texture.
3. Patching of imperfections at the plant shall require the City's approval before the unit is shipped from the manufacturer's plant.

D. Curing.

1. Units shall be cured by suitable heating moisture or steam curing until the required strength for release or handling is obtained. During this time, no surface shall be exposed to direct sunlight or direct wind.

3.03 ACCESS HATCH

- A. Access hatch shall be cast into the top section of the vault in accordance with manufacturer's written instructions.

END OF SECTION

SECTION 15120

WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required to install, complete, and ready for operation. Test all piping specialties concurrent with the pipe section within which installed.

1.02 RELATED WORK

- A. Piping materials and systems are included in other Sections of Division 15.
- B. Section 15050, Piping Installation.
- C. Section 15052, Pipe Testing.
- D. Section 15100, Valves, Hydrants, and Appurtenances.

1.03 SUBMITTALS

- A. Submit shop drawings and product data for all piping specialties specified in this Section.
- B. Submit operating and maintenance data as required.

1.04 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM).
 - 1. ASTM A126 – Standard Specification for Gray Iron Casting for Valves, Flanges and Pipe Fittings.
 - 2. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
 - 3. ASTM A325 - Standard Specification for Strength Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 - 4. ASTM A536 – Standard Specification for Ductile Iron Castings.
- B. American National Standards Institute (ANSI).
 - 1. ANSI B1.1 - Unified Inch Screw Threads (UN and UNR Thread Form).
 - 2. ANSI B18.2 - Square and Hex Bolts and Screws Inch Series Including

Hex Cap Screws and Lag Screws.

- C. American Society of Mechanical Engineers (ASME).
 - 1. ASME B2.1 - Specifications, Dimensions, Gauging for Taper and Straight Pipe Threads (except dry seals).
 - 2. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800.
 - 3. ASME B16.5 - Pipe Flanges and Flange Fittings.
- D. American Welding Society (AWS).
 - 1. AWS B3.0 - Welding Procedure and Performance Qualifications.
- E. American Water Works Association (AWWA).
 - 1. AWWA C110 - Ductile-Iron and Gray-Iron Fittings, 3-in. Through 48-in. (75mm through 1200mm), for Water and Other Liquids.
 - 2. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

1.05 QUALITY ASSURANCE

- A. All materials shall be new and unused.
- B. Install piping to meet requirements of local codes.
- C. Provide manufacturer's certification that materials meet or exceed minimum requirements as specified.
- D. Coordinate dimensions and drilling of flanges with flanges for valves, pumps, and other equipment to be installed in piping systems. Bolt holes in flanges to straddle vertical centerline.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. The use of a manufacturer's name and/or model number is for the purpose of establishing the standard of quality and general configuration desired.
- B. Materials and products shall be of the sizes and types shown on the Drawings or as noted herein. As far as possible, materials and products of the same type shall be identical and shall be from one manufacturer.
- C. Materials and products shall have the name of the manufacturer, nominal size,

flow directional arrows (if applicable), working pressure for which they are designed, and standard referenced specifications cast in raised letters or indelibly marked upon some appropriate part of the body.

- D. Unless otherwise noted, piping specialties shall have a minimum working pressure of 150 psi or be of the same working pressure as the pipe they connect to, whichever is higher and suitable for the pressures noted where they are installed.

2.02 UNIONS

- A. Unions shall be brass or bronze unions for joining nonferrous pipe; malleable brass or bronze-seated iron or steel unions for joining ferrous pipe.

2.03 DIELECTRIC CONNECTORS

- A. Dielectric pipe fittings/insulators and unions shall be used to prevent galvanic action wherever valves or piping of dissimilar metals connect. This shall be particularly the case for copper, brass, and bronze piping connecting to cast iron or steel piping systems.
- B. Dielectric unions shall be used for 2-inch and smaller connections. Steel union nuts shall meet ASTM A575 requirements. The steel or ductile iron connection end shall have a steel body and shall have accurately machined taper tapped pipe threads in accordance with ASME B2.1. The copper connection end shall meet requirements of ASTM B88. Dielectric unions shall be rated for at least 250 psi at 210 degrees F.
- C. Dielectric flange unions shall be used for connections 2-1/2-inches and larger. Cast iron flanges shall meet ASTM A126; the copper solder end shall meet ASTM B62 and the pipe thread shall meet ASME B2.1. Dielectric flange unions shall be rated for at least 175 psi at 210 degrees F.
- D. Dielectric unions and flange unions shall be as manufactured by Epco Inc., Cleveland, OH, or equal.
- E. Flange insulating kits shall be as manufactured by PSI, or equal.

2.04 MISCELLANEOUS ADAPTERS

- A. Special adapters may be required between different types of pipe and/or fittings to provide proper connection. Some of these may be indicated on the Drawings or specified with individual types of pipe or equipment. Provide all adapters as required, whether specifically noted or not, to ensure proper connection between various types of pipe, to structures and between pipe and valves, gates, fittings, and other appurtenances.
- B. Adapters shall be suitable for direct burial when installed below grade, with

proper dielectric insulation. If metallic (not stainless steel or galvanized), adapters shall be painted with two (2) coats of Coal Tar Epoxy.

2.05 FLEXIBLE CONNECTORS

A. Sleeve couplings.

1. Flexible couplings shall be of a gasketed, sleeve type. Each coupling shall consist of a middle ring, two (2) followers, two (2) wedge section gaskets and sufficient track head steel bolts to properly compress the gaskets. Couplings shall be of the type to match piping in which installed. Couplings shall be Style 38 as manufactured by Dresser Manufacturing Division of Dresser Industries or Smith-Blair Type 441.
2. Nuts and bolts.
 - a. Provide bolts and bolt-studs in accordance with ASTM A307 and ANSI B1.1 with hexagonal or square heads, coarse thread fit, threaded full length with ends chamfered.
 - b. Project ends 1/4-inch beyond surface of nuts.
 - c. Hexagonal nuts with dimensions in accordance with ANSI B18.2 and coarse threads in accordance with ANSI B1.1.
3. Middle ring of each mechanical coupling shall have a thickness at least equal to that specified for size of pipe on which coupling is to be used and shall not be less than 10 inches long for pipe 30 inches and larger and not less than 7 inches long for pipe under 30 inches in diameter.
 - a. Omit pipe stop from inner surface of middle rings of couplings whenever necessary to permit removal of valves, flow meters, and other installed equipment.
 - b. Provide pipe stops in other couplings.
4. Clean and shop prime with manufacturer's standard rust inhibitive primer.
5. Furnish gaskets of a composition suitable for exposure to the fluid service.
6. Where shown on the Drawings, anchor sleeve-coupled joints with harness bolts.
 - a. Joint harness bolts shall be of sufficient length, with harness lugs placed so that coupling can be slipped at least in one direction to clear joint. Provide harnesses of sufficient number and strength to withstand test pressure.

- b. Each harness shall have a minimum of 2 3/4-inch diameter bolts.
- 7. Similar insulation type couplings shall be provided at the face of buildings, between different type metals or where otherwise noted.
- B. Oversize couplings.
 - 1. Couplings used to join pipes of differing outside diameters shall be of a gasketed sleeve type and shall be listed for the intended purpose. Gaskets shall allow for adjustment based on the receiving pipe diameter. Pressure rating of the coupling shall be a minimum of 260 psi. Couplings shall be Hymax 2000 or approved equal.
 - 2. Body shall be carbon steel with fusion-bonded epoxy coating conforming to NSF 61.
 - 3. Nuts and bolts shall be Type 304 stainless steel.
 - 4. Gaskets shall be EPDM rubber conforming to NSF 61.
 - 5. Coupling shall meet or exceed the requirements of AWWA C 219.

2.06 SERVICE SADDLES

- A. Service saddles for ductile iron pipe shall conform to the requirements of AWWA C800 with a working pressure of 200 psi. The saddle assembly shall be brass or bronze with a single, full-width stainless steel strap and tapered AWWA threads.
- B. Service saddles for 4- through 12-inch outlets where the outlet size is not greater than 1/2 the size of the main pipe shall have ductile iron bodies and a neoprene circular cross section O-ring gasket confined within the body. Outlet shall be AWWA C110 flange or AWWA C111 mechanical joint as required for the application. Straps shall be alloy steel, minimum 1/4-inch by 1-1/2-inch in cross section and fabricated with 3/4-inch threaded ends.

2.07 CORPORATION STOPS

- A. Corporation stops and quarter-bend couplings for 3/4-inch through 2-inches diameter water service lines shall be manufactured in accordance with AWWA C800. Inlet threads shall be AWWA/CC taper threads. Quarter-bend coupling outlet shall be flared copper connection. Acceptable corporation stops shall be F600, as manufactured by Ford, H-10003, as manufactured by Mueller, or approved equal. Quarter-bend couplings shall be Ford L02-77 (2"), L02-66 (1-1/2"), L02-44 (1"), L02-33 (3/4") or Mueller H-15490, or approved equal.

2.08 COPPERSETTERS

- A. Coppersettters shall be manufactured in accordance with ANSI/AWWA C900 with a minimum seven (7)inch rise. The coppersetter shall have a lock-winged angle ball valve and appropriate flared copper connection for joining copper service tubing on supply side. Customer side shall have a plain angle ball valve with a multi-purpose connection.
- B. Coppersettters shall be manufactured by Ford Series 70, 5/8" x 3/4" McDonald, Mueller an approved equal.

2.09 STRAINERS

- A. Plate strainer.
 - 1. Plate strainers shall be furnished upstream of all meters 3 inches and larger and for all 1-1/2 and 2-inch turbine-type meters. The strainer body shall be of cast bronze construction. The strainer elements, including screen, shall be constructed of Type 304 or Type 316 stainless steel. Strainers shall be designed for a maximum operating pressure of 150 psig. Unless otherwise specified, screens shall have 3/16-inch openings.
 - 2. The design of the strainer body shall be such that the bolted lid and basket may be easily removed for inspection and cleaning without disassembly of the inlet and outlet piping.

2.10 MECHANICAL SLEEVE SEALS

- A. Mechanical sleeve seals shall be used to secure and seal the annular space around all new sleeved and core-drilled wall penetrations.
- B. A single seal shall be provided for all sleeve and cores in walls up to 14 inches thick; dual sleeves shall be provided in larger walls.
- C. Galvanized steel wall sleeves and concrete core diameter shall be sized sufficiently larger to accommodate the modular elements, per the manufacturer's recommendations.
- D. Bolts and hardware shall be carbon steel, zinc-plated, or stainless steel. Pressure plates shall be corrosion-resistant resin.
- E. Mechanical sleeve seals shall consist of modular bolted, interlocking synthetic rubber sealing elements, shaped to fill the annular space between the pipe and the wall sleeve. The mechanical sleeve seals shall be Link Seal by Thunderline Corp., or equal.

2.11 FLANGED ADAPTERS

- A. Flanged adapter connections for plain end pipe at fittings, valves, and equipment shall be Dresser Style 127 or 128, or equal by ITT/Smith-Blair.

2.12 HARNESSING AND RESTRAINT

- A. Where harnessed couplings or adapters are noted, they shall conform to AWWA Manual M11 except as modified by the Drawings or this Section.
- B. Unless otherwise noted, size and material for tie rods, clamps, plates, and hex nuts shall be as shown on the Drawings, or, if not shown on the Drawings, shall be as required in AWWA Manual M11. Manufactured restraining clamp assemblies shall be as manufactured by Stellar Corporation, Columbus, OH, or equal.
- C. Ductile iron pipe mechanical joint restraints. Restraint for standardized mechanical joints shall be incorporated in the design of the follower gland and shall impart multiple wedging action against the pipe, increasing its resistance as the pressure increases. The assembled joint shall maintain its flexibility after burial and shall maintain its integrity by a controlled and limited expansion of each joint during the wedging action. Restraining glands shall be manufactured of ductile iron conforming to the requirements of ASTM A536. Wedging mechanisms shall be manufactured of ductile iron heat treated to a hardness of 370 BHN minimum and shall be contoured to fit each pipe size exactly. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee head bolts conforming to the requirements of ANSI/AWWA C111/A21.11 and ANSI/AWWA C153/A21.53, latest revision. Twist off nuts shall be incorporated in the design of the wedge activation screws to insure proper torque during installation. The mechanical joint restraining device shall have a working pressure rating of 250 psi minimum with a safety factor of at least 2:1 against separation when tested in the dead-end situation. The mechanical joint restraint shall be Megalug Series 1100 by Ebaa Iron Works, Uni-Flange Series 1400 by Ford Meter Box Co., or approved equal.

2.13 BACKFLOW PREVENTERS

- A. Backflow preventers shall be installed on all potable water lines having potential for cross-contamination and per International Building Code.
- B. Backflow preventers shall be tested per International Building Code Standard 321.9.
- C. The following manufacturers have backflow prevention devices: Ames, Conbraco, Febco, Watts, and Wilkins. Other manufacturers must be approved by the Utilities Engineer.

