

Article 8:
TOWN DESIGN STANDARDS

Town of Smithfield Design Standards

Smithfield, Virginia



October 2025

SECTION 1. DESIGN STANDARDS:

- 1.1 **GENERAL**: The Design Standards of the Town of Smithfield shall provide both public and private users with the requirements and guidelines for design and construction of projects within the Town of Smithfield.

The Town reserves the right to waive or modify any or all parts of the Design Standards in specific instances as is deemed appropriate, except where the Virginia Department of Health Waterworks Regulations or the Department of Environmental Quality Sewage Collection and Treatment Regulations would be violated by such a waiver.

All site and subdivision plans shall be sealed by a Professional Engineer or Land Surveyor licensed in the Commonwealth of Virginia. Plan submittals shall be accompanied by the “Water and Sanitary Sewer System Design Checklist” provided in Appendix D. Any plans submitted without a Professional seal or a completed checklist will be returned without review.

When a Professional Engineer or Surveyor (Professional) with a current said professional license with the Commonwealth of Virginia prepares design documents for a specific project and incorporates the HRPDC Regional Construction Standards and/or Smithfield’s Design Standards into that design by reference, the Professional’s signed and dated seal of the particular plans, specifications and drawings for that project represents their approval of the HRPDC Regional Construction Standards and/or Smithfield’s Design Standards as incorporated by reference into such particular plans, specifications and drawings for such project. In other words, the Professional who stamps or seals any plans, specifications, reports or other documents incorporating the HRPDC Regional Construction Standards and/or Smithfield’s Design Standards by reference is responsible for assuring that such plans, and the HRPDC Regional Construction Standards and/or Smithfield’s Design Standards incorporated into such plans by reference, are adequate and appropriate for the particular project. The ultimate decision about what goes into such plans, specifications, reports, or other documents for a specific project must be that of the Professional who signs and seals them.

1.2 **DESIGN OF FACILITIES:** Design of all public sewer systems to be dedicated to the Town of Smithfield shall be performed by a Professional Engineer or Professional Land Surveyor with Part A and B license certified by the Commonwealth of Virginia. Water systems, pump systems, well facilities, and sanitary sewer pressure systems shall be prepared by or under the supervision of a licensed professional engineer legally qualified to practice in the Commonwealth of Virginia, and will require current Professional Engineers certification. All designs shall meet or exceed the latest edition of the Virginia Department of Health *Waterworks Regulations*, the Department of Environmental Quality *Sewage Collection and Treatment Regulations*, and the Smithfield Design Standards (including the HRPDC Regional Construction Standards).

Virginia Department of Health (VDH), Department of Environmental Quality (DEQ), and Hampton Roads Sanitation District (HRSD) approvals are required for, but not limited to, the following:

DEQ:

- All gravity sanitary sewer projects with a 40,000 gpd or greater Average Design Flow or, 100 or more connections regardless of phasing.
- All pump stations with a 20 gpm or greater pump rate.
- All pump stations discharging into a common force main with one or more other stations.
- The approval by DEQ may require a Certification by the *Professional* that all SCAT Regulation requirements are met, if DEQ does not review the project. The Certification shall be as required by the DEQ Certificate to Construct application.

VDH:

- All water mains 16-inches and larger.
- All transmission mains.
- All water production facilities (including wells).
- All master metered projects which have on-site, private water distribution piping larger than 8-inches in diameter or serving more than 14 residential connections.

HRSD:

- All gravity sanitary sewer projects with a 40,000 gpd or greater Average Design Flow or, 100 or more connections regardless of phasing.
- Any project proposing a direct connection to HRSD mains.
- Any project proposing work in proximity to existing HRSD mains.
- Any project discharging Industrial Waste.

It is the responsibility of the Applicant to coordinate submittals to and receive approval from the above agencies. A copy of the developer's/engineer's transmittal to these agencies, where required, shall be included as part of the site plan submittal. Agency approvals are required prior to final plan approval by the Town of Smithfield.

- 1.3 **VERTICAL AND HORIZONTAL SURVEY DATUM CONTROL:** Vertical and horizontal survey datum control shall be based upon, the Town of Smithfield, Virginia 2003 Geodetic Control Network, Horizontal NAD 83 (1996), Vertical NAVD 88. A minimum of one permanent bench mark that meets the requirements of the Subdivision Ordinance of Smithfield, Virginia shall be established for each project.
- 1.4 **CONTRACTOR LICENSING:** Contractor registration shall be in accordance with Title 2.2 Chapter 43 of the Code of Virginia. The Contractor responsible for installing the water and sanitary sewer facilities will be required to provide their State Contractor's License number.
- 1.5 **WORK IN TOWN RIGHT OF WAY:** All work performed within Town rights-of-way (ROWS) shall be permitted, bonded, and performed by competent individuals whose specialize in the type of work being conducted and are licensed and bonded Class A Highway/Heavy and Utility contractor and subcontractor.

A list of all contractors and subcontractors who intend to perform the work, as well as three (3) references for each shall be submitted to the Community Development & Planning and Engineering & Public Works Departments for their review and approval prior to the granting of an ROW permit for any construction activities proposed in Town ROWs.

All references for all contractors and subcontractors must be individuals who were directly involved in the contractors' and subcontractors' previous projects.

SECTION 2. WATER AND SANITARY SEWER SYSTEM DESIGN:

2.1 WATER DISTRIBUTION PRESSURE:

- A minimum residual pressure of 20-psi shall be maintained throughout the water distribution system under any condition.
- Where the pressure at the service tap exceeds 80 psi, the provisions of the Uniform Statewide Building Code shall apply. Pressures may exceed 80-psi for areas where the finish floors are less than 70-feet in elevation.
- Flows required for fire protection shall be in accordance with applicable requirements of the National Fire Protection Agency, Insurance Services Office, State and local agencies, and subject to the approval of the Fire Chief of the Town of Smithfield.
- A water distribution system hydraulic analysis, with fire flow analysis, showing the hydraulic gradient at key points shall be included with plan submittals requiring water main extension of the Smithfield water system or as required by the Town of Smithfield.

2.2 ACCEPTABLE WATER MAIN SIZES: The Town of Smithfield permits 8, 12, 14, 16 inch diameter mains as part of its distribution system. Proposed mains, larger than 16-inch in diameter, shall be coordinated with the Public Works Department at the conceptual plan stage. The minimum size of pipe where fire protection is to be provided or required shall be eight inches in diameter unless otherwise approved by the Fire Chief and Town of Smithfield.

- A. Pipes of smaller diameter may be used in the following instances where fire protection is not required, and justification is provided with a hydraulic analysis including the proposed and future domestic and irrigation water uses as follows:

- Six-inch pipe and lesser diameter pipe may be used if 40-psi minimum pressure and flow of three (3) gallons per minute plus irrigation demands per connection can be maintained.
- Four-inch pipe may be used when the run is less than 600-feet but more than 300-feet, and a flow rate of three (3) gallons per minute plus irrigation demands per connection, with a 40-psi minimum pressure can be maintained.
- Two-inch pipe may be used when the run is less than 300-feet, and a minimum pressure of 40-psi can be maintained with a flow rate of three (3) gallons per minute plus irrigation demands.

2.3 WATER MAIN PIPE MATERIAL AND PLACEMENT: Unless otherwise specified by the Town of Smithfield, water mains shall be Class 52 Ductile Iron pipe conforming to the HRPDC Regional Construction Standards, inclusive of Town of Smithfield Special Provisions. Water mains 2-inch and smaller shall be Municipex pipe. Use of Type K copper must be approved by the Town. Water mains shall be located in the roadway one foot inside the edge of pavement.

- A. Waterlines should run above other utilities where at all possible. Offsets under storm lines should be avoided where going over will meet cover requirements as noted in Sec. 2

2.4 **ACCEPTABLE WATER SERVICE CONNECTION SIZES:** The acceptable water service connection sizes are 5/8, 3/4, 1, 1-1/2, 2, 4, 6, 8, 10, 12, 14, and 16-inches in diameter. A gate valve shall be installed at the tee for all service connections 4-inches and larger.

All residential connections shall utilize a 1-inch water service line. If a smaller service is needed, the service line shall be reduced to the required size at the meter setter. Owner will only be required to pay the fee for the size meter required.

All commercial sites shall have a 2-inch water service line. If a smaller service is needed, the service line shall be reduced to the required size at the meter setter. Owner will only be required to pay the fee for the size meter required. In the event that a commercial property renovates their building, the water service line shall be upgraded to 2-inch.

2.5 **COVER:** Water distribution systems and sanitary force mains shall have a minimum of 36 inches and a maximum of 42 inches, measured from the top of the pipe to the established finished grade above the pipe, unless otherwise approved by the Town. Water service lines shall have a minimum of 18 inches and a maximum of 2 feet of cover. During design, site layout of other infrastructure (i.e. storm sewer, gravity sanitary sewer, etc) shall be considered in minimizing the need to have deep pressure mains.

2.6 **EASEMENTS:** Permanent easements of 20-feet width for water mains and services and 20-feet width for sanitary sewer mains and services, minimum, shall be provided on all private property. (Combined water and sanitary sewer easements shall be 30-feet minimum.) For gravity sanitary sewers over 10-feet deep, the width of easement shall be 30-feet minimum. Additional easement width may be required by the Town of Smithfield. Prior to considering an easement as permanent, all surface conditions must be restored to original or better condition. The easement shall be stabilized within 30 calendar days of the completion of construction. Easement plats and deeds shall be recorded prior to site plan approval, except where the easements will be recorded as part of a subdivision plat. Any proposed offsite easements shall be secured by the Developer prior to plan approval by the Town.

The Town of Smithfield shall not accept nor be responsible for repairing, maintaining, or locating any portion of the water or sanitary systems prior to dedication of the appropriate corresponding utility easement(s) relating to the said development. Existing water and sanitary systems within the said development currently not within an easement shall also have appropriate easements dedicated prior to acceptance of new development water and sanitary systems. Dedication of an easement does not mean the utilities within that easement are accepted by the Town. The Town of Smithfield will not accept any utility until final completion requirements of Section 4.1 have been met. The Town reserves the right to require existing easements to comply with current easement width criteria for development projects (i.e. increase existing easement width from 10-feet to 20-feet).

No building or permanent structures shall be constructed within a Town Utility Easement. No trees, shrubs, structures, irrigation mains, invisible pet fences or other obstacles shall be placed within an easement which would render the easement inaccessible by equipment. Shrubs shall be a minimum of 5 feet, and trees a minimum of 10 feet, from the center of water and sanitary sewer pipelines. The Town of

Smithfield will not be responsible for replacement of trees and shrubs placed within the easement.

Water and sanitary sewer easements are exclusive, and shall be designated on the plans and Plat as “Utility Easement dedicated to the Town of Smithfield,” with the width specified, unless otherwise authorized by the Town.

The following note shall be added to all plats containing Town of Smithfield Utility Easements:

“Easements denoted as “Utility Easement dedicated to the Town of Smithfield” are for the exclusive use of the Town of Smithfield and the property owner. Other utility service providers desiring to use these easements with the exception of perpendicular utility crossings must obtain authorization for access and use from the Town of Smithfield and the property owner. All utilities must maintain a 5-foot separation from Town owned utilities. Additionally, the Town of Smithfield shall not be held responsible for any damage to improvements within this easement, from any cause.”

Any existing Town of Smithfield easement requiring abandonment or extinguishment will require approval by the Town of Smithfield. Appropriate materials (plat, deed, exhibits, etc) including fees shall be submitted by the Developer/Engineer for presentation to the Town.

2.7 **DEAD ENDS AND HIGH POINTS:** Dead ends shall be minimized by looping of all water lines where possible. Where dead-end lines occur, they shall be provided with a blow off valve. The blow off valve shall not be directly connected to any sanitary sewer. Approved air release devices shall be installed at all system high points. **All devices shall be inspected by the Town prior to backfilling.**

2.8 **EXTENSION PROVISIONS:** Provisions shall be made for logical future water and sanitary sewer extensions. Future water main and sanitary force main extensions shall be provided with a gate valve and a minimum of a full joint of pipe beyond the gate valve. This pipe shall be properly restrained, plugged, blocked, pressure tested, and disinfected (water mains only) along with the rest of the piping system. After passing inspection, the gate valve shall be closed. A temporary blow-off assembly shall be installed at the end of all extensions. No sanitary stub outs shall be installed on manholes for future extensions. Future manhole inverts shall be cored in the field.

2.9 **HYDRAULIC ANALYSIS:** A hydraulic analysis is required for all water system design projects requiring an extension of the water distribution system, and/or installation of new fire hydrants and/or as required by the Town. The hydraulic analysis shall be used to verify flow demands and pressure availability for the proposed project and to justify pipe sizes. The analysis shall also demonstrate the effect the proposed project will have on the existing distribution system. The hydraulic analysis shall include as a minimum the following:

- A. Under peak hour demands (excluding fire demands), the water distribution system shall maintain pressures above 40-psi.
- B. Under maximum day plus fire demands plus applicable irrigation demands, the water

system shall maintain pressures above 20-psi.

- C. Water system layouts shall be designed to minimize dead ends. Looping water lines is required where possible.
- D. Velocity in any pipe line (excluding fire hydrant six-inch runs) shall not exceed 5 fps under any condition.
- E. Head losses in any pipe line (excluding fire hydrant six-inch runs) shall not exceed 20 psi per 1,000 feet of pipe line.
- F. Provide a separate hydraulic analysis for each phase of the project to confirm adequate system design.
- G. The water model calculations must be sealed, signed and dated by a Licensed Professional Engineer, currently licensed by the Commonwealth of Virginia.
- H. The hydraulic analysis shall be neatly organized and bound. Provide a summary describing the project, the basis of the calculation procedures performed, name and version of the software. The analysis shall be provided in printed form as well as electronic form. The electronic copy shall include the input data for inclusion in the Town system model.
- I. Provide a node map that includes pipe numbers, reservoirs, pumps, junction numbers, contours to check elevations, locations of fire hydrants, and lot locations.
- J. Provide in the model, irrigation demands that might be applied to this development. If no irrigation demands are included in the model, then provide justification of how the irrigation will not be allowed for this project. If irrigation demands are included for this development, then describe how the irrigation demands were developed and what mechanisms will be in place to control them. An example of justification might include the homeowner covenant documentation prohibiting outdoor irrigation of all kinds or allowing irrigation under specific circumstances that support the irrigation demand calculations. Provide a written discussion of irrigation demands with the analysis.
- K. Provide a software generated date/time stamp on all water model pages.
- L. Provide in the hydraulic analysis the following:
 1. Fire hydrant flow tests for which the model is based and a description of input assumptions such as reservoir data and pump data that simulates the flow test.
 2. Listing of all inputs for all pipes, nodes, pumps, reservoirs, etc, used in the model.
 3. Include Average Day Demand Analysis.
 4. Include Maximum Day Demand Analysis.

5. Include Maximum Day Demand + Fire Flow + any applicable irrigation demands. The water system must maintain 20-psi at all nodes.
6. Include Peak Hour + any proposed irrigation demands. The pressures in the system must be maintained above 40-psi at all nodes.
7. Include a Global Fire Flow Analysis.
8. No pipe velocities shall exceed 5 fps, under any condition
9. No pipe head losses in any pipeline shall exceed 25-feet per 1,000-feet of pipe.
10. Provide separate hydraulic analysis for each phase of the project to confirm adequate system pressures and flows during phase development. Apply the fire flow within the phased area.
11. Pipe reports must include the following information at a minimum:
 - a. Pipe number
 - b. Starting Node number and Ending Node number
 - c. Status
 - d. Pipe diameter (inches)
 - e. Pipe length (feet)
 - f. C-Factor (C-Factor of 130 is the maximum allowed)
 - g. Discharge (gpm)
 - h. Velocity (fps)
 - i. Head losses (ft)
 - j. Minor losses (ft)
12. Junction reports must include the following information at a minimum:
 - a. Junction number
 - b. Elevation (ft)
 - c. Demand (gpm)
 - d. Description (description for calculating demand)

- e. Calculated demand (gpm)
 - f. Pressure Head (ft)
 - g. Residual pressures at all nodes (psi)
 - h. Hydraulic Grade Line (ft)
13. Reservoir report must include the following information at a minimum:
- a. Label
 - b. Elevation (ft)
 - c. Hydraulic Grade Line (ft)
 - d. Inflow (gpm)
 - e. Outflow (gpm)
14. Pump report must include the following information at a minimum:
- a. Label
 - b. Status
 - c. Elevation (ft)
 - d. All input information
 - e. Intake pump grade (ft)
 - f. Discharge pump grade (ft)
 - g. Discharge (gpm)
 - h. Pump head (ft)

2.10 **WATER AND SANITARY SEWER SYSTEM DATA SHEETS:**

- A. **Water Data Sheet:** Provide a completed Water Data Sheet with all water system projects. The Water Data Sheet shall be completed as follows:
1. Date: Provide the date the Water Data Sheet was completed. If revisions are necessary, add each revision date.

2. Provide the following information under General Information:
 - a. Provide the project name.
 - b. Provide the project address: Provide the address if available or a description of the location of the project.
 - c. Developer: Provide the firm name of the responsible party for the development.
 - d. Submitted By: Provide the name of the firm submitting this project for review.
 - e. Contact Person: Provide the name of the contact person the Town may contact to address questions concerning the application.
 - f. Address: Provide the address of the contact person.
 - g. Provide the phone and fax numbers and the e-mail address of the contact person for this application.
3. Provide the following information requested under Design Information as follows:
 - a. Source of Water: List the source of water for this project.
 - b. Flow Information: Flow information shall be in accordance with the types of development, units, flow, and flow duration in accordance with Table 2.1. Any deviations from this Table will require supporting documentation and will require VDH approvals.
 - i. Total Flow (GPD): Provide the calculated total GPD based on the project development type.
 - ii. Irrigation Demand (gpm): Provide the irrigation demands that are applicable to this project. If no irrigation demands are included in this project, then no in-ground irrigation systems will be allowed with this project.
 - iii. Average Day Demand (gpm): Provide the calculated average day demand using the values associated with Table 2.1 based on the number of units, flow rate and flow duration for each development type for master planning purposes and residential developments. For site specific site projects, the demand shall be calculated based on the International Plumbing Code (IPC) for fixture counts and flow values. The IPC flow value, which is a peaked demand, shall be divided by a factor of 4 for the Average Day Demand.
 - iv. Maximum Day Demand (gpm): Provide the calculated maximum day demand based on the average day demand with a peaking factor of no less than 1.7. Different peaking factors must be supported with documentation and will be subjected to VDH approvals.

- v. Peak Hour Demand (gpm): Provide the calculated peak hour demand based on the average day demand with a peaking factor of no less than 4.0. Different peaking factors must be supported with documentation and will be subjected to VDH approvals.
 - c. Hydraulic Analysis: Provide the combined volume of the peak hour demand plus the irrigation demand and at what minimum residual pressure as supported by the hydraulic model.
4. Provide the Fire Hydrant(s) Flow Information as follows:
- a. Provide the actual fire hydrant flow test information and attach a copy to the hydraulic analysis. Information to be provided is the fire hydrant number or address, static pressure (psi), residual pressure (psi), pitot pressure (psi), residual flow (gpm) and the estimated flow at 20-psi and the date the fire hydrant flow test was performed.
 - b. Provide the fire flow volume required for this project as stipulated in Section 2.11. Deviations from the Town of Smithfield required fire flow volumes must be approved in writing by the Smithfield Fire Department and the supporting documentation attached.
 - c. Hydraulic Analysis: Provide the volume (gpm) of the total fire flow plus maximum day demand plus any applicable irrigation demands and the minimum pressure in psi.
 - d. Number of Existing Fire Hydrants: Provide the number of existing fire hydrants used to support this project.
 - e. Number of Proposed Fire Hydrants: Provide the number of proposed fire hydrants to be added to support this project.
 - f. This sheet will be sent by the Town of Smithfield to the Smithfield Fire Department for their approval. The Fire Department approval will be required as a component to the Town approval of this Water Data Sheet.
5. Provide the Water Distribution Information as follows:
- a. Water Distribution Piping: Provide the diameter (inches), length (feet) and pipe materials (DI, PVC, etc) for the water distribution system piping for this project. The length of pipe must correspond to the pipe within proposed Town easements or pipe within public right-of-ways. If multiple phases or sections of a project are anticipated, include only the piping proposed on the phased site plan.
 - b. Water Meter Assemblies: Provide the size (inches) and the number of each meter

size for the water distribution system submitted. Developer or Owner must purchase meters. Water meter sizing for commercial developments shall be calculated using the International Plumbing Code as adopted and amended by the Uniform Statewide Building Code (latest edition) for fixture counts and flow values and AWWA Manual - M22 for water meter size based on the calculated flow rates. Provide a copy of the water meter sizing calculations with this analysis. Also provide calculations for justification of irrigation meters if a separate irrigation meter is proposed. Detector Check Valve water meters shall be listed individually. If multiple phases or sections of a project are anticipated, include only those water meters proposed on the phased site plan.

- c. The use of multiple meters in lieu of a single, larger meter, is prohibited unless as authorized by the Town of Smithfield.
- d. Submit calculations which verify the existing or proposed water service line velocities do not exceed 5 feet per second based on the peak hour demand.
- e. Casing Pipe: Provide the casing pipe diameter (inches) and length (feet).

WATER DATA SHEET

Date: _____ Revised: _____

I. GENERAL INFORMATION:

- a. Project Name: _____
- b. Project Address: _____
- c. Developer: _____
- d. Submitted By: _____
- e. Contact Person: _____
- f. Address: _____

- g. Phone: _____ Fax: _____ Email: _____

II. DESIGN INFORMATION:

- a. Source of Water: _____
- b. Flow Information:

Type of Development	Number of Units	Flow (GPD/Unit)	Flow Duration (Hr)	Total Flow (GPD)
Totals				

Type of Development	Irrigation Demand (gpm)	Average Day Demand (gpm)	Maximum Day Demand (gpm)	Peak Hour Demand (gpm)
Totals				

- c. Hydraulic Analysis: Peak Hour Demand (gpm) + Irrigation Demand (gpm):
_____ @ _____ psi > 40 psi (Node _____)
(Attach a hydraulic analysis that supports the above flow and pressure results)

WATER DATA SHEET (continued)

Date: _____ Revised: _____

Project Name: _____

Project Address: _____

III. FIRE FLOW INFORMATION:

- a. Actual Fire Flow Test Information: (*Attach a copy of fire flow test with this form.*)

Date Performed: _____ Nozzle Size: 2-1/2 inch

Hyd. No. _____ Static _____ psi Residual _____ psi

Hyd. No. _____ Pitot _____ psi Flow _____ gpm

Hyd. No. _____ Pitot _____ psi Flow _____ gpm

Hyd. No. _____ Pitot _____ psi Flow _____ gpm

Total Residual Flow _____ gpm

Calculated Flow @ 20 psi _____ gpm

- b. Fire flow to support this project per Town Standards Section 2.11: _____ gpm @ 20 psi

- c. Fire flow to support this project per Smithfield Fire Department (provide supporting documentation if different from the Town fire flow standards above) _____ gpm @ 20 psi

- d. Hydraulic Analysis: Fire Flow + Maximum Day Demand + any applicable irrigation demands:

_____ gpm @ _____ psi. > 20 psi (Node _____)
(Attach a hydraulic analysis that supports the above flow and pressure results)

- e. Number of Existing fire hydrants: _____

- f. Number of Proposed fire hydrants: _____

NOTE: A maximum single flow from any fire hydrant shall not exceed 1000 gpm.

Fire Department Approval (Town use only):

Approved by: _____

Date: _____

WATER DATA SHEET (continued)

IV. WATER DISTRIBUTION INFORMATION:

- a. Water Distribution Piping (Include Fire Hydrant piping, exclude service lines smaller than 4-inch diameter):

Pipe Diameter (Inches)	Pipe Length (Feet)	Material Type (DI, PVC, etc)
Totals		

- b. Water Meter Assemblies:

Water Meter Size (Inches)	Quantity

Note: Water meter sizing for commercial site plans shall be calculated using the International Plumbing Code as adopted and amended by the Uniform Statewide Building Code (latest edition) for fixture counts and flow values and the AWWA Manual – M22 for water meter size based on the calculated flow rates. Meter sizing shall be based on not exceeding 80% meter capacity unless approved otherwise by the Town of Smithfield. Provide a copy of the water meter sizing calculations with this form. Submit calculations which verify the existing or proposed water service line velocities do not exceed 5 feet per second based on the peak hour demand.

Casing Pipe:

Diameter _____ (Inches), Length _____ (Feet)

Diameter _____ (Inches), Length _____ (Feet)

B. **Sanitary Sewer System Data Sheet:** Provide a completed sanitary sewer data sheet with all sanitary sewer system projects. The Sanitary Sewer System Data Sheet shall be completed as follows:

1. Date: Provide the date the Sanitary Sewer System Data Sheet was completed. If revisions are necessary, add each revision date.
2. Provide the following information under General Information:
 - a. Provide the project name.
 - b. Provide the project address: Provide the address if available or a description of the location of the project.
 - c. Developer: Provide the firm name of the responsible party for the development.
 - d. Submitted By: Provide the name of the firm submitting this project for review.
 - e. Contact Name: Provide the name of the contact person the Town may contact to address questions concerning the application.
 - f. Address: Provide the address of the contact person.
 - g. Provide the phone and fax numbers and the e-mail address of the contact person for this application.
3. Provide the following information requested under Design Information as follows:
 - a. Sanitary Sewer System: Provide the name of the collection basin or receiving lift station or pump station.
 - b. Design Population: Provide the breakdown of the proposed development such as 100-single-family homes and/or 10,000-gross square feet Office Building, etc. This item and flow duration shall reflect the type of development listed in Table 2.1- Flow Demands. Provide the total peak flow in accordance with Section 2.10, paragraphs E and F.
 - c. Sanitary Sewer System Piping: Provide the diameter (inches), length (feet) and pipe materials (DI, PVC, HDPE, etc.) for the sanitary sewer gravity and force main system piping for the development. The length of pipe must correspond to the pipe within proposed Town easements or pipe in public right-of-ways. If multiple phases or sections of a project are anticipated, include only the piping proposed on the phased site plan.
 - d. Sanitary Sewer Manholes: Provide number of standard manholes, number of 60-inch diameter manholes, and their respective average depths.
 - e. Casing Pipe: Provide the casing pipe diameter (inches) and length (feet).

SANITARY SEWER SYSTEM DATA SHEET

Date: _____ Revised: _____

I. GENERAL INFORMATION:

- a. Project Name: _____
- b. Project Address: _____
- c. Developer: _____
- d. Submitted By: _____
- e. Contact Person: _____
- f. Address: _____
- g. Phone: _____ Fax: _____ Email: _____

II. DESIGN INFORMATION:

A. Sanitary Sewer System: _____

B. Design Population: (attach chart if additional space is required)

Type of Development	Number of Units	Flow (GPD/Unit)	Flow Duration (Hr)	Total Average Flow (GPD)	Total Peak Flow (GPM)
Totals					

C. Sanitary Sewer System Piping: (include 6-inch sewer laterals)

Pipe Diameter (Inches)	Piping System (Gravity or Force Main)	Length (Feet)	Material (DI, PVC, etc)

D. Sanitary Sewer Manholes:

Standard Manholes: _____, Average Depth: _____

60-inch Manholes: _____, Average Depth: _____

E. Casing Pipe:

Diameter _____ (inches), Length: _____ (feet)

2.11 **FLOW DEMANDS AND DESIGN CONSIDERATIONS:** Design basis for new developments shall be based on the following flow criteria:

- A. Maximum Day Water Demand - maximum day demand is defined as 1.7 times average day demand.
- B. Peak Hour Water Demand - peak hour demand is defined as 4.0 times average day demand.
- C. Average Day Water Demand - average day demand is defined by Table 2.1 based on the number of units, flow rate and flow duration for each development type for master planning purposes and residential developments. For site specific site projects, the demand shall be calculated based on the International Plumbing Code (IPC) for fixture counts and flow values. The IPC flow value, which is a peaked demand, shall be divided by a factor of 4 for the Average Day Demand.
- D. Water meter sizing for commercial site plans shall be calculated using the International Plumbing Code as adopted and amended by the Uniform Statewide Building Code (latest edition) for fixture counts and flow values and the AWWA Manual – M22 for water meter size based on the calculated flow rates. Meter sizing shall be based on not exceeding 80% meter capacity unless approved otherwise by the Town. Provide a copy of the water meter sizing calculations with this form. Submit calculations which verify the existing or proposed water service line velocities do not exceed 5 feet per second based on the peak hour demand.
- E. Peak Sewer Flow - lateral and sub-main sewers.
 - 1. Lateral - a sewer that has no other common sewers discharging into it.
 - 2. Sub-main - a sewer that receives flow from one or more lateral sewers.
 - 3. Minimum Peak Design Flow should be 400-percent of the average design flow.
- F. Peak Sewer Flow - main trunk and interceptor sewers.
 - 1. Main or Trunk - a sewer that receives sewage from one or more sub-main sewers.
 - 2. Interceptor - a sewer that receives sewage flow from a number of gravity mains, trunk sewers, sewage force mains, etc.
 - 3. Minimum Peak Design Flow should be 250-percent of the average design flow.
- G. General -In general, sanitary sewer systems should 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 system that can be readily increased in capacity. Consideration shall be given to land use plans and to the other planning

documents and to the maximum anticipated capacity of institutions, industrial parks, apartment development, etc.

H. Sanitary Sewer Design Considerations: All sanitary sewer systems shall be designed with the following considerations:

1. Peak hourly sewage flows
2. Additional maximum sewage or waste flow from industrial plant
3. Ground water infiltration
4. Topography of area
5. Depth of excavation
6. Slope of sewer lines and laterals
7. Pumping requirements
8. Downstream system capacity

Table 2.1

Type of Development	Contributing Design Units	Flow or Demand (GPD/Unit)	Flow or Demand Duration (hours)	Sewer Flow Peaking Factor	Water Flow Peaking Factor
Dwellings	Per Unit	310	24	2.5	(6)
Trailer Courts, Apartments, Condos, Townhomes & Timeshares	Per Unit	310	24	2.5	(6)
Schools	Per Person	10	8	3	(6)
Boarding Schools	Per Person	75	16	3	(6)
Hotels & Motels	Per Room	130	24	3	(6)
Restaurants (including fast food)	Per Seat	30	16	3	(6)
Service Stations	Per Gross SF	0.4	16	3	(6)
Shopping Centers	Per Gross SF	0.2	12	3	(6)
Hospitals	Per Bed	300	24	3	(6)
Nursing Home/Assisted Living	Per Bed	160	24	3	(6)
Doctor's Office in Medical Center	Per Gross SF	0.25	12	3	(6)
Laundromats	Per Machine	500	16	3	(6)
Community Colleges	Per Student and Faculty	10	12	3	(6)
Theaters (auditorium type)	Per seat	2.5	12	3	(6)
Picnic Areas	Per Person	5	12	3	(6)
Camps, Resort day & Night with Limited Plumbing	Per Site	50	24	3	(6)
Luxury Camps With Flush Toilets	Per Site.	100	24	3	(6)

Table 2.1 (Cont'd)

Type of Development	Contributing Design Units	Flow or Demand (GPD/Unit)	Flow or Demand Duration (hours)	Sewer Flow Peaking Factor	Water Flow Peaking Factor
Warehouse	Per Gross SF	0.05	24	3	(6)
Convenience Store	Per Gross SF	0.3	24	3	(6)
Office Building	Per Gross SF	0.1	12	3	(6)
Fitness Center	Per Gross SF	0.1	16	3	(6)
Religious Assembly	Per Seat in Main Assembly Room	2.5	6	3	(6)
Heavy Industrial	Per Gross SF	0.35 ⁽¹⁾	16	3	(6)
Light Industrial	Per Gross SF	0.10 ⁽¹⁾	16	3	(6)

Sanitary Sewer Flow Projection Notes:

- (1) The stated flow per day per unit is provided as a guide and should only be used if known data for similar heavy or light industrial facilities is not available.
- (2) For undeveloped property zoned other than residential, average daily flows may be projected at a rate of 1,000 gpd per acre. Consideration should be given to designated wetlands and Chesapeake Bay Preservation Act Resource Protection Areas (CBPA RPA) which should be excluded from the gross acreage. A peaking factor of 3 shall be used.
- (3) For undeveloped property zoned residential, average daily flows may be projected at a rate of 310 gpd per unit based on the zoning density. A peaking factor of 2.5 shall be used.
- (4) Flow duration should be taken into account for design of onsite infrastructure and when discharging into publically owned force mains, but need not be considered for downstream publically owned gravity collection systems. Additionally, the SCAT Regulations require a peaking factor of 4 be applied to the average daily flow when designing laterals and sub-mains. For example, in designing an on-site sanitary sewer lateral or an on-site private pump station for a shopping center that has a gross square footage of 7,500 SF, the flow duration should be applied as follows:

$$\begin{aligned}
 7,500 \text{ SF} \times 0.20 \text{ gpd/SF} &= 1,500 \text{ gpd} \\
 1,500 \text{ gpd} / (12 \text{ hour duration} \times 60 \text{ min/hr}) &= 2.08 \text{ gpm} \\
 2.08 \text{ gpm} \times 4 \text{ (peak factor per SCAT regulations)} &= 8.32 \text{ gpm}
 \end{aligned}$$

- (5) Sound engineering judgment must be used in all application of these flow projection guidelines.

Table 2.1 (Cont'd)

- (6) Water Demand Peaking Factors shall be as defined in Section 2.10 for Average Day, Maximum Day (1.7 x Average Day) and Peak hour Demands (4 x Average Day).
- (7) For all undeveloped property, water demands shall be based on the number of residential units and/or commercial square footage anticipated for the development either by current zoning or where limited by Proffers. Peaking factors shall be as defined in Section 2.10.

2.12 **FIRE FLOW REQUIREMENTS:** Fire flow demands are specified by the Smithfield Fire Department and are based on the designated zoning, use, and specific type of construction. The zoning categories are:

- A. Residential: To include, but not limited to, Single-family, Manufactured Homes, Apartments, Townhouses, Condominiums, Motels, etc.
- B. Commercial: To include, but not limited to, Offices, Small Businesses, Hotels, Shopping Centers, Food Markets, Small Buildings, Churches, etc.
- C. Industrial: To include, but not limited to, Plants, Factories, Larger Buildings, Industrial Facilities, etc.

The fire demand ranges from 1,000 gpm to 4,500 gpm. The following table shows the guidelines for specified fire demands based on project type. The maximum flow allowed for a single fire hydrant is 1,000 gpm. If the project has a required demand greater than 1,000 gpm, then additional hydrants must be included for the project to meet the specified demand. Each project's fire flow requirements shall be specified by the Fire Chief for the Smithfield Fire Department. Available fire flows for existing fire hydrants shall be verified by a fire hydrant flow test performed by the Smithfield and/or the Smithfield Fire Department.

FIRE FLOW DEMANDS

Single-family		1,000 gpm
Apartments/Townhouses/Condominiums		2,500 gpm
Motels/Hotels/High Rise Apartments		2,500 gpm
Commercial	Light	2,500 gpm
	Heavy	3,500 gpm
Industrial	Light	3,000 gpm
	Heavy	4,500 gpm

2.13 **THRUST RESTRAINTS:** Thrust restraints shall be provided at all pipe fittings, bends, tees, and valves. Thrust restraints shall consist of retainer glands. Manufactured joint restraints may be used, where appropriate, in place of retainer glands.

Manufactured joint restraints shall be supplied by the same manufacturer as the pipe material and shall be subjected to the same submittal and compliance requirements as the approved pipe. The minimum restrained lengths shall be in accordance with the Joint Restraint Table found in the Smithfield standard details (Detail JR.1). Fire hydrant assemblies shall be restrained at least two full joints of pipe in each direction on the mainline.

2.14 **CONNECTION TO EXISTING WATER AND SANITARY SEWER SYSTEMS:**

All connections to existing water systems to include saddles, service lines, tapping sleeves and valves and direct taps, and connections to existing sanitary sewer systems to include saddles, laterals, manhole connections, force main connections, etc., shall be scheduled with the Town of Smithfield. **The connections shall be made only in the presence of the Town of Smithfield.** Connections to existing manholes shall be made by core-drilling the manhole and connecting the pipe using a KOR-N-SEAL boot, or equal. Existing manholes shall be vacuum tested upon completion of the new connection.

Fernco couplings, or similar products, shall not be permitted on Smithfield water mains, sanitary sewer mains, force mains, laterals or standpipes. Must use Shear Guard fitting, or approved by Town.

All water service connections shall be metered. Private water and sanitary sewer services and plumbing shall conform to the Uniform Statewide Building Code (latest edition.)

All connections to sanitary force mains of 4 inches and larger shall be made with a 4 inch tap and valve.

All connections to AC water mains shall be made utilizing a stainless steel wrap-around repair clamp with a tap. All connection construction methods for connecting to existing AC watermains must be approved by the Town.

All connections larger than 2" to existing DI shall be made with a cast iron tapping sleeve and valve.

The Town reserved the right to dictate water or sewer connection locations within the ROW. Connections from new force mains to existing gravity sewer will not be permitted if an existing force main is available and capable of handling the additional flow.

2.15 **MINIMUM GRADES:** Sanitary sewers shall have a uniform slope and straight alignment between manholes (unless approved otherwise by Smithfield), and be designed and constructed to achieve total containment. Minimum grades shall not be less than those required to produce a velocity of approximately two (2) feet per second when the size pipe selected is flowing full and using an "n" value of 0.013 in the Manning Equation. Minimum grades shall be as follows:

Sewer Size (inches)	Minimum Slope (Feet per 100 Feet)
8	0.40
10	0.28
12	0.22
15	0.15

18	0.12
21	0.10
24	0.08
27	0.067
30	0.058
36	0.046

2.16 **MAXIMUM VELOCITY**: Generally, the maximum permissible velocity in gravity sewers shall not exceed fifteen (15) feet per second. Where velocities greater than fifteen (15) per feet per second are expected, special provisions shall be made to protect against internal erosion by high velocity. The pipe shall conform to appropriate ASTM or AWWA specifications which provide protection against internal erosion. Drop manholes shall be provided to break steep slopes to limit the velocities in connecting sewer pipes between manholes. Where drop manholes are impractical, the sewer main shall be ductile iron or other abrasion resistant material. Sanitary sewer on 20% slope or greater shall be anchored with concrete anchors in accordance with Section 21.05.03 of the SCAT Regulations. Suggested minimum anchorage is as follows:

- A. Not over 36-feet center to center on grades 20 percent and up to 30 percent.
- B. Not over 24-feet center to center on grades 30 percent and up to 50 percent.
- C. Not over 16-feet center to center on grades 50 percent and over.

2.17 **JUNCTIONS**: At all junctions where a smaller sewer joins a larger one, the invert of the larger sewer shall be lowered to maintain the same energy gradient. This may be accomplished by one of the following methods:

- A. Positioning the 0.8 depth point of both sewers at the same elevation, or
- B. Positioning the crown of both sewers at the same elevation.

2.18 **MANHOLES**: Manholes shall be designed to include the following:

- A. Manholes shall be installed at the end of each line of eight (8) inch diameter or greater; at all changes in grade, size, or alignment; at all intersections; and at distances not greater than 400-feet.
- B. Manholes for sewers up to 24-inches in diameter shall not be less than 48-inch inside diameter.
- C. Manholes for sewers larger than 24-inches in diameter shall not be less than 60-inch inside diameter.
- D. Manholes 10 feet and over in depth shall be 60-inch diameter. No sewer manholes over 13 feet in depth will be allowed in the Town.
- E. Manhole top elevations shall be above the 100-year Flood Elevation or shall be sealed watertight frame and cover with approved casting or inserts. Ventilation of gravity sewer systems shall be provided where continuous watertight sections greater than 1,000-feet in length are incurred.
- F. Minimum elevation difference across manhole from inlet to outlet shall be 0.1 feet.

G. Epoxy manhole coatings shall be provided where lift station force mains or low pressure lines with five (5) or more residential grinder pumps connect to a manhole. A minimum of three (3) manholes and 1200 feet downstream of these force main connections shall be coated. Plans shall clearly designate the manholes requiring coating, the coating manufacturer and minimum Type A coating as defined in the HRPDC standards. The Town reserves the right to require additional manholes for epoxy coating where deemed necessary.