2.14 WARNING TAPE

- A. Warning tape shall have a minimum 5.0 mil overall thickness. The warning tape, including labeling, shall not contain any dilutants, pigments, or other contaminants, and shall resist degradation by elements encountered in the soil. The warning tape for water service installations shall be color-coded blue and imprinted with the words, "Caution -- Water Line Buried Below."

PART 3 - EXECUTION

3.01 GENERAL

- A. All dirt, scale, weld splatter, water and other foreign matter shall be removed from the inside and outside of all pipe and sub-assemblies prior to installing.
- B. All pipe joints and connections to equipment shall be made in such a manner as to produce a minimum of strain at the joint.
- C. Install piping in a neat manner with lines straight and parallel or at right angles to walls or column lines and with risers plumb. All work shall be accomplished using recognized methods and procedures of pipe fabrication and in accordance with the latest revision of applicable ANSI/AWWA Standards.
 - 1. Use full length of pipe except where cut lengths are necessary. Do not spring or deform piping to make up joints.
 - 2. Pipe shall be cut square, not upset, underside, or out-of-round. Ends shall be carefully beveled and cleaned before being installed. Bending of pipe is not permitted. Use fittings for all changes in direction.
 - 3. Reducers shall be eccentric to provide for drainage from all liquid-bearing lines and facilitate air removal from water lines.
 - 4. Verify the locations and elevations of any existing piping and manholes before proceeding with work on any system. Any discrepancies between the information shown on the Drawings and the actual conditions found in the field shall be reported at once to the City. If the above provision has not been complied with, no claim for extra payment will be considered.
 - 5. Where lines of lower service rating tie into services or equipment of higher service rating the isolation valve between the two shall conform to the higher rating.
 - 6. Mitering of pipe to form elbow is not permitted.
 - 7. All piping interiors shall be thoroughly cleaned after installation and kept

clean by approved temporary closures on all openings until the system is put in service. Open pipe ends shall be subjected to re-cleaning and re-testing.

8. End caps on pre-cleaned pipe shall not be removed until immediately before assembly. All open ends shall be capped immediately after completion of installation.

D. Installation of Sleeve Couplings

1. Prior to installation of sleeve couplings, the pipe ends shall be cleaned thoroughly for a distance of at least 12 inches. Soapy water may be used as a gasket lubricant. A follower and gasket, in that order, shall be slipped over each pipe to a distance of about 6 inches from the end, the middle ring shall be placed on the already installed pipe and shall be inserted into the middle ring flair and brought to proper position in relation to the pipe already installed. The gaskets and followers shall then be pressed evenly and firmly into the middle ring flares.
2. After the bolts have been inserted and all nuts have been made up finger tight, diametrically opposite nuts shall be progressively and uniformly tightened all around the joint, preferably by use of a torque wrench of the appropriate size and torque for the bolts.
3. The correct torque as indicated by a torque wrench shall not exceed 75 ft.lbs. for 5/8-inch bolts and 90 ft.lbs. for 3/4-inch bolts.
4. If a wrench other than a torque wrench is used, it should be no longer than 12 inches so that when used by the average person the above torque values shall not be exceeded.
5. To prevent sleeve couplings from pulling apart under pressure, a suitable harnessing or flange clamp assembly shall be provided and installed.

3.02 TESTING

- A. Testing of pipelines, including valves, appurtenances, and piping specialties, is specified in Section 15052. Furnish all labor, testing plugs or caps, pressure pumps, pipe connections, gauges, and all other equipment required to complete the tests as specified.
- B. Repair faulty joints, remove defective pipe, valves, fittings, and specialties, and replace as required. Retest.

END OF SECTION

**DIVISION 15 – MECHANICAL
SANITARY SEWER**

SECTION 15250

MANHOLES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install all precast manholes.
- B. General.
 - 1. Manholes shall conform in shape, size, dimensions, material, and other respects to the Details shown.
 - 2. The Contractor will provide the cast-iron frames and covers.
 - 3. Cast-in-place manholes will not be permitted unless specifically approved by the City.
 - 4. Masonry manholes will not be permitted.
- C. Related sections.
 - 1. Design Requirements.
 - 2. Division 2, Site Work.
 - 3. Division 15, Mechanical.

1.02 QUALITY ASSURANCE

- A. Reference standards.
 - 1. ASTM C478 - Specification for Precast Reinforced Concrete Manhole Sections.
 - 2. AWWA C302 - Reinforced Concrete Pressure Pipe, Noncylinder Type, for Water and Other Liquids.
 - 3. ASTM C923 – Resilient Connectors Between Reinforced Concrete Manhole Structures.
 - 4. ASTM A48 – Class 30 gray iron for manhole frame and covers.
 - 5. AWWA C302 – AWWA Standard C302 for Reinforced Concrete Pressure Pipe, Non-cylinder Type, for Water and Other Liquids.

1.03 SUBMITTALS

- A. Shop drawings. Submit for approval drawings showing design and construction details of precast concrete manholes, standard frames and covers, water-tight frames and covers, and any specialized appurtenances.

PART 2 - PRODUCTS

2.01 PRECAST CONCRETE MANHOLES

- A. Precast manholes shall conform to the Details shown and as specified herein.
- B. Except where otherwise specified, precast manhole components shall consist of reinforced concrete pipe sections especially designed for manhole construction and manufactured in accordance with ASTM C478, except as modified herein.
- C. Precast, reinforced concrete manhole bases, riser sections, flat slabs, and other components shall be manufactured by wet cast methods only, using forms which will provide smooth surfaces free from irregularities, honeycombing, or other imperfections. Concrete used in the construction of the manholes shall have a minimum 28 day strength of 4000 psi and be air entrained with four (4) to six (6) percent air. The base inside diameter of manholes shall be a minimum of 48 inches. Larger base diameters are preferred.
- D. Joints between manhole components shall be the tongue and groove type employing a single, continuous rubber O-ring gasket and shall conform to AWWA C302. The circumferential and longitudinal steel reinforcement shall extend into the bell and spigot ends of the joint without breaking the continuity of the steel. Joints between the base sections, riser sections, and top cones or slabs of manholes 72 inches in diameter and less shall be rubber and concrete joints. Joints for manhole components greater than 72 inches in diameter shall be provided with steel bell and spigot rings.
- E. All precast manhole components shall be of approved design and of sufficient strength to withstand the loads imposed upon them. They shall be designed for a minimum earth cover loading of 130 pounds per cubic foot, an H-20 wheel loading, and an allowance of 30 percent in roadways and 15 percent in rights-of-way for impact. Manhole bases shall have 2 cages of reinforcing steel in their walls, each of the area equal to that required in the riser sections. Wall thickness shall not be less than five (5) inches. Base thickness shall not be less than six (6) inches.
- F. The barrel of the manhole shall be constructed of various lengths of riser pipe manufactured to provide the correct height with the fewest joints. Openings in the barrel of the manholes for sewers or drop connections will not be permitted closer than 1 foot from the nearest joint. Special manhole base or riser sections shall be furnished as necessary to meet this requirement.

- G. A precast eccentric cone, as shown or approved, shall be provided at the top of the manhole barrel to receive the cast iron frame and cover. Straight wall, flat top manholes may be required for large diameter manholes, manholes above grade, or manholes less than four feet.
- H. Manhole sections shall contain manhole steps accurately positioned and embedded in the concrete.
- I. Gasketed flexible watertight connections shall be supplied for any inlet and outlet pipes joined to the manhole. Provide flexible pipe-to-manhole connectors as manufactured by KOR-N-SEAL, NPC or equal.
- J. Manhole interior coating. If required, manhole interior shall receive one (1) coat protective, solvent-free, colored epoxy resin coating. Color shall be light gray or other approved color. Use Sikagard 62 manufactured by Sika Corporation of Lyndhurst, NJ or approved equal. The City may require that some manholes have coatings applied after construction by a certified applicator.
- K. Manhole exterior coating. Manhole exterior to receive one (1) coat coal tar epoxy coating. Coal tar epoxy to be amine cured with a mix ration of 1:1.

2.02 MISCELLANEOUS METALS

A. Metal frames and covers.

1. Frames and covers shall be gray iron castings except as otherwise specified or indicated on the Drawings. Sizes shall be as shown on the Drawings. Depending on the application, covers shall have letters "SANITARY SEWER" or "WATER" embossed on top.
2. Standard frames and covers shall be Model MH-3000 24" as manufactured by Capitol Foundry of Virginia, Inc., or Model 1040 C by East Jordan Iron Works, Inc., or approved equal.
3. Watertight frame and cover shall have bolt-holes for anchoring the frame to the precast manhole cone. The joint between the frame and the manhole section shall be sealed with a polysulfide base sealant. Proposed model shall be submitted to the City for approval. Watertight frame and cover shall be Model MH-1678-CL-WT 24" as manufactured by Capitol Foundry of Virginia, Inc. or Model MH 1040 AGX with Cam Cover by East Jordan Iron Works, Inc., or approved equal.
4. The clear opening in the manhole frame shall be a minimum of 24 inches.

B. Manhole steps.

1. Manhole steps shall be "Wedge-Lok" type as manufactured by Delta Pipe

Products, or approved equal. Step shall be steel bar encapsulated in polyurethane plastic conforming to requirements of ASTM C478 and OSHA standards.

2. Space steps uniformly at a maximum of 16 inches on centers and project evenly from manhole or chamber walls. Encasement depth shall be as required by manufacturer (4 inches minimum).
3. The first step shall be no greater than 28 inches and no less than 24 inches from the top of the frame.

2.03 DROP CONNECTIONS

- A. Exterior drop connections for manholes shall be constructed where shown in Drawings or as approved by the City. Exterior drops shall conform to the design and details shown in the Detail Drawings or City detail WW2.2. Pipe and fittings shall be ductile iron (thickness class 52) or SDR-26 PVC. Drop connections shall be ductile iron pipe or PVC pipe backfilled in six (6) inch lifts and compacted by hand tampers.
- B. Interior drop manholes will only be allowed where specifically approved by the City. Interior drops shall conform to the design and details shown in the Detail Drawings or City detail WW2.3. If allowed, provide a drop manhole cross as manufactured by GPK Products, Inc., or equal.
 1. Drop stacks may be placed inside the manhole only if the inside diameter is 48 inches or greater. For manholes less than 48 inches in diameter, drop stacks must be installed outside the manhole.
 2. Drop stacks must discharge onto a prepared channel at no greater than 18 inches from the manhole invert.

PART 3 - EXECUTION

3.01 MANHOLE BASES

- A. Precast bases shall be set on No. 57 stone foundation as shown in City details WW2.0, WW2.1 and WW2.2. Precast bases shall be set at the proper grade and carefully leveled and aligned. Manholes shall be installed plumb. The flow channel through the manhole shall be of such shape and slope to provide smooth transition between inlet and outlet sewers and to reduce turbulence. Benches shall be sloped to the channel to prevent accumulation of solids.

3.02 PRECAST MANHOLE SECTIONS

- A. Set sections vertical with steps and sections in true alignment. The base of the bell or groove end at joints between components shall be buttered with 1:2 cement-sand mortar to provide a uniform bearing between components. All

joints shall be sealed with cement mortar inside and out and troweled smooth to the contour of the wall surface. Raised or rough joint finishes will not be accepted.

- B. Install sections, joints, and gaskets in accordance with manufacturer's recommendations.

3.03 MANHOLE CHANNELS

- A. All invert channels through manholes shall be constructed of concrete or grout. Channels shall be properly formed to the sizes, cross sections, grades, and shapes shown or as directed. Benches shall be built up to the heights shown or as directed and given a smooth, steel trowel finish. Care shall be taken to slope all benches for proper drainage to the invert channel.

3.04 GRADING RINGS

- A. Grading rings shall be used for all precast manholes where required. Grade rings shall be stacked in 2- or 3-inch increments to a maximum of 9 inches in height constructed on the cone section on which the manhole frame and cover shall be placed. A single grade ring shall be used where possible. The height of the grade rings shall be such as is necessary to bring the manhole frame to the proper grade. If more than 3 adjustment grade rings are required, a separate riser section must be used. Grade rings, when used, shall receive an interior sealing coat of Flex-Seal Utility Sealant by Sealing Systems, Inc., in accordance with manufacturer's instructions.

3.05 FLEXIBLE MANHOLE CONNECTION AT MANHOLE BASE

- A. Provide a flexible manhole connection between each pipe entering and exiting the manhole. The joint shall be completely watertight. Provide flexible pipe-to-manhole connectors as manufactured by KOR-N-SEAL, NPC, or equal.

3.06 GRADING AT MANHOLES

- A. All manholes in unpaved or unlandscaped easement areas shall be built as shown or directed to an elevation higher than the original ground. Install top of manhole 24 inches above finished grade, unless otherwise noted. The ground surface shall be graded to drain away from the manhole. Fill shall be placed around manholes to the level of the upper rim of the manhole frame, and the surface evenly graded on a 1:5 slope to the existing surrounding ground unless otherwise shown. In maintained, seeded areas such as yards, parks, etc., top of manhole must be flush with finished grade.
- B. Manholes in paved areas shall be constructed to meet the final surface grade. Manholes shall not project above finished roadway pavements.
- C. Contractor shall be solely responsible for the proper height of all manholes

necessary to reach the final grade at all locations. Contractor is cautioned that the City's review of Shop drawings for manhole components will be general in nature and Contractor shall provide an adequate supply of random length precast manhole riser sections to adjust any manhole to meet field conditions for final grading.

3.07 MANHOLE WATERTIGHTNESS

- A. Each manhole shall be tested for leaks, and all leaks found shall be repaired in a manner subject to the City's approval. Manhole testing shall be accomplished by one of the following two methods:
1. Exfiltration test. Inflatable stoppers shall be used to plug all lines into and out of the manhole being tested. The manhole shall be filled with water to the top of the rim. Manholes shall be filled with water and allowed to sit up to a maximum of 12 hours prior to beginning test to allow for absorption. After testing, water shall be disposed of in a suitable manner as approved by the City.
 - a. Test duration: 2 hours
 - b. Allowable leakage: 0.25 gallon per hour per foot of depth.
 2. Vacuum test.
 - a. Testing shall be accomplished in accordance with ASTM C1244, latest edition, for watertightness. Testing shall include the entire manhole, including the joint between the cone section and the frame.
 - 1) The test method is only to be applied to precast concrete manholes.
 - 2) Stub outs, manhole boots, and pipe plugs shall be secured to prevent movement while the vacuum is drawn.
 - b. A measured vacuum of 10 inches of mercury shall be established in the manhole. The time for the vacuum to drop to 9 inches of mercury shall be recorded. Acceptance standards for leakage shall be established from the elapsed time for a negative pressure change from 10 inches to 9 inches of mercury. The maximum allowable leakage rate shall be in accordance with the following:

Manhole Size (Diameter in Feet)	Depth*	Minimum Time for a 1” Hg Pressure Change
4	Less than 10’	60 sec.
4	Greater than 10’ but less than 15’	75 sec.
4	Greater than 15’ but less than 25’	90 sec.
5	Less than 10’	75 sec.
5	Greater than 10’ but less than 15’	90 sec.
5	Greater than 15’ but less than 25’	105 sec.
6	Less than 10’	90 sec.
6	Greater than 10’ but less than 15’	105 sec.
6	Greater than 15’ but less than 25’	120 sec.

*Manholes greater than 25 feet in depth shall be reviewed and testing requirements established on a case-by-case basis.

- c. If the manhole fails the test, necessary repairs shall be made and the vacuum test repeated until the manhole passes the test or the manhole shall be tested in accordance with the standard exfiltration test and rated accordingly.

END OF SECTION

SECTION 15251

SEWER PIPING INSTALLATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to install and test all piping, fittings, and specials. The Work includes, but is not limited to, the following:

1. All types and sizes of piping except those specified under other Sections.
2. Supports, restraints, and thrust blocks.
3. Pipe encasements.
4. Work on or affecting existing piping.
5. Testing.
6. Cleaning.
7. Installation of all jointing and gasketing materials, specialties, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, tie rods, and all other Work required to complete the piping installation.

B. Related sections.

1. Section 02200, Excavation and Backfill.
2. Section 15250, Manholes.
3. Section 03300, Concrete.
4. Section 15260, PVC Pipe.
5. Section 15270, Ductile Iron Pipe and Fittings.

1.02 QUALITY ASSURANCE

A. All pipe to be installed under this Contract may be inspected at the place of manufacture for compliance with the Specifications by an independent testing laboratory provided by the City. The Contractor shall require the manufacturer's cooperation in these inspections. The cost of inspection of all pipe approved for this Contract will be borne by the City.

B. The City will inspect the pipe after delivery. The pipe shall be subject to

rejection at any time due to failure to meet any of the specified requirements herein, even though pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall be removed from the job.

- C. Reference standards. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
 - 1. ASTM D2321 - Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.
 - 2. ASTM D2321-11 - Underground Installation of Thermoplastic Pipe for Sewer and Other Gravity-Flow Applications.
 - 3. AWWA C105 - Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids.
 - 4. AWWA NU3 - PVC - Design and Installation.
 - 5. ANSI/ASTM A746 - Standard Specification for Ductile Iron Gravity Sewer Pipe.

1.03 SUBMITTALS

- A. Shop drawings. Submit for approval the following:
 - 1. Laying schedules for all pipe.
 - 2. Full details of piping, specials, manholes, joints, and connections to existing piping, structures, equipment, and appurtenances.
- B. Certificates. Submit certificates of compliance with referenced standards.
- C. Record drawings. Submit record drawings prior to the time of final completion.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Handle all pipe, fittings, specials, and accessories carefully with approved handling devices as per manufacturer's requirements. Do not drop or roll material off trucks. Do not otherwise drop, roll, or skid piping.
- B. Store pipes and fittings on heavy wood blocking or platforms so they are not in contact with the ground. Pipe shall not be stacked higher than the limits recommended by the manufacturer and storage shall conform to the manufacturer's recommendations. Pipe and fittings strung out for installation within 5 working days may be placed in contact with the ground.
- C. Unload pipe, fittings, and specials opposite to or as close to the place where

they are to be installed as is practical to avoid unnecessary handling. Keep pipe interiors completely free from dirt and foreign matter.

- D. Inspect delivered pipe for cracks, gouges, chips, dents, or other damages and immediately remove damaged pipe from site.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Refer to applicable Pipe Sections for material specifications.
- B. Pipe marking.
 - 1. Cast or paint material, type, and pressure designation on each piece of pipe or fitting four (4) inches in diameter and larger.
 - 2. Warning tape. Warning tape shall have a minimum 5.0 mil overall thickness. The warning tape, including labeling, shall not contain any dilutants, pigments, or other contaminants, and shall resist degradation by elements encountered in the soil. The warning shall be color-coded green and imprinted with the words, "Caution -- Sewer Line Buried Below." Tape to be Lineguard underground marking tape, or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General.
 - 1. Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe, linings, or coatings. Pipe or fittings shall not be dropped. All pipe and fittings shall be examined before laying and no piece shall be installed which is found to be defective. Any damage to the pipe linings or coatings shall be repaired as directed. Handling and laying of pipe and fittings shall be in accordance with the manufacturer's instructions and as specified herein.
 - 2. If there is a conflict between manufacturer's recommendations and the Drawings or Specifications, request instructions from the City before proceeding.
 - 3. All pipe shall be sound and clean before laying. When laying is not in progress, including lunchtime, the open ends of the pipe shall be closed by watertight plugs or other approved means.
 - 4. All piping and fittings shall be installed true to alignment and rigidly supported. Anchorage shall be provided where required. Any damage to

linings shall be repaired to the satisfaction of the City before the pipe is installed. Each length of pipe shall be cleaned before installation.

5. Pipe trench shall be backfilled according to details WW 1.0 and WW 1.1. Blocking will not be permitted. If any defective pipe is discovered after it has been laid, it shall be removed and replaced with a sound pipe in a satisfactory manner by the Contractor, at Contractor's own expense.
6. Where pipe cutting is required, the cutting shall be done by abrasive saw, leaving a smooth cut at right angles to the axis of the pipe. Any damage to the lining shall be repaired to the satisfaction of the City. Field cuts ends shall be in accordance with the manufacturer's instructions. Piping with Protecto 401 liner the is cut shall be repaired using the Field Repair Kit per manufacturers instructions.
7. Rights-of-way and easements.
 - a. The Contractor shall confine construction operations to the immediate vicinity of the project location as shown on the Plans, and in no case shall the Contractor encroach beyond the limits of the City's property, easements, or rights-of-way. He shall further use due care in placing construction tools, equipment, excavated materials, and pipeline facility materials and supplies so as to cause the least possible damage to property and the least interference with traffic. The placing of such tools, equipment, and materials shall be subject to the approval of the City. Any damage resulting from the placement of equipment and materials or construction operation occurring outside of designated work areas shall be the sole responsibility of the Contractor. The Contractor shall make satisfactory settlement for any damage directly with the property owner involved.
 - b. The Contractor shall conduct the construction in such a manner to cause the least inconvenience to the citizens of the area, thereby maintaining good public relations. The Contractor shall not unnecessarily interfere with the use of any public or private improvements, including landscaping; nor shall he unnecessarily damage such improvements. The Contractor shall repair any damage to such improvements to pre-construction condition, or as otherwise directed by the City.
 - c. The Contractor shall use care in protecting existing property irons and monuments adjacent to his working area. If a property iron or monument must be removed to install new facilities, the Contractor shall retain the services of a properly registered surveyor to immediately replace it after construction of the new facilities.
8. Work within city rights-of-way, VDOT rights-of-way, and City

easements. Work within railroad property and right-of-way only with the permission of the railroad and in compliance with all applicable law, rules and regulations.

- a. Permits. The Contractor shall be responsible for obtaining and paying for all permits, insurance, and bonds required to complete the Work.
- b. The Contractor shall comply with all provisions of all permits required by the governing authorities at his own expense. The Contractor's responsibility under this paragraph may include, but is not limited to, the following:
 - 1) Constructing and removing temporary facilities or structures.
 - 2) Providing details of construction methods.
 - 3) Providing detailed construction schedules.
 - 4) Reimbursing the applicable authority for all expenses incurred by them in connection with the Work.
 - 5) Traffic maintenance.
 - 6) Coordination of scheduling with the City.
 - 7) Necessary clean up and restoration.
- c. Maintenance of traffic.
 - 1) The Contractor shall provide maintenance of traffic within the construction area for the duration of the construction period, including during any temporary suspension of Work. Maintenance of traffic shall conform to the current editions of the Manual on Virginia Traffic Control Devices, Virginia Work Area Protection Manual, Virginia Department of Transportation Road and Bridge Specifications, and the Virginia Department of Transportation Guidelines for Temporary Traffic Control and shall be subject to the approval of the City Traffic Engineer.
 - 2) The City may provide a general Traffic Maintenance Plan for portions of the Work to be performed under this contract. If a general Traffic Maintenance Plan is provided, the Contractor is required to conform to this plan. The City may require that the Contractor submit a detailed Traffic Maintenance Plan prior to commencing work on a particular portion of the project. If the Contractor is asked to submit such a plan, work must not commence on the portion of the project covered by the plan until approval of the detailed Traffic Maintenance Plan by the City.

- 3) The amount of roadway closure shall be limited to the immediate work area and shall be in accordance with the above-mentioned manuals and specifications.
- d. Maintenance of ingress and egress. The Contractor shall strive to maintain, at all times during the execution of the Work, continuous ingress and egress to all affected parcels and traveled ways. When ingress and egress to affected parcels must be blocked due to the direct execution of the Work, 24-hours advance notice must be given to the affected property owner. In no case shall the blocking of ingress and egress be allowed for more than 24 consecutive hours.
 - e. Construction activities within City rights-of-way are subject to the requirements of the City. Contractor shall ascertain from the City its rules, regulations, and requirements.
 - 1) The Contractor shall maintain traffic control in a safe and professional manner. All traffic control measures, including signage, shall be in conformance with VDOT Guidelines for Temporary Traffic Control subject to the approval of the City Traffic Engineer.
 - 2) Contractor shall erect and maintain barriers, lights, and other necessary protective devices as required by the City. Road, sidewalk, or other access-way closure will only be allowed with prior approval of the City.
 - 3) Required notice for work within City roadways is seven (7) calendar days.
 - f. Construction within VDOT rights-of-way shall be subject to the approval and issuance of a construction permit by VDOT. Contractor shall at all times conduct his work and operations in accordance with the issued permit and the Virginia Department of Transportation Road and Bridge Specifications. If required by VDOT, the Contractor shall submit for approval specific details of construction methods proposed for Work within VDOT rights-of-way.
 - g. Materials and methods of construction used on railroad company property or rights-of-way shall be subject to the approval of the railroad company. Contractor shall at all times conduct his work and operations fully within the railroad company's rules, regulations, and requirements. The Contractor must ascertain from the railroad company its rules, regulations, and requirements, and what, if any, delays may be encountered. If required by the railroad company, the Contractor must submit for approval specific details of the methods of construction he intends to utilize together with any sketches or

drawings.