H. Sanitary sewer laterals shall connect to the mainline unless otherwise directed by the Town.

I. Interior drop connections shall be constructed when the vertical difference between the invert of the outlet pipe and the invert of the inlet pipe is 15-inches or greater. Where drop connections are required, manholes shall be a minimum of 60 -inch. Inside drop system by Reliner, or equal, shall be used. Inside drop pipe shall extend to the invert and turn toward the direction of flow. Where the difference in elevation between the incoming sewer and the manhole invert is less than 15-inches, the invert shall be filleted to prevent solids deposition.

2.19 **MINIMUM SIZES:** No public sanitary sewer shall be less than 8-inches in diameter. The minimum size for a single lateral connection is 6-inches inside diameter. The Town reserves the right to specify the size of any sanitary sewer main or lateral.

2.20 **SEWER PIPE MATERIALS:** Unless otherwise specified by the Town of Smithfield, gravity sewer mains shall be PVC SDR 26 or Class 52 P401 Ductile Iron, conforming to the HRPDC Regional Construction Standards, inclusive of Town of Smithfield Special Provisions. Gravity sewers 10 feet deep at the invert of the pipe shall be ductile iron. Pipe materials cannot change materials between manholes.

Force mains shall be Class 52 P401 Ductile Iron, conforming to the HRPDC Regional Construction Standards, inclusive of Town of Smithfield Special Provisions. Force mains 2-inch and smaller shall be green Municipex pipe.

Where Class 52 Ductile Iron Pipe is used, Protecto 401 Ceramic Epoxy Lining shall be applied.

2.21 **DEPTH OF SEWERS:** All sewers shall be constructed in such a manner that a minimum of 3-feet of cover is maintained between the top of the pipe and the finished grade elevation. Where conditions dictate that the cover be less than 3-feet, ductile iron pipe will be required, and the installation shall be approved by Smithfield. For depths of sewer exceeding 10-feet, ductile iron pipe shall be used. No sewer over 13 feet in depth will be allowed.

2.22 **SURFACE WATER CROSSING:** Surface water crossings, both over and under water, present special problems and should be discussed with Smithfield and the Department of Environmental Quality prior to final plan preparation. Water and sanitary sewer mains passing over surface water shall be adequately supported, protected from damage due to

freezing, accessible for repair or replacement, and located above the 100 year flood level. Water and sanitary sewer mains passing under surface water shall be of a special type of construction utilizing flexible watertight joints. Also, for pressure pipelines, valves and sample taps shall be located at both ends of the surface water crossing for testing and repairs. The valves shall be easily accessible and not subject to flooding. Sample taps shall also be available at a reasonable distance from each side of the crossing. All surface water crossings shall be approved by the Department of Environmental Quality prior to construction.

2.23 **PIPE CROSSING SEPARATION:** Pipe separation at crossings between water, sanitary sewer, storm, gas, or other pipe systems shall be 18-inches unless approved by the Town. Where the Town allows less than 18-inches separation, the pipe crossing shall comply with HRPDC Standard Detail WS_09. Reference the HRPDC Regional Construction Standards, Section 805, for additional requirements regarding separation of water mains and sewers.

2.24 **PROXIMITY TO BEST MANAGEMENT PRACTICES (BMP'S):** Water and sanitary sewer mains, appurtenances and easements shall not be placed within a BMP, stormwater structure, or associated embankment. BMP's or stormwater structures shall not be constructed within existing water or sanitary sewer easements.

2.25 **PLAN CLARITY:** Water and sanitary sewer force main appurtenances such as valves, fittings, air release valves, etc., shall be shown in both plan and profile views. Plan of development shall be clear and concise. It is necessary to call the appurtenances out in only one location, with stationing and offset annotated, as long as they are depicted graphically in both. Water and sanitary sewer pipe material (PVC or DIP) shall be clearly identified on the plan and/or profile. Plan and profiles shall be developed at a maximum scale of 1"=40' horizontal and 1"=4' vertical. Plan and profile horizontal scales shall be the same with the vertical profile scale a tenth of the horizontal scale.

Plan revisions and/or slip-sheeting during the site plan submittal process shall be properly described in the border revision block with date of revision. Any plan revisions made after site plan approval shall also include "clouding" the revision for clarity.

Smithfield and/or HRPDC references to the applicable standard details (i.e. Typical Water Meter Installation, W13.0) shall be provided on the plan, either individually labeled or tabularized. Standard details shall be provided on the plan. If details are modified, the engineer shall clearly identify those modifications on the detail.

2.26 **GREASE TRAPS:** Grease traps are required for all restaurants or other commercial establishments expected to discharge FOG (fats, oils, and grease) to the wastewater collection system. Grease trap design shall comply with the International Plumbing Code. Provide a tee with a 4-inch vertical standpipe and a cast iron clean- out frame and cover to be used as a sampling station for the proposed grease traps. This sampling station should be located within 5-feet from the grease trap on the effluent side.

2.27 **GRINDER PUMPS:** Grinder Pumps shall be considered on a case by case basis and will remain privately maintained. They must be illustrated on the site plan.

2.28 **GENERAL SYSTEM DESIGN CONSIDERATIONS:**

- A. Buried ductile iron pipe and fittings shall have mechanical or push-on joints. Above ground ductile iron pipe and fittings shall have flange joints or restrained joint mechanical joints as appropriate and approved by the Town. For flange piping, use of multi-gaskets and spacers are prohibited.
- B. Water mains 2-inch and smaller shall be Municipex pipe.
- C. Valves shall be installed on all temporary dead-end pressure pipelines, on small branching mains as close as possible to the larger main, and on loop networks. Valves shall also be placed on water mains so that a break or failure will not affect more than 800-linear feet of main. Valves shall be located at the tee for all intersecting water mains and sanitary sewer force mains. Provide at intersecting mains one valve per the number of connecting waterlines (i.e. provide four (4) valves for an intersecting cross fitting).
- D. Air release valve assemblies shall be constructed at all high points along pressure pipelines. Where practical, high points shall be eliminated by slight adjustments to the pressure pipeline profile. Locations of air release valves shall be shown on the construction plan and profile drawings.
- E. Locations for the fire hydrants shall be shown on the construction plan and profile drawings.
- F. Fire Hydrant Locations: Fire hydrants shall be installed in the public right-of-way or in a Town easement. Fire hydrants shall be located in non-traffic areas (i.e., in an island or behind a curb). Fire hydrants shall be installed at an intersection whenever possible. Fire hydrants installed at an intersection shall be located at the curb's point of curvature. All other fire hydrants shall be located in-line with a property line perpendicular to the right-of-way line, whenever possible. In townhouses, condominiums, apartments, commercial and industrial areas, fire hydrants shall be located in a raised island (grass or concrete) when not at an intersection. Each fire hydrant location shall be approved by the Smithfield Volunteer Fire Department. In addition, fire hydrants shall be located on the following:
 1. On highways divided by a median strip, hydrants shall be located on each side of the right-of-way as per the fire hydrant spacing requirements.
 2. The Town, in consultation with the Fire Chief, may require that additional fire hydrants be provided on the site at specified locations in order to ensure adequate fire suppression capabilities and to allow the system to be flushed periodically of accumulated sediments.
 3. For developments that are served by independent water production facilities, the water source and facilities shall be constructed to provide adequate fire protection.

G. Fire Hydrant Spacing Requirements: Fire hydrant spacing is specified by the Smithfield Fire Department. The hydrant spacing ranges from 400-feet for commercial/industrial areas to 600-feet for single-family residential areas.

H. All fire hydrants and valves shall be open left only.

I. Sanitary sewer cleanouts shall be placed at the edge of ROW or with a utility easement dedicated to the Town of Smithfield if none are present by the contractor, builder or homeowner. Sanitary sewer laterals and cleanouts shall maintain a minimum 18-inch horizontal edge-to-edge clearance from driveways and/or drive paths, sidewalks or bike paths, unless approved otherwise by the Town. At no point shall laterals run under driveways within the right-of-way. Smithfield reserves the right to require SS_12 cleanouts be provided at its direction. No cleanout shall have an invert elevation greater than 4.5 feet below grade.

J. New water mains shall be located in the roadway, at least one foot inside the edge of pavement.

K. Sewer Laterals and water service lines shall be installed at least 10-feet apart.

L. Water and sewer mains shall be installed at least 10-feet apart.

M. On water mains 16-inch diameter or greater, butterfly valves may be used in place of gate valves if cover restrictions exist, unless otherwise directed by the Town. Butterfly valves shall be manufactured by M&H Valve Company.

N. The Town must approve tie in points for all utilities prior to plan approval.

2.29 **WATER METER:** Water meters shall be Neptune and shall register in gallons. The Town shall purchase and install meters 1" and smaller. The Contractor shall purchase and install meters larger than 1" under the supervision of the Town. Meter type/model shall be approved by the Town prior to the Contractor purchasing the water meter.

Parameters for designing/installing water meters and service connections shall involve the following:

1. Water meter box and water service line installation shall maintain a minimum 18-inch horizontal edge-to-edge clearance from driveways and/or drive paths, sidewalks or bike paths, unless approved otherwise by the Town. At no point shall water service lines run under driveways, sidewalks, or bike paths within the right-of-way.
2. Water meters shall be placed at the edge of ROW or with a utility easement dedicated to the Town of Smithfield.
3. Water meter relocations shall require a new tap when modifications to the property require relocation of the existing service which shall be at the owner's expense.
4. Water service lines shall be perpendicular to the main.

2.29a **Fire Line Meter:** Fire lines shall have an appropriate size fire meter. An RPZ or RPDA is required.

2.30 **DETECTOR CHECK VALVE**: A detector check valve with a backflow prevention device located downstream is required at the following locations:

- A. Master meters for entire water systems (Neptune Protectus III). Master meters are only permissible when looping the system and individual meters are not possible.
- B. Fire services or automatic sprinkler services.
- C. Locations of backflow prevention devices shall be approved and inspected by the Town.

The detector meter shall be 5/8-inch x 3/4-inch.

2.31 **BACKFLOW PREVENTION DEVICES**: Backflow prevention devices shall be installed as required by the Town of Smithfield's Cross Connection and Backflow Prevention Program. The installer's responsibility is to make proper installation of approved backflow prevention devices, in accordance with the manufacturer's installation instructions, the Uniform Statewide Building Code, and any additional instructions offered by the Town. Approved backflow prevention devices and assemblies are those that meet AWWA standards, and are approved by ASSE and the USC-FCCC (University of Southern California Foundation for Cross Connection Control and Hydraulic Research). Flow orientation, access, and installation of backflow preventers shall be provided in accordance with USC-FCCC guidelines and as specified by the installation instructions of the approved manufacturer. NOTE: USC approval is specific to orientation, horizontal or vertical, device model number and size. Approvals are continuously verified and can be rescinded. Thermal expansion and/or water hammer downstream of the assembly can cause excessive pressure. To avoid possible damage to the system and assembly, the installer will use water hammer arresters, surge protectors, relief valves and expansion tanks as appropriate. Only testable devices that meet or exceed current and future hazards to the Town's distribution system shall be approved and accepted by the Town's Backflow Prevention Manager. Approved method or type of construction shall be included. Backflow prevention assemblies must not be installed in locations subject to flooding such as underground vaults. Protection of backflow preventers shall meet current code requirements and outdoor enclosures for backflow preventers shall comply with ASSE 1060. Refer to the Town of Smithfield's Cross Connection and Backflow Prevention Program Weblink at <https://www.smithfieldva.gov/departments/public-works-&-utilities/cross-connection-and-backflow-prevention-program#:~:text=This%20program%20is%20established%20by,of%20the%20Commonwealth%20of%20Virginia>, for further information.

2.32 **CONTROL VALVES (2 inches in Diameter and Larger)**: Control valves (2" and larger) shall be hydraulically operated, pilot-controlled diaphragm-type globe valve. All control valves shall be constructed in an above ground structure meeting the requirements of it. The main valve shall have a single removable seat and a resilient disc. The stem shall be guided at both ends by a bearing in the valve core and an integral bearing in the valve seat. No external packing glands are permitted and there shall be no pistons operating the main valve or any pilot controls. The pilot control shall be a direct-acting, adjustable, spring loaded, normal open, diaphragm valve, designed to permit flow when controlled pressure is less than spring setting. The control valve shall be class 125 bronze fittings manufactured in accordance with ANSI B16.1, ASTM A48, B61, and B62, adjustable from 30 to 300 psi. Valves shall have

an internal and external epoxy coating in accordance with AWWA C550-latest revision. Valves shall be furnished with a Delrin stem in both normally open and normally closed configurations. Valves shall also include position indicator devices. Control valve functions include one or more of the following:

- A. **Check Valve:** Check valves shall be no-slam operation, drip tight shut off and shall have adjustable dual speed controls.
- B. **Pressure Reducing:** Pressure reducing valves shall provide sensitive and accurate pressure control, shall provide easy adjustment and maintenance, shall be tamper resistant, and shall include a fully supported frictionless diaphragm. This valve shall be Cla-Val or approved equal and have remote control and SCADA (Supervisory Control and Data Acquisition) features as required by the Town.
- C. **Combination Pressure Reducing and Pressure Sustaining Valves:** Combination pressure reducing and pressure sustaining valves shall have accurate response to slight pressure changes, a check feature, shall be completely automatic operation, drip tight, positive seating; and, shall have fully hydraulic operation
- D. **Solenoid Actuated Valve:** Solenoid actuated valve shall have quick acting solenoid actuation, and shall provide for ease for installation and maintenance.
- E. **Rate of Flow Control Valves:** Rate of flow control valves shall accurately limit flow rate, shall have automatic operation, shall include orifice plate and holder, and shall have a check valve feature and allow for ease of adjustment.
- F. **Altitude Valve:** Altitude valves shall include accurate repeatable level control, drip tight positive shut-off, reliable hydraulic operation, easy adjustable controls, complete automatic operation, and shall be either double acting or single flow as required by the Town. This valve shall be Cla-Val or approved equal and have remote control and SCADA (Supervisory Control and Data Acquisition) features as required by the Town.

2.33 **SUBSURFACE UTILITY LOCATING:** Test holes shall be performed and information incorporated in the design for all existing pipe crossings where conflicts with proposed utilities may occur. This shall include physically locating all proposed connections to existing Town of Smithfield water and sanitary force main systems. As part of the site plan process, the developer/engineer shall provide test hole data sheets to the Town which substantiate the horizontal and vertical location of each crossing/connection.

2.34 **MASTER UTILITY PLAN DEVELOPMENT:** Where required by the Town of Smithfield, Master Utility Plans with associated hydraulic modeling and calculations shall be submitted prior to site plan submittal. Generally, Master Utility Plans shall be submitted for large scale developments, projects being developed in phases, and developments requiring multiple water and or sewer pump station facilities. Town of Smithfield general guidelines for development of Master Utility Plans are included in Appendix E.

SECTION 3. SITE WORK, DRAINAGE, STREETS:

- 3.1 **GENERAL:** Design shall be by a professional engineer licensed in accordance with the requirements of the Code of Virginia. The Town prior to commencement of construction shall approve all plans, plats and specifications in writing.

The Contractor shall be responsible for traffic control during the course of the work and shall provide certified flagmen, signs, etc., as necessary to meet requirements of VDOT and/or the Town of Smithfield. At least one (1) lane of traffic shall be maintained on existing residential streets at all times.

Tree trunks, branches, and exposed roots damaged during equipment operation or construction shall be pruned as directed by a certified arborist or the Town of Smithfield.

The Contractor shall construct and maintain all necessary erosion and sediment control devices sufficient to prevent soil from being eroded from the site into any adjacent system, ditch or watercourses. Any material that is eroded shall be promptly removed. The Contractor shall comply with the current requirements of the "Virginia Erosion and Sediment Control Handbook".

All excavated materials shall be stockpiled so as not to interfere with existing drainage. Stockpiles shall comply with Virginia Erosion and Sediment Control regulations.

The Contractor shall be responsible for removing and replacing with matching materials any pavement, driveways, walks, curbs, etc., that must be cut or that are damaged during construction. Cuts in pavements shall be straight-line saw cut. Cuts in curbs and walks shall be saw cut at an existing joint. Repair as per Section 3.3.7 of these standards

Plans, profiles and specifications shall include provisions for excavation and backfill, dewatering, sheeting and bracing, maintenance of traffic and protection of the public, protection of existing utilities and structures, trench widths and preparation, materials, material testing, details of pipe laying and construction of pipe lines and appurtenances and other items as may be applicable to the project and all in accordance with good engineering practice. Plans (Scale 1"=25' or larger) shall include profiles, details and topographic information such as existing and proposed zoning, lot numbers, street pavement, sidewalks, driveways, curb and gutter, storm drains, utilities, trees, shrubbery, property lines, street names and house numbers (where available) and appropriate elevations. Plans shall also include a vicinity map, map and deed book references for adjacent property and existing easements, and typical sections of streets, roads and ditches. Plans shall not be larger than 24"x36". Plans shall include typical sections for streets and ditches.

Datum shall be Town of Smithfield, Virginia 2003 Geodetic Control Network, Horizontal NAD 83 (1996), and Vertical NAVD 88. Plans shall show referenced benchmark and a minimum of two (2) benchmarks established for the project. The developer shall establish permanent benchmarks in subdivisions. The number and locations are to be determined by the Town of Smithfield's representative and developer. The benchmark elevation is to be certified by a licensed land surveyor or a professional engineer.

3.2 **DRAINAGE DESIGN:** Drainage shall be designed in general by the criteria established in the current VDOT Drainage Manual. Design and construction shall also meet the applicable requirements of the Town of Smithfield "Chesapeake Bay Preservation Area Ordinance"; and stormwater management and erosion and sediment control requirements of the Commonwealth of Virginia Soil and Water Conservation Board. Refer to the current "Virginia Erosion and Sediment Control Handbook" and "Virginia Stormwater Management Handbook". No submerged drainage systems are to be allowed in the Town of Smithfield.

Drainage shall be designed by the criteria established in the Virginia Department of Transportation Drainage Manual and in coordination with the following guidelines:

- (1) Peak runoff shall be computed by the rational method with the intensity taken from the intensity-duration curve for Norfolk, Virginia.
- (2) Where the drainage basin exceeds 200 acres or when a retention design is involved, hydrographic or other approved methods are to be used for design purposes.
- (3) Runoff coefficients shall be based on a weighted coefficient for the composite area.
- (4) Inlet capacities and pavement spread calculations shall be designed in accordance with the current VDOT Drainage Manual. These capacities shall be designed for a storm having a minimum 10-year recurrence frequency. Inlets shall be spaced to eliminate pavement spreads in excess of ten feet (10') on the typical street section calculated on a 10-year recurrence frequency.
- (5) Pipe Capacities:
 - (a) Hydraulic grade line calculations are required which take into account structure and bend losses, etc. Pipe joints must be designed to withstand pressures proposed. System must be designed to prevent flooding during the design event.
 - (b) Hydraulic grade line calculations must reflect the same design event in the downstream or receiving facility.
- (6) Off-site drainage improvements will be required to prevent the proposed development from having any significant detrimental effect on the downstream facilities or natural channels.
- (7) Minimum slope for storm drain pipes is 0.5%
- (8) Minimum size for RCP is 15" unless approved by the town.

(9) Drainage Easements:

All storm drainage systems collecting runoff from a public right-of-way must have a drainage easement dedicated to the Town of Smithfield to the point of outfall from the proposed site. Any storm drainage system that collects runoff from a private property encroaching on other private property must also have a drainage easement granting drainage rights to the third party. Easements required by and conveyed to the Town shall be used solely for drainage and utilities that are maintained by the Town.

Drainage easements for storm drain pipes shall be centered over the storm pipes. The width of the drainage easement shall be determined by the following unless otherwise approved by the Town:

$$W = 2d + D + 2 \text{ feet}$$

Where :

W = easement width (in feet)

d = depth of pipe (invert to final grade, in feet)

D = Diameter of pipe (in feet)

All easement widths should be rounded to the nearest 5 feet and have a minimum width of 10 feet.

All open channel drainage design systems (ditches and channels) shall have a drainage /access easement which will vary with the width of the top of bank. Open channel drainage systems with the top of bank width of:

- 5 feet or less should have an easement width of 25 feet, with a 15-foot access easement on one side.
- 15 feet or less should have a minimum easement of 20 feet larger than the top of the width of the open channel, with a 15-foot access easement on one side.
- Greater than 15 feet should have a minimum easement of 30 feet greater than the width of the open channel, including a 20-foot access easement on one side.

All subdivision and commercial site plans must meet this requirement for approval from the Town of Smithfield.

No building or permanent structures shall be constructed within a Town Drainage Easement. No trees, shrubs, structures, irrigation mains, invisible pet fences or other obstacles shall be placed within an easement which would render the easement inaccessible by equipment. Shrubs shall be a minimum of 5 feet, and trees a minimum of 10 feet, from the center of storm sewer pipelines. The Town of Smithfield will not be responsible for replacement of trees and shrubs placed within the easement.

Drainage easements are exclusive, and shall be designated on the plans and Plat as "Drainage Easement dedicated to the Town of Smithfield," with the width specified, unless otherwise authorized by the Town.

The following note shall be added to all plats containing Town of Smithfield Drainage Easements:

“Easements denoted as “Drainage Easement dedicated to the Town of Smithfield” are for the exclusive use of the Town of Smithfield and the property owner. All utilities must maintain a 5-foot separation from Town owned utilities. Additionally, the Town of Smithfield shall not be held responsible for any damage to improvements within this easement, from any cause.”

3.3 **DRAINAGE MATERIALS AND STANDARDS:** Materials and standards shall be in accordance with the current Virginia Department of Transportation (VDOT) "Road and Bridge Specifications" and "Road and Bridge Standards", unless otherwise stated.

- (1) Temporary drainage during construction shall be provided by the Contractor to relieve areas that may cause damage to roadways, etc. or as directed by the Town of Smithfield.
- (2) Concrete shall be Class "A3" Air Entrained (3,000-psi. minimum) for general concrete and Class "A4" Air Entrained (4,000 psi minimum for pre-cast units).
- (3) All storm sewer pipes in Town of Smithfield Right-of-Way shall be reinforced concrete tongue and groove, Class III minimum. Corrugated metal pipe and plastic pipe will not be permitted. Any concrete pipe that has an end section that is broken, chipped, or has been saw cut during installation will be required to be epoxy grouted as per approval of the Town and / or their representative.
- (4) Pre-cast structures are acceptable. These drainage structures shall meet all current VDOT Standards and Specifications. Drop Inlet T-DI-1 shall be furnished with square "Alternate Top" where wheel loading is not a factor.
- (5) Riprap shall be provided at endwalls and flared end sections or as otherwise specified by the Town of Smithfield.
- (6) All new and, where required, existing downstream, storm sewer pipes and structures shall be cleaned of debris and eroded material upon completion of construction.
- (7) No open cut of a public roadway shall be allowed except with written permission from the Town of Smithfield, accompanied with all necessary sureties. This repair shall be equal to or greater than VDOT LUP-OC.

- (8) Relocation of any utilities shall be at the Contractor's expense and completed with site work.
- (9) Before digging the Contractor shall contact VA811 (formerly MISS UTILITY of Tidewater) for location of existing utilities. Prior to construction or excavation, the Contractor shall assume the responsibility of locating any underground utilities (public or private) that may exist and cross through the area of construction. Utility companies shall be notified 72 hours in advance of any excavation in the proximity of their utilities. The Contractor shall be responsible for repairing, at his expense, any existing utilities damaged during construction. The above referenced statement shall be noted on all construction plans. At their expense, the contractor shall be responsible for repairing any existing utilities or infrastructure within the right of way of the Town of Smithfield during construction. This repair shall meet the approval of the Town.

3.4 **PAVEMENT DESIGN CRITERIA:** Pavement design shall be performed by a Professional Engineer/Land Surveyor licensed to perform this type of work. Soil sampling shall be performed as per the current VDOT Pavement Design Guide. Samples should be taken a minimum of 10' below the finish grade of the proposed street. The Engineer shall submit to the Town for review test logs, pavement design and bore location map. The following information shall be submitted to the Town of Smithfield with the pavement design:

- (1) **Soil Analysis** - Ten-foot (10') deep boring logs of sufficient quantity to determine the soil profile, related to elevations. The borings shall reflect ground water elevations; description of materials and blow counts on the samplers. Borings shall indicate normal water table elevation, and projected seasonable high water table elevation. Maximum spacing of test shall be 500 foot (250' radius of coverage per test) and as per the current VDOT Pavement Design Guide. No less than 2 tests are to be provided. All soil tests are to be performed by a certified Testing Laboratory licensed to perform this type of work. Soil Analysis of subgrade material shall include:
 - (a) Gradation (Sieve and Hydrometer Analysis)
 - (b) Atterberg Limits.
 - (c) Moisture density relationships and curves.
 - (d) Maximum dry weight.
 - (e) Optimum moisture content.
 - (f) Specific gravity.
 - (g) Swell.
 - (h) California Bearing Ratio in accordance with Virginia Test Method (VTM-8), with soaked and unsoaked test results required. Samples

shall be taken at the proposed street subgrade elevation.

- (2) **Traffic Volumes** - On proposed new streets the following minimum 24-hour trip generation information shall be used or the I.T.E. Trip Generation Table from the latest edition of the "I.T.E. Trip Generation Manual", whichever is greater:

<u>Development</u>	<u>Trip Generation Rate</u>	<u>%Heavy Trucks</u>
Single Family Residential	10/ dwelling unit	5
Townhouse Residential	6/ dwelling unit	5
Apartment Residential	6/ dwelling unit	5
Elementary and Intermediate Schools	0.8/ student	5
High School	1.4/ student	5
Industrial	52/ AC	12
Shopping Centers	600/ AC	5

Where proposed streets intersect the boundary of the subdivision providing access to adjoining undeveloped property, the design traffic shall be based on the number of acres and the total number of units expected to contribute traffic to the street.

- 3.5 **PAVEMENT DESIGN:** The pavement shall be designed per the current "VDOT Pavement Design Guide for Subdivision and Secondary Roads in Virginia".

- 3.6 **PAVEMENT MATERIALS AND STANDARDS:** Materials and standards shall be in accordance with the current edition of the VDOT Road and Bridge Specifications and Standards.

- 3.7 **PAVED PRIVATE ENTRANCE:**

- (1) Applicants to whom permits are issued shall at all times indemnify and save harmless the Town of Smithfield, Virginia from responsibility for, damage to, or liability arising from the exercise of the privileges granted in such permit either during construction or at any time in the future.
- (2) A permit may be denied any applicant, and all permits issued by the Town of Smithfield may be revoked, whenever in the opinion of the Town Manager, the safety, or use of maintenance of the highway, so requires.
- (3) The permittee agrees that if the work authorized by this permit, including any work necessary to restore shoulders, ditches and drainage structures to their original condition, is not completed by the applicant to the satisfaction of the Town, the Town of Smithfield will do whatever is necessary to restore the area within the right of way to its original condition, and the permittee will pay to the Town the actual cost of completing the work.
- (4) The absence of a Town representative does not in any way relieve the permittee of responsibility to perform the work in accordance with the provisions of this permit.
- (5) No trees are to be cut or trimmed within the right of way.
- (6) The entrance is to be constructed so as not to impair drainage within the right of way, with any and all drainpipe being supplied by the permittee.
- (7) All precautions will be taken for the protection of traffic, such as flagmen, signs, barricades, lights, etc. as necessary.
- (8) **Note:** The paved area (the area between the edge of the pavement/back of curb and the right of way line) shall consist of one of the following treatments in accordance with the current Virginia Department of Transportation specifications and/or approval by the Towns' Engineer:
 - a. Asphalt Entrance: The base course shall be crushed stone, Type I, No. 21A, 21B or 22, minimum 8" in depth compacted to 95% density at optimum moisture. The surface course shall consist of a prime with RC-250 at the rate of 0.3 gal. per sq. yd. and an application of bituminous concrete Type SM-12.5A at a rate of 220 lbs./sq. yd. geometrical design of the entrance, if piped, should meet the requirements of the Town Design Standards. If it is a curb and gutter roadway section, minimum 2 – foot flares should be installed at the curb line. The minimum width for a driveway is 12 feet measured at the edge of right of way.

- b. Concrete Entrance: The paved area shall consist of Class A3 concrete 7" thick (minimum), current Virginia Department of Transportation Road and Bridge standards, Sections 201 and 203. Geometrical design of the entrance, if piped, should meet the requirements of the Town Design standards. Allowance will be given on 20 – foot radial section with minimum 3 – foot flares. If it is a curb and gutter roadway section; minimum 2 – foot flares should be installed at the curb line. If an entrance is being installed in an existing curb line; the existing curb should removed and replaced to the nearest joint if the wipedown for driveway is within 5 feet of the closest joint. The minimum width for a driveway is 12 feet measured at the edge of right of way.

3.8 **STREET LIGHT POLICY**

- (1) The Town of Smithfield requires all new residential developments to install street lights. The following guidance is provided for spacing and/or location of street lights in new or existing areas. All new street light approvals are at the discretion of Town staff, cannot exceed the yearly budgeted amount allocated for new street lights and installation, and must meet the design requirements set forth by the Town of Smithfield and the appropriate Utility.
- (a) **DOWNTOWN DISTRICT:** Where businesses are closely located together, street lights shall be no less than every other utility pole or approximately 200 feet apart.
- (b) **RESIDENTIAL (Neighborhood Residential and Suburban Residential) NEW DEVELOPMENT:** Street lights in newly developed residential neighborhoods should be no more than 400 feet apart.
- (c) **RESIDENTIAL (Neighborhood Residential and Suburban Residential) ESTABLISHED DEVELOPMENT:** Street lights in already established residential neighborhoods may be installed in front of residences at the owner's request, provided they are not closer than 200 feet from an established street light, and provided they provide a petition showing the support from a majority of neighbors located 400 feet in each direction, or to the next closest street light in each direction, on each side of the street, whichever distance is less, from the proposed Street light. Minimum street lights will be provided by the Town, where utility poles are available, at intersections and cul-de-sacs.
- (d) **CONCENTRATED RESIDENTIAL (Attached Residential and Multi-Family Residential) NEW DEVELOPMENT:** Street lights in newly developed residential neighborhoods should be no more than 200 feet apart.

- (e) **CONCENTRATED RESIDENTIAL (Attached Residential and Multi-Family Residential) ESTABLISHED DEVELOPMENT:** Street lights in already established residential neighborhoods may be installed in front of residences at the owner's request, provided they are not closer than 200 feet from an established street light, and provided they provide a petition showing the support from a majority of neighbors located 200 feet in each direction, or to the next closest street light in each direction, on each side of the street, whichever is distance is less, from the proposed Street light. Minimum street lights will be provided by the Town, where utility poles are available, at intersections and cul-de-sacs.
- (f) **RURAL RESIDENTIAL:** Street lights where residential units are widely separated may be installed in front of residences at the owner's request, provided they are not closer than 500 feet from an established street light. Minimum street lights will be provided by the Town, where utility poles are available, at intersections and cul-de-sacs.
- (2) **UPGRADING OF STREET LIGHTS IN DEVELOPED SUBDIVISIONS WITHOUT UTILITY POLES:** In subdivisions where utilities are buried and no utility poles are available, the Town will contribute capital in an amount equivalent to the cost of installing utility poles and lights. It shall be the developer or owner's responsibility to pay the difference for ornamental or decorative lighting.
- (3) **REQUIREMENT FOR PUBLIC STREETS:** Street lights paid for with public funds may only be installed on streets or right of ways accepted into the Virginia Department of Transportation (VDOT) system. The Town of Smithfield will not pay for the installation or operation of street lights on private streets, roads, or driveways.

3.9 SUBDIVISION STREET LIGHT REQUIREMENTS

- (1) **Entrance:** When built as part of a subdivision where underground utilities are present, all entry way street lights must be built to the following specifications:
- Must be between 10' and 14' in height
 - Must be at least 8,000 Lumens
 - Must be mounted on a sturdy decorative pole
 - Must be no further than 100 feet apart.
 - Must be installed on both sides of the entrance and along the front of the property
- a. The required lights are the 8,000 Lumen traditional colonial lights on the approved list provided by Dominion Energy and/ or Community Electric. The required lights can be found on Dominion Energy's website at <https://www.dominionenergy.com/virginia/products/lighting-fixtures> and Community Electric's website at <https://www.comelec.coop/area-lighting>.

- - b. The entrance will be defined as the section of road at the beginning of the subdivision to the first cross-street. All subdivisions are encouraged to install LED streetlights where feasible in lieu of traditional street lights.
- (2) Inside Subdivision: When built as part of a subdivision where underground utilities are present, all interior street lights must be built to the following specifications:
- Must be in substantial conformance with entry way streetlights
 - Must be no less than 14' in height
 - Must be at least 8,000 Lumens

SECTION 4. PROJECT CLOSE-OUT:

4.1 FINAL COMPLETION REQUIREMENTS:

A. Record Drawings for Town of Smithfield CIP Projects and Development Projects:

Record drawings are required at the completion of all water, sanitary sewer, and storm sewer system projects constructed for, or dedicated to, the Town of Smithfield and shall include the following:

Prior to acceptance of the water, sanitary sewer, and storm sewer system improvements by the Town of Smithfield, five (5) complete paper copies of preliminary record drawings for the project shall be submitted to the Town for review and approval. An electronic copy in AutoCAD compatible format and PDF shall also be provided. The record drawings shall show the location of all easements, above ground appurtenances, service connections, water, sanitary sewer, and storm sewer system components (including type, material, and material class of pipe), appurtenances, and all other data necessary to operate, maintain, and locate the water, sanitary sewer, and storm sewer system improvements. All **fire hydrants, water main valves, tees, bends, blow-off valves, air release valves, water meter boxes and service lines, manholes, cleanouts and laterals, storm structures, force main valves, bends and fittings, air release valves, offsets, abandoned facilities and repairs** shall have dimensions on the drawings to a minimum of two (2) permanent structures, such as property pins, edge of pavement, etc. Record drawings shall include elevations for all sanitary sewer and storm manhole rims, inverts, and cleanouts. All record drawings shall be stamped by a Engineer or Surveyor with a current license in the Commonwealth of Virginia. Vertical and horizontal survey datum control for record drawings shall comply with Section 1.3 of these Design Standards.

Water mains along roadways shall be dimensioned from the edge of pavement to the main every 50-feet. The Town of Smithfield reserves the right to require additional dimensioning on the record drawings for areas of long distances between fittings.

B. Development Projects:

1. Final Inspection Requirements:

- a.** No final inspection will be scheduled until all property pins are installed, flagged, and staked, installation of all other utilities serving the development (to include Virginia Power, Telephone, Gas, Cable, and others) is complete, and record drawings are submitted. Record drawings shall be submitted in accordance with Section 4.1.A and delivered fifteen (15) days prior to scheduling the final inspection.
- b.** A letter shall be provided by the Developer/Owner confirming that all utilities (i.e. electric, gas, cable, telephone and others) have been installed. The letter shall include the cost associated with the installation

of the water, sanitary sewer, and storm sewer system, both on-site and off-site.

- c. A copy of the recorded plat and/or related documentation shall be submitted to the Town of Smithfield.
- d. The Developer/Owner will provide a signed letter by the Engineer or Surveyor of record stating that the construction work was completed according to the approved plans and specifications. This statement will be based upon inspections of the construction, during and after construction.
- e. Contractor shall provide personnel responsible for exercising all valves in the presence of the Town during the final inspection walkthrough.

C. Post-Installation TV inspection:

Post-Installation TV inspection for all gravity sewer and storm sewer installations or rehabilitations shall be submitted to the Town prior to acceptance of sewer system improvements. Lines shall be cleaned prior to inspection.

For gravity sewer, prior to inserting the television camera into the pipeline, the Contractor shall flush and clean the mainline and the laterals. The Contractor shall introduce a minimum of 15 gallons of clear, potable water to each lateral and 1,000 gallons of clear, potable water into the terminal upstream manhole or last access structure on any given gravity sewer branch of the pipeline to be inspected with a television camera. The Contractor shall run the camera within 8 hours after the water has been introduced to the main and laterals. The Contractor is responsible for acquiring, collecting and disposing of the water, at no additional cost to the Owner. TV inspection shall include all joints and manhole inverts. No TV Inspection during cleaning of the lines shall be accepted.

D. Construction Data Tolerances:

HRPDC Regional Construction Standards indicate requirements for the various components of the Construction Record Drawings contained herein. See HRPDC Region Construction Standards for full details. In the event of conflict the most restrictive standards shall govern.

CRDs with construction deficiencies that exceed established tolerances are subject to rejection. Such deficiencies in construction and proposed corrective action should be identified by the developer's representative to expedite CRD approval

4.2 **WARRANTY (DEVELOPMENT PROJECTS):** The Developer/Contractor will be responsible for, and obligated to, correct all deficiencies in construction and installation of the project for two years from the date of acceptance of the facilities by the Town of Smithfield. This will include repairs to any valves, meters, meter boxes, yokes, piping, manholes, manhole frames and covers, cleanouts, cleanout boxes, storm sewer structures, etc., damaged by subcontractors, builders or others, or to correct defects in installation or materials.

In addition to the above stated two (2) year warranty, the developer or contractor shall for all equipment installed for which the manufacturer thereof has a standard guarantee in excess of the one (1) year, transfer to the Town of Smithfield all necessary warranties to properly guarantee such equipment by the manufacturer for the standard term of the manufacturer's guarantee.

- 4.3 **DEDICATION (DEVELOPMENT PROJECTS):** Following verification of the record drawings and completion of the punch list, the developer/owner will formally dedicate the water distribution, sanitary sewer, and storm sewer system, easements, and/or property to the Town of Smithfield. Such dedication will be acknowledged in writing by the Town. Dedication does not mean acceptance of the utilities. The Town of Smithfield will not accept any utility until final completion requirements of Section 4.1 have been met.

Through the Engineer or Surveyor of record for the project submit: Five (5) paper copies and one (1) electronic copy of the recorded plat and accompanying deeds of easements; Five (5) paper copies and one (1) electronic copy of the record drawings. Provide record drawing information in electronic AutoCAD compatible format and PDF. Coordinates in the AutoCAD compatible file shall be Virginia coordinate system in accordance with Section 1.3.

- 4.4 **WATER METER INSTALLATION:** Before installation of water meters, all water, sanitary sewer, and storm sewer utilities must be fully accepted by the Town. This will require installation of all other utilities (i.e. natural gas, electricity, telephone, TV cable, etc), completion of all deficiencies identified by the Town in pre-final punch list, and submittal and approval of record drawings for the water and sanitary sewer desired for acceptance by the Town. The Town of Smithfield will not accept any utility until final completion requirements of Section 4.1 have been met.

SECTION 5. WATER FACILITIES AND PUMPING STATIONS:

5.1 WELLS, STORAGE TANKS AND WATER PRODUCTION FACILITIES:

A. General:

1. Wells, storage tanks, water production and pumping stations shall meet or exceed all applicable requirements of the Commonwealth of Virginia Department of Health, the American Water Works Association, and the National Fire Protection Association; and shall be submitted to the Town of Smithfield for review and approval.
2. All water production facilities shall be dedicated to the Town.

B. Design:

1. Water production shall be equipped with an approved alarm system, standby power supply and disinfection facilities.
2. The size of storage and production facilities shall be based on the needs of the development and as approved by the Town
3. Water storage facilities shall consist of disinfection, peak demand and fire flow storage unless otherwise approved by the Town.
4. Water production facilities shall be equipped with a SCADA system that is compatible and tied into the Town's SCADA system. Remote alarm terminal will be furnished by the Town but paid for and installed by the Contractor. Contractor shall provide duplex outlet for service to alarm transmitter. Connections to alarm transmitter shall be by 18-gauge stranded telemetry wire. The Town's programmer will take it from the termination in the panel vox to the RTU and do start-up, but the work shall be paid for by the developer. If exterior control box is provided it shall be NEMA 4X and have sufficient space for the alarm transmitter
5. Modification to the existing RO Plant PLC and Servers shall be performed by the Town's Programmer but paid for and installed by the Contractor.
6. Water production facilities shall be equipped with Rosemount magnetic flow meters that can detect reverse flow. Flow meters shall be tied into the SCADA system.

C. Arc Flash:

1. Contractor shall perform a Short Circuit/Equipment Evaluation, Time Current Coordination Study, and Arc Flash Analysis Study. The limits of the Study shall begin at the Utility Primary Source of Connection and end at (including but not limited to) all Three Phase Panel boards, Switchboards, Fused Switches, Motor Starters and

Serviceable Enclosures/Equipment containing exposed live parts. Standby Power Generators and associated Equipment shall also be included in this Study.

2. The study shall be performed in accordance with NFPA 70 and 70E.
3. The Study shall be performed with the aid of a digital computer program designed for such purposes and shall be accomplished in accordance with the latest applicable references and standards.
4. Contractor shall submit (3) copies of the complete Short Circuit / Equipment Evaluation, Time Current Coordination Study, and Arc Flash Analysis Study report.
5. Contractor shall furnish and install arc flash warning labels on all new and existing electrical equipment per NFPA 70 and 70E. The arc flash warning labels shall be marked and contain the following:
 - a. Nominal system voltage
 - b. Arc Flash boundaries
 - c. Available incident energy and the corresponding working distance or arc flash PPE category
 - d. Minimum arc rating of clothing

5.2 **WASTEWATER PUMPING STATIONS:**

A. General:

1. Pumping Stations shall meet all applicable requirements of the Department of Environmental Quality (DEQ), and shall be submitted to the Town of Smithfield for review and approval. Pumping Stations shall be designed in accordance with the DEQ SCAT Regulations, and the Town of Smithfield Design Standards. The size of the pumping station shall be based on the needs of the development and the Town.

B. Plans:

1. Plans and specifications shall include provisions for excavation, foundation, and backfill, dewatering, sheeting and bracing, protection of the public, materials, material testing, details of construction of pump station and appurtenances and other items as may be applicable to the project, all in accordance with good engineering practice. Plans shall include elevations showing site appearance of the station, sections, details, electrical details and a site plan showing existing topographic information such as pavement, storm drains, utilities, trees, shrubbery, property lines, and appropriate elevations as well as new construction including layout dimensions and final elevations. Details provided by Town of Smithfield and HRPDC must be referenced where applicable.
2. The plans shall be clear and legible. They shall be drawn to a scale that will

permit all necessary information to be clearly shown. Plans shall not be larger than 24 inches x 36 inches. Datum shall be Town of Smithfield, Virginia 2003 Geodetic Control Network, Horizontal NAD 83 (1996), Vertical NAVD 88, and a referenced benchmark and project benchmark shall be shown.

3. Dimensions and relative elevation of structures, finished floor elevations, the location and size of piping, surface water levels, 100-year flood level, and ground elevations shall be shown.
4. Plans submitted for approval shall be accompanied by technical specifications, hydraulic calculations, pump curves, and pump cycle calculations.

C. Design:

1. Pump station will have two pumps setup as lead / lag. Each pump shall be capable of handling peak flows at required force main pressures. All stations shall be provided with an equivalent spare pump for Town use. Pumps shall be capable of passing 3-inch diameter solids. Pumps rated 20HP to 39HP shall have a minimum rating of 230 volts. Pumps rated 40HP and above shall have a minimum rating of 460 volts
2. Pump stations designed for greater than 250 gpm shall be wet well/dry well type with Fairbanks Morse pumps or approved equal unless otherwise specified by the Public Works Department. Pumps shall turn to clockwise. Pump stations up to 250 gpm shall be approved by the Town of Smithfield. All pumps and controls shall be explosion proof. All stations shall have three-phase power where available. If three-phase power is not available, a VFD (type approved by Town) shall be used to convert single-phase power to three-phase power. Pump stations must have an electric hoist installed on the dry well.
3. If non-clog pump is selected, it shall be a Hydromatic chopper pump, or approved equal.
4. Capacity of the wet well shall be such that the pump runs continuously for five (5) minutes with a fill time of no more than 15 minutes at the average flow.
5. When discharging into Hampton Roads Sanitation District (HRSD) force main system, both minimum and maximum pressures shall be considered in pump selection . Variable Frequency Drives (VFD) is required for connection to HRSD unless authorized by the Public Works Department . A pressure Transmitter with indicator complete with $\frac{1}{2}$ "stainless steel process seal with clean out port and magnetic flow meter wired to control shall be installed on proposed discharge piping. Engineer shall notify Southside HRSD Interceptor Engineer 30 days prior to design of connection to HRSD force main for pressure letter. Engineer shall obtain HRSD flow certification letter for all connections to HRSD.
6. As a minimum, provide design calculations to include service area map with flow

rates, project description, vicinity map, piping schematic, pump design curves with operating points, structural calculations, and HRSD pressure letter if applicable, and the following minimum design calculations:

- a. Sanitary Flows (Minimum, Average, and Peak)
 - b. Size Wet Well
 - c. Well Elevations
 - d. Well Flotation
 - e. Structural
 - f. Force Main Sizing
 - g. Pipe Headloss and Velocity
 - h. Equivalent Length of Force Main
 - i. System Head
 - j. Pump Selection
 - k. System Head Curve vs. Pump Curve
 - l. Pump Cycle Times (HRSD Minimum and Maximum Head, if applicable)
 - m. Sewage Overflow
 - n. Ventilation
7. Force main velocities shall remain between 2-8 ft/sec.
 8. Wet well bottom shall have fillet of 1:1 occupying approximately 25% of wet well bottom.
 9. Influent pipe shall be installed with a StationGuard manual bar screen or an inside drop with a Reliner Drop Bowl, as determined by the Town.
 10. All pump stations shall have a manhole on site with minimum slope pipe entering wet well.
 11. Wet well ventilation must be separate from dry well ventilation. Dry well ventilation shall vent through the outside wall and be thermostat controlled.
 12. All pump stations shall have a flow meter installed on the force main downstream of the emergency bypass pump.
 13. All pump stations must meet DEQ SCAT Regulations method of continuous operation. Method of continuous operation must be provided in writing by the developer and approved by the Town and DEQ. Pump stations discharging to pressure pipe shall obtain DEQ approval prior to construction.

D. Construction:

1. Building construction shall be approved by the Town.

2. Pump station building shall have a GFI receptacle on the outside of the building.
3. All hatches and aluminum fabrications shall be 6061-T6 with safety grate.
4. All fasteners (nuts, bolts, etc.) shall be stainless steel grade 316. All other metals in pump station shall be non-corrosive aluminum 6061-T6 or stainless steel grade 304.
5. Wet well shall contain aluminum bar screen with maximum 3/4-inch openings, aluminum stairs, emergency suction, intermediate floor, and be provided with ventilation.
6. Dry well shall contain pumps, header piping and valves, sump pump, air relief piping, stairway, adequate lighting, pressure gauge, dehumidifier, and ventilation.
7. Control Room shall contain pump control panel, remote alarm terminal, adequate lighting and ventilation, and back-up pump.
8. Pump suction velocity shall be 2-6 fps and discharge velocity shall be 2-8 fps.
9. Wet well interior shall be coated with Tnemec coating or approved equal. Coating shall be applied by a qualified and approved applicator. Application procedures shall conform to the recommendations of the coating product manufacturer, including environmental controls, product handling, mixing, application, safety, equipment, and methods. Structure exterior shall be coated with approved bituminous coating. Consult manufacturer for recommended mil thickness and obtain approval from Town.
10. Electrical service shall be underground. Control panel shall include phase monitors, running time meters, convenience outlet, and lightning suppression. Electrical conduits shall be PVC.
11. Remote alarm terminal will be furnished by the Town, but paid for and installed by the Contractor. Contractor shall provide duplex outlet for service to alarm transmitter. Connections to alarm transmitter shall be by 18 gauge stranded telemetry wire. The Town's programmer will take it from termination in the panel box to the RTU and do start-up, but the work shall be paid for by the developer. If exterior control box is provided for pump controls, it shall be NEMA 4X and have sufficient space for the alarm transmitter. Separate dry well high-level float shall be wired directly to the alarm transmitter. Separate wet well, dry well high-level float, phase monitors, bypass pump running, bypass pump fail, and door entry alarms shall be wired directly to the alarm transmitter and shall not rely on Pump Control Panel to activate alarms.
12. The developer / engineer shall contact the Town of Smithfield Public Works Department for current information and specifications involving the Town's SCADA Alarm System.

13. Emergency pump connection shall be furnished on the discharge force main no higher than two feet above finished grade with a 6 - inch 90 degree bend, 4-inch check valve and 4-inch quick disconnect compatible with the Town system. Any above ground pipe shall be insulated.
14. Emergency suction pipe shall be furnished in the wet well with 4-inch quick disconnects compatible with the Town system.
15. A Godwin stationary pump, with diesel engine and sound attenuated enclosure, will be

- required to be hard piped to the system with floats and inverter. The inverter shall have a 110 volt receptacle. The 110 volt receptacle will go from the inverter on the bypass pump to the alarm panel receptacle with the label: "Power from Bypass Pump." This will be turned over to the Town to supplement the Town's continuous operability program and satisfy DEQ. It shall be wired to prevent station pumps from running when the bypass pump is running. Above ground piping shall be insulated. To include expansion joints with lock washers or lock nuts on suction and discharge pipes. Color of stationary bypass pump shall Sherwin Williams quiver tan sw6151.
16. Pump stations shall have 8' high chain link fence with a 16' double gate and a 4' walk-through gate around the site as approved by Town. The double gate should swing inwards and the gate panels cannot block any other entrances when in the open position.
 17. All stations shall have a paved surface entrance drive a minimum of 16 feet wide with turnaround. The entrance driveway shall have an 8-inch stone base and 8 inches of asphalt. Provide onsite parking for minimum of two (2) service vehicles. Parking area shall have an 8-inch stone base and 4 inches of asphalt.
 18. All stations shall have separate check valves and gate valves located outside the wet well in an approved vault with aluminum weather tight top and access hatch. A separate valve vault with sump pump and sump pit shall contain a pressure transmitter/gauge (approved by the Town) in the control panel and flow meter capable of communicating with the control panel through a PLC. The flow meter shall be installed on the force main downstream of the emergency bypass pump. Check valves shall be ball check for under 4-inch by Danfoss Flowmatic or approved equal and swing check with weighted arm for 4-inch and above by Kennedy. Swing check valves shall be provided with a proximity switch.
 19. Submersible stations shall have a sealed stainless steel electrical junction box, location and materials to be approved by Town. See detail S-5.
 20. There shall be five mounted outside lights (one pole mounted) with a switch inside the pump station and an exterior duplex receptacle.
 21. All stations shall be provided with a flow meter capable of communicating with the control panel through a PLC. The flow meter shall be installed on the force main downstream of the emergency bypass pump connection. A water service equipped with a hose bib and a backflow preventer approved by the State Department of Health will be required at all stations. If termination is outside, hydrant shall be freeze proof type, Simmon #802 yard hydrant with minimum two (2) feet of soil cover. Provide hose bib inside and outside station where building is specified.
 22. A compact or submersible station shall have at least a 16 x16 inside enclosed building with HVAC split system for control panels. Construction shall be of concrete block with brick exterior, unless otherwise approved the Town. All wall penetrations shall

be sleeved.

23. Level controls shall be a level transducer with float backup. A digital force main pressure indicator shall also be included.
24. All pump stations shall have a submersible liquid level transmitter, digital level indicator/controller with float backup. A digital force main pressure transmitter shall be included.
25. All wet wells shall have a stainless steel float switch hook mounting bracket. Bracket shall be mounted on the hatch frame. All cables and wires should be hung separately utilizing cable support grips.
26. All pump station controls shall have the following features as a minimum:
 - a. Three phase power monitor
 - b. Pump Run Indicator for each pump
 - c. Hand-Off-Auto selector switch for each pump
 - d. Pump Flow-Fail indicator for each pump
 - e. Pump 1 – Alternate – Pump 2 selector switch
 - f. Pump Run elapsed time meter for each pump
 - g. Control Power indicator
 - h. Float Backup activated indicator
 - i. Pump Over-Temperature indicator for each pump (where applicable)
 - j. Pump Seal-Fail indicator for each pump (where applicable)
 - k. Bypass pump run
 - l. ALL above indicators shall be push to test LED type.
 - m. High Wet Well
27. All vaults and wet wells shall have a confined space zinc plated floor mount (Miller DH-7ZPI) or wall mount (Miller DH-8ZPI). The Town will direct the Contractor on placement and type.
28. All pump stations turned over to the Town of Smithfield shall have a minimum of one (1) spare pump, transducer, and VFD provided at the expense of the developer.

E. Arc Flash:

6. Contractor shall perform a Short Circuit/Equipment Evaluation, Time Current Coordination Study, and Arc Flash Analysis Study. The limits of the Study shall begin at the Utility Primary Source of Connection and end at (including but not limited to) all Three Phase Panel boards, Switchboards, Fused Switches, Motor Starters and Serviceable Enclosures/Equipment containing exposed live parts. Standby Power Generators and associated Equipment shall also be included in this Study.
7. The study shall be performed in accordance with NFPA 70 and 70E.

8. The Study shall be performed with the aid of a digital computer program designed for such purposes and shall be accomplished in accordance with the latest applicable references and standards.
9. Contractor shall submit (3) copies of the complete Short Circuit / Equipment Evaluation, Time Current Coordination Study, and Arc Flash Analysis Study report.
10. Contractor shall furnish and install arc flash warning labels on all new and existing electrical equipment per NFPA 70 and 70E. The arc flash warning labels shall be marked and contain the following:
 - a. Nominal system voltage
 - b. Arc Flash boundaries
 - c. Available incident energy and the corresponding working distance or arc flash PPE category
 - d. Minimum arc rating of clothing

5.3 **OPERATIONS, MAINTENANCE AND REPAIR MANUALS:** Operation, maintenance, programming, and repair manuals shall be provided for all individual pieces of equipment and electrical systems. Provide four (4) copies of each manual bound in hardback binders or an approved equivalent. One (1) complete manual shall be provided to the Town for approval prior to system or equipment tests being performed. All revisions or comments from the system and equipment testing shall be incorporated into the final four (4) copies to be submitted to the Town prior to project completion. The manual shall include the following information:

- A. On the exterior of the manual denote the following “OPERATION, MAINTENANCE AND REPAIR MANUAL”, the name of the project, location of the building, and the name of the Contractor.
- B. The manual shall include the name, addresses, and telephone numbers of each subcontractor installing the equipment and systems and the name, address and phone numbers for the local representatives for each item of equipment and each system.
- C. The manual shall include a table of contents, with tab sheets placed before instructions covering the subject.
- F. The manual shall include, but not be limited to the following:
 1. A system layout showing circuits, devices, and controls
 2. As-built wiring diagrams with the data to explain detailed operation, maintenance and repair for each component or system.
 3. A control sequence describing the start up, operation and shutdown.

4. Detailed instructions on the function of each piece of equipment or system to include the start up, operation, repair and shutdown procedures.
5. Provide a detailed parts list for each piece of equipment or system including
6. Programs, hardware, software, and any passwords.names, addresses and phone numbers of suppliers.
7. The manual shall be complete in all respects for all equipment, control, accessories and systems.
8. The manual shall be clearly and concisely written and shall be specifically prepared for makes, models and types of equipment and systems furnished.
9. General literature shall be modified or highlighted for the specific piece of equipment or system furnished.

SECTION 6. GENERAL NOTES:

6.1 The following notes shall be provided on all Developer constructed water distribution and sanitary sewer system facility construction plans and specifications and compliance is required by the Contractor/Developer:

TOWN OF SMITHFIELD GENERAL NOTES FOR WATER DISTRIBUTION AND SANITARY SEWER SYSTEMS:

- A. All components of the water distribution and sanitary sewer system shall be installed and tested in accordance with the latest edition of the Town of Smithfield Design Standards, the HRPDC Regional Construction Standards (Sixth Edition dated June 2016), the Virginia Department of Health Waterworks Regulations, and the Department of Environmental Quality Sewage Collection and Treatment Regulations. The Contractor shall use only new materials, parts, and products on all projects. All materials shall be stored so as to assure the preservation of their quality and fitness for the work. A copy of the Town of Smithfield Design Standards and HRPDC Regional Construction Standards must be kept on-site by the contractor during time of installing, testing, and conveying facilities to the Town.
- B. The Contractor/Developer shall acquire a Certificate to Construct for Water and Sanitary Sewer Facilities from VDH/DEQ prior to commencement of construction of any water or sanitary sewer facilities.
- C. A preconstruction meeting shall be held between the Town, the Developer, the Contractor including relevant subcontractor(s), and the Project Engineer prior to the start of construction. It shall be the responsibility of the Contractor to schedule this meeting with the Town and coordinate with the other attendees.
- D. Any work that involves repairing or shutting down water, the contractor must notify in writing affected residents and the Town of Smithfield 48 hours in advance of shut down.
- E. The Developer's representative shall submit shop drawings for all materials and receive Town approval prior to commencement of construction. All materials ordered and installed prior to the Town's review and acceptance will be at the Contractor's/Developer's risk.
- F. Pipe lines and services shall be installed after grading to within 6-inches of final grade and prior to placement of base material. If any grading adjustments are made after utilities are installed, the Contractor shall adjust the heights of meter boxes, cleanouts, valve boxes, hydrants, and manholes accordingly.
- G. All water mains shall be fully flushed, pressure tested, and disinfected and satisfactory bacteriological samples obtained, in accordance with the Town of Smithfield Design Standards. Flushing of water mains shall be scheduled with Smithfield Public Works a minimum of 3 business days prior to the flushing. Contractor shall provide the required duration and volume to Smithfield Public Works. Flushing will be scheduled Tuesday through Thursday, unless authorized otherwise by the Town, and will be on a first come-first serve basis.

- G. Routine periodic inspections during construction will be provided by the Town. These inspections do not relieve the Developer/Contractor/Owner from his obligation and responsibility for constructing a water distribution and sanitary sewer system in strict accordance with the Town of Smithfield Design Standards and HRPDC Regional Construction Standards.
- H. Any field modifications or changes to the approved plans shall be verified and checked by the Engineer of Record and approved by the Town prior to any field modifications or changes. All approved changes and field modifications shall be accurately indicated on the record drawings.
- I. All lots shall be provided with water service and sanitary sewer connections. The connections shall be extended from the main to the property line or easement line, and shall terminate with a yoke in a meter box, or at the clean out, set at final finished grade. Meters larger than 1" shall be purchased by the Contractor per Town specification. The Town shall purchase and install meters 1" and smaller. The Contractor shall install meters larger than 1" under the supervision of the Town. Meter type/model shall be approved by the Town prior to the Contractor purchasing the water meter.
- J. Any required easements, permits and approvals shall be acquired by the Developer prior to commencement of water main and/or sanitary sewer construction.
- K. The Contractor shall comply with all applicable laws, ordinances, rules, regulations and orders of any public body having jurisdiction. The Contractor shall erect and maintain, as required by the conditions and progress of the work, all necessary safeguards for safety and protection. The Contractor shall also notify "VA811" prior to performing any underground excavation.
- L. Water meter box and water service line installation shall maintain a minimum 18-inch horizontal edge-to-edge clearance from driveways and/or drive paths, sidewalks, bike paths, curbing and adjacent water meter boxes. At no point shall service lines run under driveways within the right-of-way.
- M. Only Town of Smithfield personnel are authorized to operate valves on existing Town water mains and sanitary force mains. Once a system has been hydraulically energized, the Town will be responsible for operating the valves. The Contractor shall contact Smithfield Public Works at 757-365-4200 if there is an emergency or need to open/close a valve.
- N. Any existing unused well(s) shall be abandoned in accordance with State Private Well Regulations and Town of Smithfield Code.
- O. Bedding of Town utilities shall be in accordance with HRPDC Detail EW_01, Type IV for all utilities Type III for RCP storm pipe.
- P. No trees, shrubs, structures, irrigation mains, invisible pet fences or other

obstacles shall be placed within an easement which would render the easement inaccessible by equipment. Shrubs shall be a minimum of 5 feet, and trees a minimum of 10 feet, from the center of water, storm, and sanitary sewer pipelines.

- Q. Joint restraint shall be provided in accordance with minimum requirements of Town of Smithfield Detail JR-1, unless shown otherwise on the plans. All pressure pipelines shall have joint restraint. Fire hydrants shall be restrained at least one full joint of pipe in each direction on the mainline.
- R. All private utilities in the right-of-way shall be 5-feet away from Town utilities. Water and sanitary sewer facilities shall have a minimum 10-foot horizontal edge-to-edge separation.
- S. Any proposed backflow prevention device and/or grease trap must be inspected by the Town of Smithfield Backflow Prevention Manager/FOG Inspector (757- 365-4200).
- T. The Contractor/Developer shall acquire a Certificate to Construct for Water and Sanitary Sewer Facilities from VDH/DEQ prior to commencement of construction of any water or sanitary sewer facilities. Plumbing inside of proposed buildings must be inspected by the Town's Backflow Prevention Manager (757-365-4200), for potential cross connections. Any cross connections must be protected by the appropriate backflow prevention device(s).
- U. Easements denoted as "Easements dedicated to the Town of Smithfield" are for the exclusive use of the Town and the property owner. Other utility service providers desiring to use these easements must obtain authorization for access and use from the Town and the property owner. Additionally, the Town shall not be held responsible for any damage to improvements within this easement, from any cause.
- V. The Town of Smithfield shall not be held responsible for any pavement settlement due to pipe bedding, backfilling, backfill materials or compaction for water or sanitary sewer facilities for this project.
- W. Fire hydrants to be installed within existing or proposed VDOT rights-of-way shall be located in accordance with VDOT Requirements.
- X. Privately owned utilities, (e.g., water and sewer lines and private fire service mains), shown on this plan are regulated by the Virginia Uniform Statewide Building Code, and enforced by the Isle of Wight County Permits Division. These privately owned utilities must comply fully with the International Plumbing Code, the National Fire Protection Association Standard 24, and the Virginia Statewide Fire Prevention Code. Contractors working from this site plan are cautioned not to install or conceal privately owned site utilities without first obtaining the required permits and inspections.
- Y. Sanitary sewer laterals shall connect to the mainline unless otherwise directed by the Town.

- Z. Sanitary sewer lateral and cleanout installation shall maintain a minimum 18-inch horizontal edge-to-edge clearance from driveways and/or drive paths, sidewalks, and bike paths. At no point shall laterals run under driveways within the right-of-way.
- AA. On any water service removal or disconnect, a brass end cap shall be installed on the corporation stop.
- BB. All private Underground Fuel Storage tanks shall have leak monitors and secondary containment in accordance with Virginia State Department of Environmental Quality requirements.
- CC. All water and sewer accessory kits, adapter fittings, pipe restraint bolts, T-bolts and nuts shall be Cor-Blue type or Fluoropolymer epoxy coated bolts and nuts.

6.2 The following notes are a supplement to the Town of Smithfield General Notes for Water Distribution Systems and shall be provided on all Developer constructed water production facility construction plans and specifications and compliance is required by the Contractor/Developer:

TOWN OF SMITHFIELD GENERAL NOTES FOR WATER PRODUCTION FACILITIES:

- A. All well facilities shall be designed by a Commonwealth of Virginia Licensed Professional Engineer (Consultant), and the design, construction and installation shall be in accordance with the following:
 1. Commonwealth of Virginia Department of Health (VDH) Waterworks Regulations.
 2. Town of Smithfield Design Standards.
 3. Approvals of the Town and VDH shall be obtained prior to commencement of construction.
- B. Construction plans shall be submitted through the Town for review and approval. The Developer/Contractor/Consultant shall supply minimum three (3) sets of construction plans and specifications detailing all phases of the well and water production construction including testing, materials, shop drawing submittals, painting and installation. These shall be submitted to, and approved by, the Town.
- C. The Developer/Contractor/Consultant shall be responsible for assuring that all work is performed in accordance with the approved plans and specifications. Any deviation from the approved plans and specifications shall be approved by the Town and VDH prior to performing such work.
- D. Drilling fluid shall be sodium bentonite drilling clay commercially processed to meet

- or surpass the viscosity specifications in API “Standard 13-A for Drilling Fluid Materials”, or approved equal.
- E. Organic drilling muds shall not be used in any phase of drilling or construction. Lime shall not be used to thicken the drilling mud.
 - F. Drilling fluid mix water shall be from a potable source and initially Chlorinated to 50 mg/l free Chlorine concentration. Periodic addition will be required to maintain a 10 mg/l free Chlorine residual. All drilling fluids additives shall comply with industry standards and practices.
 - G. During drilling and well construction, a “Driller’s Log” shall be prepared and submitted to the Town upon completion of the drilling.
 - H. Upon completion of the geophysical logging, recommendations shall be submitted to The Town for approval prior to the installation of the well casing and screens.
 - I. Grout of the surface casing shall be placed under pressure using an external tremie pipe in one continuous operation to a minimum depth of 100-feet.
 - J. Grouting operations shall be performed in the presence of the Town’s Inspector and a VDH representative. Both agencies shall be notified a minimum of 48-hours in advance of the grouting operations.
 - K. Grout mixtures shall be approved by VDH and the Town prior to installation. Grout shall be firmly set (minimum of 72-hours) prior to proceeding with the well construction.
 - L. The well casing shall be stainless steel 316L. PVC well casing may be used with the prior approval of the Town and VDH as to material specifications and construction installation methods.
 - M. The screen shall be stainless steel 316L continuous slot wire wound screen, reinforced with longitudinal bars; the bars having a cross section that will form an opening between each adjacent coil of wire.
 - N. Prior to installation, the Consultant/Driller’s recommended screen slot and gravel size along with supporting calculations shall be submitted to the Town for approval.
 - O. Prior to gravel packing, the hole shall be conditioned to ensure stability and to provide a clear filter cake. The gravel shall be disinfected by adding sufficient Chlorine to the placement fluid to produce a minimum Chlorine residual of 400 mg/l.
 - P. The well shall be developed in such a way as to remove the fines and sort the gravel pack. Records of the development steps and the chemicals used shall be submitted to the Town.

- Q. A well plumbness and alignment, 48-hour pump test and recovery test shall be performed and the results documented and submitted to the Town.
- R. Water samples shall be collected and analyzed for all parameters, required by VDH, including VOC's.
- S. Final pump size and setting recommendations, along with test results and supporting documentation, shall be submitted to the Town for review and approval prior to installation.
- T. The well shall be disinfected in accordance with VDH requirements.
- U. The Developer shall obtain construction and operational permits from VDH and DEQ.
- V. The Developer shall obtain all easements, approvals and regulatory permits.
- W. The Developer shall acquire and provide 3-phase electrical service for the facility.
- X. The water production facilities shall be equipped with a standby generator. Generator shall be rated for continuous duty and provide all power to operate the complete facility and systems.
- Y. Shop drawings and operational, maintenance and repair manuals shall be provided to The Town, along with a one-year warranty on all facility components and workmanship.
- Z. Record drawings shall be submitted and the facilities shall be dedicated as a public water supply prior to acceptance by the Town. Dedication does not mean acceptance of the water facility. All required easements shall be dedicated to the Town with recorded documents submitted to the Town.
- AA. The facility shall have an 8' fence with barbed wire.

APPENDIX A
Smithfield Construction Standards

SECTION 105

CONTROL OF WORK

I. REUSE OF CONTRACT DOCUMENTS

- 1.1 Neither the Contractor nor any Subcontractor or Supplier or other person or organization performing or furnishing any of the Work under a direct or indirect contract with the Owner shall have or acquire any title to or ownership rights in any of the Contract Documents (or copies thereof) prepared by or bearing the seal of the Engineer; and, they shall not reuse any of the Contract Documents on extensions of the Project or any other project without written consent of the Owner and Engineer and specific written verification by the Owner.

II. COPIES OF CONTRACT DOCUMENTS

- 2.1 The Owner will furnish to the Contractor up to _____ () copies of the Contract Documents as are reasonably necessary for the execution of the Work. Additional copies will be furnished, upon request, at the cost of reproduction, unless a digital version is provided by the Owner.

III. CONTRACT DOCUMENTS

- 3.1 The Contract Documents will govern the Work set forth therein.

In cases of conflicts, Special Provisions shall govern over the *Regional Construction Standards*; Specifications shall govern over Drawings; figure dimensions shall govern over scaled dimensions; and, detailed Drawings shall govern over general Drawings; unless, the interpretation would result in a violation of any law or regulation applicable to the performance of the Work

- 3.2 The Contractor shall, upon discovering any error, omission, or discrepancy in the Contract Documents, immediately notify the Owner.

IV. SHOP DRAWINGS AND SUBMITTALS

- 4.1 The Contractor shall compile a complete and comprehensive schedule of all the submittals anticipated to be made during the progress of the Work. The schedule shall include a list of each type of item for which the Contractor's drawings, Shop Drawings, material affidavits, material samples, certificates, warranties, guarantees, operations and maintenance manuals, testing and adjustment reports, plans, schedules or other types of submittals are required by the Contract Documents.

- 4.2 Prior to each submittal, the Contractor shall carefully review and coordinate all aspects of each item or sample submitted with any other item or sample being submitted and verify that each item and sample adheres in all respects with the requirements of the Contract Documents.

- 4.3 The Contractor shall certify that all materials used in the Work are in complete compliance with all specified provisions. Certification shall not be construed as relieving the Contractor from its responsibility of furnishing satisfactory materials. At the time of each submission, the Contractor shall in writing call the Owner's attention to any deviations that the Shop Drawings or samples may have from the requirements of the Contract Documents. By making a submission for approval, the Contractor shall be deemed to have certified that he has checked the items in the Shop Drawings before submitting them and that he is satisfied that, in their present state, they not only meet the requirements of the Contract Documents, but will present no difficulties in the performance and

completion of the Work. The Contractor shall clearly note his approval on the Shop Drawings prior to submission to the Owner. Failure of the Contractor to note his approval will be reason for the Owner to return such submission to the Contractor unchecked.

1. If it appears to the Owner that the Shop Drawings submitted by the Contractor have not been properly checked, even though the Contractor's approval has been noted thereon, Owner may return such submission to the Contractor unchecked.
 2. Markings, written or otherwise, made by the Contractor or by his suppliers or manufacturers must be made on the Submittal in a color other than red. RED is reserved for the exclusive use of the reviewer in marking Submittals.
- 4.4 The Contractor shall submit four (4) copies, plus the number of copies desired to be returned, of Shop Drawings or submittals that are required by Section 105 or the Special Provisions. Each submission shall be accompanied by letter of transmittal in duplicate, listing the contents of the submission and identifying each item by reference to specification section or Drawing. The data shown on the Shop Drawings shall be complete with respect to quantities, dimensions, specified performance and design criteria, materials and similar data to show the Owner the materials and equipment the Contractor proposes to provide. Digital Shop Drawing submittals may be made when acceptable to the Owner and all provisions in this section are satisfied.
- 4.5 The Contractor shall also submit samples to the Owner for review and approval in accordance with the accepted schedule of submittals. Each sample shall be identified clearly as to material, supplier, pertinent data such as catalog numbers and the use for which intended and otherwise as the Owner may require for review. The review of a separate item or sample will not indicate approval of any assembly in which the separate item or sample functions.
- 4.6 The Contractor is responsible for submitting all Shop Drawings and schedules in a timely manner to avoid delaying the Work. The Owner shall within 21 Days after receipt, return Shop Drawings and schedules to the Contractor indicating approval or disapproval.
- 4.7 Review and/or approval of Shop Drawings will be for general conformance with the Contract Documents and shall not relieve the Contractor from the responsibility of furnishing materials and equipment of proper dimension, size, quality, quantity, and all performance characteristics to efficiently perform the requirements and intent of the Contract Documents. Approval shall not be construed as permitting any departure from the Project requirements, authorization of any increase in price, or approval of departures from additional details or instructions previously furnished by the Owner.
- 4.8 Before submitting each Shop Drawing or sample, the Contractor shall have determined and verified:
- A. All field measurements, quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers and similar information with respect thereto;
 - B. All materials with respect to the intended use, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
 - C. All information relative to the Contractor's sole responsibility in respect of means, methods, techniques, sequences and procedures of construction and safety precautions and progress incident thereto.

- 4.9 Each Shop Drawing and sample submission shall bear a stamp or specific written indication that the Contractor has satisfied Contractor's obligation under the Contract Documents with respect to the Contractor's review and approval of that submission. The Contractor's Shop Drawing stamp shall be as follows (or as otherwise approved by the Owner and Engineer):

*(Owner's Name)
(Project Name)*

Shop Drawing No.: _____

Specification Section: _____

With respect to this Shop Drawing or Sample, I have determined and verified all quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers, and similar data with respect thereto and reviewed or coordinated this Shop Drawing or Sample with other Shop Drawings and samples and with the requirements of the Work and the Contract Documents.

No variation from Contract Documents

Variation from Contract Documents as shown

(Contractor's Name and Address)

By: _____

Date: _____

- 4.10 The Engineer will review and approve or disapprove or return as incomplete Shop Drawings and samples in accordance with the schedule of submittals submissions accepted by the Engineer. The Engineer's review and approval or disapproval will not extend to means, methods, techniques, sequences or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The Contractor shall make corrections required by the Engineer, and shall return the requested number of copies of Shop Drawings and samples for review and approval. The Contractor shall direct specific attention in writing to revisions other than the corrections called for by the Engineer on previous submittals. Upon approval, two marked copies will be returned to the Contractor.

- 4.11 No progress payments will be made to the Contractor until the schedules are submitted to and acceptable to the Engineer. The progress schedule shall be acceptable to the Engineer as being the Contractor's schedule for the orderly progression of the Work to completion within any specified Contract Times, but such acceptance will neither impose on the Engineer responsibility for the sequencing, scheduling or progress of the Work nor interfere with or relieve the Contractor from the Contractor's full responsibility therefor.

- 4.12 The Engineer will record time required by the Engineer or Engineer's consultants for excessive submittal review occasioned by the Contractor's re-submission, in excess of one re-submission of a

required submittal, caused by unverified, unchecked or un-reviewed, incomplete, inaccurate or erroneous, or nonconforming submittals. The Engineer's costs will be an estimated average billing rate for labor plus related expenses and shall be paid by the Contractor upon terms satisfactory to the Owner.

- 4.13 Within ten (10) Days after the Effective Date of the Agreement, the Contractor shall submit to the Engineer for approval a schedule listing the manufacturer of the items of equipment and materials proposed for the construction. Following approval of the schedule, no changes in material or equipment from those listed will be allowed except in unusual or extenuating circumstances. When such circumstances arise, the Contractor shall request, in writing, the Owner's approval of the proposed change, stating the circumstances necessitating such a change. The intent of this schedule is to name the manufacturers of material specified by a product standard and to designate which manufacturer will be used when more than one has been named for an item. The schedule shall not be interpreted as allowing any change from base Bid items or those substitute items offered with the Bid and accepted in the Agreement.
- 4.14 Submittals shall be made in logical groupings representing all submittals from a technical specification section and/or, where appropriate, related section(s). Shop drawing submissions lacking all required submittals under a technical specification section(s) will be returned without review.
- 4.15 The approval of Shop Drawings shall not relieve the Contractor from the responsibility for proper fittings and construction of the Work nor from furnishing materials and work required by the Contract which may not be indicated on the Shop Drawings when approved.
- 4.16 Where a Shop Drawing or sample is required by the Specifications, and related work is performed prior to the Owner's review and approval of the pertinent submission, such work will be the sole responsibility of the Contractor. Owner shall have the right to inspect any such Work, but failure of Owner to inspect such Work shall not be deemed an acceptance by the Owner.
- 4.17 In proposing alternate materials or construction methods or in requesting Owner determination of alternate materials, submittals must clearly demonstrate that the proposed alternate items clearly meet, in all respects, the requirements of the Contract Documents, design intent of the Project. The burden of proof in all such determinations is up to the Contractor and the Owner's determination is un-reviewable and final. All such proposals count as submittals in determining the cost of additional reviews in accordance with paragraph 4.12 above.
- 4.18 Manufacturer's Certificates
- A. The Contractor shall furnish at the time of submitting Shop Drawings the manufacturer's certificates for items of equipment and products in the various sections of these Specifications.
 - B. The manufacturer's warranty and certification submitted for equipment, a product, or component of a product shall indicate that the manufacturer has examined the Contract Documents and the equipment, product or component of a product provided will meet the performance criteria and conforms in all respects to the requirements of the Contract Documents.
 - C. A statement originating from the Contractor, or any of his Subcontractors, suppliers, or any other agent, which merely indicates that a particular item of equipment, product, or component of a product, meets the requirements of the Contract Documents, shall not be

considered a certificate. Any such submittal made in this manner will not be approved and the corresponding equipment, product, or component of a product, shall not be approved.

V. RECORD DRAWINGS

- 5.1 The Contractor shall keep one record copy of all Special Provisions, Specifications, Drawings, Addenda, Written Amendments, Change Orders, Shop Drawings, Owner-approved submittals, and samples at the site in good order and annotated to show all changes made during the construction process. These documents shall be available to the Owner for examination and shall be submitted to the Owner upon completion of the Work. As-built information (including dimensions, materials, existing utilities) shall also be included on the Drawings. Progress payments may be withheld for failure to keep neat, accurate and complete record drawings.
- 5.2 The Contractor shall include any field changes, deviations from the Drawings due both to field conditions and Change Orders.
- 5.3 Record information for projects shall include the following as a minimum:
- A. Size, horizontal and vertical location of all existing utilities uncovered during the course of the Work. This shall include telephone cables and conduits, TV cables and conduits, electrical cables and conduits, gas lines, water line, sewer force mains, sanitary sewers, storm sewers and the like.
 - B. Horizontal and vertical location of the water, force main, sanitary and storm sewer installed at every 100-foot station, at interconnections, and at fittings, tees, bends and offsets. The frequency and location of survey shots will match the proposed grade elevations shown on the Drawings.
 - C. Location of lines plugged or capped, blowoffs, and air vents.
 - D. Location of all restraining devices used; for example, thrust blocks, retainer glands, tie rods, etc.
 - E. Location of all valves, ends of all lines and other fittings shall be accurately located by triangulation from two permanent structures, which will be visible on the ground surface.
 - F. Location and size of all taps and service line connections made, including corporation stops (if any) used for testing purposes.
 - G. Size (if greater than $\frac{3}{4}$ "), material, depth and location of both ends of the water service lines are required.
 - H. Rim elevations of manholes and invert elevations of pipes entering and exiting the manhole.
 - I. Size, material, depth and location of sewer laterals including:
 1. Measurements taken from the nearest downstream manhole, then measure over perpendicular from that point on the main to the end of the lateral. All measurements are taken from the center of the manhole cover.
 2. If lateral comes out of a manhole in a cul-de-sac; triangulation from that manhole will be required.

3. Measured depth from the finished grade at the end of the lateral.

J. Information required for public storm drain systems:

1. Size, material and location of all storm sewer lines.
2. Elevations shall be provided for all ditch, pipe and structure inverts and rims.

5.4 The Record Drawings shall include the following minimum accuracy for survey measurements and field measurements.

A. Horizontal accuracy:

1. Both surface and subsurface gravity sanitary sewer systems shall be measured in a survey to +/- 1.0 foot at the structure location.
2. Both surface and subsurface pressure systems shall be measured in a survey to +/- 1.0 foot at the structure location.
3. Curb/curb and gutter shall be measured in a survey to +/- 1.0 foot at high points, low points, curb returns, and various other positions following good engineering, construction and surveying practices.
4. Storm Water Management Facilities (SWMF) shall be measured in a survey to +/- 1.0 foot, including the top of bank, bottom of bank, edge of water, pipes, structures, and setback distances to property lines and/or right-of-way lines and any unusual feature of each SWMF.
5. Utility system components including, but not limited to, fire hydrants, meter vaults, meter boxes, water services, corporation stops, fittings, thrust restraint, laterals, cleanouts, valves, blowoff assemblies, air vent assemblies, water sampling stations, etc. shall be measured in a survey to +/- 1.0 foot.
6. Project landscaping shall be measured in a survey to +/- 1.0 foot. Only large significant features, such as trees, will be surveyed. The species and caliper (size) shall be noted.
7. Street signs and light poles shall be measured in a survey to +/- 1.0 foot.