The Contractor must observe all necessary and appropriate safety precautions when working on railroad rights-of-way or property. At the discretion of the railroad, the Contractor shall provide a qualified watchman or pay for a watchman supplied by the railroad to warn workmen of the approach of any train or other moving equipment upon the tracks of the railroad, and to keep all workmen or other persons, equipment, and materials from the tracks including any power, communication, and signal wires, so that there will be no contacts with trains, rolling equipment, or wires. Contractor shall comply with all railroad requirements.

9. Warning tape shall be installed with each reach of sanitary sewer line and each service lateral. Warning tape shall be installed 12 inches above the sewer line or lateral and shall be continuous over the length of the sewer line or lateral. Tracer wire shall be installed with all PVC piping (sewer lines and laterals). Terminate tracer wire in a loop within a 1/2-inch diameter PVC pipe located at manholes or clean-outs as applicable.

B. Above-grade pipe installation.

1. All above-grade pipe shall be flanged unless otherwise shown or specified.
2. Flanged joints shall be made using gaskets, bolts, bolt studs with a nut on each end, or studs with nuts where the flange is tapped. The number and size of bolts shall conform to the same ANSI standard as the flanges.
3. Bolts in flanged joints shall be tightened alternately and evenly as per manufacturer's recommendations.

C. Buried piping installation.

1. Separation of sewers and potable water lines.
 - a. Parallel installations.
 - 1) Potable water lines and sanitary sewers shall be separated horizontally by a clear distance of not less than ten (10) feet edge-to-edge wherever possible.
 - 2) When local conditions prohibit this horizontal separation of ten (10) feet, the installation will be permitted provided the sewer line is in a separate trench or an undisturbed earth shelf located on one side of the sewer and the bottom of the water line is at least 18 inches above the top of the sewer.

- 3) Where this vertical separation cannot be obtained, the sewer shall be constructed of water pipe material in accordance with AWWA specifications and pressure tested in place without leakage prior to backfilling. The hydrostatic test shall be conducted in accordance with the most recent edition of the AWWA standard (ANSI/AWWA C600-82) for the pipe material, with a minimum test pressure of 30 psi. Sewer manholes shall be of watertight construction and tested in place.

b. Crossings.

- 1) Provide a minimum vertical separation of 18 inches between the top of the sewer line and the bottom of the potable water line where the sewer passes under the water line.
- 2) When local conditions prohibit this vertical separation, the sewer shall be constructed of AWWA specified water pipe and pressure tested in place without any leakage prior to backfilling, in accordance with these standards.
- 3) Sewers crossing over potable water lines shall be constructed of AWWA approved water pipe, and pressure tested in place without leakage prior to backfilling, in accordance with these standards. Minimum vertical separation of potable water line and sewer shall be 18 inches measured edge to edge.
 - a) Center one (1) full-length section of pipe so that the sewer joints will be equidistant from the potable water line joints.
 - b) Provide adequate structural support for the sewer so as to maintain line and grade.

c. Separation of sewers and other utilities.

- 1) A minimum horizontal separation of five (5) feet shall be maintained between parallel sewers and gas lines. Should this horizontal separation not be obtainable, the separation may be reduced to three (3) feet with the written approval of the Chief Gas Engineer.
- 2) Sewers shall have a minimum edge-to-edge separation of 12 inches from all other utilities.
- 3) At all crossings, provide a minimum vertical separation of 12 inches between sewers and other utilities.
- 4) Sanitary sewers crossing under storm sewers shall maintain a minimum separation of 12 inches. Where this separation is not

possible, the sanitary sewer shall be constructed of AWWA specified ductile iron pipe. Concrete support piers shall be required for the storm sewer and these piers shall be built on undisturbed earth with ready mix Class A3 concrete. Details of the design are subject to the approval of the City Engineer.

2. Pipe bedding.

- a. Bed pipe as specified below and in accordance with the Details and Drawings.
- b. Trench excavation, backfill, and bedding materials shall conform to the requirements of Section 02200, Excavation and Backfill, and Section 02230, Fill and Granular Fill Materials.
- c. Excavate trenches below the pipe bottom by the amount specified. Remove all loose and unsuitable material from the trench bottom.
- d. Rock shall be removed to a minimum 6-inch clearance around the bottom and 12-inch minimum clearance on the sides of all pipe being laid.
- e. Carefully and thoroughly compact all pipe bedding with hand-held compactors.
- f. If a conflict exists, obtain clarification from the City before proceeding.
- g. No pipe shall be brought into position until the preceding length has been bedded and secured in its final position.

3. Laying pipe.

- a. Conform to manufacturer's instructions and requirements of the reference standards where applicable.
- b. Install all pipe accurately to line and grade shown on the Drawings unless otherwise approved by the City. When local conditions prohibit horizontal separation, the sewer may be laid closer provided that the water main is in a separate trench or an undisturbed earth shelf located on one side of the sewer and the bottom of the water main is at least 18 inches above the top of the sewer.
- c. Re-lay pipes that are not laid correctly.
- d. Slope piping uniformly between elevations shown with no dips or sags in the pipe.

- e. Ensure that ground water level in trench is at least 6 inches below bottom of pipe before laying piping. Do not lay pipe in water. Maintain dry trench conditions until jointing and backfilling are complete.
 - f. Start laying pipe at lowest point and proceed towards the higher elevations, unless otherwise approved by the City.
 - g. Place bell and spigot pipe so that bells face the direction of laying, unless otherwise directed or approved by the City.
 - h. Field cut pipe, where required, with a machine specially designed for cutting piping. Make cuts carefully, without damage to pipe or lining, and with a smooth end at right angles to the axis of pipe. Cut ends on push-on joint shall be tapered and sharp edges filed off smooth. Flame cutting will not be allowed unless otherwise approved in writing by the City Engineer.
 - i. Inspect interior of all pipe and fittings and completely clean all dirt, gravel, debris, or other foreign material from pipe interior and joint recesses before it is moved into the trench. Bell and spigot mating surfaces shall be thoroughly wire brushed and wiped clean, and dry immediately before the pipe is laid.
 - j. Carefully examine all pipe for cracks, damage, or other defects while suspended above the trench before installation. Immediately remove defective materials from site.
 - k. Excavate around joints in bedding and lay pipe so that the barrel bears uniformly on the trench bottom.
 - l. Blocking under piping will not be permitted unless specifically approved by the City for special conditions.
 - m. Touch up protective coatings in a satisfactory manner prior to backfilling.
 - n. On steep slopes, take measures to prevent movement of the pipe during installation.
 - o. Exercise care to avoid flotation of pipe when placing concrete around pipe during concrete encasement.
 - p. Change in pipe material or size and pipe couplings will not be permitted between manholes.
4. Polyethylene encasement.

- a. Provide polyethylene encasement for ductile iron piping where shown on the Drawings to prevent contact between the pipe and surrounding bedding material and backfill.
 - b. Polyethylene may be supplied in tubes or in sheet material.
 - c. Polyethylene encasement materials and installation shall be in accordance with the requirements of AWWA C105.
5. Jointing pipe.
- a. Ductile iron mechanical joint pipe.
 - 1) Wipe the socket, plain end, and adjacent areas clean immediately before making joint. Make certain that cut ends are tapered and sharp edges are filed off smooth.
 - 2) Place the gland on the plain end with the lip extension toward the plain end.
 - 3) Lubricate the plain end and gasket with soapy water or an approved pipe lubricant in accordance with AWWA C111, and slip the gasket onto the plain end of the joint assembly with the narrow edge of the gasket toward the plain end.
 - 4) Insert the pipe into the socket and press the gasket firmly and evenly into the gasket recess. Keep the joint straight during assembly.
 - 5) Push gland toward socket and center it around pipe with the gland lip against the gasket.
 - 6) Insert bolts and hand-tighten nuts.
 - 7) Make deflection after joint assembly, if required, but prior to tightening bolts. Alternately tighten bolts 180 degrees apart to seat the gasket evenly. The bolt torque shall be as follows:

Pipe Size (Inches)	Bolt Size (Inches)	Range of Torque (Ft. lbs.)
3	5/8	45-60
4-24	3/4	75-90
30-36	1	100-120
42-48	1-1/4	120-150

- b. Ductile iron push-on joint pipe.

- 1) Prior to assembling the joints, the last 8 inches of the exterior surface of the spigot and the interior surface of the bell shall be thoroughly cleaned with a wire brush, except where joints are lined or coated with a special protective lining or coating.
 - 2) Rubber gaskets shall be wiped clean and flexed until resilient. Refer to manufacturer's instructions for procedures to ensure gasket resiliency when assembling joints in cold weather.
 - 3) Insert gasket into joint recess and smooth out the entire circumference of the gasket to remove bulges and to prevent interference with the proper entry of the spigot of the entering pipe.
 - 4) Immediately prior to joint assembly, apply a thin film of approved lubricant to the surface of the gasket that will come in contact with the entering spigot end of pipe. Contractor may, at his option, apply a thin film of lubricant to the outside of the spigot of the entering pipe.
 - 5) For assembly, center spigot in the pipe bell and push pipe forward until it just makes contact with the rubber gasket. After gasket is compressed and before pipe is pushed or pulled all the way home, carefully check the gasket for proper position around the full circumference of the joint. Final assembly shall be made by forcing the spigot end of the entering pipe past the rubber gasket until it makes contact with the base of the bell. When more than a reasonable amount of force is required to assemble the joint, the spigot end of the pipe shall be removed to verify the proper positioning of the rubber gasket. Gaskets that have been damaged shall not be reused.
 - 6) Maintain an adequate supply of gaskets and joint lubricant at the site at all times when pipe-jointing operations are in progress.
- c. Proprietary joints. Pipes which use proprietary joints shall be installed in strict accordance with the manufacturer's instructions.
- d. Thermoplastic pipe joints (PVC).
- 1) Solvent cement joints.
 - a) Bevel pipe ends and remove all burrs before making joints. Clean both pipe and fittings thoroughly. Do not attempt to make solvent cement joints if temperature is below 40 degrees F, or in wet conditions.
 - b) Use solvent cement supplied or recommended by the pipe manufacturer.

- c) Apply joint primer and solvent cement and assemble joints in strict accordance with the recommendations and instructions of the manufacturer of the joint materials and the pipe manufacturer.
 - d) Observe safety precautions with the use of joint primers and solvent cements. Allow air to circulate freely through pipelines to permit solvent vapors to escape. Slowly admit water when flushing or filling pipelines to prevent compression of gases within pipes.
- 2) Push-on joints.
- a) Bevel all field-cut pipe, remove all burrs, and provide a reference mark the correct distance from the pipe end.
 - b) Clean the pipe end and the bell thoroughly before making the joint. Insert the O-ring gasket making certain it is properly oriented. Lubricate the spigot with an approved lubricant; do not lubricate the bell or O-ring. Insert the spigot end of the pipe carefully into the bell until the reference mark on the spigot is flush with the bell.

6. Backfilling.

- a. Conform to the applicable requirements of Section 02200.
- b. Place backfill as construction progresses. Backfill by hand and use power tampers until pipe is covered by at least 1 foot of fill.

D. Installation of sewer service laterals.

1. Connection to new sanitary sewer lines.

- a. All lateral connections to a new sanitary sewer main shall be made at appropriate fittings installed during construction of the new sewer; or shall be installed as described below for connections to an existing sanitary sewer line.
- b. The tee fitting for the branch size shall be the same diameter as the lateral pipe (e.g. use an 8"x4" tee for a 4" lateral.)
- c. Fittings for lateral connections shall be oriented such that connected laterals will enter the sewer main on a slope of 45 degrees from horizontal.
- d. Lateral connections into new manholes shall be as described below for connections to existing sanitary sewer line manholes.

2. Connection to existing sanitary sewer lines.
 - a. All Work necessary to install a sewer lateral to an existing sanitary sewer line shall be performed by workers experienced in the installation of sewer lines and laterals.
 - b. Contractor shall notify the City 48 hours prior to beginning construction.
 - c. When tapping the sewer line, a mechanical hole-cutter designed specifically for the piping material and an approved pipe saddle must be used. The tap shall be located such that the lateral connections will enter the existing main sewer line on a slope less than 45 degrees from horizontal. Pipe saddles shall be the strap-on type – Romac “CB” or approved equal.
 - d. When tapping into a manhole, insure the lateral connection enters above the manhole shelf but no higher than one (1) foot above the outlet pipe invert. A channel to carry flow from the connection must be built inside the manhole. Contractor may elect to install a “drop” at deep manholes in accordance with the detail Drawings and these standards.
 - 1) All holes cut into existing manhole walls shall be made with a mechanical hole-cutter unless otherwise approved in writing by the City Engineer. Seal annular space between manhole wall and installed sewer lateral with non-shrink grout and pour a concrete collar around connection.
 - 2) Maximum number of lateral connections at any one manhole shall be three (3) unless otherwise approved in writing by the City Engineer.
 - 3) Maximum number of internal “drops” at any one manhole 48-inches diameter or less shall be one (1). Internal “drops” shall be installed only upon prior written approval by the City Engineer.
3. Minimum lateral inside diameter shall be four (4) inches.
4. Tracer wire: Per the Virginia Uniform Statewide Building Code, nonmetallic sanitary sewer piping that discharges to public systems shall be locatable. An insulated copper tracer wire, 14 AWG minimum in size and suitable for direct burial or an equivalent product, shall be utilized. The wire shall be installed in the same trench as the sewer within 12 inches (305 mm) of the pipe and shall be installed to within five feet (1524 mm) of the building wall to the point where the building sewer intersects with the public system. At a minimum, one end of the wire shall terminate above grade in an accessible location that is resistant to physical damage,

such as with a cleanout or at the building wall.