B. Vertical accuracy:

	Survey Accuracy	Field Measurement
Manhole Rim	+/- 0.01 ft.	
Manhole Invert	+/- 0.01 ft.	
Gravity Sewer Slope	+/- 0.02%	
Valve Depth	+/- 0.1 ft.	
Pressure/vacuum systems	+/-0.05 ft.	
SWMF	+/- 0.01 ft.	
Curb/curb and gutter	+/- 0.01 ft.	
Offset		+/- 1.0 ft.
Lateral Depth		+/- 0.25 ft.

The Contractor shall provide on the record drawings, if applicable, coordinate values (northing's and easting's based on the locality's monumentation) for the following:

Gravity Sewer

- Manholes
- Cleanouts and connections to the main

Force Mains

- Valves and tracer wire boxes
- Air release assemblies
- Horizontal bends 45-degrees (and greater if allowed) and combinations of fittings equaling 45-degrees or greater, spaced no greater than 10-feet of the start of the bends to the bend's terminus
- Offsets (vertical and horizontal)
- Connections (tees and taps)
- Limits of lined pipe

Grinder Pump and Low Pressure Systems

- Grinder pump
- Control panel
- Air release/cleanout assemblies
- Valves
- Connections to force mains (taps, corporation stops, etc.)

Water Systems

- Water meters
- Hydrants
- Valves and tracer wire boxes
- Connections and intersections (taps, etc.)
- Air release assemblies
- Corporation stops/taps to mains
- Offsets (vertical and horizontal)
- End of line blow-off assemblies
- Sample stations

Storm Sewer

- Manholes
- Curb Inlets
- Yard Drains

The Contractor shall provide all information on all valves installed as part of the project in the chart provided below and is to be included on the Record Drawings.

Item No.	Data	Valve				
1	Project Name					
2	Date Installed					
3	Branch ID					
4	Station No. (0+00)					
5	Valve No. (IMS); to be provided by Owner					
6	Size (diameter)					
7	Material of Construction (DI, PVC, Brass, etc.)					
8	No. of Turns					
9	Opens (L, R)					
10	Operating Status (NO/NC)					
11	Depth (Elevation from finish grade to operator)					
12	Manufacturer & Model No.					
13	Type *					
14	Casting Date					
15	End Conn. **					
16	Coordinates (northing/easting)					

* FMV = Force Main Valve, ARV = Air Release Valve, FP = Flush Point, FMCV = Force Main Check Valve, WB = Wire Box, NRS = Non Rising Stem, GV = Gate Valve, BFV = Butterfly Valve, BV = Ball Valve, GA = Gear Actuated, H = Horizontal, V = Vertical. NO = Normally Open; NC = Normally Closed
** (MJ x type, Flange x type, Restrained, Glue, Threaded, Other)

Note: No information required for Check Valves in items 8 – 10.

5.5 Record Drawings shall be provided in two versions: a sealed PDF version and an electronic format acceptable to the Owner

VI. ACCESS TO PROJECT

6.1 The Owner, the Owner's Representatives, the Engineer, testing agencies and governmental agencies with jurisdictional interests shall have access to the Project at all times for their observations, inspecting, and testing. The Contractor shall provide proper and safe conditions for such access.

VII. SURVEYS AND REFERENCE POINTS

7.1 The Owner shall furnish all necessary Drawings showing property lines and/or easements and the location of the Work. The Contractor shall provide a land surveyor licensed in the Commonwealth of Virginia to execute the Work in accordance with the Contract Documents and shall be responsible for the accuracy of this Work.

7.2 The Owner has established or will establish such general reference and control points and benchmarks on or about the Project site as will enable the Contractor to proceed with the Work. Prior to issuance of the Notice to Proceed, if the Contractor finds that any previously established reference

points have been destroyed or misplaced, the Contractor shall promptly notify the Owner, and the Owner shall replace such general reference points and benchmarks at the Owner's expense.

- 7.3 The Contractor shall protect and preserve the established control points, bench marks and monuments and shall make no changes in locations without the written approval of the Owner. Any of these which may be lost or destroyed or which require shifting because of necessary changes in grades or locations shall, subject to prior approval of the Owner, be replaced and accurately located by the Contractor, at no expense to the Owner.

VIII. WORKING HOURS

- 8.1 Normal working hours shall be _____ a.m. to _____ p.m., Monday through Friday, except that Work shall not start any earlier than one-half hour after sunrise or continue beyond one-half hour prior to sunset. If the Contractor desires to perform Work outside the normal working hours, on holidays, or on weekends, the Contractor shall request permission, in writing, 48-hours in advance to allow arrangements to be made. The Contractor may be charged an inspection fee by the Owner if such Work is approved. Where the Owner specifically directs the Contractor to work outside of normal working hours, no inspection fee will be imposed. The Owner may refuse the Contractor permission to work outside the normal working hours. The Contractor shall make reasonable efforts to avoid undue noise during the night and on weekends, including, but not limited to, fireproof covering necessary to dampen excessive noise from engines or pumps which operate before 7:00 a.m. and after 9:00 p.m., if it is necessary to work at those times.
- 8.2 The Contractor shall designate a representative and furnish a telephone number at which the representative may be contacted at any time after working hours. This representative shall be empowered and authorized to provide such personnel and equipment as may be required to remedy emergency situations that may develop after normal working hours, or on weekends and holidays.
- 8.3 The Contractor shall receive approval of the Owner, in advance, of any Work to be performed on holidays. The Owner reserves the right to deny permission to work on Sundays and/or holidays without cause.
- 8.4 Holidays are as listed below:

New Years' Day	1 st day of January
Martin Luther King's Birthday	3 rd Monday in January
President's Day	3 rd Monday in February
Memorial Day	Last Monday in May
Independence Day	4 th day in July
Labor Day	1 st Monday in September
Veteran's Day	11 th day of November
Thanksgiving Day	4 th Thursday in November
Day after Thanksgiving	Friday after 4 th Thursday in November
Christmas Eve	24 th day of December
Christmas Day	25 th day of December

If a holiday falls on a Sunday, the following Monday shall be considered the holiday. If these dates fall on a Saturday, the previous Friday shall be considered the holiday. If any part of a two-day holiday falls on a weekend, the observance of the holiday shall be scheduled at the Owner's discretion in such a way as to result in a four-day weekend.

The Contractor's attention is called to Section 109-1.6.C.1.d. regarding Owner compensation by the Contractor for overtime Work performed outside normal working hours.

June 2016

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Project Title
Date
Owner
Bid Number



IX. PROJECT COORDINATION

9.1 Coordination with Owner

- A. The Contractor shall coordinate all construction activities with the Owner and shall obtain the Owner's approval as to schedule of Work, permits, temporary Work, and traffic control.
- B. Progress meetings shall be held monthly on a date to be set by the Owner. The Contractor shall be present at all progress meetings. If progress is not made as scheduled, or if the Owner desires to discuss revised progress schedules or the quality of workmanship or other aspects of the Work, additional progress meetings can be required.
- C. The Owner may construct or reconstruct any utility service in the highway or street or grant a permit for the same at any time. The Contractor shall not be entitled to any damages occasioned thereby other than a consideration of an extension of time.
- D. When authorized by the Owner, the Contractor shall allow any person, firm, or corporation to make an opening within the limits of the Project upon presentation of a duly executed permit from the Owner. When directed by the Owner, the Contractor shall satisfactorily repair portions of the Work disturbed by the openings. The necessary Work will be paid for as extra Work in accordance with these specifications and shall be subject to the same conditions as the original Work performed.

9.2 Coordination with Utilities

- A. The Owner and Contractor agree that disruption to public services shall be avoided whenever possible and minimized when it is not avoidable. In cases where the disruption of existing facilities could adversely impact public service delivery, acceptable duration(s) and time(s) of the outages shall be coordinated between the Contractor and Owner, so as to explicitly minimize disruption to public service delivery.
- B. Before the initiation of any excavation, the Contractor shall locate all existing utilities, culverts, and other structures. Work shall be coordinated with affected utility companies. Prior to excavation, the Contractor shall contact MISS UTILITY at (800) 552-7001 and comply with all MISS UTILITY requirements.
- C. All existing utilities, both public and private (including sewer, gas, water, electrical services, etc.), shall be protected and their operation shall be maintained throughout the course of the Work. Any temporary shutdown of an existing service shall be arranged by the Contractor between the Contractor and the responsible agency. The Contractor shall assume full responsibility and defend and hold the Owner harmless from the result of any damage that may occur as a result of the Contractor's activities.
- D. If any utility service is interrupted as a result of accidental breakage or of being exposed or unsupported, the Contractor shall promptly notify the proper authority and shall cooperate with the authority in the restoration of service. If utility service is interrupted, repair work shall be continuous until service is restored. The Contractor shall be responsible for any damage to utilities that are attributable to his neglect or methods of performing the Work.
- E. The Owner shall provide Utility companies with copies of the construction plans and or scope of work prior to construction. If requested by the Owner, the Contractor shall provide

each affected utility company with a copy of the proposed schedule of progress prior to commencing Work.

- F. Existing facilities (such as water and sewer valves) shall be operated only by the facility owner or under the direct supervision of the facility owner's personnel. The Contractor shall inform the owner at least 48-hours in advance of the need for the operation of existing facilities.
- G. At points where the Contractor's operations are adjacent to the properties of any utility, including railroads, and damage to which might result in considerable expense, loss, or inconvenience, Work shall not commence until arrangements necessary for the protection thereof have been completed.
- H. The Contractor shall cooperate with owners of utilities so that location, removal and adjustment operations may progress in a reasonable manner; duplication of adjustment work may be reduced to a minimum; and, services rendered by those parties will not be unnecessarily interrupted.
- I. The Contractor should be aware that in some instances buried cables, gas lines, water lines, etc., two inches and smaller in diameter may have to be excavated by hand and slightly relocated to facilitate construction of the Work under this contract. This shall be considered incidental to the Work, and shall be performed at no additional cost to the Owner.
- J. Should the location of any pipe or conduit greater than two-inches in diameter, pole, or other structures, above or below the ground be such that in the opinion of the Owner or his representative its removal, realignment, or change will be required due to Work to be performed under this Contract, the removal, realignment, or change will be done as a Change Order, or will be done by the Owner of the obstructions, without cost to the Contractor. The Contractor shall maintain at his own expense the structures until such removal and before and after such realignment or change. The Contractor shall not be entitled to any claim for damages or extra compensation because of the presence of said structure, or because of any delay in the removal or relocation of the same.

X. SUPERVISION

- 10.1 The Contractor shall supervise and direct the Work, and shall be solely responsible for the means, methods, techniques, sequences and procedures of construction. The Contractor shall employ and maintain on the Project a qualified supervisor who shall have been designated in writing by the Contractor as the Contractor's representative at the site. The supervisor shall have full authority to act on behalf of the Contractor and all communications given to the supervisor shall be the same as if mailed to the business address of the Contractor. The supervisor or a designated representative shall be present on the site at all times as required to perform adequate supervision and coordination of the Work. The Contractor shall notify the Owner in writing prior to any change of supervisor, and receive the Owner's approval for the replacement.
- 10.2 Upon notification to the Contractor, the Owner reserves the right to suspend the Work until such time as a supervisor satisfactory to the Owner is assigned to the project. Contract Time shall not be extended for such suspension nor shall the Contractor be entitled to any additional payment of any kind whatsoever as a result of such suspended Work.

- 10.3 Any employee of the Contractor or Subcontractor who is deemed unsuitable may be removed from the job site by the Owner, provided that Written Notice and just cause is given to the Contractor. Said employee shall be removed immediately upon receipt of said Notice.

XI. UNCOVERING WORK

- 11.1 If any Work has been covered or concealed without the Owner's approval prior to being covered or concealed, the Owner may request to see such Work and it shall be exposed by the Contractor. The Contractor shall pay the cost of opening or uncovering and replacement and shall, in addition, at no cost to the Owner, make the necessary corrections to bring the Work into accord with the Contract Documents.
- 11.2 Uncovering Work shall be at the Contractor's expense unless the Contractor has given the Owner timely notice of the Contractor's intention to cover the same and the Owner has not acted with reasonable promptness in response to such notice.
- 11.3 If the Owner considers it necessary or advisable that covered Work previously approved be re-inspected or tested by others, the Contractor, at the Owner's request, shall uncover, expose or otherwise make available for observation, inspection or testing as the Owner may require, that portion of the Work in question, furnishing all necessary labor, materials, tools, and equipment. If it is found that such Work is defective, the Contractor shall bear all the expenses of such uncovering, exposure, observation inspection and testing and of satisfactory reconstruction. If, however, such Work is not found to be defective, the Contractor will be allowed an increase in the Contract Price or an extension of the Contract Time or both directly attributable to such uncovering, exposure, observation, inspection, testing and reconstruction and an appropriate Change Order shall be issued.

XII. REMOVAL OF UNACCEPTABLE WORK

- 12.1 All Work that does not conform to the requirements of the Contract Documents shall be unacceptable.
- 12.2 The Contractor shall remove or correct all unacceptable and defective Work or materials. The replacement of Work and materials shall conform to the Contract Documents or be in a manner acceptable to the Owner. The Contractor shall bear all costs of such correction and/or removal and replacement.
- 12.3 Work done contrary to or regardless of the instructions of the Owner, Work done beyond the lines shown or as directed, except as herein provided, or any extra Work done without authority, will be considered unauthorized and will not be paid for under the provisions of the Agreement. Work so done may be ordered removed or replaced at no cost to the Owner.
- 12.4 If the Work is defective, or the Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to furnish or perform the Work in such a way that the completed Work will conform to the Contract Documents, the Owner may order the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of the Owner to stop the Work shall not give rise to any duty on the part of the Owner to exercise this right for the benefit of the Contractor or any surety or other party. If the Contractor does not remedy, remove, or replace the rejected or condemned Work as instructed by the Owner within the time period stated by the Owner but in no case to exceed 30 Days after receiving written Notice, such remedy, removal, or replacement may be accomplished by the Owner at the Contractor's expense.

XIII. SUBSTANTIAL COMPLETION

- 13.1 Prior to Final Payment, but following completion of all required tests and inspections, the Contractor may request in writing that the Owner certify that the entire Project or any phase of the Project is Substantially Complete and request the Owner issue a Certificate of Substantial Completion. Within fourteen (14) working days the Owner will conduct an inspection of the Project with the Contractor and either issue a Certificate of Substantial Completion or notify the Contractor in writing of the incomplete items. The Certificate and attachments shall include the following:
- A. A listing of responsibilities for the security, operation, safety, maintenance, utilities and insurance on the substantially completed portion;
 - B. A tentative list of items to be completed or corrected prior to final payment; and,
 - C. The maximum time for items to be completed or corrected prior to final payment.

- 13.2 The Owner shall have the right to exclude the Contractor from the Project or phase of the Work certified to be Substantially Complete; however, the Owner will allow the Contractor reasonable access to complete or correct the Work.

XIV. USE OF COMPLETED PORTIONS

- 14.1 The Owner shall have the right to take possession of and use any completed or partially completed portions of the Work, notwithstanding that the time for completing the entire Work or such portions may not have expired, but such taking possession and use shall not be deemed an acceptance of any Work not completed in accordance with the Contract Documents. If such prior use increases the cost of or delays the Work, the Contractor shall be entitled to such extra compensation or extension of time or both as the Owner and the Contractor may agree by a Change Order.

XV. FINAL INSPECTION

- 15.1 Upon receiving written Notice from the Contractor that the entire Work or an agreed upon portion is complete, the Owner will make a final inspection with the Contractor, and will notify the Contractor in writing of all particulars in which this inspection reveals that the Work is incomplete or defective. The Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.
- 15.2 This procedure shall be repeated until all items are corrected to the satisfaction of the Owner. Only written notification to the Contractor from the Owner will constitute final acceptance of any part of the Work under the Agreement.

XVI. CLAIMS

- 16.1 All claims, disputes, demands and other matters in question arising out of or relating to the Agreement or the Contract Documents, except for claims which have been waived by the Contractor's acceptance of final payment, will be addressed in accordance with the provisions of the Virginia Public Procurement Act and as stated herein; provided, however, the provisions of Section 2.2-4366 of that Act will not be applicable without the separate express written consent of the Owner.
- 16.2 Early or prior knowledge by the Owner of an existing or impending claim for damages could alter the plans, scheduling, or other action of the Owner or result in mitigation or elimination of the effect of the act objected to by the Contractor. Therefore, a written statement describing the act of omission or

commission by the Owner or its agents that allegedly caused damage to the Contractor and the nature of the claimed damage shall be submitted to the Owner at the time of occurrence or beginning of the Work upon which the claim and subsequent action are based. If such damage is deemed certain in the opinion of the Contractor to result from his acting on an order from the Owner, he shall immediately take written exception to the order. Submission of a notice of claim as specified shall be mandatory. Failure to submit such notice shall be a conclusive waiver to such claim for damages by the Contractor. An oral notice or statement will not be sufficient nor will a notice or statement after the event.

If the Contractor's claim contains data that cannot be verified by the Owner's records, the data shall be subject to a complete audit by the Owner or its authorized representative if they are to be used as a basis for claim settlement.

If the Contractor wishes to make claim for an increase in the Contract Price or Contract Time, he shall submit all supporting data to the Owner and Engineer within twenty (20) Days from the time of initial occurrence. Failure to submit such data within twenty (20) Days shall be a conclusive waiver to such claim by the Contractor.

16.3 All claims, disputes, and other matters relating to or arising out of the Agreement or the Contract Documents pertaining to the performance of the Work and claims in respect to changes in the Contract Price or Contract times shall be submitted to the Owner and Engineer in writing. Written Notice of each such claim, dispute or other matter shall be delivered by the Contractor to the Engineer and the Owner promptly (but in no event later than twenty (20) days) after the start of the occurrence or event giving rise thereto, and written supporting data shall be submitted to the Engineer and the Owner promptly, (but not later than twenty (20) days) after the start of such occurrence or event and monthly thereafter for continuing events unless the Owner and Contractor mutually agree to extend the time required to submit the written Notice to allow for the submission of additional accurate data in support of such claim, dispute or other matter. The Owner shall submit any response to the Engineer and the Contractor within twenty (20) days after receipt of the Contractor's last submittal (unless the Owner requests reasonable additional time to evaluate the claim).

The Engineer shall render a non-binding and non-final written recommendation regarding the manner in which to resolve the dispute within twenty (20) days of receipt of the Owner's response. Engineer's written recommendation shall be used to assist the Owner and Contractor towards the expeditious and amicable resolution of their dispute.

Within ten (10) days of the delivery of Engineer's written recommendation, senior representatives of the Owner and the Contractor, having authority to settle the dispute, and the Engineer, shall meet at a mutually acceptable time and place, and thereafter as often as they reasonably deem necessary, to exchange relevant information and to exercise their reasonable and good faith efforts to expeditiously resolve the dispute. The Owner's and Contractor's representatives will participate in good faith during the negotiation and will each have authority to approve changes in the Contract Time and Price, if any.

In the event a mutually acceptable agreement cannot be reached through negotiation within twenty (20) days of the delivery of Engineer's written recommendation, (or mutually agreeable longer period), or if either party will not meet within ten (10) days of the delivery of said written recommendation, the Owner or Contractor may declare, by written Notice, delivered to the other party and to the Engineer, that the negotiation was unsuccessful. If Owner chooses non-binding

mediation, it shall be a condition precedent to the institution of any further administrative, legal or equitable proceedings by either party.

In the event that the negotiation process is unsuccessful and upon the Owner's request that the parties participate in non-binding mediation, the parties shall endeavor to agree to a single mediator to mediate the dispute in a session not to exceed one-half day in length, unless extended by the agreement of both parties. If the parties cannot agree on a single mediator, they shall request the chief judge of the local state circuit court to designate a mediator. Unless the parties mutually agree otherwise, the mediation shall occur within ten (10) days of the mediator's selection. The costs of the mediation shall be paid by the parties on a pro rata basis.

The results of successful mediation will be implemented by a Change Order. Should the mediation be unsuccessful, it shall be terminated by written Notice to all involved by the mediator or Owner or Contractor.

- 16.4 In the event that the Owner does not elect mediation or the mediation is unsuccessful, a formal proceeding may then be instituted by either party in a forum of competent jurisdiction within the Owner's locality. The parties' Agreement, Contract Documents, and their performance obligations shall be governed, interpreted and enforced pursuant to the laws and regulations of the Owner's locality, and in accordance with the laws of the Commonwealth of Virginia without regard to the conflicts of law principles thereof.

All disputes arising out of or relating to this Agreement, the Contract Documents, or the performance obligations of the parties shall be brought in the Circuit Court or Federal Court in Virginia having jurisdiction over the location where the Work will be or has been performed. The Agreement and the Contract Documents shall be governed by, enforced and interpreted pursuant to the laws of the Commonwealth of Virginia without regard to conflicts of law principles.

- 16.5 The Contractor shall carry on the Work and adhere to the progress schedule during all disputes or disagreements with the Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as the Owner and the Contractor may otherwise agree in writing.

XVII. ENGINEER'S STATUS

- 17.1 All Work shall be performed under the general observation of the Engineer (if specified in the Special Provisions, otherwise, the Owner shall serve as the Engineer at its discretion). The Contractor shall carry out the Work in accordance with the Contract Documents. The construction means, methods, techniques, sequences of procedures, and safety precautions and programs in connection with the Work shall be at the direction and the responsibility of the Contractor. The Engineer shall have authority to and shall reject any and all Work whenever it is necessary to do so in order to insure the proper execution of the Work in accordance with the Contract Documents. The Engineer shall have no authority to approve or order changes in the Work that alter the terms or conditions of the Agreement. The Owner shall confirm by written Notice within fourteen (14) calendar Days any oral order, direction, requirement or determination.
- 17.2 In case of the termination of the employment of the Engineer, the Owner may appoint a capable and reputable Engineer as a replacement. The status under the Agreement of the Engineer shall be that of the former Engineer.
- 17.3 Approval by the Engineer of any materials, plans, equipment or drawings proposed by the Contractor, shall be construed only to constitute an approval of general design. Such approval shall

not relieve the Contractor for any responsibility for the accurate and complete performance of the Work in accordance with Contract Documents, or from any duty, obligation, performance guarantee or other liability imposed upon him by the provisions of the Agreement.

XVIII. DOCUMENTATION OF PRECONSTRUCTION CONDITIONS

- 18.1 The Contractor may be required to accompany the Owner for an on-site review of the project after award, but prior to the pre-construction conference and issuance of the Notice to Proceed. The purpose of the on-site review will be to compile a property report that will list, according to the following categories, the properties affected by construction as determined mutually by the Contractor and the Owner, or his representative.
- A. Unrestrained access to and from residences and business locations. This includes but is not limited to, the following types of scheduled projects:
1. Street repair (non-emergency) or improvement projects.
 2. Utilities repair (non-emergency) or improvement projects.
 3. Sidewalk repair (non-emergency) or improvement projects.
- B. Right to enjoy one's residence or business free of disturbing and unusual environmental changes as a result of an Owner-authorized construction project. Examples of such changes are excessive noise, dust, light, as well as unusual working hours and odors. This includes, but is not limited to, projects such as:
1. Drainage repair (non-emergency) or improvement projects.
 2. Sewage repair (non-emergency) or improvement projects.
- C. The right to properly plan for the relocation of one's personal property which must be moved as a result of an Owner-authorized construction project. This includes, but is not limited to, the following:
1. Trees, shrubs, plants and flowers.
 2. Play equipment.
 3. Portable buildings.
 4. Fences (above grade or underground electric pet containment).
 5. Automobiles.

The property report is to remain on file with the Owner and the Contractor until project closeout.

XIX. NOTICE TO COMPLY ORDER

See page 105-18.

XX. STOP WORK ORDER

See page 105-19.

End of Section

June 2016

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Project Title
Date
Owner
Bid Number



CITY/COUNTY OF _____

NOTICE TO COMPLY

Department of _____

Pursuant to Section _____ of the Code of the City/County of _____, Virginia, as amended, a City Manager/County Administrator Designee inspected your site at _____ on _____, 20____ at _____ a.m. / p.m.

The following conditions of noncompliance were noted:

- SILT FENCE DOWN
 - DISTURBED AREAS NOT STABILIZED
 - SEDIMENT TRAPPING DEVICES NOT INSTALLED PROPERLY
 - TRACKING ON PUBLIC ROAD
 - OTHER: _____
-

The following corrective measures are needed to bring you into compliance:

- _____
 - _____
 - _____
 - _____
-

These measures are to be completed before _____, 20____.

Notice ordered by _____, on _____, 20____.
(Designee of City Manager/County Administrator)

Hand Delivered _____ Certified Mail _____

If you have any questions, please call _____.
(Telephone number)

CITY/COUNTY OF _____

STOP WORK ORDER

Permit Number _____

Date _____

Department of _____

Pursuant to Section _____ of the Code of the
City/County of _____, Virginia, as amended, a substantial
Code violation exists at _____. You are
hereby notified that further Work at this location must be

IMMEDIATELY DISCONTINUED

Corrective Measures Required:

Ordered by: _____, on _____, 20_____.
(Designee of City Manager/County Administrator)

Notice served to _____, on _____, 20_____.

Stop Work Order in Effect Until _____

(Signature of Enforcement Officer)

V. PRODUCTS

Unless specifically stated otherwise, all materials shall be new, free from defects, and shall be in accordance with this Section.

5.1. AGGREGATE

A. MINERAL FILLER

These specifications cover inorganic material such as lime or fly ash, usually of very fine grading, added to soil or asphalt to produce a desired effect and shall meet the requirements of the latest edition of the *VDOT Road and Bridge Specifications*, Section 201.

B. FINE AGGREGATE

These specifications cover material for use as fine aggregate in the production of hydraulic cement concrete, mortar, asphalt concrete, and asphalt surface treatments and shall meet the requirements of the latest edition of the *VDOT Road and Bridge Specifications*, Section 202.

C. COARSE AGGREGATE

These specifications cover material used as coarse aggregate in the production of hydraulic cement concrete, asphalt concrete, asphalt surface treatments, and in drainage and shall meet the requirements of the latest edition of the *VDOT Road and Bridge Specifications*, Section 203.

D. SUBBASE AND AGGREGATE BASE MATERIAL

These specifications cover material used to form a foundation for base or surface pavement and shall meet the requirements of the latest edition of the *VDOT Road and Bridge Specifications*, Section 208.

E. OPEN-GRADED SHOULDER MATERIAL

These specifications cover the requirements for open-graded material used on roadway shoulders where designated on the plans or other contract documents and shall meet the requirements of the latest edition of the *VDOT Road and Bridge Specifications*, Section 209.

F. CRUSHER RUN AGGREGATE

These specifications cover crushed aggregate used for backfilling and bedding pipe and box culverts, maintaining traffic, and repairing and constructing all-weather private access pavements and shall meet the requirements of the latest edition of the *VDOT Road and Bridge Specifications*, Section 205.

G. LIGHTWEIGHT AGGREGATE

These specifications cover crushed aggregate used for backfilling and bedding pipe and box culverts, maintaining traffic, and repairing and constructing all-weather private access pavements and shall meet the requirements of the latest edition of the *VDOT Road and Bridge Specifications*, Section 206.

H. SELECT MATERIAL

These specifications cover nonplastic material obtained from roadway cuts, borrow areas, or commercial sources used as foundation for subbase, shoulder surfacing, fill, backfill, or other specific purposes and shall meet the requirements of the latest edition of the *VDOT Road and Bridge Specifications*, Section 207.

5.2. ASPHALT MATERIALS

These specifications cover the manufacturing and material requirements for asphalt material consisting of asphalt, asphalt cement, asphalt cutback, or asphalt emulsion as defined in ASTM D8 and shall meet the requirements of the latest edition of the *VDOT Road and Bridge Specifications*, Section 210.

5.3. CASING PIPE

A. Steel Casing Pipe

1. Steel casing pipe shall be in accordance with ASTM A53 or ASTM A139, Grade B, 35,000 psi minimum yield strength, seamless (under 26-inch diameter), with beveled joints suitable for welding.
2. The diameter shall be as indicated in the Contract Documents and shall be in accordance with the *VDOT Road and Bridge Specifications*. Wall thickness shall be in accordance with the *VDOT Road and Bridge Specifications* but in no case shall be less than 1/2-inch. If casing is to be installed under railroad tracks, the railroad owner's requirements or AREA standards shall govern.

B. Carrier Pipe

1. Carrier pipe shall be as specified in the Contract Documents.
2. Skids and casing spacers shall be in accordance with the *VDOT Road and Bridge Standards*.

5.4. CLEARING AND GRUBBING

- A. Temporary and /or tree protection fencing shall be as shown in the Contract Documents and in accordance with the *Virginia Erosion and Sediment Control Handbook*, as appropriate.
- B. Tree wrapping where shown in the Contract Documents shall be burlap in accordance with AASHTO M182, Class 1, and/or waterproof paper, 30-30-30 krinklecraft or its equivalent, in strips 4-inches in width. Tree wound dressing shall be antiseptic and waterproof, asphalt base.

5.5. DRAINAGE STRUCTURES - PIPE AND PIPE ARCHES

These specifications cover materials used for drainage and storm water applications only and shall meet the applicable requirements of the latest edition of the *VDOT Road and Bridge Specifications*, Section 232. Specifications for materials used in water distribution and sanitary sewer collection systems (gravity and force main) are described in Sections V.5.19 (Water), V.5.11 (Sanitary Gravity Sewer), and V.5.10 (Sanitary Force Main). Corrugated metal and plastic pipe shall not be used in the Town.

5.6. HYDRAULIC CEMENT CONCRETE

These specifications cover materials, design criteria, mixing, and testing procedures for hydraulic cement concrete and shall meet the requirements of the latest edition of the *VDOT Road and Bridge Specifications*, Section 217.

A. JOINT MATERIALS

These specifications cover resilient products made from various materials that are designed to accommodate the movement of rigid structures, such as component parts of hydraulic cement concrete, and seal the joint from intrusion of water or incompressibles and shall meet the requirements of the latest edition of the *VDOT Road and Bridge Specifications*, Section 212.

B. HYDRAULIC CEMENT MORTAR AND GROUT

These specifications cover hydraulic cement mortar and grout used in bonding units together, filling voids, and making surface repairs and shall meet the requirements of the latest edition of the *VDOT Road and Bridge Specifications*, Section 218.

C. CONCRETE CURING MATERIALS

These specifications cover materials used to maintain the humidity and temperature of freshly placed concrete to ensure satisfactory hydration and proper hardening of the concrete and shall meet the requirements of the latest edition of the *VDOT Road and Bridge Specifications*, Section 220.

D. DAMP-PROOFING AND WATERPROOFING MATERIALS

These specifications cover materials, generally asphalt based, that are intended to prevent or delay the passage of water, usually through a section of hydraulic cement concrete and shall meet the requirements of the latest edition of the *VDOT Road and Bridge Specifications*, Section 213.

E. HYDRAULIC CEMENT

These specifications cover cements that harden when mixed with water. The various types have special characteristics to be used as denoted in other parts of these specifications and on the plans or in other contract documents and shall meet the requirements of the latest edition of the *VDOT Road and Bridge Specifications*, Section 214. For concrete color control, concrete mixtures for all exposed concrete surfaces of walks, curbs, gutters and pour-in-place structures shall be from the same supplier and cement manufacturer.

F. HYDRAULIC CEMENT CONCRETE ADMIXTURES

These specifications cover materials that are chemical or organic elements that may be added to a hydraulic cement concrete mixture, when permitted elsewhere in these specifications, to achieve some desired effect and shall meet the requirements of the latest edition of the *VDOT Road and Bridge Specifications*, Section 215.

G. WATER FOR USE WITH CEMENT OR LIME

These specifications cover water for use in mixing with cement or lime and shall meet the requirements of the latest edition of the *VDOT Road and Bridge Specifications*, Section 216.

H. FLOWABLE FILL

Flowable fill may be used on an Owner approved, case-by-case basis for trench backfill and pipe abandonment fill. Pipe bedding requirements will remain unchanged unless otherwise specified in the Special Provisions. Fly ash may be approved for use provided it complies with the requirements of ASTM C618, Class F or Class C. A mix design certificate shall be submitted for Owner approval prior to placement of the material. Flowable fill shall meet a minimum 50 psi mix design and a maximum 300 psi mix design

5.7. PLANTING

A. Plants

1. Plants shall be obtained from approved sources. The Owner may withdraw its approval of sources that do not consistently furnish acceptable plants.
2. The botanical and common name of plants shall be in accordance with the latest edition of Standardized Plant Names, prepared by the Editorial Committee of the American Joint Committee on Horticultural Nomenclature, in effect on the date of the Invitation for Bids.
3. Plants shall be inspected and identified in accordance with the Standardized Plant Names prepared by the Editorial Committee of the American Joint Committee on Horticultural Nomenclature. The Owner may inspect and reject plants at any time and place. Plants will be inspected immediately prior to being planted. If they are planted prior to inspection and found to be unsatisfactory, they shall be replaced with approved plants at the Contractor's expense.
4. Plants and sod shipped from geographical areas that are quarantined for fire ant infestation by the U.S. Department of Agriculture shall have their roots or container contents chemically treated to destroy and/or prevent the transmission of fire ants, their eggs, or larvae. Proper certification of this treatment shall be provided with each shipment.
5. Plants shall conform to the requirements of American National Standard for Nursery Stock, by the American Association of Nurserymen, Inc. and these specifications. Plants shall be first class representatives of their normal species and varieties; shall have well-furnished branch systems and vigorous fibrous root systems characteristic of their respective kinds; shall be nursery grown; and shall bear evidence of proper nursery care, including adequate transplanting and root pruning. Plants shall comply with state and federal laws governing inspection for plant diseases and insect infestation and shall be free from insect pests, plant diseases, disfiguring knots, stubs, sun scalds, bark abrasions, or any other form of damage or objectionable disfigurements. Where a minimum and maximum size or range is specified, an average size shall be furnished. Plants shall not be pruned before delivery or cut back from larger sizes to conform to the sizes specified. Sizes furnished shall be those specified at the time of delivery and before the usual pruning at the time of planting. Nursery-grown trees shall be free from cuts of limbs that are not healing and cuts more than 3/4-inch that have not completely callused over. Deciduous shade trees shall conform to the requirements for street trees as specified in the American National Standard for Nursery Stock. Plants from cold storage will not be accepted.

6. In addition to the requirements of the American National Standard for Nursery Stock, container-grown plants shall conform to the following:
 - a. The space between the rim or top of the container and the soil line within the container shall not be more than 1 1/2-inches for the 1 gallon and 2 gallon sizes and not more than 2 1/2-inches for the 5 gallon size.
 - b. Encircling roots shall not have grown in such a manner that they will cause girdling of the trunk or stems.
 - c. Roots shall not protrude through drainage holes or over the rim of the container to the extent that they will be damaged while the root ball is removed from the container.
7. Plants shall have been acclimated to outside conditions. Container grown plants may be used provided their use is approved in writing by the Owner.
8. Collected plants from wild or native stands shall not be used without the written permission of the Owner unless specified in the Contract Documents. Wild or native plants shall be clean, sound stock, and free from injury, and the quality of the plants shall be similar to that specified for nursery grown material. Stock shall have sufficient root systems to ensure successful transplanting. Balls, when specified, shall be tight and well formed.
9. Clumps shall be dug from good soil that has produced a fibrous root system typical of the nature of the plant and shall have earth and incidental vegetation adhering to roots.

B. Miscellaneous Planting Materials

1. Peat moss shall be granulated, shredded, or milled sphagnum moss, nearly free from woody materials and consisting of at least 75 % decomposed leaves and stems of sphagnum moss essentially brown in color. The texture may vary from porous to spongy fibrous. Peat moss shall be free from sticks, stones, mineral matter, or other foreign material. Peat moss shall have a pH range between 3.5 and 5.5.
2. Tree wrap shall be waterproof paper, 30-30-30 krinklecraft or its equivalent, in strips 4-inches in width.
3. Twine for wrapping trees shall be jute twine, at least two-ply.
4. Soil mixture to backfill planting pits shall consist of 1 part peat moss and 4 parts topsoil as specified herein. Prior to use, peat moss and topsoil shall be thoroughly mixed. The method of mixing and the area in which the mixing operation is performed shall be approved by the Owner.
5. Water used in watering plants shall be obtained from fresh water sources and shall be free from chemicals and other toxic substances harmful to plants. Brackish water shall not be used. The source of water will be subject to the approval of the Owner.
6. Mulch used in planting plants shall be pine bark, wood chips, or other material specified in the Contract Documents or approved by the Owner. Mulch shall not be used until it has been inspected and approved by the Owner.

5.8. STEEL REINFORCEMENT

These specifications cover steel items designed to give added flexural strength to hydraulic cement concrete or to control and reduce cracking in such applications and shall meet the requirements of the latest edition of the *VDOT Road and Bridge Specifications*, Section 223.

5.9. STONE FOR MASONRY, RIPRAP, POROUS BACKFILL, AND GABIONS

These specifications cover aggregate materials used in the construction of masonry items and stone gabions, to protect ground slopes from erosion or wave action and to facilitate drainage, generally behind a backwall or abutment and shall meet the requirements of the latest edition of the *VDOT Road and Bridge Specifications*, Section 204.

5.10. SANITARY FORCE MAIN SYSTEMS

A. Ductile-Iron (DI) Pipe

1. DI pipe shall be furnished in 18- or 20-foot laying lengths, with push-on joints, except where mechanical or restrained joint, or flanged pipe is shown in the Contract Documents.
2. DI pipe shall conform to the requirements of ANSI/AWWA C150/A21.50 and C151/A21.51.
3. DI pipe shall be Class 52 for all pipe diameters; or Class 350 minimum pressure classification for diameters 24-inches and smaller and, 250 psi for diameters larger than 24-inches; or the thickness classification indicated in the Contract Documents. The manufacturer's mark, country where cast, year the pipe was produced, pipe class, and the letters "DI" or "Ductile Iron" shall be cast or stamped on the pipe.
4. Joints and gaskets shall conform to AWWA/ANSI C111/A21.11 or AWWA/ANSI C115/A21.15, as applicable. The minimum acceptable pressure rating for all joints is 250 psi. All flanges and glands for pipes shall be made of ductile iron.
5. Fittings shall be manufactured in accordance with ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53, as applicable, and shall be ductile iron. Compact fittings are required and shall have a minimum acceptable pressure rating of 350 psi for pipe diameters less than 16-inch and 250 psi for diameters larger than 16-inch. Fittings shall have the same pressure rating, as a minimum, as the connecting pipe.
6. Nuts and Bolts:
 - a. Mechanical and buried flanged joints – provide per AWWA C111, manufactured in accordance with ASTM 588 – High strength low-alloy structural steel, up to 50 ksi minimum yield point, with atmospheric corrosion resistance (Corten steel)
 - b. Heads and dimensions per ASME B1.1.
 - c. Threaded per ASME B1.1.
 - d. Project ends 1/4 inches to 1/2 inches beyond nuts.

7. ASTM A674 – Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids.
8. AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems
9. Coatings shall be provided on the exterior of all pipe, joints and fittings as required by AWWA/ANSI C110/A21.10, C111/A21.11, C115/A21.15, C116/A21.16, C151/A21.51, or C153/A21.53 as applicable. All pipes, joints, and fittings shall be examined after laying to determine if the coating was damaged during installation. Any damaged areas shall be coated with a minimum of 2 mils of an approved bituminous coating.
10. Pipe diameters 12-inches and smaller shall be gaged and delivered round and true throughout its entire length. Pipe diameters over 12-inches shall have one piece of gaged pipe delivered for each fitting and at connections to existing pipelines. Gaged pieces shall be marked on the pipe with markings indicated in the shop drawings.
11. Corrosion Resistant Linings
 - a. All ductile iron pipe and fittings shall be seal coated in accordance with ANSI/AWWA C104/A21.4.
 - b. Ductile iron pipe and fittings shall be lined with ceramic epoxy coating.

The lining shall be shop applied to bare metal in strict accordance with the manufacturer's recommendations to cover the inner surface of the pipe and fittings. The lining shall be a nominal thickness of 40 mils and a minimum thickness of 35 mils. The gasket area and spigot end up to 6-inches back from the end of the spigot on the outside of the pipe shall be coated with 6 mils nominal, and 10 mils maximum.