3.02 TESTING

- A. Test piping in accordance with Sections 15253 and 15255.
- B. Test manholes in accordance with Section 15250.

END OF SECTION

SECTION 15253

SEWER PIPE TESTING

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. This Section specifies the general requirements for testing the piping systems shown on the Drawings and specified elsewhere in these Specifications.

1.02 RELATED WORK

- A. Piping materials and systems are included in other Sections of Division 15.
- B. Section 15251, Piping Installation.

1.03 SUBMITTALS

- A. Test records.
 - 1. Maintain records of all tests performed.
 - 2. Test records shall include:
 - a. Date of testing.
 - b. Identification of piping tested.
 - c. Test fluid.
 - d. Test pressure.
 - e. Signature of contractor.
 - 3. If leaks are found, they shall be noted on the record, and then repaired as approved by the City. After repair, retest as specified for original test.
 - 4. Submit test records to City within 24 hours of testing.

1.04 GENERAL REQUIREMENTS

- A. General.
 - 1. Test all newly installed sanitary sewer main except as otherwise authorized by the City.
 - 2. The Contractor shall notify the City 48 hours in advance of testing.

3. Provide all testing apparatus, including pumps, compressor, hoses, gauges, and fittings.
4. Repair and retest pipelines which exceed the allowable leakage rate.
5. Conduct all tests in the presence of the City's representative.
6. Manholes should be tested per Section 15250 prior to pipeline testing.

PART 2 - PRODUCTS

2.01 TEST FLUIDS

- A. Hydrostatic Test. Potable water shall be used as the test fluid whenever possible. In piping systems where access to potable water is not possible, non-potable water may be used upon written authorization from the City Engineer.
- B. Pneumatic Test. Compressed air shall be used for all pneumatic tests.

2.02 TEST EQUIPMENT

- A. Pneumatic Test.
 1. Provide a compressor capable of the required test pressure.
 2. Valves shall be provided on the discharge side of the compressor.
 3. Relief valve to relieve at 10 to 15 percent over the test pressure
 4. Pressure gauge(s) capable of reaching 50 percent over the test pressure
- B. Thermoplastic Pipe Distortion Test (Mandrel Test)
 1. A properly sized "go no-go" rigid mandrel or sewer ball per the following table:

Nominal Size (PVC SDR-26)	Average ID (inches)	Mandrel Size (inches)
6"	5.612	5.33
8"	7.488	7.11
10"	9.342	8.87
12"	11.102	10.55
15"	13.575	12.90
18"	16.586	15.76
24"	21.964	20.87
30"	28.461	27.04

PART 3 - EXECUTION

3.01 SAFETY

- A. All tests shall be performed under the direct supervision of the Contractor and in the presence of a representative of the City.
- B. Restrict personnel in the test area to those involved in the test.
- C. Safety glasses must be worn throughout testing.

3.02 TESTING OF GRAVITY SEWER PIPING

- A. All gravity sewer lines shall be tested in accordance with the procedures outlined below. Leakage test may be either hydrostatic ex-filtration or air test, as determined by the City's designated inspector.
- B. Visual Alignment Test
 - 1. A light will be flashed between manholes by means of a flashlight or reflection of sunlight with a mirror, or by other methods as may be adopted by the City. If the illuminated interior of the pipe shows poor alignment, displaced pipe, blockage, or other defects, the defects shall be corrected so as to meet all standards governing the construction of sewer mains. All costs involved shall be born by the Contractor.
- C. Thermoplastic Pipe Distortion Test (Mandrel Test)
 - 1. All thermoplastic pipe shall be subject to a distortion test. Such test shall be conducted 30 days following completion of backfill.
 - 2. Maximum allowable distortion shall not exceed 5 percent of the pipe's internal diameter. Distortion test shall be conducted using a properly sized "go-no-go" mandrel or by other methods acceptable to the City.
 - 3. Sewer sections failing to meet the distortion requirements shall be corrected at Contractor's expense.
- D. Hydrostatic Ex-filtration Test
 - 1. Test shall be conducted between successive manholes under observation of a representative of the City.
 - 2. The reach under test shall be subjected to a minimum of four (4) feet of head (water column) or up to the head to the top of the previously tested manhole, whichever is the lesser, above the crown of the pipe at the upstream manhole of the section being tested.
 - 3. Contractor shall maintain the water column (head) for the two(2) hour test

duration, recording the volume of water added. The added water shall be the leakage experienced by the pipe reach during the test.

4. Allowable leakage shall not exceed 100 gallons per inch of nominal pipe diameter per mile per day (2400 gpd/mile maximum) for any section of the system.

E. Air Test

1. Test methods and acceptability criteria shall be in accordance with the procedures outlined below and the appropriate ASTM specification for the pipe material being tested.
2. Air test equipment shall consist of two (2) inflatable plugs, air compressor, air shut-off valve, pressure regulating valve, pressure reduction valve, and a monitoring pressure gauge having a range from 0.0 to 5.0 psi graduated in 0.1 psi with an accuracy of ± 0.04 psi. The test equipment shall be set up outside the manhole.
3. Pressurize pipe to be tested, including all connecting laterals to four (4) psig. Allow the pressure inside the pipe to stabilize at or above the initial test pressure of 3.5 psig.
4. Adjust the pressure inside the pipe to the test pressure. Test pressure shall be 3.5 plus 0.5 psi for every foot of ground water over the 1 psi of ground water level is unknown. Commence test once test pressure is reached.
5. Record the drop in pressure for the test period as calculated by the following equation:

$$T = (0.0007) 2 * D L$$

T = Required test period (min.)

D = Nominal pipe diameter (in.)

L = Length of reach under test (ft.)

6. No pipe reach will be accepted if the pressure drop during the test period calculated exceeds 1.0 psig.
- F. Any leaks or deficiencies noted during either ex-filtration or air testing are to be remedied at Contractor's expense, even to the extent of disassembling and remaking the joint. All defective pipe and fittings shall be removed and replaced in a manner acceptable to the City.
- G. Chemical sealants, tape, or cement shall not be used to repair leaks unless approved by the City. Leaks in PVC piping shall be repaired as specified and conforming to the manufacturer's current printed recommendations. Cemented PVC socket weld fittings and screwed nipples with improperly cut

threads shall not be reused, nor shall threaded PVC pipe and fittings be over-tightened or sealed with chemical sealants. Leaks shall not be repaired by back welding.

- H. Wherever possible, each piping system shall be tested as it is completed in order to uncover faulty materials or workmanship.

3.03 CLEANING

- A. Thoroughly clean all piping and flush prior to placing in service in a manner approved by the City.

3.04 VIDEO INSPECTION

- A. Video inspection is required by the City. The Contractor shall perform a video inspection of the new pipe. In some cases, depending on the availability of equipment and manpower, the City may conduct the inspection with its own equipment and crew. This decision will be at the City's sole discretion.
- B. Video inspection shall be in accordance with City specifications, which will be provided to the Contractor when video inspection is requested.
- C. City-required video inspections will not be considered extra work.

END OF SECTION

SECTION 15255

SEWER CLEANING AND TELEVISION INSPECTIONS

PART 1 - GENERAL REQUIREMENTS

1.01 SCOPE

- A. This section specifies requirements for furnishing all labor and equipment required to completely clean sewers from manhole to manhole and to inspect and document the interior condition of gravity sanitary sewer mains and service laterals utilizing closed circuit television (CCTV) equipment. The television inspections are required for final acceptance of all new sewers and service laterals by the City of Charlottesville (City).
- B. All new main sewers and service laterals shall be televised.
- C. Television inspections shall not be performed until all other acceptance testing requirements are completed (after all air-testing and mandrel testing of main sewers and vacuum testing of manholes) and after all punchlist items are corrected (in particular manhole punchlist items). Any television inspections performed prior to completion of other acceptance testing and punchlist items shall not be accepted by the City.
- D. The sewers shall be thoroughly cleaned prior to the CCTV inspections as specified. Sewers that are not clean will not be accepted.

1.02 SUBMITTALS

- A. The Contractor shall provide one copy of the CCTV inspections to the City. The inspections and submittals shall be in digital format as specified herein. The inspection logs shall be submitted in hard copy format (printed) and the videos and inspection database shall be submitted on portable hard drives and/or DVDs.

1.03 QUALIFICATIONS

- A. The Contractor performing the sewer cleaning and television inspections shall be approved by the City prior to performing any work on the project. The Contractor shall have at least 3 years of sewer cleaning and television inspection experience and shall have cleaned and televised at least 200,000 feet of sewer. The Contractor shall submit documentation to the City to demonstrate his experience and that these requirements are met.
- B. In addition, the Contractor shall submit a sample CCTV inspection (video, logs and database file) to demonstrate the proposed video quality to be provided for this work and to demonstrate that the specifications will be met with regard to data format requirements.

- C. The Contractor must be approved by the City prior to any work, and the quality of the work must meet these specifications and the sample CCTV inspection that was submitted. If the quality is not acceptable, the CCTV inspections shall be re-performed at no additional cost to the City.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.01 SEWER CLEANING

- A. The Contractor shall perform and provide all necessary traffic control measures to complete the work in accordance with the City's requirements.
- B. The Contractor shall thoroughly clean and televise the sewers and submit one copy of the final television inspection videos and logs to the City as specified herein. The Contractor's cleaning operations shall fully clean the sewers and remove all dirt, mud, silt, debris, etc. The cleaning shall be performed prior to the television inspections of the sewers. Lines not acceptably clean will not be accepted and shall be re-cleaned, re-televised and re-submitted to the City for review at no additional cost to the City.
- C. The equipment used for the cleaning operations shall be specifically designed for cleaning sewers. The Contractor shall use the appropriate equipment to clean all dirt, mud, silt, debris, etc. from each sewer segment thoroughly. The cleaning equipment shall be high velocity water jet cleaning equipment only – no mechanical cleaning equipment such as cutters or rodders shall be used under any circumstance. All solids (dirt, mud, silt, debris, etc.) shall be removed at the downstream manhole of the section being cleaned - passing material from one sewer segment to another will not be permitted. Cleaning operations shall begin at the most upstream sewers and proceed downstream. The solids shall be removed from the site and properly disposed of at approved locations provided by the Contractor.
- D. Ductile Iron Pipe: The Contractor shall use extreme care when cleaning ductile iron pipe lined with Protecto 401 and shall follow all of the manufacturers' recommendations for cleaning such pipe. The cleaning pressure shall not exceed 1,300 psi at any time during the cleaning operations to prevent damaging the coating.
- E. Water for use on this project will be available from selected hydrants owned and operated by the City. Use of hydrants other than those approved by the City will not be allowed. In order to use the City's water supply, the Contractor shall meet all City requirements for connecting to hydrants, and the Contractor shall obtain a permit for connecting to the City's hydrants.

The requirements for connecting to hydrants include obtaining a meter from the City, repairing malfunctioned meters promptly, providing an air gap or an

approved AWWA back flow preventer, providing a reduced pressure principle assembly, installing the complete assembly and obtaining approval of the installation from the City. A permit and complete assembly are required for each vehicle that will obtain water – meters cannot be moved from one vehicle to another unless otherwise approved by the City. The hydrants shall be operated in a manner as defined by the City. The Contractor shall be responsible for any damage caused by improper operation of hydrants. The Contractor is responsible for meeting all requirements of referenced policies, ordinances, and/or specifications regardless if such requirements are explicitly stated herein or not.

The Contractor shall pay the City for all water used for the cleaning and CCTV operations. Water usage will be determined from the meter readings at the end of the project. The City will not accept the sewers until the Contractor has paid for all water used on the project.

- F. The Contractor shall take precautions to avoid damage or flooding to public or private property being served by the line being cleaned. The Contractor shall be responsible for all flooding and pay for cleanup from flooding to the satisfaction of the property owner. The Contractor shall document all backups and submit documentation to the City including the reason for the backup, the time and date of the backup, the property owner's name, address and phone number, the resolution to problem, the time and date the problem was resolved, and any special cleanup work that had to be performed. This required documentation shall be submitted for all backups regardless of when they occur. All cleanup shall be completed within 4 hours of the backup.