The lining in each joint of pipe and fitting shall pass a 2,500 volt pin hole/holiday test. The pin hole/holiday detection testing shall be conducted over 100% of all lined surfaces for the ductile iron pipe and fittings. All holidays shall be repaired in accordance with the manufacturer's instructions and tested again to ensure a pinhole free lining. Short lengths of pipe required to accommodate the pipeline geometry shall be furnished factory-lined. All outlets shall be tapped by the pipe manufacturer at the factory prior to applying the pipe lining.

Where field touch up is required to seal cut ends and repair damaged areas, Joint Compound shall be applied by brush to ensure complete coverage in accordance with the manufacturer's recommendations. Joint Compound may be used over lined pipe and fittings, or on bare substrate. Care must be taken that the joint compound is applied smooth, without excessive buildup in the gasket seat or on the spigot ends and allowed to cure for 24 hours in accordance with the manufacturer's recommendations. At least 1-inch of overlap shall be applied to the area being repaired. Protecto 401 shall not be applied over Protecto 401 Joint Compound. Joint Compound shall not be applied over wet or frozen surfaces.

12. Each length of ductile iron pipe shall be hydrostatically tested at the point of manufacture to 500 psi for a duration of 10 seconds per AWWA C151. Testing may be performed prior to machining bell and spigot. Failure of ductile iron pipe shall be defined as any leak or rupture of the pipe wall.
13. For ductile iron pipe diameters 16-inches and greater:
 - a. 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 Owner at the Owner's expense.
 - b. A manufacturer's representative shall be made available when requested by the Owner during the manufacturing furnishing, transporting, and unloading of the pipe and during installation and testing to assist in confirming that the pipe is properly fabricated, transported, unloaded, stored in the field, joined and tested.
 - c. The manufacturer's representative shall be made available a minimum of 2 working days (time on site) during the project when requested by the Owner, including the first 2 Days of pipeline installation.
 - d. The cost for the services of the manufacturer's representative, including expenses, shall be considered incidental to the project and will not be paid separately.

B. Polyvinyl Chloride (PVC) Pipe

1. PVC pipe shall be furnished in 20-foot laying lengths, with push-on joints. Pipe shall be restrained joint where shown in the Contract Documents.
2. PVC pipe, 4 to 12-inches in diameter, shall conform to the requirements of AWWA C900 - Class 150 (DR-18), unless otherwise indicated in the Contract Documents. PVC pipe greater than 12-inches in diameter shall be AWWA C-905 - Class 235 (DR 18) or Class 165 (DR 25), as specified in the Contract Documents.
 - a. The pipe, shall be made from virgin polyvinyl chloride resin or clean rework materials generated from the manufacturer's own pipe production that equals or exceeds cell class 12454-B as defined by ASTM D 1784, and shall bear the seal of approval by the NSF. The pipe shall be unplasticized polyvinyl chloride plastic pressure pipe with integral wall bell and spigot joints.
 - b. Joints shall be push-on type with a flexible factory assembled elastomeric ring in the integral bell-end. O-ring gaskets shall conform to ASTM F 477. Joint material including gaskets and lubricants shall conform to AWWA C900 and ASTM D3139.
 - c. Fittings shall be manufactured in accordance with ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53, and shall be ductile iron. Compact fittings are required and shall have a minimum acceptable pressure rating of 350 psi.
3. Pipe smaller than 4-inches in diameter shall be Schedule 80 PVC, in accordance with ASTM D-1785 or ASTM D-2241 for SDR (Standard Dimension Ratio) 13.5, or as

specified in the Contract Documents. Solvent cement for non-gasketed PVC pipe shall meet the requirements of ASTM D-2564. All sewer force mains 2-inch and smaller shall be green Municipex pipe.

4. Pipe shall bear identification markings that will remain legible during normal handling, storage, and installation. The markings shall be applied in a manner that will not reduce the strength of the pipe or coupling or otherwise damage either. Pipe markings shall be applied at intervals not to exceed five (5) feet and shall include the nominal size and outside diameter (e.g. 4 CI), PVC, DR 18, AWWA Pressure Class (PC 150), manufacturer's name or trademark and production record code, and the seal of the testing agency that verified the suitability of the pipe material for potable water service.
5. The manufacturer's representative shall be made available a minimum of 2 working days (time on site) during the project when requested by the Owner, including the first 2 Days of pipeline installation.
6. The cost for the services of the manufacturer's representative, including expenses, shall be considered incidental to the project and will not be paid separately.

C. High Density Polyethylene (HDPE) Pipe

1. HDPE pipe shall be in accordance with AWWA C906-15 and shall have a nominal DIPS (Ductile Iron Pipe Size) outside diameter unless otherwise specified. The nominal size, pressure classification rating, and SDR of the pipe shall be as specified in the Contract Documents. ODs and tolerances for IPS outside diameter pipe shall be in accordance with ANSI B36.10 as illustrated in AWWA C906-15 Table 3.
2. A Pipe shall be homogeneous and uniform throughout; shall be free of injurious defects such as visible cracks, holes, foreign inclusions, voids, and blisters; and shall have uniform color and physical properties according to the provisions of AWWA C906-15.
3. Commercial virgin PE Compounds shall meet ASTM D3350 physical property requirements and shall be classified per ASTM D3350 as shown in Table 1 of AWWA C906-15. The compound shall have HDB (Hydrostatic Design Basis) ratings at 73°F (23°C) and at 140°F (60°C) and HDS (Hydrostatic Design Stress) ratings at 73°F (23°C) determined in accordance with ASTM D2837 and PPI TR-3 (Policies and Procedures for Developing Recommended Hydrostatic Design Stress for Thermoplastic Pipe Materials).
4. The PE Compound in the pipe shall contain color and ultraviolet (UV) stabilizer meeting the requirements of ASTM D3350 Codes C or E. Code C compounds shall contain 2 to 3 percent carbon black when material from the pipe is tested in accordance with Section 4.3.11 of AWWA C906-15. Code E compounds used for solid color pipe, color stripes, or color layer (shell) shall contain sufficient UV stabilizer to protect the pipe against UV degradation for at least 24 months of unprotected outdoor exposure. Color PE compounds used for stripes or color layers shall be of the same materials designation codes as the pipe material, varying only by color and UV stabilizer.
5. Clean rework materials derived from pipe production by the same manufacturer are acceptable as part of a blend with virgin PE compound meeting section 4.2.1 of

AWWA C906-15 for the production of new pipe, including sections 4.2.3.1, 4.2.3.2, 4.2.3.3 and 4.2.4.

6. PE fittings or components may be molded, thermoformed from pipe sections or fabricated. Molded fittings shall meet the requirements of AWWA C906-15 and the requirements of ASTM D2683 for socket-type fittings, or ASTM D3261 for butt-type fittings, or ASTM F1055 for electrofusion-type fittings. Thermoformed and fabricated fittings shall meet the requirements of AWWA C906-15 and ASTM F2206.
7. Pipe sections shall be joined on the job site above ground into continuous lengths by the thermal butt-fusion or electrofusion method, which shall be performed in strict accordance with the manufacturer's recommendations. The butt-fusion equipment used in the joining procedures shall be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements of 400 ° F, alignment, and 75 psi interfacial fusion pressure. Butt-fusion joining shall be 100% efficient and shall provide a joint weld strength equal to or greater than the tensile strength of the pipe. Socket-fusion, extrusion welding or hot gas welding of HDPE shall not be used for pressure pipe applications. Flanges, unions, grooved-couplers, transition fittings, and some mechanical couplers may be used to mechanically connect HDPE pipe without butt-fusion, if specified in the Contract Documents and approved by the manufacturer.
8. The manufacturer's representative shall be made available a minimum of 2 working days (time on site) during the project when requested by the Owner, including the first 2 Days of pipeline installation.
9. The cost for the services of the manufacturer's representative, including expenses, shall be considered incidental to the project and will not be paid separately.
10. Transition couplings from HDPE to other pipe materials shall be as indicated in the Contract Documents.

D. Fusible Polyvinylchloride (fPVC) Pipe

1. Pipe Supplier shall furnish fPVC pipe conforming to all standards and procedures, and meeting all testing and material properties as described in this specification. Pipe, 4 to 12 inches in diameter, shall conform to AWWA C900 – Class 150 (DR 18), unless otherwise indicated in the Contract Documents. Pipe greater than 12 inch shall conform to AWWA C905 – Class 235 (DR 18) or Class 150 (DR25), as specified in the Contract Documents.
2. fPVC pipe shall be tested at the extrusion facility for properties required to meet all applicable parameters as outlined in AWWA C900 or C905, as appropriate. Rework material shall be allowed per AWWA C900 and AWWA C905 standards. All piping shall be made from a PVC compound conforming to cell classification 12454 per ASTM D1784.
3. fPVC pipe shall be extruded with plain ends and shall normally be supplied in standard 40 foot lengths. The ends shall be square to the pipe and free of any bevel or chamfer. There shall be no bell or gasket of any kind incorporated into the pipe. fPVC pipe shall be blue in color for potable water use or green for wastewater.

4. Acceptable fittings for use with fPVC pipe shall include standard ductile iron fittings conforming to AWWA/ANSI C110/A21.10 and AWWA/ANSI C153/A21.53.
5. Connections to fPVC pipe may be made using a restrained or non-restrained retainer gland product for PVC pipe, as well as for MJ or flanged fittings.
6. Bends, tees and other ductile iron fittings shall be restrained as indicated in the Contract Documents.
7. Ductile iron fittings and glands must be installed per the manufacturer's guidelines.
8. Pipe generally shall be marked per AWWA C900 or AWWA C905, and shall include as a minimum:
 - a. Nominal pipe size
 - b. PVC
 - c. Dimension Ratio, Standard Dimension Ratio or Schedule
 - d. AWWA pressure class and Standard number
 - e. Extrusion production-record code
 - f. Trademark or trade name
 - g. Cell Classification 12454 and/or PVC material code 1120 may also be included.
 - h. NSF-61 mark, if for potable water service.
9. The manufacturer's representative shall be made available a minimum of 2 working days (time on site) during the project when requested by the Owner, including the first 2 Days of pipeline installation.
10. The cost for the services of the manufacturer's representative, including expenses, shall be considered incidental to the project and will not be paid separately.

E. Valves

1. Gate Valves
 - a. Resilient-seated gate valves shall be used on pipelines from 3-inches in diameter up to and including 16-inches in diameter. Valves under 16-inches shall operate in a vertical position (valves 16-inches and larger shall operate in a horizontal position). Gearing shall be provided on 16-inch and larger valves. Resilient-seated gate valves shall be in accordance with AWWA C509 or AWWA C515 and shall be supplied with an interior and exterior epoxy coating in accordance with AWWA C550. Resilient-seated gate valves shall be ductile iron body, non-rising bronze or stainless steel stem with standard 2-inch wrench nut, rubber encapsulated disc valve seat, o-ring seals, and suitable for buried service. Valve ends shall be flanged, mechanical joint, or mechanical joint by flange to suit the pipe or fittings as indicated in the Contract Documents. All gate valves for force main installations shall be drip tight with bidirectional shutoff and open counter clockwise.
Gate valves shall be manufactured by Kennedy Valve Company, Mueller Company, AVK, AFC or as specified in the Special Provisions.

- b. Gate valves smaller than 3-inches in diameter shall be cast bronze, solid-wedge disc, screwed bonnet, inside screw, non-rising stem valves. Valves shall conform to Standard SP-80, Type 2, Class 150, Manufacturer's Standardization Society of the Valve and Fitting Industry, Inc. **Gate valves 2" and smaller shall be manufactured by AVK or AFC.**
 - c. Gate valves larger than 16-inches in diameter shall meet the requirements of AWWA C500, except Section 4.4.8.1.1 will not be allowed. Valves shall be rated for 150 psi working pressure and a minimum 300 psi test pressure. Valves shall be iron body, bronze-mounted, double disc, parallel seat, non-rising stem type fitted with O-Ring seals. Valves shall be capable of drip tight, bi-directional shut off and operate in the horizontal position. The operating nuts shall be 2-in square. Valves shall open counter clockwise. Seats in the body shall be replaceable without removing the valve from the pipeline. Discs shall be cast iron and bronze faced. Valves to be furnished with bronze rollers and, bronze tracks and bronze scrapers.
 - d. Coatings
All interior ferrous surfaces of all valves shall be coated in accordance with ANSI/AWWA C550 and shall not contain lead, coal tar resins, lampblack, carbon black or bituminous materials. The exterior surfaces shall receive a factory applied fusion bonded epoxy coating.
 - e. Valve Operators
Buried valves shall have a 2-inch square operating nut conforming to AWWA C509, and shall open counter-clockwise, unless otherwise noted. Valves in vaults shall have a hand wheel of cast iron conforming to ASTM A 126, Class B.
 - f. Valve Stem Extensions
Valve stem extensions, when allowed by the locality, shall be furnished when the distance from the operating nut to the top of the valve box frame is greater than 36-inches from finished grade. Extension stems shall have a 2-inch square wrench nut on the top end and shall be at least as strong as the valve stem. Extension stems shall be coated in accordance with Paragraph, above.
2. Ball Valves
Owner-approved ball valves smaller than 3-inches in diameter shall be:
- a. Brass with threaded connections, O-ring seals, and a coated ball conforming to AWWA C800 and Standard SP-80, Type 2, Class 150 Manufacturer's Standard Society of the Valve and Fittings Industry, Inc. Valves shall be manufactured by the Ford Meter Box Company B11, Mueller Company 300 Ball Curb Valve, B-20283.
 - b. **Ball valves 2" and smaller shall be manufactured by AVK or AFC.**

- c. NSF approved.
- 3. Plug Valves (16-inch and larger)

Valves shall be full port size, designed for a minimum working pressure of 150 psi, conforming to AWWA C517. Valve actuators shall be sized based upon the working pressure. The valve body and plugs shall be ASTM A126 Class B cast iron. Plugs shall be one piece with a cylindrical seating surface eccentrically offset from the center of the shaft. Plug facing shall be Buna-N with a minimum hardness (Shore A) of 70 durometer. Seats shall be welded in overlay minimum 1/8 inch nickel raised surface of not less than 95% pure nickel. Bearings shall be sintered, permanently lubricated 316 stainless steel. Packing shall be multiple v-type or "U" cup type. Washers at the top and bottom of the plug journal shall be provided to keep grit and debris out of the bearings and packing. Gear cases and shafts shall be totally enclosed suitable for buried services. Valves shall have an interior and exterior epoxy coating. All exposed nuts, bolts, springs and washers shall be 316 stainless steel.

Valves shall operate in a horizontal position and have non-rising stems operated with a standard 2-inch wrench nut. Operator stems and nuts shall be provided with an enclosure that will protect the stem from being bent and provide a base and guide for the riser pipe.

Opening shall be counter clockwise. Extension stems shall not be allowed. Plug valves in the horizontal position shall be installed so that the plug rotates upward as the valves opens. Valves ends shall be mechanical joint unless otherwise specified and shall be oriented so that the plug rotates 90 degrees to the top of the pipe when open.

A bidirectional leakage test and low pressure 5 psi seat test shall be applied in accordance with the procedures in AWWA C157. Certified copies of the Proof-of-Design test reports documenting that all requirements of AWWA C-517 were successfully met shall be furnished to the Owner prior to installation.

Valves shall be manufactured by DeZurik, Inc., Milliken Valve Company, Inc., Val-Matic Valve and Manufacturing Corp., or approved equal, or as specified in the Special Provisions.

F. Appurtenances

- 1. Force Main Air Vent Assemblies shall be as indicated in the Standard Details. Air Vent Assemblies shall be installed where indicated in the Contract Documents and shall be as specified in the Special Provisions.
- 2. Brass Pipe shall be red brass pipe meeting the requirements of ASTM B 43. Pipe sizes, wall thickness and dimensions shall meet the requirements of ASTM B 251 Table I for regular pipe. Brass pipe fittings shall be screwed end malleable iron pattern meeting the requirements of ANSI B16.15. They shall be finished rough, unless otherwise specified. Unions shall be of all brass or bronze with ground joints and shall be left semi-finished. Fittings shall be rated for steam working pressures up to 125 psi. Joints shall be screwed type with threads clean cut, tapered and smooth, meeting the requirements of ANSI B2.1.

3. Service Saddle - Shall be designed and sized for the force main on which the saddle is to be installed. The service saddle shall also meet the following requirements:
 - a. Stainless steel saddle bodies shall be 18-8, Type 304, stainless steel with all welds fully passivated to restore stainless steel characteristics.
 - b. Ductile iron saddle bodies shall conform to ASTM A-536 and have a fusion applied epoxy coating 12-mils dry thickness (D.T.). Straps shall be double strap stainless steel, 18-8, Type 304 fully passivated for corrosion resistance.
 - c. Threads shall be AWWA C-800 CC/Taper.
 - d. The saddle band shall be a minimum of 2-inches in width.
 - e. The saddle shall be provided with a Buna-N rubber gasket meeting ASTM D2000 to seal the saddle and the main pipe.
 - f. The nuts, washers, bands, and bolts shall be 18-8 stainless steel.
 - g. Acceptable manufacturers are The Ford Meter Box Co., Inc., Model FS202/FS303/FRS202, JCM Model 406, Romac Industries Inc., Style 202N, Cascade Products Style CNS2, or approved equal.

G. Joint Restraint Devices

1. Joint restraints shall be provided where indicated in the Contract Documents.
2. The restrained joint system shall have a pressure rating equal to or greater than that of the pipe on which it is used. Restrained joint devices shall be installed in strict accordance with the manufacturer's recommendations.
3. Ductile Iron Pipe
 - a. Push-on Joints

For push-on joint type pipe, the restrained joint system shall be a manufacturer's standard restrained joint system, SnapLock (U.S.Pipe), TR Flex (U.S. Pipe), FlexRing (American Pipe), or approved equal.
 - b. Mechanical Joints

For mechanical joint type pipe, the restrained joint system shall be a manufacturer's standard restrained joint system, Series 1100 Megalug ductile iron glands (EBAA iron, Inc.), Series 1400 retainer glands (Ford Meter Box Company, Inc.), or approved equal.
4. PVC Pipe (4-inch and larger)
 - a. Bell and Spigot PVC Joints

The restraint system for bell and spigot PVC joints shall be Series 1600/2800 ductile iron retainers as manufactured by EBAA Iron, Inc, Series 1390

retainers as manufactured by Ford Meter Box Company, Inc., or approved equal.

b. PVC to Mechanical Joint Fittings

The restraint system for restraining PVC pipe to ductile iron mechanical joint fittings shall be Series 2000 PV ductile iron retainers as manufactured by EBAA Iron, Inc., Series 1500 retainers as manufactured by the Ford Meter Box Company, Inc., or approved equal.

5. Concrete Reaction Blocking

Concrete reaction blocking shall not be permitted, unless approved by the Owner.

6. Tie Rods

Tie rods shall not be used unless specifically approved by the Owner and shown in the Contract Documents. When appropriate, Tie rods, bolts, washers and nuts shall be stainless steel in accordance with ASTM A-307.

H. Tapping Valves and Sleeves

1. Tapping valves and sleeves shall be compatible for use with the pipe being tapped and as approved by the Owner. The Contractor shall verify the material and diameter of the pipe being tapped prior to ordering tapping valves and sleeves.

2. Tapping valves for ductile iron pipe shall meet the same specifications as gate valves, except they shall have a full, unobstructed opening to receive a full size shell cutter. Tapping valves shall contain a standard mechanical joint on one end and a flanged joint on the other end. The valves shall be subjected to a factory test pressure of 400 psi and be designed for a working pressure of 200 psi.

3. Tapping sleeves shall be split sleeve with mechanical joint type end seals. Cast sleeves for tapping cast iron pipe, shall be ductile iron meeting ASTM A536 Grade 65-42-12.

4. Tapping sleeves for Ductile Iron and PVC C-900 Pipe

As appropriate, tapping sleeves shall be mechanical joint, furnished complete with plain rubber gaskets, mechanical joint accessories, and approved interior and exterior coatings. The outlet flange shall be 125 pound, drilling per ANSI B16.1, with standard tapping flange counterbore per MSS SP-60. Tapping sleeves shall be in accordance with ANSI/AWWA C110/A21.10 and approved by the manufacturer for use on the type and class of pipe being tapped.

5. Tapping sleeves for PVC Pipe (Other than C-900)

Tapping sleeves shall be complete, furnished with plain rubber gaskets, have a full circumference band made of 18-8 type 304 stainless steel. The flange and all bolts and nuts shall conform to AWWA C207 Class D 150 lb. drilling, made of 18-8 type 304 stainless steel.

6. Gaskets shall conform to the applicable requirements of ANSI/AWWA C111/A21.11, and shall be clearly marked to identify the diameter range for which intended.
7. When approved by the Owner and indicated in the Contract Documents, stainless steel tapping sleeves may be used and shall be constructed of all stainless steel conforming to the following requirements:
 - a. Flange - The flange shall be 18-8, type 304 stainless steel, with recess to accept the standard tapping valve according to MSS-SP60. The flange shall also conform to AWWA C207-latest revision, Class D ANSI 150 lb. drilling. The bolt hole shall be aligned to straddle the pipe centerline.
 - b. Body - The body shall be 18-8, type 304 stainless steel. All welds shall be fully restored to stainless steel characteristics.
 - c. Gaskets - The gaskets shall be virgin SBR compounded for water service. ASTM D2000 8M 4AA607. The gasket shall be a full 360 degree pipe coverage. The outlet gasket shall be Buna-N.
 - d. Test Plug - Provide a waterworks brass 3/4-inch test plug with standard square head.
 - e. Bolts and Nuts - The bolts and nuts shall be 18-8, type 304 stainless steel UNC threads. Provide heavy hex nuts and washers fluorocarbon coated to prevent galling.
 - f. Manufacture - Acceptable manufacturer is the Ford Meter Box Co., Inc., Model FTSS, Smith-Blair Style 665, Romac Industries Inc., SST or JCM Industries, Inc., Model 432, or approved equal.

I. Sleeves and Couplings

1. Mechanical joint sleeves shall be solid type, long body pattern as approved by the Owner, manufactured in accordance with ANSI/AWWA C110/A21.10. Sleeves shall have a minimum pressure rating of 350 psi. Glands, gaskets, bolts, and nuts shall be in accordance with ANSI/AWWA C111/A21.11.
2. Sleeves shall not be machined in order to facilitate use with pipe of a class or type other than that for which the sleeve was manufactured.
3. The use of bolted steel couplings shall be restricted to joining pipes of different outside diameters, joining pipes of dissimilar materials, and joining sections of steel pipe. Ferrous surfaces shall be coated with a fusion bonded epoxy lining and coating with stainless steel nuts and bolts. Enamel coatings are not acceptable.
 - a. Bolted steel transition couplings shall be HI Max 2 or Smith Blair 421, or approved by the Town.

5.11. SANITARY GRAVITY SEWER SYSTEMS

A. Ductile-Iron Pipe (DI)

1. DI pipe shall be furnished in 18- or 20-foot laying lengths, with push-on joints, except where mechanical or restrained joint or flanged pipe is shown in the Contract Documents.
2. DI pipe shall conform to the requirements of ANSI/AWWA C151/A21.51.
3. DI pipe for gravity sewer systems shall be minimum pressure class 350 psi, for diameters 24-inches and smaller and, 250 psi for diameters larger than 24-inches, unless otherwise indicated in the Contract Documents. The manufacturer's mark, country where cast, year the pipe was produced, and the letters "DI" or "Ductile Iron" shall be cast or stamped on the pipe. P401 DI pipe for gravity sewers shall be Class 52.
4. Joints and gaskets shall conform to ANSI/AWWA C111/A21.11 or ANSI/AWWA C115/A21.15 as applicable. The minimum acceptable pressure rating for all joints is 250 psi. All flanges and glands for pipes shall be made of ductile iron.
5. Fittings shall be manufactured in accordance with ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53, and shall be ductile iron. Compact fittings are required and shall have a minimum acceptable pressure rating of 350 psi.
6. Coatings shall be provided on the exterior of all pipe, joints and fittings as required by ANSI/AWWA C110/A21.10, C111/A21.11, C115/A21.15, C116/A21.16, C151/A21.51, or C153/A21.53 as applicable. All pipes, joints, and fittings shall be examined after laying to determine if the coating was damaged during installation. Any damaged areas shall be coated with a minimum of 2 mil of an approved bituminous coating.
7. Corrosion Resistant Linings
 - a. All ductile iron pipe and fittings shall be cement lined and seal coated in accordance with ANSI/AWWA C104/A21.4.
 - b. Where corrosion resistant linings are identified in the Contract Documents for ductile iron pipe and fittings, linings shall be ceramic epoxy. If ceramic epoxy is specified, the lining shall be shop applied to bare metal in strict accordance with the manufacturer's recommendations to cover the inner surface of the pipe and fittings. The lining shall be a nominal thickness of 40 mils and a minimum thickness of 35 mils. The gasket area and spigot end up to 6-inches back from the end of the spigot on the outside of the pipe shall be coated with 6 mils nominal, and 10 mils maximum. The lining in each joint of pipe and fitting shall pass a 2,500 volt pin hole/holiday test. The pin hole/holiday detection testing shall be conducted over 100% of all lined surfaces for the ductile iron pipe and fittings. All

holidays shall be repaired in accordance with the manufacturer's instructions and tested again to ensure a pinhole free lining. Short lengths of pipe required to accommodate the pipeline geometry shall be furnished factory-lined.

Where field touch up is required to seal cut ends and repair damaged areas, Joint Compound shall be applied by brush to ensure complete coverage in accordance with the manufacturer's recommendations. Joint Compound may be used over lined pipe and fittings, or on bare substrate. Care must be taken that the joint compound is applied smooth, without excessive buildup in the gasket seat or on the spigot ends and allowed to cure for 24 hours in accordance with the manufacturer's recommendations. At least 1-inch of overlap shall be applied to the area being repaired. Protecto 401 shall not be applied over Protecto 401 Joint Compound. Joint Compound shall not be applied over wet or frozen surfaces.

8. Pipe inside diameters 12-inches and smaller shall be gaged and delivered round and true throughout its entire length. Pipe inside diameters greater than 12" inside shall have one piece of gaged pipe delivered for each fitting. Gaged pieces shall be marked as such on the pipe and shall be accompanied by the manufacturer's certification. Manufacturer's certification of inspection and testing shall accompany each delivery.

B. Polyvinyl Chloride (PVC) Non-Pressure Pipe

1. PVC pipe shall be integral bell and shall be furnished in 20-foot laying lengths with gasketed joints, except where specified otherwise in the Contract Documents.
2. Pipe and fittings shall be manufactured from approved PVC compound conforming to ASTM D1784.
3. PVC pipe sizes 4-inch through 15-inch in diameter and less than 10 feet deep shall conform to ASTM D3034 SDR 26. Fittings shall be heavy wall, H-Series Gasketed SDR 26.
4. PVC pipe sizes 18-inch through 27-inch in diameter shall conform to ASTM F679.
5. Joints shall meet all requirements of ASTM D3034, Section 6 and shall conform to the performance requirements of ASTM D3212. Restrained joints shall be provided where shown in the Contract Documents.
6. Rubber gaskets shall meet physical requirements specified in ASTM F477 and ASTM D1869.

C. Polyvinyl Chloride (PVC) Pressure Pipe

1. PVC pipe shall be furnished in 20-foot laying lengths with push-on joints.
2. PVC pipe 6 to 12 inches in diameter shall conform to the requirements of AWWA C-900 – DR-18, unless otherwise indicated in the Contract Documents. PVC pipe greater than 12-inches in diameter shall conform to the requirements of AWWA C-905 – DR 25, unless otherwise indicated in the Contract Documents.
3. PVC pipe shall be plasticized polyvinyl chloride plastic pressure pipe with integral wall bell and spigot joints and shall bear the seal of approval by the National Sanitation

Foundation (NSF). All manhole joints or intrusions shall be cemented or mortared inside and out of manhole.

4. Joints shall be push-on type with a factory assembled elastomeric ring in the integral bell-end. O-ring gaskets shall conform to ASTM F477. Joint material including gaskets and lubricants shall conform to AWWA C-900/C-905 and ASTM D3139.
 5. Pipe shall bear identification markings that will remain legible during normal handling, storage, and installation. The markings shall be applied in a manner that will not reduce the strength of the pipe or otherwise damage. Pipe markings shall be applied at intervals not to exceed five (5) feet and shall include the nominal size and outside diameter, DR, manufacturer's name or trademark and production code, and the seal of the testing agency that verified suitability of the pipe material for potable water service.
- D. A DFW/HPI non-shear coupling, Mission Flex Seal ARC Coupling, Fernco R/C Strong Back, or approved equal shall be used between transitions of pipe materials and connections to existing pipe.
- E. Manholes
1. Precast concrete manholes shall be manufactured in accordance with ASTM C478 and shall conform to the Standard Details.
 2. Lifting devices shall be used in lieu of thru-wall lifting holes, unless approved by the Owner. Lift voids shall be filled with non-shrink grout upon installation. Grout to be in accordance with Paragraph V.5.6.A.1 and of Paragraph V.5.6.F.
 3. Manhole joints shall be sealed with profile gasket (Type 4G manufactured by Press Seal Corp. or equal), or butyl resin sealants, or equal. Joints shall be watertight. Gaskets and sealants for section joints shall meet the requirements of ASTM C443 or ASTM C990.
 4. The manhole frame and cover shall conform to ASTM A48. Frame and covers are to be even grained and free from unsightly defects, and shall be machined to insure a uniform bearing in all positions. The frame and cover; including dust cover, locking cover, and watertight assemblies, where required, shall conform to the Standard Details. Casting shall be finished with a minimum of one coat (2 mils) of bituminous asphaltic coatings, or in accordance with manhole coating procedures, described below.
 5. When required, manhole steps shall be corrosion-resistant and shall be one-half inch grade 60 steel reinforcing rod encapsulated in a copolymer polypropylene. The steps shall conform with ASTM C478 and to the dimensions shown on the Standard Details.
 6. Pipe connections shall be flexible rubber pipe-to-manhole connections of the locked-in factory assembled rubber ring type utilizing a stainless steel band as manufactured by NPC, Inc. (Kor-N-Seal), International Precast Supply Flexible Pipe, or Press-Seal Gasket Corp. (PSX or Press Boot) gasket adjustable ring. The resilient flexible manhole connector shall conform to ASTM C443 and ASTM C923 and the stainless steel band shall be totally non-magnetic Series 304 Stainless. Other flexible connectors must be approved by the Owner.

7. Manhole inverts shall be built up of brickwork and cement mortar to match the inside diameters of the connecting sewers (bricks shall be surfaced with cement mortar, $\frac{1}{2}$ -inch thick and shall be trowel finished). Invert channels and manhole bottoms shall be shaped and smoothed with sand-cement grout or as otherwise approved by the Owner. Inverts shall have a positive slope as indicated on the Standard Details. When benching and channel shaping is performed prior to manhole field installation, adequate clear space must be provided to allow adjacent piping to be properly inserted in the manhole and “brought home” at the pipe joint.
8. To enhance the bonding capacity between the manhole or structure and a coating system, a Concrete Surface Profile (CSP), as defined by the International Concrete Repair Institute's (ICRI) Guideline No. 03732 dated January 1997, and as specified by the coating Manufacturer's requirements, shall be provided on all interior surfaces of manholes or structures designated to receive protective coatings.
9. Sections are to be assembled so as to provide a plumb structure with uniform bearing at all joints, and at the base slab.
10. Polymer Concrete Manholes shall comply with the requirements of items 1 through 7 and 9 of this section (200.5.11) and the following:
 - a. Shall be acid resistant polymer manhole sections, base sections and related components conforming to ASTM D 6783, ASTM C 857, and ASTM C 478.
 - b. Base riser section shall have integral floors, unless otherwise shown.
 - c. Polymer mixture shall consist solely of thermosetting resin sand and aggregate with no cementitious materials. Polymer concrete shall have a minimum unconfined compressive strength of 9,000 psi when measured in accordance with ASTM C 497.
 - d. Manholes wall thickness shall be designed to resist hydrostatic pressures with a minimum safety factor of 2.0 for full depth conditions from grade to invert. Wall thickness for all members shall be stated by the polymer manhole manufacturer based on loading conditions and material properties. The wall thickness of risers and conical tops shall not be less than that prescribed by the manufacturer's design by more than 5%. In no cases shall the wall thickness be less than 3 inches.
 - e. Manholes shall be designed with sufficient bottom anchorage and side friction to resist buoyancy.
 - f. Round manhole components shall be connected with an elastomeric sealing gasket as the sole means to maintain joint water tightness and both the gasket material and the manhole joint shall meet the requirements of ASTM C443. Round manholes shall utilize spigot and bell type joints incorporating either a confined O-ring or single step profile joint. Square and rectangular structures shall utilize a shiplap joint and be sealed with a butyl rope sealant per ASTM C990 as recommended by the structure manufacturer.
 - g. Thermosetting resin shall have a minimum deflection temperature of 158 °F when tested at 264 psi following ASTM Test Method D 648. The resin shall

not be less than 7% of the weight of the sample as determined by ASTM test method D 2584. Resin selection shall be suitable for applications in the corrosive conditions to which the structures will be exposed.

h. Polymer bench and channel:

- (i) Polymer bench and channels are to be constructed with all resin aggregate material containing no alternative fill material. Invert channels shall provide a smooth flow transition waterway with no disruption of flow at pipe-manhole connections. Invert slopes shall be as indicated in the Contract Documents.
- (ii) If brick benching is indicated in the Contract Documents, brick shall be sewer grade brick SS in accordance with ASTM C32-05. Mortar shall be furan resin-based brick mortar. Mortar shall be 100% carbon filled and have the following physical properties and minimum values per referenced test method:
 - (1) Compression Strength, 14,500 psi, ASTM C579
 - (2) Tensile Strength, 1,400 psi, ASTM C307
 - (3) Flexural Strength, 3,900 psi, ASTM C580
 - (4) Bond Strength to Bricks, 750 psi, Pull Blocks
 - (5) Water Absorption, 0.15%, ASTM C413
- (iii) Concrete surfaces that have a furan resin mortar placed against them shall be coated with the furan resin mortar manufacturer's recommended primer and prepared in accordance with the furan resin mortar manufacturer's recommendations.
- (iv) The bench and channel brick mortar components shall be free of cracks, holes, delaminations, foreign inclusions, blisters, or other defects that result in a variation of inside diameter of more than 1/8 inch from that obtained on the adjacent unaffected portions of the surface or defects that would, due to their nature, degree, or extent, have a deleterious effect on the manhole performance as determined by the Owner.
- (v) Mortar manufacturer shall be Furalac Green Panel Mortar by Henkel, or Owner approved equal.

i. All materials needed for grouting and patching shall be a polyester mortar compound provided by the manufacturer or an Owner approved equal.

11. Stainless Steel Manhole Inserts

The manhole insert body shall be manufactured of 304 stainless steel with a minimum thickness of 18 gauge. The insert shall have a straight side design to allow a loose fit into the ring for easy removal. The insert manufacturer shall submit a load test

verification showing a load test failure in excess of 3,000 pounds. Inserts shall have a closed cell neoprene gasket with pressure sensitive adhesive backing installed by the manufacturer on one side. Gaskets shall have a minimum thickness of 1/8 inch. The insert shall have one handle made of 3/16 inch plastic coated 304 stainless steel cable. The handle shall be attached with a # 6 high grade stainless steel rivet or with bolts, flat washers and locking nuts, all made of 304 stainless steel. The handle shall be capable of withstanding a pull force of at least 500 pounds before it fails or separates from the insert. The gas relief valve shall be designed using one valve capable of releasing gas at a pressure of 0.5 to 1.5 psi and have a water leak down rate no greater than 5 gallons per 24 hours. The valve shall be installed by means of a hole tapped in the insert by the manufacturer. The valve shall be made of nitrile or similar material for the prevention of corrosion from the contact with hydrogen sulfide, dilute sulfuric acid and other gases associated with wastewater collection systems. The insert shall be custom made to fit the manhole frame, outside diameter (cover), and inside diameter.

F. Manhole /Structure Coatings

Sanitary sewer manholes are often exposed to environments with various degrees of aggressiveness thereby degrading the concrete and reinforcing, and shortening the useful life of the structures. A number of measures have been used to maintain manhole structural integrity and component life, including epoxy coatings, concrete additives, embedded liners, etc. Choosing the appropriate protective measure should be determined during the design of the project. Any protective system must be applied in strict accordance with the protective system Manufacturer's recommendations. The manhole coating specifications presented in this document are intended to be used by experienced Engineers and are not meant to be inclusive of all available protective measures. Because of their current widespread usage in the Hampton Roads area, only epoxy coating systems are addressed herein. Other protective measures may be used if approved by the Owner. See also the Special Provisions for Owner-specified manufacturers, alternative coating systems, and specific coating thickness.

1. Products are to be stored and handled according to their material safety data sheets and the manufacturer's instructions.
2. Coatings are to be applied to manholes/structures in strict accordance with the coating manufacturer's requirements.
3. Manhole Coatings shall be 100% solids, solvent-free, epoxy resin systems.
4. Manhole Coatings are defined as:
 - a. Type A Coating (40 to 50 mils thickness)
 - b. Type B Coating (80 to 125 mils thickness), as specified

G. Clean-Out Assemblies

Clean-out assemblies include Fernco Strong Back RC Series coupling or Non-Shear DFW-HPI (if required), mainline or wye, riser pipe, end caps, and clean-out box as indicated on the Standard Details.

5.12. SEEDING

A. Seed

1. Seeds shall comply with applicable state and federal seed laws and the Contract Documents. Seed shall be accompanied by the Form of Affidavit provided in VDOT *Road and Bridge Specifications* Section 244.
2. Seed shall be subject to inspection by the Virginia State Seed Regulatory Inspectors of the Virginia Department of Agriculture and Consumer Services.
3. Seed test shall be completed within the twelve-month period prior to the time the seed is to be used.
4. Seed shall not be, or have been, stored in an enclosure where herbicides, kerosene, or other material detrimental to seed germination is stored.
5. Noxious weed seeds, as defined by the rules and regulations adopted for enforcement of the Virginia Seed Law, will not be permitted. The number of restricted noxious weed seeds shall be not more than the number per ounce or per pound of noxious weed seeds specified in the rules and regulations.

Schedule of Grass Seed Mixture:

Mix	Proportion by Weight	Common Name	Botanical	Min. % Germ.	Min. % Pure Seed	Max. % Weed Seed
Permanent	100%	Fescue	Festuca arundinacea	85	98	0.25
Temporary	100%	Annual Rye Grass	Lolium multiflorum	90	95	0.15

B. Fertilizer

1. Fertilizer shall be uniform in composition, free flowing, and suitable for application with approved equipment.
2. Urea formaldehyde shall be slow-release fertilizer material containing 38 % nitrogen. The material shall have an activity index of 40 to 50 % as determined by tests in accordance with the Association of Official Agricultural Chemists.
3. Fertilizer for general seeding shall be Grade 15-30-15 fertilizer, uniform in composition, free flowing, and suitable for application with approved equipment, and shall be applied at the rate of 600 lb/acre (unless specified otherwise by soil tests).
4. Fertilizer for planting plants shall have an analysis of approximately 10-30-6. Approximately 75 % of the nitrogen shall be slow release nitrogen from methylene ureas, also termed urea formaldehydes, which become slowly available for plants through nitrogen breakdown by soil microbes. Urea nitrogen shall not be used except as specified hereinafter. The phosphate fraction shall be triple superphosphate. Fertilizers to be mixed shall be delivered to the project or another approved location in separate bags bearing the manufacturer's label and shall be thoroughly mixed in the presence of the Owner on the job or other approved location in the following amounts:

20 pounds of urea-formaldehyde as specified herein (38%N), 5 pounds of ureas (45%N), 65 pounds of triple superphosphate (46%P₂O₅), and 10 pounds of muirate of potash (60%K₂O).