3.02 MAIN SEWER CCTV INSPECTIONS

- A. After the sewers are completely cleaned, the sewers shall be inspected via closed circuit television (CCTV). The purposes of the CCTV inspections are to verify that the sewers have been thoroughly cleaned and have been properly installed in accordance with the City's technical specifications. If the CCTV inspections begin and reveal the pipe is still dirty, the CCTV inspections shall be terminated and the sewers shall be re-cleaned. The CCTV inspections shall then start over.

All CCTV work performed by the Contractor shall be completed in NASSCO PACP format by PACP Certified professionals. A current PACP certification number shall be included for each person creating/gathering inspection reports.

The CCTV inspections shall be performed and submitted in digital format as specified in Paragraph 3.4 herein.

- B. The camera equipment used for the CCTV inspections shall be one specifically designed and constructed for such inspection. The camera shall be

a color, pan-and-tilt camera capable of 360-degree rotation.

Lighting for the inspections shall be bright enough to fully and clearly view the sewer but not too bright to cause undue reflection which would diminish the picture quality. The lighting shall allow a clear picture for the entire periphery of the pipe. The Contractor is advised that ductile iron pipe lined with 401 Protecto epoxy coating is extremely black, and additional and/or auxiliary lighting may be required.

- C. The picture quality and definition shall be to the satisfaction of the City. As specified previously, the Contractor shall submit a sample television inspection so that the Contractor and City can agree on performance and quality of the inspections which must be met. Sewers not inspected to the City's satisfaction shall be re-inspected by the Contractor at no cost to the City.
- D. Immediately prior to performing the CCTV inspections, water (1,000 gallon minimum for main sewer inspections) shall be dropped into the top section of the sewer being televised so that sags and dips in the new pipes can be identified during the television inspections by any standing water in the pipes. There shall be no running water in the sewer while being televised.
- E. All cameras shall move through the sewers via self-powered tractor assemblies – no skid assemblies shall be permitted. The tractor assemblies used for the inspections shall be the appropriate size assembly for the pipe being televised according to the manufacturer of the television equipment. For example, an 8-inch tractor assembly shall be used to televise 8-inch-diameter sewers.
- F. The CCTV inspections shall be completed sequentially from manhole to manhole for new main sewers and from the farthest cleanout or end of the pipe to the main sewer for new service laterals. Service laterals installed with the main sewer but capped off for future connection shall also be televised.
- G. All inspections shall begin in the center of the start manhole and end in the center of the end manhole. The camera shall be panned and tilted to clearly and completely show each pipe connection at the manholes and the interior of each manhole. The camera shall be moved through the line at a uniform rate, and in no case shall exceed thirty (30) feet per minute. The camera shall be stopped at major defects and service connections and shall be panned, tilted and rotated to fully view the defects and connections. All such inspections shall be documented on digital recordings as specified. Particular attention should be paid to service connections. The entire pipe shall be visible including the bottom of the pipe. The inspections shall be complete from manhole to manhole without the need for reverse setups.
- H. The accuracy of the measurements cannot be stressed too strongly. Daily

calibration of measuring devices shall be performed. Sewer lengths shown and reported on the CCTV inspection video and logs shall be within 1% of the actual sewer length as measured above ground from center of one manhole to the center of the next manhole. CCTV inspections that do not meet these criteria shall be re-performed and re-submitted to the City at no cost to the City.

- I. If the Contractor's cleaning or television equipment become lodged in the sewers during the work, the Contractor shall be responsible for removing the equipment, including excavation of the sewer, and paying all costs associated with the removal and repair of the sewer.
- J. Upon completion of the cleaning and television inspection work, the Contractor shall submit one copy of the final digital television inspections to the City as specified in Paragraph 3.4. The inspections must be in order and complete or the City will immediately return the inspections to the Contractor for corrections. The final inspection shall mean that the sewer has been completely cleaned (no mud, dirt, debris, etc.) and the inspection is complete from manhole to manhole.
- K. The City will review the inspections and provide comments back to the Contractor on any inspections that do not meet these Specifications. The Contractor will be expected to immediately correct any deficiencies in the CCTV inspections.

3.03 DIGITAL VIDEO INSPECTIONS AND CCTV DATABASE

- A. All televised sewer inspections shall be submitted to the City in electronic (digital) format.
- B. Each submittal to the City shall include the database file along with the MPEG 4 video files. The Contractor shall make all adjustments necessary to adhere to the required format specified herein. Submittals that do not meet these formatting requirements will not be accepted by the City, and the Contractor will have to re-perform the inspections and/or re-format the data to meet these requirements.
- C. The digital recording shall include video information that accurately reproduces the original picture of the video inspection. The video portion of the digital recording shall be free of electrical interference and shall produce a clear and stable image.
- D. Video shall include overlay/text display. Each inspection start shall include overlay display of section details including at a minimum:
 - 1. Owner name
 - 2. Project name

3. Contractor name
 4. Street name (if applicable)
 5. Date/time of inspection
 6. MH Start #/MH End #
 7. Pipe material
 8. Pipe size
 9. Direction of Video
 10. Weather or Flow Level
 11. A constant display of the street name, MH start #/MH End #, date and distance shall appear on screen.
- E. The CCTV inspector shall move or remove overlay display accordingly so it does not interfere with the inspection review of particular observations/defects as the inspection is occurring. As an observation/defect is noted by the inspector, a text display shall appear with the text describing the observation/defect. Text shall display for a minimum of 4 seconds. Distance shall appear continuously in the lower right corner of the video image as the camera is traveling down the line. It is imperative that distance is accurate. The CCTV inspector shall calibrate/test footage at the beginning of each day as incorrect footage will result in return of inspections.
- F. The completed work shall consist of MPEG 4 video files captured live off the inspection camera. The video file resolution shall be 640 x 480. All MPEG 4 video files created shall be consistent with the City's existing MPEG 4 codec.
- G. Each pipe inspection's observations shall be related to a time point within the video.
- H. During the inspection, the video file recording shall pause as the operator selects the observation/defect notation, eliminating "on hold" video. In situations of reverse inspection, the reverse inspection shall be in a separate video file.
- I. The MPEG 4 files shall be named as:
STARTMH_ENDMH_PIPEID_DATE.mp4
- J. The database file and the corresponding video files shall be submitted to the City on portable external hard drives and/or DVDs. Each hard drive/DVD submitted shall include a transmittal listing the file names and all sewer segments and video files included on the hard drive/DVD.

- K. Recorded Observations for each inspection shall include: Observation distance, Observation defect/description, MPEG 4 counter time where observation occurs within digital video, Severity rating for each observation/defect.
- L. All work submitted by the Contractor shall be completed by PACP Certified professionals. A current PACP certification number shall be included for each person creating/gathering inspection reports.
- M. The digital database file of the television inspections shall be submitted in a PACP export file format (unless the Contractor is using PipeTech software) so that the City can import the data into their PipeTech CCTV software system. A sample PACP export file shall be submitted with the sample CCTV inspection to verify that the export/import is working properly.

3.04 REVIEW BY THE CITY

- A. The City will review all CCTV inspections for formatting and adherence to these CCTV specifications and to confirm that the new sewers, service laterals and manholes meet the City's technical specifications and details. The City will not accept any new sewers, service laterals or manholes until the CCTV inspections are reviewed and accepted.
- B. The City will notify the Contractor/Developer of any pipe or manhole defects evident from the CCTV inspections and will state required repairs and/or corrective measures to be taken. After completing all required repairs, the Contractor/Developer shall re-clean and re-CCTV the repaired sections of sewer and re-submit the CCTV inspections to the City for review and final approval. The re-CCTV shall be complete from manhole to manhole even if the repair was only to a short section of the sewer pipe. The City will not accept the new sewers, service laterals and manholes until all sewers are accepted (all repairs and re-CCTV submitted and approved by the City).

END OF SECTION

SECTION 15260

PVC SEWER PIPE

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required to install poly(vinyl chloride) (PVC) pipe, complete as shown on the Drawings and as specified herein.
- B. Installation of piping in accordance with Section 15051, Sewer Piping Installation.
- C. Where the word "pipe" is used, it shall refer to pipe, fittings, or appurtenances unless otherwise noted.

1.02 RELATED WORK

- A. Section 02200, Excavation and Backfill.
- B. Section 02230, Fill and Granular Fill Materials.
- C. Section 15251, Piping Installation.
- D. Section 15253, Pipe Testing.
- E. Section 15270, Sewer Piping Specialties.

1.03 SUBMITTALS

- A. Submit shop drawings and schedules of all PVC pipe and fittings as required to the City.
- B. Submit tabulated layout drawings showing actual pipe lengths, diameters, fittings, and appurtenances.
- C. Prior to each shipment of pipe, submit certified test reports that the pipe for this Contract was manufactured and tested in accordance with the ASTM standards specified herein.

1.04 REFERENCE STANDARDS

- A. ASTM D1784 – Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds.
- B. ASTM D3034 – Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe.

- C. ASTM F679 – Standard Specification for Poly(Vinyl Chloride) (PVC) Large Diameter Gravity Sewer Pipe.
- D. ASTM D2231 – Underground Installation of Thermoplastic Pipe for Sewer and Other Gravity-Flow Applications.
- E. ASTM F477 – Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

1.05 QUALITY ASSURANCE

- A. All PVC pipe shall be from a single manufacturer. The supplier shall be responsible for the provisions of all test requirements specified.
- B. The City may make inspections of the pipe after delivery. The pipe shall be subject to rejection at any time due to failure to meet any of the Specification requirements. Pipe rejected shall be marked for identification and shall be removed from the job at once.
- C. Certificates of compliance with applicable ASTM designations and strength classifications covering the pipe, joints, gaskets, and fittings will be required directly from the pipe manufacturer as deemed necessary by the City.

PART 2 - PRODUCTS

2.01 NON-PRESSURE SEWER PIPE

- A. PVC gravity sewer pipe and fittings shall be manufactured of compounds conforming to ASTM D1784-81, current revision. Pipe and fittings shall meet and/or exceed all of the requirements of ASTM Specification D3034-89 PSM SDR 26 (cell class 12454-B), or current revision, for heavy wall PVC as manufactured by National Pipe & Plastics, Johns-Manville Corporation, Certainteed, or approved equal.
- B. PVC sewer pipe shall be SDR 26 unless shown otherwise on the Drawings.
- C. The maximum allowable joint length for PVC pipe is 13 feet.
- D. PVC pipe will only be allowed for gravity sewer pipe diameters less than or equal to 12”.

2.02 JOINTS

- A. Poly(vinyl chloride) pipe.
 - 1. PVC pipe shall be joined by bell and spigot type connections. The pipe joint shall be tightly sealed against infiltration and ex-filtration by means of a locked-in rubber sealing ring conforming to ASTM D3212, latest

revision. The connection shall also permit the thermal expansion or contraction of the pipe.

B. Gaskets.

1. Gaskets for sewer pipe and fittings shall be vulcanized natural or vulcanized synthetic rubber free of porous areas, foreign material, or visible defects. Rubber gaskets shall conform to all applicable provisions of ASTM F477.
2. Gaskets shall be protected from exposure to excessive heat, cold, direct sunlight, ozone (from electric motors and equipment), oil, grease, or other contaminants.

PART 3 - EXECUTION

3.01 INSTALLATION OF PVC PIPE AND FITTINGS

- A. PVC pipe shall be shipped and stored so that warping of pipe does not occur. PVC pipe to be stored outside should be covered to protect it against the sun's rays, per manufacturer's published recommendations.
- B. No single piece of pipe shall be laid unless it is generally straight. The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than 1/16-inch per foot of length. If a piece of pipe fails to meet this requirement check for straightness, it shall be rejected and removed from the site. Laying instructions of the manufacturer shall be explicitly followed.
- C. PVC pipe installations shall be in strict accordance with manufacturer's instructions and Section 15251.
- D. PVC sewers shall be tested per specification Sections 15253 and 15255.

END OF SECTION

SECTION 15265

DUCTILE IRON PIPE AND FITTINGS FOR SEWER

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required to install ductile iron pipe and fittings complete as shown on the Drawings and as specified herein.
- B. Installation of piping in accordance with Section 15251, Sewer Piping Installation.
- C. Where the word "pipe" is used, it shall refer to pipe, fittings, or appurtenances unless otherwise noted.

1.02 RELATED WORK

- A. Section 02200, Erosion and Backfill.
- B. Section 02230, Fill and Granular Fill Materials.
- C. Section 15251, Sewer Piping Installation
- D. Section 15253, Sewer Pipe Testing.
- E. Section 15270, Sewer Piping Specialties.

1.03 SUBMITTALS

- A. Submit to the City shop drawings and product data required to establish compliance with this Section.
- B. Submit tabulated layout drawings showing actual pipe lengths, diameters, fittings, and appurtenances.
- C. Prior to shipment of pipe, submit a certified affidavit of compliance from the pipe manufacturer stating that the pipe, fittings, gaskets, linings, and exterior coatings for this project have been manufactured and tested in accordance AWWA and ASTM standards and requirements specified herein.

1.04 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM).
 - 1. ASTM A377 - Standard Index for Specification for Ductile-Iron Pressure Pipe

2. ASTM C150 - Standard Specification for Portland Cement.
3. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs 60,000 psi Tensile Strength.

B. American National Standards Institute (ANSI).

1. ANSI B1.1 - Unified Inch Screw Threads (UN and UNR Thread Form).
2. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
3. ANSI B18.2 - Square and Hex Bolts and Screws Inch Series Including Hex Cap Screws and Lag Screws.

C. American Water Works Association (AWWA).

1. AWWA C110 - Ductile-Iron and Gray-Iron Fittings 3-In. through 48-In. (75MM through 1200 mm) for Water and Other Liquids.
2. AWWA C111- Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
3. AWWA C115 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
4. AWWA C150 - Thickness Design of Ductile-Iron Pipe.
5. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast for Water or Other Liquids.

D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

- A. All ductile iron pipe and fittings shall be from a single manufacturer, unless otherwise approved by the City.
- B. All ductile-iron pipe and fittings to be installed under this Contract shall be inspected and tested at the foundry as required by the standard specifications to which the material is manufactured. Furnish in duplicate to the City sworn certificates of such tests and their results prior to the shipment of the pipe.
- C. All pipe and fittings to be installed under this Contract may be inspected at the plant for compliance with this Section by an independent testing laboratory selected by the City, at the City's expense.
- D. Inspection of the pipe and fittings will also be made by the City after delivery. The pipe shall be subject to rejection at any time on account of failure to meet

any of the specified requirements, even though sample pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall be removed from the job.

- E. All pipe and fittings shall be permanently marked with the following information:
 - 1. Manufacturer, date.
 - 2. Size, type, class, or wall thickness.
 - 3. Standard produced to (AWWA, ASTM, etc.).

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Care shall be taken in loading, transporting and unloading to prevent injury to the pipe or coatings. Under no circumstances shall the pipe be dropped or skidded against each other. Slings, hooks, or pipe tongs shall be padded and used in such a manner as to prevent damage to the exterior surface or internal lining of the pipe. All manufacturer's recommendations shall be strictly followed.
- B. Materials, if stored, shall be kept safe from damage. The interior of all pipes, fittings, and other appurtenances shall be kept free from dirt or foreign matter at all times.
- C. Pipe shall not be stacked higher than the limits recommended by its manufacturer. The bottom tier shall be kept off the ground on timbers, rails, or concrete. Stacking shall conform to manufacturer's recommendations.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Joints shall be as shown on the Drawings and as specified. If not shown or specified, provide push-on or mechanical joints for buried pipe and flanged joints for above-grade pipe.
- B. Conform to AWWA C151 for material, pressure class, dimensions, tolerances, tests, markings, and other requirements.
- C. Use Special Thickness Class 52 for all pipe unless otherwise shown or specified.
- D. Ductile iron pipe and fittings shall have a shop-applied Protecto 401 interior lining.
- E. Unless otherwise specified, ductile iron pipe and fittings shall receive a shop-

applied exterior asphaltic coating. Field repair of damaged pipe coating shall be allowed. However, if, in the opinion of the City, the coating damage is beyond repair, the pipe shall be replaced at the expense of the Contractor. Unless otherwise noted, field applied coating material shall be compatible with or equal to the shop applied material.

2.02 FLANGED DUCTILE IRON PIPE AND FITTINGS

A. Flanged joint pipe.

1. Ductile iron pipe shall conform to AWWA C115. Pipe wall thickness shall be Special Thickness Class 53 minimum.
2. Flange shall be flat face type, unless otherwise noted, conforming to ANSI B16.1, Class 125.
3. Flange gasket shall be full-face rubber per AWWA C111. Thickness shall be 1/8 inch unless otherwise indicated.
4. Assembly bolts shall be square headed carbon steel machine bolts with hexagon nuts per ANSI B18.2. Thread shall conform to ANSI B1.1. Bolt length shall be such that after joints are assembled, the bolts shall protrude through the nuts, but not more than 1/2 inch.

B. Flanged joint fittings.

1. Flanged joint fittings shall conform to AWWA C110.
2. Pipe fittings shall be ductile iron with a pressure rating of 250 psi.
3. Flanges shall be flat face meeting the requirements of ANSI B16.1, Class 125.
4. Flange gaskets shall be full-face rubber per AWWA C111, 1/8 inch thick unless otherwise indicated.
5. Assembly bolts and nuts shall be as specified for flange joint pipe above.

2.03 MECHANICAL JOINT PIPE AND FITTINGS

A. Mechanical joint pipe.

1. Mechanical joint pipe shall conform to AWWA C151 with joint accessories conforming to AWWA C111.
2. Glands shall be ductile iron.
3. Gaskets shall be plain-tipped rubber.

4. Assembly bolts and nuts shall be high-strength, low alloy steel.

B. Mechanical joint fittings.

1. Mechanical joint fittings shall conform to AWWA C110 with accessories conforming to AWWA C111.
2. Pipe fittings shall be cast iron or ductile iron with a pressure rating of 250 psi.
3. Fitting glands shall be cast iron for cast iron fittings and ductile iron for ductile iron fittings.
4. Gaskets shall be plain-tipped rubber.
5. Assembly bolts and nuts shall be as specified for mechanical joint pipe above.

2.04 PUSH-ON JOINT PIPE AND FITTINGS

A. Push-on joint pipe.

1. Push-on joints shall conform to AWWA C151 and AWWA C111.
2. Gaskets shall be molded rubber.
3. Each plain end shall be painted with a circular stripe to provide a guide for visual check that joint is properly assembled.

B. Push-on joint fittings.

1. Push-on joint fittings are not acceptable.

2.05 PROPRIETARY RESTRAINED JOINT PIPE AND FITTINGS

A. Restrained joint pipe and fittings shall be ductile iron restrained push-on joint.

B. Restrained pipe shall conform to applicable requirements of AWWA C151. Restrained fittings shall conform to applicable requirements of AWWA C110 or AWWA C153.

C. Joints shall be suitable for 250 psi working pressure and be fabricated of heavy ductile iron casting.

D. Bolts and nuts shall conform to ASTM A307, Grade B.

E. Restrained joint pipe and fittings shall be “TR Flex” restrained joint pipe by U.S. Pipe and Foundry; “Flex-Ring” and “Fast-Grip” restrained joint pipe by American Cast Iron Pipe Company; “SNAP LOK” restrained joint pipe by

Griffin Pipe Products Co., or approved equal.

- F. Retainer Glands may be used in lieu of restrained joint pipe and shall be manufactured by EBAA Iron, Inc., Series 1100 “Megalug.” “Or Equals” will be considered but must be approved in advance by the City Engineer. Retainer glands may be used on proposed mains to restrain pipe with mechanical joints in accordance with the manufacturer’s recommendation. All pipe where retainer glands are used shall have a hardness of 180-200 BHN (Brinell Hardness Number) to allow proper activation of the glands.

PART 3 - EXECUTION

3.01 PIPE INSTALLATION

- A. No single piece of pipe shall be laid unless it is generally straight. The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than 1/16-inch per foot of length. If a piece of pipe fails to meet this requirement check for straightness, it shall be rejected and removed from the site. Laying instructions of the manufacturer shall be explicitly followed.
- B. All sewer pipe installations shall be in strict accordance with manufacturer’s instructions and Section 15251.
- C. Ductile Iron sewers shall be tested per specification Sections 15253 and 15255.

END OF SECTION

SECTION 15270

SEWER PIPING SPECIALTIES

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required to install, complete, and ready for operation. Test all piping specialties concurrent with the pipe section within which installed.

1.02 RELATED WORK

- A. Piping materials and systems are included in other Sections of Division 15.
- B. Section 15251, Piping Installation.
- C. Section 15253, Pipe Testing.

1.03 SUBMITTALS

- A. Submit shop drawings and product data for all piping specialties specified in this Section.
- B. Submit operating and maintenance data as required.

1.04 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM).
 - 1. ASTM A126 - Standard Specification for Gray Iron Casting for Valves, Flanges and Pipe Fittings.
 - 2. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
 - 3. ASTM A325 - Standard Specification for Strength Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 - 4. ASTM A536 - Standard Specification for Ductile Iron Castings.
- B. American National Standards Institute (ANSI).
 - 1. ANSI B1.1 - Unified Inch Screw Threads (UN and UNR Thread Form).
 - 2. ANSI B18.2 - Square and Hex Bolts and Screws Inch Series Including Hex Cap Screws and Lag Screws.

- C. American Society of Mechanical Engineers (ASME).
 - 1. ASME B2.1 - Specifications, Dimensions, Gauging for Taper and Straight Pipe Threads (except dry seals).
 - 2. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800.
 - 3. ASME B16.5 - Pipe Flanges and Flange Fittings.
- D. American Welding Society (AWS).
 - 1. AWS B3.0 - Welding Procedure and Performance Qualifications.
- E. American Water Works Association (AWWA).
 - 1. AWWA C110 - Ductile-Iron and Gray-Iron Fittings, 3-in. Through 48-in. (75mm through 1200mm), for Water and Other Liquids.
 - 2. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

1.05 QUALITY ASSURANCE

- A. All materials shall be new and unused.
- B. Install piping to meet requirements of local codes.
- C. Provide manufacturer's certification that materials meet or exceed minimum requirements as specified.
- D. Coordinate dimensions and drilling of flanges with flanges for valves, pumps, and other equipment to be installed in piping systems. Bolt holes in flanges to straddle vertical centerline.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. The use of a manufacturer's name and/or model number is for the purpose of establishing the standard of quality and general configuration desired.
- B. Materials and products shall be of the sizes and types shown on the Drawings or as noted herein. As far as possible, materials and products of the same type shall be identical and shall be from one manufacturer.
- C. Materials and products shall have the name of the manufacturer, nominal size, flow directional arrows (if applicable), working pressure for which they are designed, and standard referenced specifications cast in raised letters or

indelibly marked upon some appropriate part of the body.

- D. Unless otherwise noted, piping specialties shall have a minimum working pressure of 150 psi or be of the same working pressure as the pipe they connect to, whichever is higher and suitable for the pressures noted where they are installed.

2.02 MISCELLANEOUS ADAPTERS

- A. Special adapters may be required between different types of pipe and/or fittings to provide proper connection. Some of these may be indicated on the Drawings or specified with individual types of pipe or equipment. Provide all adapters as required, whether specifically noted or not, to ensure proper connection between various types of pipe.
- B. Adapters shall be suitable for direct burial when installed below grade, with proper dielectric insulation. If metallic (not stainless steel or galvanized), adapters shall be painted with 2 coats of Coal Tar Epoxy. Non-metallic adapters shall be flexible mechanical compression type couplings with No. 305 stainless steel bands as manufactured by Joints, Inc. (Calder) of Gardena, CA; Fernco Joint Sealer Co. of Ferndale, MI; or equal.

2.03 FLEXIBLE CONNECTORS

- A. Sleeve couplings.
 - 1. Flexible couplings shall be of a gasketed, sleeve type. Each coupling shall consist of a middle ring, two followers, two wedge section gaskets and sufficient track head steel bolts to properly compress the gaskets. Couplings shall be of the type to match piping in which installed. Couplings shall be Style 38 as manufactured by Dresser Manufacturing Division of Dresser Industries or Smith-Blair Type 441.
 - 2. Nuts and bolts.
 - a. Provide bolts and bolt-studs in accordance with ASTM A307 and ANSI B1.1 with hexagonal or square heads, coarse thread fit, threaded full length with ends chamfered.
 - b. Project ends 1/4 inch beyond surface of nuts.
 - c. Hexagonal nuts with dimensions in accordance with ANSI B18.2 and coarse threads in accordance with ANSI B1.1.
 - 3. Middle ring of each mechanical coupling shall have a thickness at least equal to that specified for size of pipe on which coupling is to be used and shall not be less than 10 inches long for pipe 30 inches and larger and not less than seven (7) inches long for pipe under 30 inches in diameter.

4. Clean and shop prime with manufacturer's standard rust inhibitive primer.
5. Furnish gaskets of a composition suitable for exposure to the fluid service.
6. Where shown on the Drawings, anchor sleeve-coupled joints with harness bolts.
 - a. Joint harness bolts shall be of sufficient length, with harness lugs placed so that coupling can be slipped at least in 1 direction to clear joint. Provide harnesses of sufficient number and strength to withstand test pressure.
 - b. Each harness shall have a minimum of two 3/4-inch diameter bolts.
7. Similar insulation type couplings shall be provided at the face of buildings, between different type metals, or where otherwise noted.