5. Fertilizer shall be accompanied by the Form of Affidavit provided in VDOT *Road and Bridge Specifications* Section 244.
6. The analysis and rate of application shall be verified by soil testing. The Contractor shall have the soil tests performed by a state or approved laboratory at no additional cost to the Owner. Analysis and application rates shall be adjusted as recommended by the laboratory.

C. Lime

1. Lime shall be agricultural grade ground limestone. Agricultural grade pulverized limestone may be used at no additional cost to the Owner.
2. The material source shall be registered with and approved by the Virginia Department of Agriculture and Consumer Services in accordance with the Virginia Agricultural Lime Law and shall conform to the following requirements:
3. Ground limestone shall be of such fineness that at least 86 % will pass a No. 20 mesh screen, at least 47 % will pass a No. 60 mesh screen, and at least 28 % will pass a No. 100 mesh screen. Material shall have a calcium carbonate equivalent of at least 85 %.
4. Pulverized limestone shall be of such fineness that at least 90 % will pass a No. 20 mesh screen and at least 66 % will pass a No. 100 mesh screen. Material shall have a calcium carbonate equivalent of at least 85 %.

D. Mulch for Seeding or Erosion Control

Mulches for Seeding or Erosion Control shall be in accordance with the following based on functional longevity, slope length; and slope gradient as detailed herein.

1. Dry Straw or Hay

Dry straw or hay shall be used to facilitate vegetative establishment on slopes of 4:1 or less gradient designed to be functional for up to thirty (30) days. The dry straw or hay shall be free from noxious weeds, reasonably bright in color, and not be musty, moldy, caked, decayed, or dusty. Straw or hay shall be applied by tacking with a Hydraulic Erosion Control Product (HECP), Type 1, at the rate of 1000 pounds per acre and applied as recommended by the manufacturer by punching or disking into the soil or by other Engineer-approved methods.

2. Hydraulic Erosion Control Products (HECP)

Hydraulic Erosion Control Products shall be dyed green or contain a green dye in the package that will provide a color to facilitate visual inspection of the uniformly spread slurry. Mulch, including dye and tackifiers, shall not contain germination-inhibiting or growth-inhibiting factors. The mulch shall be manufactured and processed so that it will remain in uniform suspension in water under agitation and will blend with seed, fertilizer, and other additives to form a homogenous slurry. The mulch shall form a blotter-like

ground cover on application having moisture absorption and percolation properties. It shall cover and hold grass seed in direct contact with the soil, promoting the germination and growth of grass seedlings.

The manufacturer shall provide certification that all components are pre-packaged by the manufacturer to assure material performance and compliance with the minimum requirements of Table 200-5.12-1. Under no circumstances will field mixing of HECP additives or HECP components be allowed. Mulch shall be delivered in packages of uniform weight bearing the name of the manufacturer, the net weight, and an additional statement of the net dry weight content.

When polyacrylamide is used as part of a hydroseeding mix, only an anionic polymer formulation with free acrylamide monomer residual content of less than 0.05% is allowed. Cationic polyacrylamide shall not be used in any concentration. The Contractor shall ensure polyacrylamide-containing mixtures are not sprayed onto pavement. Polyacrylamide-containing mixtures may include tackifiers, flocculants, or moisture-holding compounds.

In addition to making field performance determinations, the Owner may sample and perform such other tests on mulch as it deems warranted to ensure that the mulch conforms to these specifications. Only those materials that have been evaluated by the VDOT and are deemed acceptable will appear on the *VDOT Materials Division Approved Products List*. Mulch types shall contain a tackifier or additive as detailed below that, upon drying, becomes insoluble and non-dispersible, to eliminate direct raindrop impact on soil. Typically, all HECP products shall be applied when the soil is dry and rain is not expected within at least 48 hours after application.

HECP types are as follows:

- a. HECP, Type 1 shall be used to facilitate vegetative establishment on slopes of 1V:4H or flatter gradient. Products shall be functional for up to two (2) months after application and shall be composed of non-toxic fibers consisting of a minimum of 70% specially prepared wood fiber, paper fiber, or a mixture of shredded wood fiber and paper fiber.
- b. HECP, Type 2 shall be used to facilitate vegetative establishment on slopes of 1V:3H or flatter gradient. Products shall be functional for up to three (3) months after application and shall consist of a hydraulically applied matrix composed of a minimum of 70% of non-toxic defibrated organic fibers with, at a minimum, one of the following non-toxic tackifiers or additives:
 - (1) Soil tackifiers,
 - (2) Soil flocculants,
 - (3) Soil polymers,
 - (4) Cross-linked hydro-colloidal polymers, or
 - (5) Cross-linked tackifiers.

HECP, Type 2 products shall not contain materials composed of paper, cellulose

fiber, or any mixture containing paper or cellulose.

- c. HECP, Type 3 shall be used to facilitate vegetative establishment on slopes of 1V:2H or flatter gradient. Products shall be functional for up to six (6) months after application and shall consist of a hydraulically applied matrix composed of a minimum of 70% of non-toxic long-strand organic fibers heated to a minimum temperature of 212° Fahrenheit for sterilization purposes with, at a minimum, one or more of the following non-toxic additives that, upon drying, become insoluble and non-dispersible to eliminate direct raindrop impact on soil:
- (1) Soil tackifiers,
 - (2) Soil flocculants,
 - (3) Soil polymers,
 - (4) Cross-linked hydro-colloidal polymers, or
 - (5) Cross-linked tackifiers.

HECP, Type 3 products shall not contain materials composed of paper, cellulose fiber, or any mixture containing paper or cellulose.

- d. HECP, Type 4 shall be used to facilitate vegetative establishment on slopes of 1V:1H or flatter gradient. The product shall be functional for up to twelve (12) months after application. HECP, Type 4 shall be applied when the soil is dry, when the site requires immediate erosion protection or when there is a risk of impending adverse weather. HECP Type 4 shall consist of a hydraulically applied matrix composed of a minimum of 70% thermally refined wood fibers, cross-linked hydro-colloidal tackifiers (10% by weight), and crimped man-made fibers.

TABLE 200-5.12-1
Minimum HECP Performance and Physical Requirements

HECP Property	Test Method ¹	HECP Type 1	HECP Type 2	HECP Type 3	HECP Type 4
Physical	Requirement				
Color	Visually Observed	Colored to provide contrast upon application, shall be stable and not stain concrete or painted surfaces.			
Organic Matter	ASTM D2974	90% minimum			
Water Holding Capacity	ASTM D7367	400% minimum	500% minimum	600% minimum	700% minimum

Acute Toxicity	ASTM 7101 EPA 2021.0-1	Non Toxic			
Endurance	Requirement				
Functional Longevity	VDOT approved Testing Methods ⁴	Up to 2 Months	Up to 3 Months	Up to 6 Months	Up to 12 Months
Performance	Requirement				
Maximum Slope Application	Observed	4.0 H:1V	3.0 H:1V	2.0 H:1V	1.0 H:1V
Rainfall Event (R-Factor)	ASTM D6459 ^{2,3}	N/A	75 < R	140 < R	175 < R
Cover Factor	ASTM D6459 ^{2,3}	C ≤ 0.50	C ≤ 0.10	C ≤ 0.05	C ≤ 0.01
Vegetation Establishment	ASTM D7322 ²	200% minimum	300% minimum	400% minimum	500% minimum

¹ All products must meet the requirements of this Specification to be listed on VDOT's Materials Division Approved List for HECPs.

² ASTM test methods developed for Rolled Erosion Control Products (RECPs) that have been modified to accommodate Hydraulic Erosion Control Products (HECPs).

³ Utah State Protocol of 2.5:1 slope with rainfall simulated at 5 inches per hour for a 60 minute duration, or TTI Protocol of 2:1 slope with rainfall simulated at 3.5 inches per hour with 3 successive test durations of 30 minutes for each test in 24-hour intervals may be substituted for ASTM D6459.

⁴ Functional Longevity performed at a VDOT test facility or test facility approved by VDOT.

3. Compost Blanket

Compost blankets shall be used to facilitate vegetative establishment on slopes with gradients of 1V:2H or flatter. The compost shall meet the requirements listed in *VDOT Road and Bridge Specifications* Section 244.02 (j) with the exception of particle size as stated below:

Percentage (%) by Dry Weight Passing Sieve Size			
3"	1"	3/4 "	1/4 "
100	90-100	65-100	0-75

Compost used as a compost blanket shall be uniformly applied to the depth specified in the Contract Documents. Compost may be manually spread, or distributed by the use of a pneumatic (blower) or slinger type spreader unit. Compost shall be projected directly at the soil surface, thereby preventing water from moving between the soil/compost interface. The Contractor shall apply the compost layer approximately 3 feet beyond the top of the slope or overlap it into or underneath existing vegetation.

5.13. SODDING

A. Sod

1. Sod shall be cultivated material conforming to the requirements of the State Board of Agriculture for state-approved sod or the State Sod Certification Agency for state certified sod.
2. Root development shall be such that standard size pads will support their own weight and retain their size and shape when suspended vertically from a firm grasp on the uppermost ten (10) % of the area.
3. The top growth of sod shall be mowed so that the height of the grass will be 2 to 3 inches at the time of the stripping operation.
4. Sod may be furnished in any standard pad width and length provided the dimensions do not vary from the average by more than five (5) %.
5. Sod shall be machine stripped at a uniform soil thickness of at least 1-inch.
6. Broken, torn, or irregularly shaped pads will be rejected.

B. Fertilizer

1. Fertilizer shall be uniform in composition, free flowing, and suitable for application with approved equipment.
2. Urea formaldehyde shall be slow-release fertilizer material containing 38 % nitrogen. The material shall have an activity index of 40 to 55 % as determined by tests in accordance with the Association of Official Agricultural Chemists.
3. Fertilizer shall be accompanied by the Form of Affidavit provided in *VDOT Road and Bridge Specifications* Section 244.
4. The analysis and rate of application shall be verified by soil testing. The Contractor shall have the soil tests performed by a state or approved laboratory at no additional cost to the Owner. Analysis and application rates shall be adjusted as recommended by the laboratory.

C. Lime

1. Lime shall be agricultural grade ground limestone. Agricultural grade pulverized limestone may be used at no additional cost to the Owner.
2. The material source shall be registered with and approved by the Virginia Department of Agriculture and Consumer Services in accordance with the Virginia Agricultural Lime Law and shall conform to the following requirements:
3. Ground limestone shall be of such fineness that at least 86 % will pass a No. 20 mesh screen, at least 47 % will pass a No. 60 mesh screen, and at least 28 % will pass a No. 100 mesh screen. Material shall have a calcium carbonate equivalent of at least 85 %.

4. Pulverized limestone shall be of such fineness that at least 90 % will pass a No. 20 mesh screen and at least 66 % will pass a No. 100 mesh screen. Material shall have a calcium carbonate equivalent of at least 85 %.

5.14. SIDEWALKS, STEPS, AND HANDRAILS

- A. Concrete shall be Class A3 conforming to the requirements of Paragraph V.5.6.
- B. Aggregate for exposed aggregate concrete shall be approved by the Owner.
- C. Asphalt concrete shall conform to the requirements of Paragraphs V.5.2, V.5.22 and V.5.23.
- D. Preformed joint filler shall conform to the requirements of Paragraph V.5.6.B. Material shall be approximately $\frac{1}{2}$ inch in thickness and shall have a width and depth equal to those of the incidental structure.
- E. Curing materials shall conform to the requirements of Paragraph V.5.6.C.
- F. Reinforcing steel shall conform to the requirements of Paragraph V.5.8.
- G. Rails and posts shall conform to the requirements of VDOT *Road and Bridge Specifications* Section 232.02(c)4.b. Rails shall be of standard weight and posts shall be extra strong pipe.
- H. Geotextile drainage fabric shall conform to the requirements of Paragraph V.5.26.
- I. Detectable warning surface panels shall conform to the requirements of Paragraph V.5.24.

5.15. SOIL RETENTION COVERINGS

- A. Jute mesh shall be a uniform, open, plain weave of undyed and unbleached single jute yarn. The yarn shall be loosely twisted and shall not vary in thickness by more than its normal diameter. Jute mesh shall be new, and its length shall be marked on each roll.
- B. Openings: Between strands lengthwise, openings shall be 0.60 inch + 25 %. Between strands crosswise, openings shall be 0.90 inch + 25 %. Jute mesh shall weigh 0.9 pound per square yard + 5 %.
- C. Soil retention mats shall consist of a machine-produced mat of wood fibers, wood excelsior, or manmade fiber that shall intertwine or interlock.
- D. Matting shall be nontoxic to vegetation and germination of seed and shall not be injurious to the unprotected skin of the human body.
- E. Mats shall be of consistent thickness, with fiber evenly distributed over its entire area, and covered on the top and bottom side with netting having a high web strength or covered on the top side with netting having a high web strength and machine sewn on 2-inch centers along the longitudinal axis of the material. Netting shall be entwined with the mat for maximum strength and ease of handling.

5.16. SUBGRADE AND SHOULDERS

- A. Materials may consist of material in place, treated material in place, or imported material. Imported material may be borrow material, select material, or other material as shown in the

Contract Documents.

- B. Materials other than regular excavation or borrow material that are shown in the Contract Documents shall conform to the applicable requirements of this Section.

5.17. TOPSOIL

- A. Class A topsoil shall be stockpiled topsoil that has been salvaged in accordance with the requirements of Section 303. It shall be free from refuse or any material toxic to plant growth and reasonably free from subsoil, stumps, roots, brush, stones, clay lumps, or similar objects larger than 1-inch in their greatest dimension.
- B. Class B topsoil shall be topsoil furnished from sources outside the project limits and shall be the original top layer of a soil profile formed under natural conditions, technically defined as the "A" horizon by the Soil Society of America. It shall consist of natural, friable, loamy soil without admixtures of subsoil or other foreign materials and shall be reasonably free from stumps, roots, hard lumps, stiff clays, stones, noxious weeds, brush, or other litter. It shall have demonstrated by evidence of healthy vegetation growing or having grown on it prior to stripping that it is reasonably well drained and does not contain substances toxic to plants.
- C. Topsoil for planting plants shall have a pH in the range of 6.0 to 7.0 prior to mixing with organic matter. If the pH is not within this range, the pH shall be corrected at the Contractor's expense or a different source of supply shall be selected. Topsoil shall be subject to inspection by the Owner at the source of supply and immediately prior to use in planting and shall be mixed with organic matter as specified in the Contract Documents.

5.18. UNDERDRAINS

- A. Unless specifically stated otherwise, all materials shall be new, free from defects, and shall be in accordance with this Section.
- B. Pipe shall conform to the requirements of VDOT *Road and Bridge Specifications* Section 232.
- C. Aggregate shall conform to the requirement of Paragraph V.5.1.
- D. Geotextile drainage fabric shall conform to the requirements of Paragraph V.5.26.

5.19. WATER DISTRIBUTION SYSTEMS

- A. Ductile-Iron (DI) Pipe
1. DI pipe shall be furnished in 18- or 20-foot laying lengths, with push-on joints, except where mechanical or restrained joint or flanged pipe is shown in the Contract Documents.
 2. DI pipe shall conform to the requirements of ANSI/AWWA C151/A21.51.
 3. DI pipe shall be Class 52 for all pipe diameters; or, Class 350 minimum pressure classification for diameters 24-inch and smaller and 250 psi for diameters larger than 24-inches; or, the thickness classification indicated in the Contract Documents. The manufacturer's mark, country where cast, year the pipe was produced, and the letters "DI" or "Ductile Iron" shall be cast or stamped on the pipe.

4. Joints and gaskets shall conform to ANSI/AWWA C111/A21.11 or ANSI/AWWA C115/A21.15 as applicable. The minimum acceptable pressure rating for all joints is 250 psi. All flanges and glands for pipes shall be made of ductile iron.
5. Fittings shall be manufactured in accordance with ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53, as applicable, and shall be ductile iron. Compact fittings are required, and shall have a minimum acceptable pressure rating of 350 psi for 24-inch and smaller piping and 250 psi for larger than 24-inch piping. Fittings shall have the same pressure rating, as a minimum, of the connecting pipe.
6. Coatings shall be provided on the exterior of all pipe, joints and fittings as required by ANSI/AWWA C110/A21.10, C111/A21.11, C115/A21.15, C151/A21.51, C116/A21.16, or C153/A21.53 as applicable. All pipes, joints, and fittings shall be examined after laying to determine if the coating was damaged during installation. Any damaged areas shall be coated with a minimum of 2 mil of an approved bituminous coating.
7. All ductile iron pipe and fittings shall be double thickness cement lined and seal coated in accordance with ANSI/AWWA C104/A21.4.
8. Pipe diameters 12-inch and smaller shall be gaged and delivered round and true throughout its entire length. Pipe over 12-inches in diameter shall have one piece of gaged pipe delivered for each fitting. Gaged pieces shall be marked as such on the pipe and shall be accompanied by the manufacturer's certification. Manufacturer's certification of inspection and testing shall accompany each delivery.
9. ASTM A242 – Standard Specification for High-Strength Low-Alloy Structural Steel
10. ASTM A307 – Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
11. ASTM A674 – Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids.
12. AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
13. For pipe diameters 16-inches and greater:
 - a. Each length of ductile iron pipe shall be hydrostatically tested at the point of manufacture to 500 psi for a duration of 10 seconds per AWWA C151. Testing may be performed prior to machining bell and spigot. Failure of ductile iron pipe shall be defined as any leak or rupture of the pipe wall.
 - b. 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 Owner at the Owner's expense.
 - c. A manufacturer's representative shall be made available to the Owner during the manufacturing furnishing, transporting, and unloading of the pipe during installation and testing of the pipe to assist in insuring that the pipe is properly fabricated, transported, unloaded, stored in the field, joined and tested. Manufacturer's responsibilities relate only to the proper care and treatment of

the pipe during these procedures and not the techniques or procedures used during installation and testing.

- d. The manufacturer's representative shall be made available a minimum of 2 working days (time on site) during the project when requested by the Owner, including the first 2 Days of pipeline installation.
 - e. The cost for the services of the manufacturer's representative, including expenses, shall be considered incidental to the project and will not be paid separately.
- B. Polyvinyl Chloride (PVC) Pipe
- 1. PVC pipe shall be furnished in 20-foot laying lengths, with push-on joints. Restrained joints shall be provided where shown in the Contract Documents.
 - 2. PVC pipe, 4- to 12-inches in diameter, shall conform to the requirements of AWWA C900 - Class 150 (DR-18), unless otherwise indicated in the Contract Documents. PVC pipe greater than 12-inches in diameter shall be AWWA C-905 - Class 235 (DR 18) or Class 165 (DR 25), as specified in the Contract Documents.
 - 3. The pipe, shall be made from virgin polyvinyl chloride resin or clean rework materials generated from the manufacturer's own pipe production that equals or exceeds cell class 12454-B as defined by ASTM D 1784, and shall bear the seal of approval by the NSF. The pipe shall be unplasticized polyvinyl chloride plastic pressure pipe with integral wall bell and spigot joints.
 - 4. Joints shall be push-on type with a flexible factory assembled elastomeric ring in the integral bell-end. Joint material including gaskets and lubricants shall conform to AWWA C900.
 - 5. Fittings shall be manufactured in accordance with ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53, and shall be ductile iron. The minimum acceptable pressure rating shall be 250 psi. Compact fittings are required and shall have a minimum acceptable pressure rating of 350 psi.
 - 6. 3-inch and 4-inch diameter pipe shall be Schedule 80 PVC, in accordance with ASTM D-1785 or ASTM D-2241 for SDR (Standard Dimension Ratio) 13.5, or as specified in the Contract Documents. Solvent cement for non-gasketed PVC pipe shall meet the requirement of ASTM D-2564. Pipe 2-inches and smaller shall be **Municipex pipe**.
 - 7. Pipe shall bear identification markings that will remain legible during normal handling, storage, and installation. The markings shall be applied in a manner that will not reduce the strength of the pipe or coupling or otherwise damage either. Pipe markings shall be applied at intervals not to exceed five (5) feet and shall include the nominal size and outside diameter (e.g. 4 CI), PVC, DR 18, AWWA Pressure Class (PC 150), manufacturer's name or trademark and production record code, and the seal of the testing agency that verified the suitability of the pipe material for potable water service.
 - 8. The manufacturer's representative shall be made available a minimum of 2 working days (time on site) during the project when requested by the Owner, including the first

2 Days of pipeline installation.

9. The cost for the services of the manufacturer's representative, including expenses, shall be considered incidental to the project and will not be paid separately.

C. High Density Polyethylene (HDPE) Pipe

1. HDPE pipe and fittings shall meet the requirements for potable water and have ANSI/NSF No. 61 certification. HDPE pipe shall only be used for potable water applications when a carrier pipe is required for boring.
2. HDPE pipe 3-inches or less in diameter shall comply with AWWA C901 and shall have a nominal DIPS (Ductile Iron Pipe Size) outside diameter unless otherwise specified. The nominal size and SDR of the pipe shall be as specified in the Contract Documents. HDPE pipe greater than 3-inches in diameter shall be in accordance with AWWA C906-15 and shall have a nominal DIPS (Ductile Iron Pipe Size) outside diameter unless otherwise specified. The nominal size, pressure classification rating, and SDR of the pipe shall be as specified in the Contract Documents. ODs and tolerances for IPS outside diameter pipe shall be in accordance with ANSI B36.10 as illustrated in AWWA C906-15 Table 3.A Pipe shall be homogeneous and uniform throughout; shall be free of injurious defects such as visible cracks, holes, foreign inclusions, voids, and blisters; and shall have uniform color and physical properties according to the provisions of AWWA C906-15.
3. Commercial virgin PE Compounds shall meet ASTM D3350 physical property requirements and shall be classified per ASTM D3350 as shown in Table 1 of AWWA C906-15. The compound shall have HDB (Hydrostatic Design Basis) ratings at 73°F (23°C) and at 140°F (60°C) and HDS (Hydrostatic Design Stress) ratings at 73°F (23°C) determined in accordance with ASTM D2837 and PPI TR-3 (Policies and Procedures for Developing Recommended Hydrostatic Design Stress for Thermoplastic Pipe Materials).
4. The PE Compound in the pipe shall contain color and ultraviolet (UV) stabilizer meeting the requirements of ASTM D3350 Codes C or E. Code C compounds shall contain 2 to 3 percent carbon black when material from the pipe is tested in accordance with Section 4.3.11 of AWWA C906-15. Code E compounds used for solid color pipe, color stripes, or color layer (shell) shall contain sufficient UV stabilizer to protect the pipe against UV degradation for at least 24 months of unprotected outdoor exposure. Color PE compounds used for stripes or color layers shall be of the same materials designation codes as the pipe material, varying only by color and UV stabilizer.
5. Clean rework materials derived from pipe production by the same manufacturer are acceptable as part of a blend with Virginia PE compound meeting section 4.2.1 of AWWA C906-15 for the production of new pipe, including sections 4.2.3.1, 4.2.3.2, 4.2.3.3 and 4.2.4.
6. PE fittings or components may be molded, thermoformed from pipe sections or fabricated. Molded fittings shall meet the requirements of AWWA C906-15 and the requirements of ASTM D2683 for socket-type fittings, or ASTM D3261 for butt-type fittings, or ASTM F1055 for electrofusion-type fittings. Thermoformed and fabricated fittings shall meet the requirements of AWWA C906-15 and ASTM F2206.

7. Pipe sections shall be joined on the job site above ground into continuous lengths by the thermal butt-fusion or electrofusion method, which shall be performed in strict accordance with the manufacturer's recommendations. The butt-fusion equipment used in the joining procedures shall be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements of 400 °F, alignment, and 75 psi interfacial fusion pressure. Butt-fusion joining shall be 100% efficient and shall provide a joint weld strength equal to or greater than the tensile strength of the pipe. Socket-fusion, extrusion welding or hot gas welding of HDPE shall not be used for pressure pipe applications. Flanges, unions, grooved-couplers, transition fittings, and some mechanical couplers may be used to mechanically connect HDPE pipe without butt-fusion, if specified in the Contract Documents and approved by the manufacturer.
8. The manufacturer's representative shall be made available a minimum of 2 working days (time on site) during the project when requested by the Owner, including the first 2 Days of pipeline installation.
9. The cost for the services of the manufacturer's representative, including expenses, shall be considered incidental to the project and will not be paid separately.
10. Transition couplings from HDPE to other pipe materials, shall be as indicated in the Contract Documents.

D. Copper Water Pipe

Pipe shall be seamless copper tubing conforming to ASTM B 88, Type K, Temper 060, and shall be of the coiled type. Fittings shall be wrought copper solder-joint pressure fittings conforming to ASME B16.22. Copper tube and fittings shall be rated for a working pressure of 150 psi. Joints shall be compression style.

E. Valves

1. Gate Valves

- a. Resilient-seated gate valves shall be used on pipelines 3-inches in diameter up to and including 12-inches in diameter. Resilient-seated gate valves shall be in accordance with AWWA C509 or AWWA C515 and shall be supplied with an interior epoxy coating in accordance with AWWA C550. Resilient-seated gate valves shall be iron body, non-rising bronze or stainless steel stem, rubber encapsulated iron disc, o-ring seals, and suitable for buried service. Valve ends shall be flanged, mechanical joint, or mechanical joint by flange to suit the pipe or fittings as indicated in the Contract Documents.
Gate valves shall be manufactured by Kennedy Valve Company, Mueller Company, AVK, or AFC.
- b. Gate valves 3-inches in diameter shall be cast bronze, solid-wedge disc, screwed bonnet, inside screw, non-rising stem valves with threaded connections. Valves shall conform to Standard SP-80, Type 2, Class 150, Manufacturer's Standardization Society of the Valve and Fitting Industry, Inc.
Gate valves 2" and smaller shall be manufactured by AVK or AFC.

c. Gate valves larger than 16-inches in diameter shall meet the requirements of AWWA C500, except Section 4.4.8.1.1 will not be allowed. Valves shall be rated for 150 psi working pressure and a minimum 300 psi test pressure. Valves shall be iron body, bronze-mounted, double disc, parallel seat, non-rising stem type fitted with O-Ring seals. Valves shall be capable of drip tight, bi-directional shut off and operate in the horizontal position. The operating nuts shall be 2-in square. Valves shall open counter clockwise. Seats in the body shall be replaceable without removing the valve from the pipeline. Discs shall be cast iron and bronze faced and shall be free to revolve 360 degrees. Valves to be furnished with bronze rollers, bronze tracks and bronze scrapers.

d. Valve Operators

Buried valves shall have a 2-inch square operating nut conforming to AWWA C509, and shall open in a counterclockwise direction, unless otherwise noted. A valve key wrench of adequate length and of each type required shall be provided for each buried valve; however, not more than three of each type are required for each project. Valves in vaults shall have a hand wheel of cast iron conforming to ASTM A126, Class B.

2. Ball Valves

Owner-approved ball valves smaller than 3-inches in diameter shall be:

- a. Brass with threaded connections, O-ring seals, and a coated ball conforming to AWWA C800 and Standard SP-80, Type 2, Class 150 Manufacturer's Standard Society of the Valve and Fittings Industry, Inc. Valves shall be manufactured by the Ford Meter Box Company B11, Mueller Company 300 Ball Curb Valve, B-20283, or approved equal.
- b. Ball valves 2" and smaller shall be manufactured by AVK, AFC, or approved by Town.
- c. NSF approved.

3. Butterfly Valves

- a. Butterfly valves may be used on pipelines 16-inches in diameter and larger and shall be Pressure Class 150B in accordance with the latest revision of AWWA C504. Butterfly valves and operators shall be suitable for buried service. Valve seats shall be of synthetic rubber compound and tested in accordance with ASTM D-429. The valve shall be operable with a maximum input of 150 foot-pounds on the operating nut, and be able to withstand an overload input torque of 150 foot-pounds at full open and full closed positions without damage to the operator nut. Actuator components shall be designed to withstand, without damage, a rim pull of 200 pounds for the hand wheel, and an input torque of 300 Ft-Lbs for wrench nuts, in accordance with AWWA C504. The disc shall be capable of holding in any intermediate position without creep or flutter.

- b. Butterfly valve operators may be side-mounted, shall meet the requirements of AWWA C504, pressure class 150B, shall be capable of seating and unseating the discs against the full design pressure and velocity, and shall transmit sufficient torque to the valve to accomplish this. Buried valves shall contain permanently lubricated operators. Valve operators shall be suitable for a minimum of 10,000 cycles of operations at its rated torque.

4. Coatings

All interior ferrous surfaces of all valves shall be coated in accordance with ANSI/AWWA C550 using a coating approved by the Virginia Department of Health for contact with potable water and shall not contain lead, coal tar resins, lampblack, carbon black or bituminous materials. The exterior surfaces shall receive a factory applied fusion bonded epoxy coating.

5. Valve Stem Extensions

Valve stem extensions, when allowed by the locality, shall be furnished when the distance from the operating nut to the top of the valve box frame is greater than 36-inches. Extension stems shall have a 2-inch square wrench nut on the top end and shall be at least as strong as the valve stem. Extension stems shall be coated in accordance with above.

6. Valve Markings

Valve markings shall be cast on the bonnet or body of each valve and shall show the manufacturer's name or mark, the year the valve casting was made, the size of the valve, and the designation of working pressure.

F. Valve Boxes

Valve boxes shall be as indicated in the Standard Details.

G. Fire Hydrants

1. Fire hydrants shall be of the dry-barrel type and shall conform to AWWA C502.
2. The hydrant base shall have a 6-inch mechanical joint bell, designed for connection to a horizontal 6-inch ductile iron hydrant branch with retainer glands. The traffic coupling shall allow for 360-degree adjustment of the upper standpipe. The fire hydrant shall be painted with a high gloss, alkyd industrial enamel (colors shall be selected by the Owner). Extension spools shall be available from 6-inches to at least 48-inches, in 6-inch increments. Normal bury depth shall be 3.5 feet.
3. The flow rate shall be a minimum of 1000 gallons per minute with not more than 5-psi pressure drop through the steamer nozzle, per AWWA C502.
4. The internal valve shall be no smaller than 4½-inches in diameter and have bronze-to-bronze seating.
5. Hydrants shall include two (2) 2 1/2-inch hose nozzles placed 180 degrees apart; National Standard (American) fire hose coupling screw threads; and one steamer

nozzle with 4 1/2-inch National Standard (American) fire hose coupling screw threads (unless specified otherwise by the Owner).

6. Fire Hydrants shall conform to Mueller Super Centurion 250 Model A421 or A-423, Kennedy Guardian K-81D, or 4 1/2" American-Darling Mark 73-5.

H. Appurtenances

1. Air Vent and Blow Off Assemblies

- a. Air Vent and Blow Off Assemblies shall be as indicated in the Standard Details.
- b. Brass Pipe shall be red brass pipe meeting the requirements of ASTM B 43. Pipe sizes, wall thickness and dimensions shall meet the requirements of ASTM B 251, Table I for regular pipe. Brass pipe fittings shall be screwed end malleable iron pattern meeting the requirements of ANSI B16.15. They shall be finished rough, unless otherwise specified. Unions shall be of all brass or bronze with ground joints and shall be left semi-finished. Fittings shall be rated for steam working pressures up to 125 psi. Joints shall be screwed type with threads clean cut, tapered and smooth, meeting the requirements of ANSI B2.1.

2. Water Sampling Stations

Water sampling stations shall conform to Mainguard #94WM sampling station, or approved by Town.

3. Corporation Stops

Corporation Stops shall be manufactured to meet or exceed the AWWA C-800 latest revision. The corporation stops shall also meet the following requirements:

- a. The valve shall be of the ball type construction. A plug valve is not approved.
- b. The corporation stops shall be designed to withstand working pressures up to 300 psi.
- c. The corporation stops shall be manufactured with AWWA/CC tapered threads. See details for Swivel Eighth Bend.
- d. Corporation stops joining to existing galvanized piping shall have female iron pipe threads.
- e. Acceptable manufacturers of corporation stops are:

- (1) Ford Ball Corporation Stop:
Model FB600-4-NL for 1" (CC threads) with Swivel Bend Model LA04-44S-NL
Model FB600-7-NL for 2" (CC threads) with Swivel Bend Model LA04-77S-NL
- (2) A.Y. McDonald Ball Corporation Stop:
Model 74701BL (1" or 2") with Swivel Bend Model 74750S-22 (1" or 2").

4. Service Saddle

Service Saddle shall be designed and sized for the water main on which the saddle is to be installed. The service saddle shall also meet the following requirements:

- a. Stainless steel saddle bodies shall be 18-8, Type 304, stainless steel with all welds fully passivated to restore stainless steel characteristics.
- b. Ductile iron saddle bodies shall conform to ASTM A-536 and have a fusion applied epoxy coating 12-mils dry thickness (D.T.). Straps shall be double strap stainless steel, 18-8, Type 304 fully passivated for corrosion resistance.
- c. Threads shall be AWWA C-800 CC/Taper.
- d. The saddle band shall be a minimum of 2-inches in width.
- e. The saddle shall be provided with a Buna-N rubber gasket meeting ASTM D2000 to seal the saddle and the main pipe.
- f. The nuts, washers, bands, and bolts shall be 18-8 stainless steel.
- g. Acceptable manufacturers are The Ford Meter Box Co., Inc., Model FS202/FS303/FRS202, JCM Model 406, Romac Industries Inc., Style 202N, Cascade Products Style CNS2, or approved equal.

J. Water Meters

Meter settings shall include meter setter, meter box, water meter, and all appurtenances necessary for providing customer water service at the location designated in the Contract Documents. See the Special Provisions for additional information.

K. Joint Restraint Devices

1. Joint restraints shall be provided where indicated in the Contract Documents.
2. Ductile Iron Pipe

The restrained joint system shall have a pressure rating equal to or greater than that of the pipe on which it is used. Restrained joint devices shall be installed in strict accordance with the manufacturer's recommendations.

a. Push-On Joints

For push-on joint type pipe, the restrained joint system shall be a manufacturer's standard restrained joint system, SnapLock (U.S.Pipe), TR Flex (U.S. Pipe), FlexRing (American Pipe), Series 3000 Stargrip wedge

action restraint (Star Pipe Products), or approved equal.

b. Mechanical Joints

For mechanical joint type pipe, the restrained joint system shall be a manufacturer's standard restrained joint system, Series 1100 Megalug ductile iron glands (EBBA iron, Inc.), Series 1400 retainer glands (Ford Meter Box Company, Inc.), Series 3000 Stargrip wedge action restraint (Star Pipe Products), or approved equal.

3. PVC Pipe (4-inch and larger)

The restrained joint system shall have a pressure rating equal to or greater than that of the pipe on which it is used. Restrained joint devices shall be installed in strict accordance with the manufacturer's recommendations.

a. Bell and Spigot PVC Joints

The restraint system for bell and spigot PVC joints shall be Series 1600/2800 ductile iron retainers as manufactured by EBAA Iron, Inc, Series 1390 retainers as manufactured by Ford Meter Box Company, Inc., or approved equal.

b. PVC to Mechanical Joint Fittings

The restraint system for restraining PVC pipe to ductile iron mechanical joint fittings shall be Series 2000 PV ductile iron retainers as manufactured by EBAA Iron, Inc., Series 1500 retainers as manufactured by the Ford Meter Box Company, Inc., Series 4000 Stargrip wedge action restraint (Star Pipe Products), or approved equal.

4. Concrete Reaction Blocking

Concrete reaction blocking shall not be permitted, unless approved by the Owner.

5. Tie Rods

Tie rods shall not be used unless specifically approved by the Owner and only where shown in the Contract Documents. When appropriate, tie rods, bolts, washers, and nuts shall be stainless steel in accordance with ASTM A-307.

L. Tapping Valves and Sleeves

1. Tapping valves and sleeves shall be compatible for use with the pipe being tapped and as approved by the Owner. The Contractor shall verify the material and diameter of the pipe being tapped prior to ordering tapping valves and sleeves.
2. Tapping valves for ductile iron pipe shall meet the same specifications as gate valves, except they shall have a full, unobstructed opening to receive a full size shell cutter. Tapping valves shall contain a standard mechanical joint on one end and a flanged joint on the other end. The valves shall be subjected to a factory test pressure of 400 psi and be designed for a working pressure of 200 psi.

3. Tapping sleeves shall be split sleeve with mechanical joint type end seals. Cast sleeves for tapping cast iron pipe, shall be ductile iron meeting ASTM A536 Grade 65-42-12.
 - a. Tapping sleeves for Ductile Iron and PVC C-900 Pipe

As appropriate, tapping sleeves shall be mechanical joint, furnished complete with plain rubber gaskets, mechanical joint accessories, and approved interior and exterior coatings. The outlet flange shall be 125 pound, drilling per ANSI B16.1, with standard tapping flange counterbore per MSS SP-60. Tapping sleeves shall be in accordance with ANSI/AWWA C110/A21.10.and approved by the manufacturer for use on the type and class of pipe being tapped.
 - b. PVC Pipe (Other than C-900)

Tapping sleeves shall be complete, furnished with plain rubber gaskets, have a full circumference band made of 18-8 type 304 stainless steel. The flange and all bolts and nuts shall conform to AWWA C207 Class D 150 lb. drilling, made of 18-8 type 304 stainless steel.

Gaskets shall conform to the applicable requirements of ANSI/AWWA C111/A21.11, and shall be clearly marked to identify the diameter range for which intended.
4. When approved by the Owner and indicated in the Contract Documents, stainless steel tapping sleeves may be used and shall be constructed of all stainless steel conforming to the following requirements:
 - a. Flange - The flange shall be 18-8, type 304 stainless steel, with recess to accept the standard tapping valve according to MSS-SP60. The flange shall also conform to AWWA C207-latest revision, Class D ANSI 150 lb. drilling. The bolt hole shall be aligned to straddle the pipe center line.
 - b. Body - The body shall be 18-8, type 304 stainless steel. All welds shall be fully restored to stainless steel characteristics.
 - c. Gaskets - The gaskets shall be virgin SBR compounded for water service. ASTM D2000 8M 4AA607. The gasket shall be a full 360 degree pipe coverage. The outlet gasket shall be Buna-N.
 - d. Test Plug - Provide a waterworks brass 3/4-inch test plug with standard square head.
 - e. Bolts and Nuts - The bolts and nuts shall be 18-8, type 304 stainless steel UNC threads. Provide heavy hex nuts and washers fluorocarbon coated to prevent galling.
 - f. Manufacturer - Acceptable manufacturer is the Ford Meter Box Co., Inc., Model FTSS, Smith-Blair Style 665, Romac Industries Inc., SST or JCM Industries, Inc., Model 432, or approved equal.

M. Sleeves and Couplings

1. Diameters greater than 2-inch
 - a. Mechanical joint sleeves shall be solid type, long or short body pattern as approved by the Owner, manufactured in accordance with ANSI/AWWA C110/A21.10. Sleeves shall have a minimum pressure rating of 350 psi. Glands, gaskets, bolts, and nuts shall be in accordance with ANSI/AWWA C111/A21.11.
 - b. Sleeves shall not be machined in order to facilitate use with pipe of a class or type other than that for which the sleeve was manufactured.
 - c. The use of bolted steel couplings shall be restricted to joining pipes of different outside diameters, joining pipes of dissimilar materials, and joining sections of steel pipe. Ferrous surfaces shall be coated with an epoxy coating; enamel coatings are not acceptable.
 - d. Bolted steel transition couplings shall be Rockwell 413, Dresser style 162, or approved equal.
 - e. Bolted steel reducing couplings shall be Rockwell 415, Dresser style 62, or approved equal.
 - f. Bolted steel couplings for joining pipes of the same outside diameter shall be Rockwell 411, Dresser style 38, or approved equal.
2. Diameters 2 inches and less:
 - a. Service couplings or unions shall conform to the requirements of AWWA C800-05 with the exception that any brass part of a fitting or coupling or valve in contact with potable water shall be made of copper alloy CDA No. C89520 or “no-lead brass” complying with ASTM B30 and B584. This “no-lead brass” alloy shall contain no more than $\frac{1}{4}$ of 1 percent (0.25%) total lead content by weight.
 - b. An ANSI accredited test lab per ANSI/NSF 61, Drinking Water Components-Health Effects Section 8, shall be used to certify the lead content for all “no-lead brass” fittings and valves. Proof of certification is required.
 - c. All brass fittings and couplings and valves shall have the manufacturers name or trademark integrally stamped as well.
 - d. Service couplings or unions shall be Mueller type H-15400, McDonald 4602, Cambridge 202, or approved equal.

5.20. MISCELLANEOUS ITEMS

- A. Copper tracer wire – shall be 10 gauge, solid wire with plastic coating and shall be attached to waterline.
- B. Subsurface Utility Warning Tape - Shall be of a durable, metalized, plastic film, similar to Terra Tape D for identification of water and force mains. Bright blue tape imprinted with the

legend "Caution - Waterline Below" and bright green tape imprinted with the legend "Caution - Sewer Below" shall be used as appropriate. The utility warning tape shall have a width of 6-inches and shall be manufactured by Reef Industries, or approved equal.

5.21. SANITARY SEWER REHABILITATION

The sanitary sewer rehabilitation specifications presented here and in Section 800 are meant as a guideline for the educated and experienced designer and practitioner of gravity sanitary sewer rehabilitation. Because most of the gravity sanitary sewers in Hampton Roads range in size from 6 to 18 inches, these specifications focus on technologies that are well understood in this geographic area and can be supported with competent contractors. These specifications are not meant to be inclusive of all rehabilitation technologies available today.

A. DVDs

1. All television surveys shall be digitally recorded and supplied to the Owner on DVD disks. DVDs shall be submitted to the Owner and will become the property of the Owner.
2. Two labels are required for DVDs. One label shall be placed on the plastic storage case for the CD/DVD and the other on the face of the DVD. Permanently label each DVD and case with the following information:

Plastic case of DVD

Owner Name: _____	Contractor's Name: _____	
Tape No.: _____	Date Televised: _____	Date Submitted: _____
Project Name: _____		
Branch Name: _____	Street Name: _____	

Face of DVD

Manhole No. From	Manhole No. To	Pipe Diameter	Pipe Length	Street
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

B. Pipe Rehabilitation by Cured-In-Place Pipe Method

1. The product proposed for the cured-in-place rehabilitation of sewers must have been in use in the United States for at least three years with a minimum of 50,000 linear feet of the product installed to date in this country.
2. The liner shall generally consist of corrosion resistant polyester, vinyl ester, or epoxy thermosetting resin, or approved equal, impregnated flexible polyester felt or fiberglass fiber. The liner may also consist of glass reinforced pipe (GRP).

3. The wall color of the interior pipe surface of the cured-in-place pipe after installation shall be a light reflective color so that a clear detail examination with closed circuit television inspection equipment may be made.
4. Design inputs generally considered to be the same from site to site for a particular project, are provided in Table 200-5.21.1.

TABLE 200-5.21.1
Common Design Parameters

Safety Factor	2.0
Soil Modulus (1)	1000 psi
Soil Density (2)	120 pcf

Notes:

- (1) In the absence of site-specific information, assume a soil modulus of 1000 psi.
- (2) In the absence of site-specific information, assume a soil density of 120 lb/ft³ (pcf).

The information listed in Table 200-5.21.2 is specific to each manhole to manhole run of pipe. The Contractor shall use for design the information provided by the Owner and information the Contractor collects during site visits for each manhole to manhole run.

TABLE 200-5.21.2
Site-Specific Design Parameters

Ovality	Notes 1, 2
Ground Water Depth Above Invert	Notes 1, 3
Soil Depth Above Crown	Note 1
Live Load	Notes 1, 4
Design Condition (Fully Deteriorated)	Notes 1, 5
CIPP Thickness	Notes 1, 6, 7

Notes:

- (1) Design thickness and complete site-specific designs, in accordance with ASTM F 1216 (Appendix XI) or ASTM F 2019
- (2) The Contractor shall estimate the ovality by viewing the videotapes and other information provided by the Owner. If tapes are not available, the Contractor shall assume an ovality of 2%. In cases where the ovality exceeds 10%, the Contractor may consider employing alternative design methods (such as beam design methods) to determine the pipe thickness.
- (3) In the absence of accurate water table information or high water elevation observed during the site visit (stream, ponds, etc.), the Contractor shall assume a seasonal groundwater elevation variation of 3 feet below the ground surface.
- (4) CIPP is subjected to traffic live loads as calculated by AASHTO Standard Specifications for Highway Bridges, HS-20-44 Highway Loading.
- (5) The Contractor shall assume the pipe segments are fully deteriorated.
- (6) Thicknesses specified (designed by the Contractor and approved by the Owner) are the final, in-ground thickness required. Measured sample thicknesses will not include polyurethane or polyethylene coatings, any layer of the tube not fully and verifiably impregnated with resin, or any portion of the tube not deemed by the Owner to be a structural component of the composite.
- (7) The Contractor must consider any factors necessary to ensure the final, cured-in-place pipe thickness

is not less than specified above. These factors include any stress applied to the material during transportation, handling, installation and cure; the host pipe's material type, condition, and configuration; weather (including ambient temperature conditions); and any other factors which are reasonably expected to be found in existing combined or sanitary sewer systems.

5. The corrosion resistance of the resin system shall be tested by the resin manufacturer in accordance with ASTM D 543. The result of exposure to the chemical solutions listed in Table 200-5.21.3 shall produce loss of not more than 20% of the initial physical properties when tested in accordance with ASTM D 543 for a period of not less than 1 year at a temperature of 73.4°F plus or minus 3.6°F. For applications other than municipal wastewater, conduct chemical resistance tests with actual samples of the fluid to be transported in the pipe and in accordance with procedures approved by the Owner.

TABLE 200-5.21.3
Concentrations of Chemical Solutions for Chemical Resistance Test

<u>Chemical Solution</u>	<u>Concentration, %</u>
Tap Water (pH 6-9)	100
Nitric Acid	5
Phosphoric Acid	10
Sulfuric Acid	10
Petroleum Hydrocarbon Based Fuels (e.g. Gasoline, diesel, etc.)	100
Vegetable Oil ¹	100
Detergent ²	0.1
Soap ²	0.1
Domestic Sewage	100

1 Cotton seed, corn, or mineral oil

2 As per ASTM D 543

6. Manufacturer's Information

- a. It shall be necessary for the Contractor to obtain the Owner's prior approval for all materials or processes and the Owner shall have the power at any time to order the Contractor to modify or discontinue any practice. All such orders shall be given in writing.
- b. All fabricating and Contractor testing shall be carried out under cover and no materials shall be exposed to the weather until they are ready to be inserted. All materials should be protected from the weather and exposure to ultra-violet light as practicable during the manufacture and installation process.
- c. Each liner shall be accompanied by suitable documentation indicating time

and date of manufacture, felt thickness, number of layers, length of liner, resin types, resin content, catalyst, relevant batch numbers, etc.

7. Non-Reinforced Thermoset Cured In Place Pipe Liners (Water or Steam Cured)

- a. The liner shall meet the requirements of ASTM F 1216 and shall be constructed to withstand inversion pressures, have sufficient strength to bridge missing pipe, stretch to fit irregular pipe sections, and shall invert smoothly around bends. The liner shall fit tightly to the internal circumference of the existing pipe, and a membrane integrally bonded to the internal circumference of the felt, thus forming a smooth, chemically inert internal flow surface. The membrane shall be a minimum of 0.25 mm +5% and shall not be considered to impart any structural strength of the liner. The liner shall be fabricated to a size that when installed will neatly fit the internal circumference of the pipe to be lined. Allowance for longitudinal and circumferential stretching of the liner during installation shall be made by the Contractor.
- b. The CIPP liner shall be composed of tubing material consisting of one or more layers of a flexible non-woven polyester felt with or without additives such as woven fiberglass or other fibers and meet the requirements of ASTM F 1216, ASTM F 1743, and ASTM D 5813. The felt content of the CIPP liner shall not exceed 25 percent of the total impregnated liner volume. The fabric tube shall be capable of absorbing and carrying resins, constructed to withstand installation pressures and curing temperatures and have sufficient strength to bridge missing pipe segments, and stretch to fit irregular pipe sections.
- c. The CIPP liner tube may be made of single or multiple layer construction, with any layer not less than 1.5 mm thick. The wet-out fabric tube shall have a uniform thickness and excess resin distribution that when compressed at installation pressures will meet or exceed the design thickness after cure.
- d. The exterior of the manufactured tube shall have distance markings along its length at regular intervals not to exceed 5 feet. Contractor shall use these marks as a gauge to measure elongation during insertion. Should the overall elongation of a reach exceed 5 percent, the liner tube shall be rejected and replaced. The Contractor shall identify the wet-out facility where all CIPP liner under this Contract will be manufactured. All CIPP liner shall be manufactured from this designated wet-out facility throughout the entire Contract unless specifically approved otherwise by the Owner in writing. Multiple wet-out facilities shall not be allowed. The application of the resin to the felt tubing (wet-out) shall be conducted under factory conditions and the materials shall be fully protected against UV light, excessive heat and contamination at all times.
- e. The resin volume shall be adjusted by adding 5 to 10% excess resin for the change in resin volume due to polymerization and to allow for any migration of resin into the cracks and joints in the original pipe. The resin used shall not contain fillers, except those required for viscosity control, fire retardance, or as required to obtain the necessary pot life. Thixotropic agents which will not interfere with visual inspection may be added for viscosity control. Resins may contain pigments, dyes or colors that will not interfere with visual

inspection of the cured liner. However, the types and quantities of fillers and pigments added shall have prior approval of the Owner. The resin content of the liner shall be 10-15% by volume greater than the volume of felt in the liner bag. The felt resin tubing shall be vacuum impregnated with a thermosetting polyester resin and catalyst, vinyl ester resin and catalyst, or epoxy resin and hardener.

- f. The Contractor shall deliver the uncured resin impregnated liner bag to the site. The bag may not be impregnated at the site unless approved by the Owner. The liner bag shall be impregnated with resin not more than 80 hours before the proposed time of installation and stored out of direct sunlight at a temperature of less than 30 °F.

Certain design inputs vary by manufacturer, process design, or installation technique. These variables are listed in Table 200-5.21.4 with explanatory notes below.

**TABLE 200-5.21.4
Product-Specific Design Parameters**

Minimum Enhancement Factor, K ⁽¹⁾	K = 7
Minimum Initial Flexural Strength (ASTM D 790) ⁽²⁾	$\sigma_s = 4500$ psi
Minimum Initial Flexural Modulus of Elasticity (ASTM D 790) ⁽²⁾	$E_s = 350,000$ psi
Minimum Retention of Properties to Account for Long-Term Effects ⁽³⁾	50%
Maximum Long-Term Flexural Modulus of Elasticity ⁽³⁾	$E_L = 175,000$ psi

Notes:

- (1) Enhancement factor (K) is the additional buckling or load resistance of the rehabilitation product due to the restraining action of the host pipe. The tighter the fit of the product within the host pipe, the greater the value of K. Third party testing of external hydrostatic loading capacity of restrained pipe samples shall be conducted to verify the enhancement factor, K. The minimum values provided are based on the "Long-Term Structural Behavior of Pipeline Rehabilitation Systems," Trenchless Technology Center, 1994.
- (2) Initial values are defined in ASTM D 790. The Owner may, at any time prior to installation, direct the Contractor to make cured samples (according to ASTM F 1216 93) and test them in accordance with the listed ASTM standards to verify initial values of physical properties. In such tests the Contractor's samples must achieve a 95% pass-rate.
- (3) The initial flexural modulus is multiplied by the creep factor (or percentage retention) to obtain the long-term values used for design. Long-term values shall be verified by long-term external pressure testing of circular lengths of the pipe material by third-party labs prior to bid (e.g. Trenchless Technology Center - TTC). It is understood that the material's modulus of elasticity will not change over time; however, by convention the modulus is reduced for design purposes for all plastic pipe sections to account for the reduced ability of plastic pipe to carry loads due to the changes in pipe geometry resulting from the effects of creep over time.

8. Glass Reinforced Pipe (GRP) Liners

The materials used for GRP liners shall have the following additional properties:

- a. The fiberglass within the liner shall be non-corrosion material and shall be free from tears, holes, cuts, foreign materials and other surface defects. Its

glass fibers must extend in a longitudinal direction to insure no longitudinal stretching during the installation process. The tube shall consist of a seamless, flexible, glass fiber with no longitudinal seams.

- b. Interior and exterior plastics shall be styrene resistant to protect and contain the resin used in the liner.
- c. The exterior plastic shall be UV light resistant, when applicable, and translucent to allow visual inspection of the impregnation of the resin within the glass fibers.
- d. The resin shall be a chemically resistant, isophthalic polyester resin or vinyl ester resin. When cured the resin/liner system shall meet the structural and chemical resistance requirements of ASTM F 2019.

Certain design inputs vary by manufacturer, process design, or installation technique. These variables are listed in Table 200-5.21.5 with explanatory notes below.

TABLE 200-5.21.5
Product-Specific Design Parameters

Minimum Enhancement Factor, K ⁽¹⁾	K = 7
Minimum Initial Flexural Strength (ASTM D 790) ⁽²⁾	σ_s = 4500 psi
Minimum Initial Flexural Modulus of Elasticity (ASTM D 790) ⁽²⁾	E_s = 725,000 psi
Minimum Retention of Properties to Account for Long-Term Effects ⁽³⁾	50%
Maximum Long-Term Flexural Modulus of Elasticity ⁽⁴⁾	E_L = 362,500 psi

Notes:

- (1) Enhancement factor (K) is the additional buckling or load resistance of the rehabilitation product due to the restraining action of the host pipe. The tighter the fit of the product within the host pipe, the greater the value of K. Third party testing of external hydrostatic loading capacity of restrained pipe samples shall be conducted to verify the enhancement factor, K. The minimum values provided are based on the "Long-Term Structural Behavior of Pipeline Rehabilitation Systems," Trenchless Technology Center, 1994.
- (2) Initial values are defined in ASTM D 790. The Owner may, at any time prior to installation, direct the Contractor to make cured samples (according to ASTM F 1216 93) and test them in accordance with the listed ASTM standards to verify initial values of physical properties. In such tests the Contractor's samples must achieve a 95% pass-rate.
- (3) The initial flexural modulus is multiplied by the creep factor (or percentage retention) to obtain the long-term values used for design. Long-term values shall be verified by long-term external pressure testing of circular lengths of the pipe material by third-party labs prior to bid (e.g. Trenchless Technology Center - TTC). It is understood that the material's modulus of elasticity will not change over time; however, by convention the modulus is reduced for design purposes for all plastic pipe sections to account for the reduced ability of plastic pipe to carry loads due to the changes in pipe geometry resulting from the effects of creep over time.
- (4) E_L based on ASTM F 2019.

9. Liner Wall Thickness

- a. Liner thicknesses shall be submitted for all pipe sections for Owner approval.
- b. The required structural CIPP wall thickness shall be designed in accordance

with the guidelines in Appendix X1 of ASTM F 1216 - or ASTM F2019. In cases where ovality exceeds 10%, or where pipes are egg or oval shaped, alternative methods of design may be considered by the Owner. The categories of design parameters noted in Tables 200-5.21.1, 200-5.21.2, 200-5.21.3, 200-5.21.4 and/or 200-5.21.5 shall be used, as appropriate, unless otherwise directed by the Owner.

- c. Liner thicknesses may be modified with the Owner's approval of supporting calculations by the Contractor's Professional Engineer. The Owner reserves the right to change specified thickness based on new information. The Bid prices will be adjusted to increase or decrease unit price as liners are thickened or thinned at the Owner's direction.
- d. Maintenance of flow capacity of existing pipes is essential. Rehabilitated pipe shall have minimum or no change in capacity. An increase in flow capacity following rehabilitation is preferred, and in no case shall the flow capacity of rehabilitated pipes be reduced.
- e. Verify that installed thickness of the CIPP is within minus 5 % and plus 10 % of the specified thickness. The Contractor shall collect samples per Section 813.2.6 Testing. The results of the liner thickness measurements and structural analysis shall be submitted to the Owner within 14 Days and prior to payment.
- f. Minimum liner thicknesses for water or steam cured polyester thermoset CIPP and GRP liners shall be:

Pipe Diameter (In.)	Polyester Thermoset CIPP (mm)	GRP (mm)
6	4.5	3.0
8	6.0	4.5
10	6.0	4.5
12	6.0	4.5
15	7.5	6.0
18	9.0	7.5

- 10. The length of the liner shall be that which is deemed necessary by the Contractor to effectively carry out the insertion and seal the liner at the inlet and outlet of the manhole. Individual inversion runs may be made over one or more manhole to manhole sections as determined.
- 11. The Contractor shall provide a liner exhibiting the previously described properties. Prior approval of Shop Drawings related to any or all materials or methods of installation shall not relieve the Contractor of this responsibility.

C. Pipe Rehabilitation using the Sliplining Method

- 1. Fiberglass (GRP) pipe shall be centrifugally cast, or mandrel produced, with glass fiber reinforcement in a cured thermosetting resin manufactured in accordance with ASTM D3262, cell classification Type 1, Liner 1, Grade 1. Pipe stiffness shall meet the design requirements in ASTM D3262. Fiberglass pipe shall be shown by tests to be resistant to long-term corrosion. Testing shall be performed in accordance with

ASTM D3681 using 1.0N sulfuric acid for sanitary sewage, and ASTM C581 for industrial sewage. Fiberglass pipe shall have a gasket that has been affixed, via environmentally safe adhesive, to the pipe within the groove for the tongue and groove application. A coupling device with the gasket affixed similarly will suffice also. Loose gaskets affixed without adhesive will not be permitted.

2. PVC pipe shall have a minimum cell classification of 12364 B or C as defined in ASTM D1784. Pipe shall be closed profile per ASTM F 1803 with a tongue and groove gasketed joint. The joint shall be designed so that neither the outside diameter of the pipe is increased, nor the internal diameter of the pipe is decreased at the joint. The joint shall meet the requirements of ASTM D3212. PVC liner pipe shall have a minimum pipe stiffness of 46 psi when tested in accordance with ASTM D2412. Gaskets shall meet the requirements of ASTM F 477.
3. Fusible Polyvinylchloride (fPVC) Pipe
 - a. Pipe Supplier shall furnish fPVC pipe conforming to all standards and procedures, and meeting all testing and material properties as described in this specification. Pipe, 4 to 12 inches in diameter, shall conform to AWWA C900 – Class 150 (DR 18), unless otherwise indicated in the Contract Documents. Pipe greater than 12 inch shall conform to AWWA C905 – Class 235 (DR 18) or Class 150 (DR25), as specified in the Contract Documents.
 - b. fPVC pipe shall be tested at the extrusion facility for properties required to meet all applicable parameters as outlined in AWWA C900 or C905, as appropriate. Rework material shall be allowed per AWWA C900 and AWWA C905 standards. All piping shall be made from a PVC compound conforming to cell classification 12454 per ASTM D1784.
 - c. fPVC pipe shall be extruded with plain ends and shall normally be supplied in standard 40 foot lengths. The ends shall be square to the pipe and free of any bevel or chamfer. There shall be no bell or gasket of any kind incorporated into the pipe. fPVC pipe shall be blue in color for potable water use or green for wastewater.
 - d. Pipe generally shall be marked per AWWA C900 or AWWA C905, and shall include as a minimum:
 - (1) Nominal pipe size
 - (2) PVC
 - (3) Dimension Ratio, Standard Dimension Ratio or Schedule
 - (4) AWWA pressure class and Standard number
 - (5) Extrusion production-record code
 - (6) Trademark or trade name
 - (7) Cell Classification 12454 and/or PVC material code 1120 may also be included.
 - (8) NSF-61 mark, if for potable water service.
4. Polyethylene pipe and fittings shall be manufactured from high density compounds in accordance with ASTM D3350. All HDPE pipe shall be closed profile and have a minimum SDR rating of 32.5 and a minimum pipe stiffness of 46 psi.

5. All pipe shall be provided with joints designed so that neither the outside diameter of the pipe is increased nor the internal diameter of the pipe is decreased at the joint.
6. Cellular concrete grout for annular space provided under this Specification shall have the following characteristics:
 - a. 300 psi, 28-day compressive strength; 100 psi, 24-hour compressive strength, minimum.
 - b. Foam concentrate: ASTM C869.
 - c. Cement: ASTM C150.
 - d. Fly ash: ASTM C618, Class F, except loss of ignition shall not exceed 5%.
 - e. Water: Potable.
 - f. Admixtures: Only as approved by foam concentrate manufacturer and Owner.
7. All connectors provided for reinstatement of laterals shall be as follows:

All connectors shall be composed of synthetic rubber based compounds formulated to resist acids, alkalis, solvents, and greases encountered in sanitary and storm sewer and shall contain no reclaimed rubber. Contractor shall submit evidence of satisfactory testing in accordance with ASTM D543 with no weight loss in 1.0N sulfuric acid, 1.0N hydrochloric acid or 1.0N nitric acid. Materials shall show no etching, blistering, distortion or other evidence of chemical attack. Ultimate tensile strength shall exceed 750 psi at 80 degrees F and elongation shall exceed 150%. Water absorption shall not exceed 4% when tested in accordance with ASTM D570 and hardness shall not exceed 55 in a 5 second reading interval when tested in accordance with ASTM D2240, Type A Hardness.

8. All compression bands shall be Series 316 Stainless Steel. All nuts and bolts shall be Series 305 Stainless Steel.
9. The completed joint shall comply with ASTM C425 for resilient sewer pipe joints.

D. Pipe Saddle Lateral Connection for Rehabilitated Pipes

1. Use pipe saddles only on rehabilitated sanitary sewer mains.
2. Supply one-piece prefabricated saddle, either polyethylene or PVC, with neoprene gasket.
3. Use 1/2 inch stainless steel bands for securing saddles to liner pipe. Bands shall be resistant to corrosion for a minimum service life of 50 years.

E. Inserta Tee Lateral Connection for Rehabilitated Pipes

1. Use pipe Inserta tees only on rehabilitated sanitary sewer mains.
2. The Inserta Tee is comprised of three parts; PVC hub, stainless steel band and rubber boot as manufactured by Fowler Manufacturing Co., Inc.
3. PVC hub and rubber boot shall be engineered to accept the wall thickness and internal radius of the pipe. The PVC hub and rubber boot shall not protrude more than $\frac{1}{2}$ inch into the sewer pipe.

4. The PVC hub shall be in accordance with ASTM D 3034.
5. The rubber boot shall be in accordance with ASTM C 443.

F. Manhole Rehabilitation using Cementitious Products

1. Contractor may use the following products in conjunction with the liner material to facilitate manhole rehabilitation. Material compatibility of the products must be demonstrated prior to commencement of Work.

- a. Mix to be applied according to manufacturer's recommendations and shall have the following minimum requirements.

Compressive Strength	ASTM C 109	6 hr 1,400 psi
Shrinkage	ASTM C 596	0% at 90% relative humidity
Bond	ASTM C 321	28 day 150 psi
Cement	Sulfate resistant	
Density, when applied		105 ±5 pcf

- b. Infiltration Control Mix: A rapid-setting cementitious product specifically formulated for leak control shall be used to stop minor water infiltration and shall be mixed and applied according to manufacturer's recommendations and shall have the following minimum requirements.

Compressive Strength	ASTM C 109	1 hr	600 psi
Compressive Strength	ASTM C 579 B	24hr	1,000 psi
Bond	ASTM C 321	1 hr	30 psi
Bond	ASTM C 321	24 hr	80 psi.

- c. Grouting Mix

- (1) A cementitious grout shall be used for stopping very active infiltration and filling voids and shall be mixed and applied according to manufacturer's recommendations. The cementitious grout shall be volume stable and have a minimum 28 day compressive strength of 250 psi and a 1 day strength of 50 psi.

- (2) Chemical grouts may be used for stopping very active infiltration and shall be mixed and applied per manufacturer's recommendations.

- d. Liner Mix

- (1) Standard

The cementitious liner shall be used to form a structural/structurally enhanced monolithic liner covering all interior manhole surfaces. The material shall be applied at a minimum $\frac{1}{2}$ -inch thickness; but application must be at a thickness to ensure a structurally stable manhole, while forming an infiltration barrier to water and gases. The material shall meet the following minimum requirements at 28 days.

Compressive Strength	ASTM C 495	3,000 psi
Flexural Strength	ASTM C 293	600 psi
Shrinkage	ASTM C 596	0% at 90% relative humidity
Tensile Strength	ASTM C 496	500 psi
Sulfate Resistance	ASTM C 267	No visible at pH of 2.

(2) High Performance

The liner mix shall be a cement-based, fiber-reinforced calcium aluminate mortar specifically designed to prevent infiltration and restore structural integrity. The material shall be premixed and specifically formulated to withstand hydrogen sulfide bacterial corrosion and abrasion in municipal sanitary sewer systems. The material shall meet the following minimum requirements at 28 days.

Compressive Strength	ASTM C 109	9,000 psi
Flexural Strength	ASTM C 293	1,200 psi
Shrinkage	ASTM C 596	0% at 90% relative humidity
Tensile Strength	ASTM C 496	>800 psi
Sulfate Resistance	ASTM C 267	No visible at pH of 2 or less

G. Manhole Rehabilitation using Cured-In-Place Fiberglass Insert Liner

1. Cured-In-Place fiberglass insert liner shall contain 68 ounces per square yard of pre-saturated fabrics. The liner shall contain a felt impregnated non-porous membrane bonded between the layers of structural fiberglass. The cured-in-place fiberglass insert shall have a ten-year labor and materials, non-prorated warranty to stop infiltration and further deterioration of the structure.
2. Cured-In-Place fiberglass insert liner shall meet the minimum applicable requirements:

Test	Property	Results
ASTM-D-790	Flexural Strength	22,000 psi
ASTM-D-695	Compressive Strength, Yield	10,500 psi
ASTM-D-638	Tensile Strength	9,500 psi
ASTM-D-638	% Elongation @ Max Load	1.53%
ASTM-D-2240	Hardness, Shore D	80
ASTM-D-4541	Bond Strength	900 psi

3. Chemical Resistance: The corrosion resistance of the fiberglass liner insert shall be tested by the manufacturer in accordance with requirements noted in 5.21.G.4.
4. The manufacturer shall warrant that the products are produced in conformity with its standard specifications or formulations within recognized tolerances, free of adulteration or contamination, and that the product will perform in accordance with representations in the manufacturer's literature and technical data sheets when properly applied in strict conformance with the printed instructions on container and prescribed in technical data instructions and when applied to a properly prepared surface.

H. Manhole Rehabilitation using Epoxy Coating

1. The monolithic high-build epoxy coating shall consist of a 100% solids epoxy formulated with exceptionally high physical strengths and broad range chemical resistance. The coating system coverage shall be a minimum of 100 mils and shall be determined by the manufacturer. The manufacturer shall provide documentation for the recommended thickness.
2. The epoxy coating shall have a one-year labor and materials, non-prorated warranty to stop infiltration and further deterioration of the structure.
3. The epoxy coating shall have the following minimum requirements:

Test	Property	Results
ASTM-D-790	Flexural Strength	12,443 psi
ASTM-D-695	Compressive Strength, Yield	12,870 psi
ASTM-D-638	Tensile Strength	6,640 psi
ASTM-D-638	% Elongation @ Max Load	1.53%
ASTM-D-2240	Hardness, Shore D	80
ASTM-D-256	Impact, IZOD	0.345 ft. lb/in of notch

4. The epoxy coating shall have the following minimum requirements after seven day curing:

Test	Property	Results
ASTM-D2240-75	Hardness	82 Shore D
ASTM-638	Ultimate Elongation	6%

5. Chemical Resistance: The corrosion resistance of the epoxy coating shall be tested by the coating manufacturer in accordance with ASTM D543. The result of exposure to the chemical solutions listed below shall produce loss of not more than 20 % of the initial physical properties when tested in accordance with ASTM D543 for a period of not less than 1 year at a temperature of 73.4 °F plus or minus 3.6 °F. For applications other than municipal wastewater, conduct chemical resistance tests with actual samples of the fluid to be transported through the manhole and in accordance with procedures approved by the Owner.

**CONCENTRATIONS OF CHEMICAL SOLUTIONS
FOR CHEMICAL RESISTANCE TEST**

Chemical Solution	Concentration, (%)
Tap Water (pH 6-9)	100
Nitric Acid	5
Phosphoric Acid	10
Sulfuric Acid	10
Petroleum Hydrocarbon Based Fuels (e.g. Gasoline, diesel, etc.)	100
Vegetable Oil ¹	100
Detergent ²	0.1
Soap ²	0.1

Domestic Sewage	100
¹ Cotton seed, corn, or mineral oil	
² As per ASTM D543	

6. Other Materials: No other material shall be used with the above mixes without prior approval or recommendation from the manufacturer.
7. The manufacturer shall warrant that the products are produced in conformity with its standard specifications or formulations within recognized tolerances, free of adulteration or contamination, and that the product will perform in accordance with representations in the manufacturer's literature and technical data sheets when properly applied in strict conformance with the printed instructions on container and prescribed in technical data instructions and when applied to a properly prepared surface.

I. Cured in Place Manhole Liners

1. The liner design and selection of materials shall be suitable for all the specified design conditions and shall meet the minimum requirements outlined in Table 200-5.21.6. Thicker liners may be required based on design conditions. The liner shall be custom-designed to fit each manhole and the basis of design shall be submitted to the Owner in accordance with Section 822.1.2. It is the Contractor's responsibility to supply a CIPM liner that is most suitable for the existing conditions and that meets the requirements of this specification. Contractor shall assume groundwater at grade for all sites for the purposes of liner thickness design unless otherwise instructed by the Owner.
2. The cured in place liner shall provide a minimum service life of 25 years.

TABLE 200-5.21.6
Minimum Liner Physical Properties

Manhole Depth (grade to invert)	Minimum Liner Thickness ⁽¹⁾ (inch) ASTM D5813	Minimum Pre-Saturated Fabric Weight (ounces)	Minimum Flexural Modulus of Elasticity (psi) ASTM D790	Minimum Compressive Strength (psi) ASTM D695	Chemical Resistance Testing in accordance with ASTM F1216 Appendix X2
0 to 10 ft	0.117	56	1,000,000	11,000	PASS
10.1 to 15 ft	0.117	56	1,000,000	11,000	PASS
15.1 to 20 ft	0.158	68	1,000,000	11,000	PASS

(1) Minimum liner thickness includes only the strength portion of the liner. Non-structural layers are not included in minimum thickness requirements.

J. Calcium Aluminate Cementitious Manhole Liner

1. The calcium aluminate cementitious liner shall be made with calcium aluminate cement and shall be used according to manufacturer's recommendations in applications where there is mild sulfide conditions (substrate surface of pH 2.0 or higher).
2. The calcium aluminate cementitious liner product shall be used to form a structural monolithic liner covering all interior substrate surfaces and shall have the following

minimum requirements:

Minimum Requirements			
Compressive Strength	ASTM C109	28 days	>9000 psi
Tensile Strength	ASTM C496	28 days	>800 psi
Flexural Strength	ASTM C293	28 days	>1500 psi
Shrinkage @90% relative humidity	ASTM C596	28 days	0%
Bond	ASTM C882	28 days	>2000 psi
Density, When Applied	-		134 ± 5lbs/ft ³
Freeze/Thaw	ASTM C666	N/A	300 cycles no visible damage

3. The liner product shall be reinforced with alkaline resistant fiberglass rods or other similar fibers not less than 1/2 inch in length. The material shall meet or exceed industry standards and shall not have any basic ingredient that exceeds EPA maximum allowable limits for any heavy metals. Water used to mix product shall be clean and free from contaminants. Questionable water shall be tested by a laboratory per ASTM C-94 procedure. Potable water need not be tested.
4. When cured, the monolithic cementitious lining shall form a continuous, tight-fitting, hard, impermeable surfacing which is suitable for sewer system service and chemically resistant to any chemicals or vapors normally found in domestic sewage.

K. Manhole Frame Seals

1. Manhole frame seals shall be composed of flexible, pleated, high quality rubber gland with stainless steel expansion bands, and shall be designed to conform to the inside shape of the chimney area of the manhole frames.
 - a. The rubber gland material compound shall conform to the applicable requirements of ASTM C 923, with a minimum tensile strength of 1,500 psi, a maximum compression set of 18%, and a durometer hardness of 48 (plus/minus 5).
 - b. The manhole frame seals shall be contained in-place on the inside of the manhole frame chimney area through the use of stainless steel expansion bands designed to expand to form a compression seal between the rubber gland and the manhole chimney area surface.
 - c. The bands shall be fabricated of 16 gauge Type 304 stainless steel conforming to ASTM A 240, and shall be equipped with a positive locking, worm-screw type mechanism. Screw hardware shall be Type 304 stainless steel conforming to ASTM F 593 and ASTM F 594.
2. Frame seals shall only be installed with the cementitious lining and epoxy coating systems. Frame seals are not required with the installation of fiberglass insert liner.
3. Acceptable Manufacturer: Cretex or equal.

L. Manhole Frame Sealants

Internal manhole frame sealant shall be Flex-Seal, or equal, and shall be composed of a corrosion resistant aromatic flexible urethane resin coating to be applied to the internal or external wall of the adjustment ring area.

1. The Aromatic Urethane Resin Liner Primer shall have the following minimum requirements:

Test	Property	Results
ASTM-D-1004	Tear Resistance	210 lb. l/in
ASTM-D-903	Adhesive Strength	400 lb. l/in
ASTM-D-412	Tensile Strength	3,200 psi
ASTM-D-442	Elongation	400%
ASTM-D-2240	Hardness	85

2. The Aromatic Urethane Resin Liner Final Coat shall have the following minimum requirements:

Test	Property	Results
ASTM-D-1004	Tear Resistance	155 lb. l/in
ASTM-D-903	Adhesive Strength	175 lb. l/in
ASTM-D-412	Tensile Strength	1,150 psi
ASTM-D-442	Elongation	800%
ASTM-D-2240	Hardness	75

M. Pipe Joint Rehabilitation using Chemical Grouting

1. Chemical joint sealing materials used on this project shall be an acrylamide joint-sealing gel grout plus activators, initiators and inhibitors recommended by the manufacturer.
2. In those lines that had root removal performed, a chemical root inhibitor shall be added to the grout prior to sealing the joints. Contractor shall submit the chemical to be used for Owner's approval prior to utilization.
3. In those lines where the grouting material may be exposed to a freeze-thaw cycle (cover depths of less than 3 feet), ethylene glycol or other Owner approved additive shall be used to prevent chemical grout cracking once set.
4. Acceptable Product and Manufacturer: AV-100 manufactured by Avanti International, Houston, Texas, or equal.

N. Insitu Point Repairs using Cured-In-Place Liner

1. The finished liner shall be in accordance with Section 5.21.B. The cured-in-place sectional pipelining shall be the New Life System as manufactured by Stephen's Technologies, Inc. or equal.
2. The liner shall be fabricated to a size that when installed will neatly fit the internal circumference of the conduit to be repaired as specified by the Owner.

3. The length and number of liners shall be that deemed necessary by the Owner to effectively carry out the repairs. The Contractor shall verify the lengths in the field before cutting liner to length. In general, the length shall vary between 3 and 8 feet.
 4. Acceptable Product and Manufacturer: New Life System manufactured by Stephen's Technologies, or equal.
- O. Insitu Point Repairs using Grouted Structural Sleeve
1. Sleeve: Type 316 stainless steel with a wall thickness sufficient to support the external loading of the host pipe system. The grouting sleeve material shall be of materials resistant to raw domestic sewage and corrosion caused by hydrogen sulfide gas or its derivatives.
 2. Sealing Material: Water-cured polyurethane grout that complies with ANSI/NSF Standard 61.
 3. Acceptable Manufacturer: Link-Pipe, Inc. or equal.

5.22. NOT USED

5.23. ASPHALT CONCRETE

Asphalt concrete shall consist of a combination of mineral aggregate and asphalt material mixed mechanically in a plant specifically designed for such purpose. Mix types shall meet the requirements of the latest edition of the *VDOT Road and Bridge Specifications*, Section 211.

5.24. COMPOSITE DETECTABLE WARNING SURFACE PANELS

A. Materials

Detectable Warning Surface shall be "tiles" made of homogeneous glass and carbon, reinforced composite material or vitrified polymer composite (VPC) material with ultraviolet stabilized coating, to minimize color wear, and a "non-slip" surface, incorporating "truncated domes," made of same material. The nominal thickness of the detectable warning tile shall be 1/8-foot exclusive of the height of the truncated domes. The tiles shall be in compliance with applicable Americans with Disabilities Act Accessibility Guidelines (ADAAG) and American with Disabilities Act (ADA) regulations with regard to detectable warning surfaces.

B. Types

Detectable warning surface shall be classified as follows:

1. Cast-in-Place tile shall be installed in the concrete in accordance with manufacturer's specifications. The cast-in-place tile shall be used for new construction.
2. Surface Mounted tile shall be secured to the concrete with a structural adhesive system and fasteners that anchors into the concrete. The surface mounted tile shall be installed to existing or proposed smooth finished concrete ramps.

C. Detail Requirements

Requirements for the detectable warning surface tiles shall meet the following:

1. Compressive Strength: 18,000 PSI minimum when tested by ASTM D695.
2. Tensile Strength: 10,000 PSI minimum when tested by ASTM D638-91.
3. Flexural Strength: 24,000 PSI minimum when tested by ASTM C293-94 or ASTM D790.
4. Water Absorption: 0.35% maximum when tested by ASTM D570.
5. Slip Resistance: 0.9 minimum for the combined wet/dry static co-efficient of friction when tested by ASTM C 1028.
6. Chemical and Stain Resistance: No deterioration, discoloration or staining when tested by ASTM D543-87 or ASTM 1308.
7. Fire Resistance: 25 minimum when tested to ASTM E84.
8. Accelerated Weathering: No deterioration, fading or chalking of surface after 2000 hours minimum exposure when tested by ASTM G26-95.
9. Salt and Spray Performance: No deterioration or other detects after 100 hours minimum exposure when tested by ASTM B117.
10. Accelerated Aging and Freeze Thaw: No disintegration, cracking, delamination, warpage, blistering, color change or other defects when tested by ASTM D037 or ASTM C1026.

D. Pattern/Dimension

Pattern and dimensions of the detectable warning surface tile shall incorporate an “in-line” dome pattern of truncated domes 0.2-inches in height, 0.9-inches diameter at the base and 0.4-inches diameter at top of dome. Domes should be spaced no greater than 2 1/4-inches from center to center. The field area of the detectable warning surface should consist of raised points no greater than 0.045-inches, to create a non-slip surface for wheelchair safety. Surface mounted detectable warning surface tiles shall have countersunk fastening holes and perimeter beveled edges.

Overall dimension of the detectable warning surface tiles shall be in accordance with this specification and the Contract Documents.

E. Color

Unless otherwise called out in the Contract Documents, the detectable warning surface tiles shall be “Brick Red”, Federal Color No. 31136, or Federal Color No. 11302, for applications on standard concrete curb ramps and “Light Gray”, Federal Color No. 26280 for applications on red brick paver or red brick concrete paver ramps, or as approved by Owner. The color shall be integral with the detectable warning device tiles and shall not be surface applied. Paints or other surface coatings shall not be used. Product samples with proposed color shall be submitted to Owner for approval prior to installation.

F. Fasteners

Fasteners shall be flat-head drive anchors made of a corrosion-resistant material 1/4-inch in diameter x 1 3/4-inches long.

G. Adhesives

Adhesive shall be a urethane elastomeric adhesive material, as required by the manufacturer's specifications.

H. Sealants shall be a gray epoxy, two-component sealant, as required by the manufacturer's specifications.

5.25. FENCE

These specifications cover material requirements for fence components used in the construction of chain link, pedestrian, barbed wire, woven wire, and lawn fences and material specifications for temporary silt fences, geotextile fabric silt barriers, and filter barriers used for erosion and sediment control and shall meet the requirements of the latest edition of the *VDOT Road and Bridge Specifications 242*.

5.26. GEOSYNTHETICS

These specifications cover artificial fiber textile products to be used in transportation construction work, and low permeability liners for stormwater management facilities and shall meet the requirements of the latest edition of the *VDOT Road and Bridge Specifications 245*.

5.27. PAVERS

A. Concrete Pavers for Crosswalks and Sidewalks

1. Description

This section applies to concrete pavers used in sidewalks, crosswalks, driveways, roadways. This section also applies to concrete truncated dome pavers.