2.04 SERVICE SADDLES

- A. Service saddles for four (4) inch through 12-inch outlet sizes shall have iron bodies and a neoprene circular cross section O-ring gasket confined within the body. Outlet shall be as required for the application. Straps shall be alloy steel, minimum 1/4-inch by 1-1/2-inch in cross section and fabricated with 3/4-inch threaded ends. Service saddles shall be strap-on type Romac "CB" or approved equal.

2.05 HARNESSING AND RESTRAINT

- A. Where harnessed couplings or adapters are noted, they shall conform to AWWA Manual M11 except as modified by the Drawings or this Section.
- B. Unless otherwise noted, size and material for tie rods, clamps, plates, and hex nuts shall be as shown on the Drawings, or, if not shown on the Drawings, shall be as required in AWWA Manual M11. Manufactured restraining clamp assemblies shall be as manufactured by Stellar Corporation, Columbus, OH, or equal.
- C. Ductile iron pipe mechanical joint restraints. Restraint for standardized mechanical joints shall be incorporated in the design of the follower gland and shall impart multiple wedging action against the pipe, increasing its resistance as the pressure increases. The assembled joint shall maintain its flexibility after burial and shall maintain its integrity by a controlled and limited expansion of each joint during the wedging action. Restraining glands shall be manufactured of ductile iron conforming to the requirements of ASTM A536, Grade 65-45-12. Wedging mechanisms shall be manufactured of ductile iron heat treated to a hardness of 370 BHN minimum and shall be contoured to fit each pipe size exactly. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee head

bolts conforming to the requirements of ANSI/AWWA C111/A21.11 and ANSI/AWWA C153/A21.53, latest revision. Twist off nuts shall be incorporated in the design of the wedge activation screws to insure proper torque during installation. The mechanical joint restraining device shall have a working pressure rating of 250 psi minimum with a safety factor of at least 2:1 against separation when tested in the dead-end situation. The mechanical joint restraint shall be Megalug Series 1100 by EBAA Iron Works, Uni-Flange Series 1400 by Ford Meter Box Co., or approved equal.

PART 3 - EXECUTION

3.01 GENERAL

- A. All dirt, scale, weld splatter, water, and other foreign matter shall be removed from the inside and outside of all pipe and sub-assemblies prior to installing.
- B. All work shall be accomplished using recognized methods and procedures of pipe fabrication and in accordance with the latest revision of applicable ANSI/AWWA Standards.
 - 1. Use full length of pipe except where cut lengths are necessary. Do not spring or deform piping to make up joints.
 - 2. Pipe shall be cut square, not upset, underside, or out-of-round. Ends shall be carefully beveled and cleaned before being installed. Bending of pipe is not permitted. Use fittings for all changes in direction.
- C. Installation of sleeve couplings.
 - 1. Prior to installation of sleeve couplings, the pipe ends shall be cleaned thoroughly for a distance of at least 12 inches. Soapy water may be used as a gasket lubricant. A follower and gasket, in that order, shall be slipped over each pipe to a distance of about six (6) inches from the end, the middle ring shall be placed on the already installed pipe and shall be inserted into the middle ring flair and brought to proper position in relation to the pipe already installed. The gaskets and followers shall then be pressed evenly and firmly into the middle ring flares.
 - 2. After the bolts have been inserted and all nuts have been made up finger tight, diametrically opposite nuts shall be progressively and uniformly tightened all around the joint, preferably by use of a torque wrench of the appropriate size and torque for the bolts.
 - 3. The correct torque as indicated by a torque wrench shall not exceed 75 ft-lbs. for 5/8-inch bolts and 90 ft-lbs. for 3/4-inch bolts.
 - 4. If a wrench other than a torque wrench is used, it should be no longer than 12 inches so that when used by the average person the above torque values

shall not be exceeded.

3.02 TESTING

- A. Testing of pipelines, including piping specialties, is specified in Sections 15253 and 15255. Furnish all labor, testing plugs or caps, pipe connections, gauges, and all other equipment required to complete the tests as specified.

END OF SECTION

SECTION 15280

TEMPORARY BYPASS PUMPING SYSTEMS

PART 1 GENERAL

1.01 SCOPE

- A. The Contractor is required to furnish all materials, labor, equipment, power, maintenance, etc. to implement a temporary piping and pumping system for the purpose of diverting the existing flow around the work area for the duration of the project.
- B. The design, installation and operation of the temporary pumping systems shall be the Contractor's responsibility. The Contractor shall employ the services of a vendor who can demonstrate to the Engineer that he specializes in the design and operation of temporary bypass pumping systems. The bypass systems shall meet the requirements of all codes and regulatory agencies having jurisdiction.
- C. Contractor will be required to operate and maintain all temporary bypass piping and pumping operations during the pipe replacement and manhole replacement operations. The Contractor must complete testing of new pipelines prior to discharging flow. The Contractor must maintain flow capacity at all times.
- D. The Contractor is required to provide on-site monitoring (auto-dialers are not allowed) at all times of bypass pumping for City sewers.
- E. The Contractor shall be liable for any and all cleanup costs resulting from a sewage overflow, discharge or spill during by-pass pumping operations.

1.02 SUBMITTALS

- A. The Contractor shall submit to the Engineer detailed plans and descriptions' outlining all provisions and precautions to be taken by the Contractor regarding the handling of existing wastewater flows. This plan must be specific and complete, including such items as schedules, locations, elevations, capacities of equipment, materials and all other incidental items necessary and/or required to insure proper protection of the facilities, including protection of the access and bypass pumping locations from damage due to the discharge flows, and compliance with the requirements and permit conditions specified in these Contract Documents. No construction shall begin until all provisions and requirements have been reviewed by the Engineer.
- B. The plan shall include but not be limited to details of the following:

1. Staging areas for pumps;
2. Sewer plugging method and types of plugs;
3. Number, size, material, location and method of installation of suction piping;
4. Number, size, material, method of installation and location of installation of discharge piping;
5. Bypass pump sizes, capacity, number of each size to be on site and power requirements;
6. Calculation of static lift, friction losses, and flow velocity (pump curves showing pump operating range shall be submitted);
7. Standby power generator size and location; (if using electric pumps)
8. Downstream discharge plan;
9. Method of protecting discharge manholes or structures from erosion and damage;
10. Thrust and restraint block sizes and locations;
11. Sections showing suction and discharge pipe depth, embedment, select fill and special backfill;
12. Method of noise control for each pump and/or generator;
13. Any temporary pipe supports and anchoring required;
14. Design plans and computation for access to bypass pumping locations indicated on the drawings;
15. Calculations for selection of bypass pumping pipe size;
16. Schedule for installation of and maintenance of bypass pumping lines;
17. Plan indicating selection location of bypass pumping line locations.

PART 2 PRODUCTS

2.01 EQUIPMENT

- A. All pumps used shall be fully automatic self-priming units that do not require the use of foot-valves or vacuum pumps in the priming system. The pumps may be electric or diesel powered. All pumps used must be constructed to allow dry running for long periods of time to accommodate the cyclical nature

of effluent flows. All pumps must be constructed with acoustical enclosures that shall reduce pump and engine noise to 69 dB or less at a distance of 30 feet.

- B. The Contractor shall provide the necessary stop/start controls for each pump.
- C. The Contractor shall include one stand-by pump of each size to be maintained on site. Stand-by pumps shall be on-line, isolated from the primary system by a valve.
- D. Discharge Piping – In order to prevent the accidental spillage of flows, all discharge systems shall be temporarily constructed of rigid pipe with positive, restrained joints. Under no circumstances will aluminum “irrigation” type piping or glued PVC pipe be allowed. Discharge hose will only be allowed in short sections and by specific permission from the Engineer.
- E. Allowable piping materials will be quick disconnect steel pipe, or fused, high-density polyethylene pipe.
- F. Any by-pass pumping piping laid within the flood plain line shall be HDPE and anchored.
- G. Design Requirements:
 - 1. The Contractor shall provide all pipeline plugs, pumps of adequate size to handle peak flow, and temporary discharge piping to ensure that the total flow of the main can be safely diverted around the section to be repaired. Bypass pumping system will be required to operate 24 hours per day, until new or repaired sewer main or manholes have been approved for service.
 - 2. The Contractor shall have adequate standby equipment available and ready for immediate operation and use in the event of an emergency or breakdown. One standby pump for each size pump utilized shall be installed at the mainline flow bypassing locations, ready for use in the event of primary pump failure.
 - 3. Bypass pumping system shall be capable of bypassing the flow around the work area and of releasing any amount of flow up to full available flow into the work area as necessary for satisfactory performances of work.
 - 4. The Contractor shall make all arrangements for bypass pumping during the time when the main is shut down for any reason.
- H. Performance Requirements:
 - 1. It is essential to the operation of the existing sewerage system that there be no interruption in the flow of sewage throughout the duration of the project. To this end, the Contractor shall provide, maintain and operate all

temporary facilities such as dams, plugs, pumping equipment (both primary and back-up units as required), conduits, all necessary power, and all other labor and equipment necessary to intercept the sewage flow before it reaches the point where it would interfere with his work, carry it past his work and return it to the existing sewer downstream of his work.

2. The design, installation and operation of the temporary pumping system shall be the Contractor's responsibility. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.
3. The Contractor shall provide all necessary means to safely convey the sewage past the work area. The Contractor will not be permitted to stop or impede the main flows under any circumstances.
4. The Contractor shall maintain sewer flow around the work area in a manner that will not cause surcharging of sewers, damage to sewers and that will protect public and private property from damage and flooding.
5. The Contractor shall protect water resources wetlands and other natural resources.
6. Unless otherwise indicated, pumping requirements shall be 150% of the minimum slope capacity as indicated in the following chart.

Size	Slope	Manning's n	Full Pipe Capacity (MGD)	Pumping Capacity (MGD)
6	0.49%	0.013	0.25	0.38
8	0.40%	0.013	0.49	0.74
10	0.28%	0.013	0.75	1.13
12	0.22%	0.013	1.08	1.62
14	0.17%	0.013	1.43	2.15
15	0.15%	0.013	1.62	2.43
16	0.14%	0.013	1.86	2.79
18	0.12%	0.013	2.36	3.54

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL AND MAINTENANCE

A. Test:

The Contractor shall perform leakage and pressure tests of the bypass pumping discharge piping using clean water prior to actual operation. The Engineer will be given 24 hours notice prior to testing.

B. Inspection:

Contractor shall inspect bypass piping and pumping systems every fifteen (15) minutes to ensure that the system is working correctly. Any visible leaks shall be repaired by the contractor immediately and the Owner's representative notified.

C. Maintenance Service:

The Contractor shall insure that the temporary pumping system is properly maintained and a responsible operator shall be on hand at all times when pumps are operating.

D. Extra Materials:

1. Spare parts for pumps and piping shall be kept on site as required.
2. Adequate hoisting equipment for each pump and accessories shall be maintained on the site.

3.02 PREPARATION

A. Precautions

1. Contractor is responsible for locating any existing utilities in the area the Contractor selects to locate the bypass pipelines. The Contractor shall locate his bypass pipelines to minimize any disturbance to existing utilities and shall obtain approval of the pipeline locations from the City and the Engineer. All costs associated with relocating utilities and obtaining all approvals shall be paid by the Contractor.
2. During all bypass pumping operation, the Contractor shall protect the Pumping Station and main and all local sewer lines from damage inflicted by any equipment. The Contractor shall be responsible for all physical damage to the Pumping Station and main and all local sewer lines caused by human or mechanical failure.

3.03 INSTALLATION AND REMOVAL

- A. Contractor shall be responsible for providing a suitable temporary access to each site location including haul roads and construction entrances as required.
- B. The Contractor shall remove manhole sections or make connections to the existing sewer and construct temporary bypass pumping structures only at the access location indicated on the approved by-pass pumping plans and as may be required to provide adequate suction and/or bypass conduit.
- C. Plugging or blocking of sewage flows shall incorporate primary and secondary plugging device. When plugging or blocking is no longer needed for performance and acceptance or work, it is to be removed in a manner that permits the sewage flow to slowly return to normal without surge, to prevent surcharging or causing other major disturbances downstream.
- D. When working inside manhole or force main, the Contractor shall exercise caution and comply with OSHA requirements when working in the presence of sewer gases, combustible oxygen-deficient atmospheres, and confined spaces.
- E. The pipeline must be located off streets sidewalks and on shoulders of the roads. When the bypass pipeline crosses local streets and private driveways, the contractor must place the bypass pipelines in trenches and cover with temporary pavement. Upon completion of the bypass pumping operations, and after the receipt of written permission from the Engineer, the Contractor shall remove all the piping, restore all property to pre-construction condition and restore all pavement. The Contractor is responsible for obtaining any approvals for placement of the temporary pipeline within public ways from the City.

END OF SECTION