2. Pavers shall meet or exceed ASTM C936 specifications for Solid Concrete Interlocking Paving Units:

Average Compressive Strength (psi)	
Average of 5	8,000
Individual	7,000
Maximum Cold Water Absorption (%)	
5	5
Individual	7
Freeze/Thaw Resistance	
Resistant to 50 freeze/thaw cycles with no greater than 1% loss of material	
Freeze-thaw testing requirements shall be waived for applications not exposed to freezing conditions.	
Abrasion Resistance	
Maximum Volume Loss (%)	15 cm ³ /50cm ²
Maximum Average Thickness Loss	3mm

- a. Where 3 1/8-inch thick pavers are specified, their compressive strength test results per ASTM C 140 shall be adjusted by multiplying by 1.18 to equate the results to that from 2 3/8-inch thick pavers.
- b. Detectable warning pavers shall meet the latest truncated dome requirements of the American Disabilities Act (ADA).
- c. Color Pigments
 - (1) Color pigments for integrally colored concrete pavers shall meet or exceed ASTM C979 Standards. Products meeting this specification are concrete color pigments by the manufacturers indicated or approved equivalent if manufacturer is indicated. Integrally colored concrete pavers are defined as an acceptable color throughout the paver block as accepted by the Owner.
 - (2) Face-mix pavers are acceptable provided the pigment loading in the base mix is a minimum of 50% of the pigment loading in the face mix based on pigment loading being defined as 1 lb. pigment per 100 lbs. cement.
 - (3) The Owner shall approve the color.
- d. Concrete pavers may have spacer bars on each unit. Verify with manufacturers that overall dimensions do not include spacer bars.

3. Bedding and Joint Sand

Bedding and joint sand shall conform to the following:

- a. Washed, clean, non-plastic, free from deleterious or foreign matter, symmetrically shaped, natural or manufactured from crushed rock.
- b. Where concrete pavers are subject to vehicular traffic, utilize sands that are as hard as practically available.
- c. Bedding Sand Material Requirements

Bedding sand material shall conform to the grading requirements of ASTM C 33 with modifications as shown in Table 200-5.27.1.

TABLE 200-5.27.1
GRADING REQUIREMENTS FOR BEDDING SAND
FOR CONCRETE PAVERS
(ASTM C 33 MODIFIED)

<u>Sand Sieve Size</u>	<u>% Passing</u>
3/8 in.(9.5 mm)	100
No. 4 (4.75 mm)	95 to 100
No. 8 (2.36 mm)	85 to 100
No. 16 (1.18 mm)	50 to 85

No. 30 (0.600 mm)	25 to 60
No. 50 (0.300 mm)	10 to 30
No. 100 (0.150 mm)	2 to 10
No. 200 (0.075 mm)	0 to 1

(1) Mason sand or sand conforming to ASTM C 144 shall not be used for bedding sand.

(2) Limestone screenings or stone dust shall not be used for bedding sand.

d. Joint Sand Material Requirements

(1) Joint sand material shall conform to the grading requirements of ASTM C 144 as shown with modifications in Table 200-5.27.2 below:

TABLE 200-5.27.2
GRADING REQUIREMENTS FOR JOINT SAND
FOR CONCRETE PAVERS
(ASTM C 144 MODIFIED)

<u>Sieve Size</u>	<u>ASTM C 144 Natural Sand % Passing</u>	<u>ASTM C 144 Manufactured Sand % Passing</u>
No. 4 (4.75 mm)	100	100
No. 8 (2.36 mm)	95 to 100	95 to 100
No. 16 (1.18 mm)	70 to 100	70 to 100
No. 30 (0.600 mm)	40 to 75	40 to 100
No. 50 (0.300 mm)	10 to 35	20 to 40
No. 100 (0.150 mm)	2 to 15	10 to 25
No. 200 (0.075 mm)	0 to 1	0 to 10

(2) Coarser sand than that specified above may be used for joint sand including ASTM C 33 material as shown in Table 200-5.27.1. Use material where the largest sieve size easily enters the smallest joints. For example, if the smallest paver joints are 2 mm wide, use sand 2 mm and smaller in particle size. If ASTM C 33 sand is used for joint sand, extra effort may be required in sweeping material and compacting the pavers in order to completely fill the joints.

(3) Sieve according to ASTM C 136.

B. Clay Brick Pavers for Heavy Duty Traffic Loading Conditions

1. Description: This section applies to pavers used in crosswalks in roadways, higher traffic volume driveways, roadways and other applications where heavy vehicle loading or frequent vehicular traffic is anticipated. See Paragraph V.5.27.C for applications involving sidewalks, driveways and other applications where heavy or frequent vehicle loading is not anticipated.

2. Brick pavers shall conform to ASTM C 1272, Specification for Heavy Vehicular Paving Brick.

a. Durability

Paver Type	Type F (Pavers placed on sand base)	Type R (Pavers placed on asphalt or mortar base)
Average Compressive Strength (psi)		
Average of 5	8,000	10,000
Individual	7,000	8,800
Maximum Cold Water Absorption (%)		
Average of 5	6	6
Individual	7	7
Freeze/Thaw Resistance		
Resistant to 50 freeze/thaw cycles with no greater than 1% loss of material		
Freeze-thaw testing requirements shall be waived for applications not exposed to freezing conditions.		
Minimum Breaking Load (lb/in.)		
Average of 5	None	475
Individual	None	333
Abrasion Resistance		
Maximum Abrasion Index	.011	0.11
Maximum Volume Abrasion Loss	1.7 cm ³ /cm ²	1.7 cm ³ /cm ²

b. Dimensions

- (1) Minimum Thickness: Brick pavers used in a heavy vehicular pavement shall have a minimum thickness of 2 5/8-inches. This thickness is exclusive of any chamfers.
- (2) Dimensions: Pavers shall be commonly available sizes of pavers for flexible pavements. Length shall not be more than 4 times the thickness.
- (3) Dimensional tolerances for pavers shall be 3/32-inch.

c. Brick pavers shall conform to Application PX as defined in ASTM C902.

C. Clay Brick Pavers for Pedestrian Areas and Light Duty Traffic Loading Conditions

1. Description: This section applies to pavers used in sidewalks, driveways and other applications where heavy or frequent vehicle loading is not anticipated. See Paragraph V.5.27.B for applications involving crosswalks in roadways, higher traffic volume driveways, roadways and other applications where heavy vehicle loading or frequent vehicular traffic is anticipated.
2. Brick pavers shall conform to ASTM C 902, Type SX.

a. Properties

Paver Type	Wire Cut	Molded
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	Brick	Brick
Average Compressive Strength (psi)		
Average of 5	8,000	4,000
Individual	7,000	3,500
Maximum Cold Water Absorption (%)		
Average of 5	8	16
Individual	11	18
Freeze/Thaw Resistance		
Resistant to 50 freeze/thaw cycles with no greater than 1% loss of material		
Freeze-thaw testing requirements shall be waived for applications not exposed to freezing conditions.		
Maximum Saturation Coefficient		
Average of 5	0.78	0.78
Individual	0.80	0.80
Abrasion Resistance		
Maximum Abrasion Index	.011	0.11
Maximum Volume Abrasion Loss	1.7 cm ³ /cm ²	1.7 cm ³ /cm ²

b. Dimensions

- (1) Minimum Thickness: Brick pavers used in a heavy vehicular pavement shall have a minimum thickness of 2 1/4-inches. This thickness is exclusive of any chamfers.
- (2) Dimensions: Pavers shall be commonly available sizes of pavers for flexible pavements. Length shall not be more than 4 times the thickness.
- (3) Dimensional tolerances for pavers shall be 3/32-inch.

c. Pavers shall conform to Application PX as defined in ASTM C902.

D. Setting Beds

1. Sand Setting Bed

- a. Sand shall conform to ASTM C 33. Sand shall be washed, well-graded sand. The amount of material passing the 75 µm (No. 200) sieve shall be no more than 3 %. The sand particles shall be sub-angular. Only naturally occurring, washed silica sand with no silt content shall be used.
- b. Mason's sand, limestone screenings, or stone dust shall not be used.
- c. Cement shall not be added to the sand.

2. Sand /Cement Setting Bed

- a. Sand shall conform to ASTM C 33. Sand shall be a washed, well-graded sand. The amount of material passing the 75 µm (No. 200) sieve shall be no more than 3 %. The sand particles shall be sub-angular. Only naturally occurring, washed silica sand with no silt content shall be used.
- b. Mason's sand, limestone screenings, or stone dust shall not be used.

- c. Sand/cement mixture shall be 3 parts sand, 1 part cement. Submit each sample for approval.
- 3. Mortar Setting Bed
 - a. Mortar shall be nonshrink.
 - b. Mortar shall conform to Paragraph 5.6.F.2.
- 4. Bituminous Setting Bed
 - a. Tack coat shall be SS-1 or SS-1h asphalt emulsion complying with ASTM D 977 Specification for Emulsified Asphalt.
 - b. The asphalt cement for the bituminous setting bed shall be the same grade as that specified for the adjacent surface course construction. The type of asphalt cement will govern the mixing and rolling temperatures. The fine aggregate for the bituminous setting bed shall be natural or manufactured sand that complies with ASTM D 1073 Specification for fine Aggregate for Asphaltic Paving Mixtures, grading No. 2, or similar material used as fine aggregate at the asphalt plant. All particles shall pass the No. 4 sieve.
 - c. The proportions shall be 6-8% of asphalt cement with 94-92% of fine aggregate or approximately 1 gallon of asphalt cement to 110 lbs of fine aggregate. The exact proportions shall be verified before supplying material for the project.
 - d. The adhesive shall be a neoprene modified asphalt product specifically developed for setting pavers. It shall consist of rubberized asphalt with inorganic fibers.

E. Jointing Sand

- 1. Sand Setting Bed Applications
 - a. Heavy Duty Traffic Loading Conditions: The sand particles shall be sub-angular. Bedding sand conforming to ASTM C 33 shall be used.
 - b. Pedestrian Areas and Light Duty Traffic Loading Conditions: The sand particles shall be sub-angular. Bedding sand conforming to ASTM C 33 or Mason Sand conforming to ASTM C 144 shall be used.
- 2. Bituminous Setting Bed Applications: Stabilized joint sand shall be provided. Stabilizers shall conform to the brick paver manufacturer's recommendations. The stabilizers shall bind the sand in the top 1/2 inch of the joint.

F. Surface Coatings

- 1. Colorless coatings (i.e. water repellents) shall not be used.

2. Coatings that prevent erosion of the jointing sand shall be of a type that has a high vapor transmission rate and will not affect the slip/skid resistance of the paver. The stabilizer shall be water based.

G. Miscellaneous

1. Edge Restraints shall conform to the type specified in the Contract Documents or Special Provisions. Manufactured edge restraints (other than cast-in-place concrete) shall be certified by the manufacturer to be appropriate for the type of application.
2. Mortar shall conform to ANSI 118.3
3. Grout
 - a. Grout shall conform to ANSI 118.3.
 - b. Grout colors shall be approved by the Owner from the manufacturer's complete color range.
 - c. Grout products shall be approved the by paver manufacturer.
4. Water that has been approved for drinking purposes is acceptable provided it is free from minerals or other materials that are detrimental to mortar and grout mixes.
5. Primer shall be as recommended by the mortar material manufacturer.
6. Sealant and backing materials shall conform to ASTM C 920.
7. Mixes - Prepare pre-mix materials in accordance with manufacturer's written instructions.
8. Geotextiles shall conform to Paragraph V.5.26, Geosynthetics. Geotextile fabric materials shall also be certified by the paver manufacturer to be appropriate for the type of application.
9. Cleaners, sealers, and joint sand stabilizers shall be certified by the paver manufacturer to be appropriate for the type of application.

5.28. GUARDRAIL

These specifications cover material requirements for components of guardrail systems and shall meet the requirements of the latest edition of the *VDOT Road and Bridge Specifications*, Section 221.

5.29. MASONRY UNITS

These specifications cover masonry units manufactured of regular or lightweight concrete or brick made from clay or shale in a plant specifically designed for such a purpose and shall meet the requirements of the latest edition of the *VDOT Road and Bridge Specifications*, Section 222.

5.30. STRUCTURAL STEEL

These specifications cover steel structural shapes furnished to specific dimensions and associated hardware and fasteners and shall meet the requirements of the latest edition of the *VDOT Road and Bridge*

Specifications, Section 226.

5.31. ALUMINUM ALLOY

These specifications cover aluminum alloy products designed in shapes and compositions to serve a specific purpose, such as a sign panel, post, or conduit, including necessary fasteners and shall meet the requirements of the latest edition of the *VDOT Road and Bridge Specifications*, Section 229.

5.32. ROADWAY CONSTRUCTION PAINT

These specifications cover a mixture of pigment in a liquid vehicle that, when applied, will dry to an opaque solid film. Use of paint in these specifications refers to the requirements for highway construction and shall meet the requirements of the latest edition of the *VDOT Road and Bridge Specifications*, Section 231. Paint materials not specified herein shall be as specified by the manufacturer and recommended specifically for or compatible with the intended application

5.33. GLASS BEADS FOR REFLECTORIZING TRAFFIC MARKINGS

This specification covers glass beads applied on the surface or incorporated into traffic-marking materials so as to produce a retroreflective surface and shall meet the requirements of the latest edition of the *VDOT Road and Bridge Specifications*, Section 234.

5.34. RETROREFLECTORS

This specification includes retroreflectors for delineators and pavement markers and shall meet the requirements of the latest edition of the *VDOT Road and Bridge Specifications*, Section 235.

5.35. WOOD PRODUCTS

These specifications cover the uses and requirements for roadway-related structural timber and lumber, miscellaneous wood products, and preservative treatments for such wood products where specified and shall meet the requirements of the latest edition of the *VDOT Road and Bridge Specifications*, Section 236. Intended uses include fence post, guardrail post, signs and signization applications.

5.36. ELECTRICAL AND SIGNAL COMPONENTS

These specifications cover roadway-related conduits, conductors, junction boxes, traffic signal components, and necessary fittings to complete a described electrical or traffic signal system and shall meet the requirements of the latest edition of the *VDOT Road and Bridge Specifications*, Section 238.

5.37. LIME

These specifications cover lime to be used as a stabilizer or soil conditioner and shall meet the requirements of the latest edition of the *VDOT Road and Bridge Specifications* 240.

5.38. PAVEMENT MARKING

These specifications cover material for use in various retroreflective pavement-marking applications and shall meet the requirements of the latest edition of the *VDOT Road and Bridge Specifications* 246.

5.39. REFLECTIVE SHEETING

This specification covers reflective sheeting used on traffic control devices to provide a retroreflective

surface or shall meet the requirements of the latest edition of the *VDOT Road and Bridge Specifications* 247. The color of the reflective sheeting shall be as specified in the Contract Documents.

End of Section

SECTION 302

DRAINAGE STRUCTURES

I. GENERAL

1.1. DESCRIPTION OF WORK

The Contractor shall furnish all labor, supervision, material (except as herein provided), tools, equipment, supplies, and services; and, shall perform all Work necessary for the installation and construction of pipe culverts, endwalls, box culverts, precast concrete and metal arches, storm drains, drop inlets, manholes, spring boxes, junction boxes, and intake boxes and removing and replacing existing structures in accordance with these specifications and in conformity to the lines and grades shown in the Contract Documents or as designated by the Owner.

1.2. MATERIALS

Materials shall be furnished by the Contractor in accordance with Section 200.

1.3. SUBMITTALS

- A. Submittals shall be made by the Contractor in accordance with the procedures set forth in Section 105 and as described below.
- B. The Contractor shall furnish copies of the manufacturer's specifications and details for cast in place installations indicated in the Contract Documents, Standard Details, and the VDOT *Road and Bridge Standards*, latest edition, listing specific materials proposed.
- C. Submittal of designs for precast items included in the Contract Documents will not be required provided fabrication is in accordance with the VDOT *Road and Bridge Standards*, latest edition. Submittal of designs for precast structures on VDOT's approved list will not be required provided the Contractor submits a certification that the item will be fabricated in accordance with the pre-approved design Drawings.
- D. The Contractor shall furnish the Owner with an affidavit stating that products to be installed on this project comply with specification requirements.
- E. The "Acceptance Procedures for Aggregates" shall be in accordance with Section 200.

II. EXECUTION

2.1. PROCEDURES

- A. Trenching, excavation, bedding and backfill operations shall be performed in accordance with the requirements of Section 303.
- B. The Contractor shall execute the Work in accordance with the latest edition of the VDOT *Road and Bridge Specifications*, Section 302.03, Procedures, however, Post Installation Inspection of Storm Sewer Pipes and Culverts shall be performed in accordance with 302.2.1.C below. Any references to "Engineer" or VDOT personnel shall mean the "Owner".

C. Post Installation Inspection of Storm Sewer Pipes and Culverts

In addition to the visual inspection if performed by the Owner during the initial installation of storm sewer pipes and pipe culverts, a post installation visual/video camera inspection shall be conducted by the Contractor in accordance with the requirements of this specification and VDOT VTM 123 on all pipes identified in the Contract Documents as storm sewer pipe and a selected number of pipe culverts. For the purposes of this Section all pipe installations not identified in the Contract Documents as storm sewer pipe are considered pipe culverts. Post installation Inspections shall be performed on straight line and radial installations.

For pipe culverts, a minimum of one pipe installation for each size of each material type utilized on the project will be randomly selected by the Owner for inspection, however, in no case will the amount of pipe subject to inspection be less than ten percent of the total contract amount for the size and material type indicated. Where possible, for all installations in which the pipe or culvert's size, orientation, or location permit deflection to be easily visually identified, (as verified with the Owner) the Contractor may perform visual inspections in lieu of video inspections. If defects as described herein are noted during the inspection, the Owner may require additional pipe installations of that size and/or material be inspected. The Contractor shall coordinate and schedule all post installation inspections so that these are made in the presence of the Owner. The post installation inspection shall be performed no sooner than 30 days after completion of the pipe installation and placement of final cover (except for pavement structure). The Contractor shall issue a report detailing all issues or deficiencies noted during the inspection (including a remediation plan for each deficiency noted where applicable) no later than 5 days after completion of the inspection.

While the intent of this requirement is to perform the post installation inspection prior to paving, project scheduling may dictate that a particular site be paved before the end of the 30 day period. In such cases, a preliminary inspection of the pipe shall be made, prior to paving over it, to insure that the pipe has been properly installed and is performing well. Performing such a preliminary inspection prior to paving will not relieve the Contractor from the requirement to perform the post installation inspection after the 30 day period.

The Contractor's inspection report shall identify and address any of the following items observed during the post installation inspection including identifying any proposed remediation measures the Contractor plans to perform where applicable. Remediation measures may consist of repairing or replacing the defective pipe section(s) or a combination of the two where differing conditions exist within the same run of pipe. Where permitted as an option, remediation methods for the various installation defects shall be proposed by the Contractor, reviewed with the Owner and must have the Owner's approval prior to implementation of the corrective action. Remediation shall be the sole responsibility of the Contractor. Further, if remediation measures are shown to be necessary, any time associated with such measures shall be reflected in the impact to the Contractor's progress schedule (may take the form of a time impact analysis, where required by the scheduling requirements) and will not relieve the Contractor of his responsibilities to finish the work required by the contract within the contract time limits or form the basis for any claim of delay where such remediation measures are determined to be a result of the Contractor's fault, omission or negligence.

Upon completion of any corrective remedial measures, the corrected installations are to be re-inspected prior to final acceptance of the project utilizing the test methods identified in VDOT VTM 123.

The following criteria shall form the basis for inspections for the respective pipe or culvert types listed:

1. Concrete Pipe\Culverts:

- a. Misalignment: Vertical and horizontal alignment of the pipe culvert or storm drain pipe barrel shall be checked by sighting along the crown, invert and sides of the pipe, and by checking for sagging, faulting and invert heaving. For the purposes of this provision faulting is defined as differential settlement between joints of the pipe, creating a non-uniform profile of the pipe. The person assigned by the Contractor to perform the inspection should take into account pipe or culvert laid with a designed camber or grade change in accordance with project or site requirements. Horizontal alignment shall be checked for straightness or smooth curvature. Any issues involving incorrect horizontal and/or vertical alignment shall be noted in the inspection report. If any vertical and/or horizontal misalignment problems are visually noted by the Owner or in the inspection report, a further evaluation shall be conducted by the Owner to determine the impact of the misalignment on the joints and wall of the pipe to ascertain what corrective actions are needed. All corrective actions determined necessary by the Owner that are a result of the Contractor's negligence, omission or fault shall be the sole responsibility of the Contractor to remedy.
- b. Joints: Leaking joints may be detected during low flows by visual observation of the joints or checking around the ends of pipes or culverts for evidence of piping or seepage.

Differential movement, cracks, spalling, improper gasket placement, movement or settlement of pipe\culvert sections, and leakage shall be noted by the Contractor in the report. Joint separation greater than one inch shall be remediated by the Contractor at his expense to the satisfaction of the Owner. Evidence of soil migration through the joint will be further evaluated by the Owner to determine the level of corrective action necessary. All corrective actions determined necessary by the Owner that are a result of the Contractor's negligence, omission or fault shall be the sole responsibility of the Contractor to remedy.

- c. Cracks: Longitudinal cracks with a width less than one hundredth of an inch (0.01) are considered hairline and minor. They shall be noted in the inspection report; however, no remedial action is necessary.

Longitudinal cracks having a width equal to or greater than one hundredth of an inch (0.01 but equal to or less than one tenth of an inch (0.1) and determined by the Owner to be detrimental to the structure shall be sealed by a method proposed by the pipe\culvert manufacturer and approved by the Owner. Pipes or culverts having longitudinal cracks with widths greater than one tenth of an inch (0.1) and determined to be beyond the limits of a satisfactory structural repair shall be replaced by the Contractor at his expense to the satisfaction of the Owner.

Pipes or culverts having displacement across the crack greater than 0.1 inch but less than 0.3 inch shall be remediated. Remediation methods shall be in

accordance with recommendations of the pipe or culvert manufacturer, be acceptable to and authorized by the Owner before implementation and shall be the sole responsibility of the Contractor. Pipes\culverts having displacement across the crack greater than 0.3 inch shall be replaced by the Contractor at his expense to the satisfaction of the Owner.

Transverse cracks will be evaluated using the same criteria as indicated above for longitudinal cracks.

- d. Spalls: Spalling is defined as a localized pop-out of concrete along the wall of the pipe\culvert generally caused by corrosion of the steel reinforcement or at the edges of longitudinal or circumferential cracks. Spalling may be detected by visual examination of the concrete along the edges of the crack. The person conducting the inspection shall check for possible delamination. If delamination is noted or if a hollow sound is produced when the area is tapped with a device such as a hammer, the pipe\culvert shall be remediated. Remediation methods shall be in accordance with recommendations of the pipe\culvert manufacturer, be acceptable to and authorized by the Owner before proceeding, and shall be the sole responsibility of the Contractor.
- e. Slabbing: Any pipe\culvert experiencing slabbing shall be remediated. Slabbing is a structural failure of the pipe\culvert that results from radial or diagonal tension forces in the pipe\culvert. These failures appear as a separation of the concrete from the reinforcing steel near the crown or invert of the pipe\culvert and may span the entire length of a pipe or culvert section (joint to joint). Remediation methods shall be in accordance with recommendations of the pipe or culvert manufacturer, be acceptable to and authorized by the Owner before proceeding, and shall be the sole responsibility of the Contractor. Where slabbing is of such magnitude that, in the opinion of the Owner the integrity or service life of the pipe or culvert is severely compromised, the section(s) of pipe or culvert exhibiting such deficiency shall be replaced at the Contractor's expense to the satisfaction of the Owner.

Remediation efforts and percentage of payment shall apply to the entire section(s) of the deflected pipe or culvert, joint to joint. The cost of the remedial measures (including removal and replacement of the pipe, if necessary) and the re-inspection of the remediated pipe necessitated as a result of the Contractor's negligence, omission or fault shall be the contractual and financial responsibility of the Contractor.

2. Thermoplastic Pipe\Culvert:

- a. Misalignment: Vertical and horizontal alignment of the pipe culvert or storm drain pipe barrel(s) shall be checked by sighting along the crown, invert and sides of the pipe, and by checking for sagging, faulting and invert heaving. The person assigned by the Contractor to perform the inspection should take into account pipes\culverts laid with a designed camber or grade change. Horizontal alignment shall be checked for straightness or smooth curvature. Any issues with horizontal and/or vertical alignment shall be noted in the inspection report. If any vertical and/or horizontal misalignment problems are noted in the

inspection, a further evaluation will be performed by the Owner to determine the impact of the misalignment on the joints and wall of the pipe\culvert to ascertain what corrective actions are needed. All corrective actions determined necessary by the Owner that are a result of the Contractor's negligence, omission or fault shall be the sole responsibility of the Contractor to remedy.

- b. Cracks: Cracks or splits in the interior wall of the pipe shall be remediated. Remediation methods shall be in accordance with recommendations of the pipe manufacturer, be acceptable to and authorized by the Owner before proceeding, and shall be the sole responsibility of the Contractor
- c. Joints: Pipes\culverts showing evidence of crushing at the joints shall be remediated. Differential movement, improper joint sealing, movement or settlement of pipe\culvert sections, and leakage shall be noted in the inspection report. Joint separation of greater than 1 inch shall be remediated. Evidence of soil migration through the joint will be further investigated by the Owner to determine the level of remedial action required by the Contractor. Remediation methods shall be in accordance with recommendations of the pipe manufacturer, be acceptable to and authorized by the Owner before proceeding. All corrective actions determined necessary by the Owner that are a result of the Contractor's negligence, omission or fault shall be the sole responsibility of the Contractor to remedy.
- d. Buckling, bulging, and racking: Flat spots or dents at the crown, sides or flow line of the pipe due to racking shall be noted in the inspection report and will be evaluated by the Owner. Areas of wall buckling and bulging shall also be noted in the inspection report and evaluated by the Owner for corrective action if deemed necessary by the Owner. All corrective actions determined necessary by the Owner shall be the sole responsibility of the Contractor.
- e. Deflection: Any one of several methods may be used to measure deflection of thermoplastic pipe\culvert (laser profiler, mandrel, direct manual measure, etc.) If the initial inspection indicates the pipe\culvert has deflected more than 5 percent of its original diameter, and if the original inspection was performed using a video camera, then a mandrel test shall also be performed in accordance with VDOT VTM 123. All deflections shall be noted in the inspection report. Deflections of less than 5 percent of the original pipe\culvert's diameter shall not require remediation. If the pipe\culvert is deflected greater than 5 percent of the original diameter, the pipe\culvert shall be replaced by the Contractor at his expense to the satisfaction of the Owner

Remediation efforts and percentage of payment shall apply to the entire section(s) of the deflected pipe or culvert, joint to joint. The cost of the remedial measures (including removal and replacement of the pipe, if necessary) and the re-inspection of the remediated pipe necessitated as a result of the Contractor's negligence, omission or fault shall be the contractual and financial responsibility of the Contractor.

D. Cleaning

Upon completion, each pipe and structure shall be cleaned of silt, debris, and foreign matter and shall be kept clear of such accumulation until final acceptance.

III. MEASUREMENT FOR PAYMENT

- A. The cost of excavation, backfill, and disposal of surplus material for drop inlets, intake boxes, manholes both new and reconstructed, spring boxes, junction boxes, and base sections of pipe tee units used as drop inlets and manholes shall be included in the bid price for such items. No additional or separate payment will be made. In the event steps or invert shaping are required, the cost thereof shall also be included in the price for such items.
- B. Bedding stone depth shall be 6-inches and shall be considered incidental to the pipe and structures.
- C. Undercut excavation and the replacement of excavated undercut material shall be as specified in Section 303.
- D. Pipe will be measured in linear feet of each size pipe and material type installed. Pipe will be measured through the fittings from center of the structure to center of structure or to the terminal end. When a partial section is required, the actual length of the partial section will be measured in place. Pipe shall be paid for at the contract unit price per linear foot, complete in place. Payment will include the cost of the following:
 - 1. Backfilling, compacting, and compaction testing
 - 2. Bedding
 - 3. Cleaning prior to acceptance, as required
 - 4. Dewatering
 - 5. Disposal of surplus material
 - 6. Excavation
 - 7. Joint Wrapping & Sealing, including geotextile fabric
 - 8. Main line fittings
 - 9. Pipe anchor blocks
 - 10. Restoration in right-of-way and shoulders and easements (including curb and gutter restoration), unless otherwise specified in the Contract Documents.
 - 11. Storm sewer and appurtenances
 - 12. Stripping and stockpiling topsoil
 - 13. Temporary seeding and stabilization
 - 14. Temporary sheeting and bracing.
- E. Pipe culverts will be measured and paid in linear feet. Pipe will be measured through the fittings from center of the structure to center of structure or to the terminal end. When a partial section is required, the actual length of the partial section will be measured in place.

- F. Pipe tees and elbows will not be measured separately.
- G. Pipe reducers will be measured and paid in linear feet of pipe for payment at the larger pipe size.
- H. Jacked pipe will be measured in linear feet to the nearest 1/10 of a foot. Jacked pipe will be paid at the contract unit price per linear foot for each size pipe installed, complete in place including all work associated with bore pit.
- I. Reinstalled pipe will be measured and paid in linear feet along a line parallel to the flow line. This price shall include excavation involved in removing pipe, hauling, cleaning, relaying, backfilling, necessary cutting for joining to other sections of pipe, furnishing new coupling bands, disposing of surplus excavation, disposing of surplus and damaged materials, and replacing any otherwise usable sections damaged or broken because of the negligence of the Contractor.
- J. End sections will be measured in units of each, complete-in-place.
- K. End walls and arch substructures will be measured per each.
- L. Box culverts will be measured in linear feet along the centerline of the barrel from face of curtain wall to face of curtain wall. This price shall include all work including, but not limited to designing, casting, reinforcing, installing, bedding, waterproofing, sealing joints, anchoring, and providing buffer zones for multiple lines.
- M. Pipe grates will be measured and paid in linear feet or each, complete and in place, as indicated on the Bid form, unless included in another Bid item. This price shall include fabricating, furnishing, galvanizing, and installing.
- N. Drop inlets, yard inlets, catch basins, and intake boxes will be measured as each as complete units, including the frame and grate or cover. Drop inlets, yard inlets, catch basins, and intake boxes will be paid for at the contract unit price per each. Where curb or curb and gutter extend along the drop inlet, the contract unit price for drop inlets shall include that part of the curb or gutter within the limits of the structure.
- O. Base sections of pipe tee units used as drop inlets and manholes will be measured and paid in linear feet horizontally of pipe specified. The riser section and additional costs for the tee shall be included in the price for the drop inlet or manhole.
- P. Manhole (4- or 5-foot diameter) installed complete in place, 0- to 6-foot in depth. Measurements will be made to the nearest foot from the bottom of the frame and cover to the invert out. Payment will be made at the unit price bid for each standard depth manhole (0- to 6-foot) installed and satisfactorily tested, and will include the cost of the following:
 - 1. All appurtenances required for satisfactory operation
 - 2. Bedding
 - 3. Cleaning prior to acceptance, as required
 - 4. Dewatering
 - 5. Excavation, bedding, backfill, and compaction
 - 6. Manhole, complete including frame and cover, benches, invert and troughs
 - 7. Openings and seals
 - 8. Sheeting and shoring
 - 9. Steps, unless otherwise noted

Q. Manhole (4- or 5-foot diameter) Extra Depth, installed complete in place, in excess of 6-feet in depth will be made based on the vertical feet of manhole installed in excess of 6-feet, measured to the nearest foot from 6-feet below the bottom of the frame and cover to the invert out in depth.

Payment will be made at the unit price bid for each additional vertical foot of manhole (in excess of 6-feet in depth) installed and satisfactorily tested and will include the cost of the following:

1. All appurtenances required for satisfactory operation
2. Cleaning prior to acceptance, as required
3. Dewatering
4. Excavation, bedding, backfill, and compaction
5. Openings and seals
6. Sheeting and shoring
7. Steps, unless otherwise noted

R. Conflict Manhole, installed complete in place.

Measurement will be made as each. Payment will be made at the unit price bid for each conflict manhole installed and satisfactorily tested will include the cost of the following:

1. All appurtenances required for satisfactory operation
2. Bedding
3. Cleaning prior to acceptance, as required
4. Dewatering
5. Ductile iron pipe
6. Excavation, bedding, backfill, and compaction
7. Manhole, complete including benches, invert and troughs, and frame and cover
8. Openings and seals
9. Sheeting and shoring
10. Steps, unless otherwise noted

S. Concrete spring boxes will be measured and paid as each.

T. Junction boxes will be measured as a complete unit including frame and cover, and paid as each.

U. Reconstructed manholes will be measured and paid as each as a complete unit.

V. Precast arches will be measured and paid in linear feet along the centerline of the invert from face of headwall to face of headwall. This price shall include designing, forming, casting, reinforcing, excavating, wingwalls, installing, waterproofing, sealing joints, anchoring and bedding, and providing buffer zones for multiple lines. The cost for cast-in-place work other than that specified in the Contract Documents shall be included in the price for precast arches.

W. Post Installation Inspection of Storm Pipes and Culverts shall be measured and paid in linear feet of televised pipe in accordance with Section 811, Television Inspection. The cost of remedial measures (including removal and replacement of the pipe, if necessary) and the re-inspection of the remediated pipe necessitated as a result of the Contractor's negligence, omission or fault shall be the contractual and financial responsibility of the Contractor.

End of Section

SECTION 801

WATER DISTRIBUTION SYSTEMS

I. GENERAL

1.1 DESCRIPTION OF WORK

The Contractor shall furnish all labor, supervision, material (except as herein provided), tools, equipment, supplies, and services; and, shall perform all Work necessary for the construction of water distribution systems less than or equal to 36-inch in diameter. All pipe greater than 16-inch diameter shall be ductile iron, unless modified by Special Provisions. The water distribution systems shall be constructed in accordance with the Contract Documents and the applicable laws, rules, ordinances, standards, and regulatory agencies.

1.2 SUBMITTALS

Submittals shall be made by the Contractor in accordance with the procedures set forth in Section 105 and as described below:

A. Submit each manufacturer's and/or supplier's certification attesting that the pipe, pipe fittings, joints, joint gaskets, valves, and appurtenances meet or exceed the specified requirement. The following information is to be shown on each certificate:

1. Name and location of the work
2. Name and address of Contractor
3. Quantity and date or dates of shipment and/or delivery to which the certificate applies
4. Name of the manufacturing or fabricating company

B. Certification shall be in the form of a letter or company-standard form containing all required data and signed by an officer of the manufacturing, fabricating, or supplying company.

If requested by the Owner, all laboratory test reports shall be provided at no additional cost and shall show the following information:

1. Date or dates of testing. Test data should be the most current available and be within 5 years of the Bid Opening.
2. The specified requirements for which testing was performed
3. Results of the test or tests

C. Manufacturer's catalog cuts, technical data, operation and maintenance data, and/or Shop Drawings are required for the following water distribution system components (Shop Drawings shall be drawn to a scale sufficiently large to show all pertinent aspects of the item and its method of connection to the work):

1. Pipe
2. Valves
3. Valve Boxes
4. Fittings, Sleeves, and Couplings
5. Hydrants
6. Pipe Restraints

7. Tapping Sleeves
8. Corporation Stops
9. Meter Boxes and Meter Setters, when required.
10. Meter and Valve Vaults
11. Gauges
12. Tracer Wire and Marking Tape

D. Flushing, testing and disinfection procedures

In those cases where the installation or procedure proposed is not detailed in the Contract Documents or in the Special Provisions or a significant modification is required; the Contractor shall submit procedures and equipment to be used for the pressure testing (including methods of temporary joint restraint), leakage testing, and disinfection testing. The Contractor shall submit his proposed methods for disposing of chlorinated water following disinfection of the main.

E. Reduction of Lead in Drinking Water Act

In compliance with Public Law 111-380, the Contractor shall not use, install or repair any pipe, fittings, fixture, solder or flux in the installation of any public water system that is not "lead free". Solders and flux shall not contain more than 0.2% lead; and pipes, fittings, and components shall not contain more than 0.25% lead based on a weighted average of the wetted surfaces. Fire hydrants, service saddles, and gate valves that are 2-inches in diameter and greater, are exempt. Products must comply with NSF/ANSI Standard 61 to include Annex G and shall bear the NSF 61-G Certification Mark.

F. Pipelines greater than 16-inch diameter

In addition to the above submittal requirements, pipe diameters in excess of 16-inches shall provide the following information:

1. Laying schedule
 - a. Submit a tabulated laying schedule for approval which references stations and invert elevations as shown in the Contract Documents as well as all fittings, valves, bends, outlets, restrained joints, tees, special deflection bells, adapters, solid sleeves and specials, along with the manufacturer's drawings and specifications providing complete details of all items;
 - b. Show pipe class, class coding, station limits and transition stations for various pipe classes;
 - c. The location of all pipes shall conform to the locations indicated in the Contract Documents;
 - d. Each pipe supplied shall be identified with sequential numbering consistent with the laying schedule and marking drawings and each marked pipe will appear on the marking drawings in the identified location for installation;
 - e. Special fittings, bends, and appurtenances requiring specific orientation will be supplied appropriately marked with the words "TOP" in the correct position and in a consistent location;
2. Submit shop drawings for approval before manufacture and shipment including, but not be limited to:

- a. The grade of material, size, wall thickness of the pipe and fittings and appurtenances;
 - b. The type of fittings and valves;
 - c. The type and limits of the lining, lining reinforcing and coating systems of the pipe and fittings.
 - d. Joint details, methods and locations of supports, and complete information concerning type, size and location of all welds. Shop welds (no field welding will be allowed) will be clearly differentiated and welds will be clearly detailed with preparation procedures for all pipe and parent material comprising each weld. Critical welding procedures will be identified along with methods for controlling welding stresses and distortions. Locations and proposed joint details will also be clearly identified; and,
 - e. All other pertinent information for all items to be furnished; product data to show compliance of all couplings, supports, fittings, coatings and related items.
3. Submit anticipated production and delivery schedule.
 4. Submit handling procedures for all phases from finished fabrication through delivery including storage, transportation, loading, and unloading. This will include storage at the project site and required protection following installation prior to startup.
 5. Prior to shipment of pipe, submit:
 - a. Certified copies of mill tests confirming the type of materials used in the pipe, and shop testing of pipe to show compliance with the requirements of the applicable standards, including hydrostatic tests.
 - b. A certified affidavit of compliance from the manufacturer stating that the pipe, fittings, gaskets, linings and exterior coatings for this project have been manufactured and tested in accordance with AWWA and ASTM standards and requirements specified herein.

G. Work Plan for Tie-ins to Existing Systems

At a minimum the Contractor's Work Plan shall include the following:

1. Schedule:
 - a. Starting date.
 - b. Sequential listing of specific tasks required to complete the tie-in.
 - c. Anticipated duration for each task of the tie-in operation.
2. Testing procedures.
3. Identification of businesses and residences that may be impacted and will require notification.
4. Method of dewatering the existing water main and quantity of water anticipated in dewatering.
5. Method of handling constant flow if valves or line stops do not close completely. The Owner cannot guarantee that full stoppage of flow will be achieved.

6. Contingency plan for meeting a deadline for full traffic to be restored if a roadway is taken out of service or the capacity reduced during the tie-in and the completion schedule cannot be met.
7. Mobile phone contacts for Contractor and Owner personnel, and other identified key stakeholders, as appropriate.
8. List of equipment and number of crews to verify adequacy of Contractor's ability to work both ends of the tie-in simultaneously and continuously until connections are complete.
9. Stone and other backfill materials to be on-site if rain is forecast and used if a heavy rain event occurs during the tie-in backfill and compaction stage.
10. Confirmation of availability and scheduling of asphalt placement and proper cure time for tie-ins under existing pavement to restore traffic movement. Asphalt patch type to meet locality requirements.

II. EXECUTION

2.1. GENERAL

- A. The Contractor shall furnish and install a complete piping system as shown in the Contract Documents and in accordance with the Contract Documents
- B. The Owner reserves the right to reject defective material shipped to and/or stored on site, and to examine the same to determine if damage has occurred prior to installation.
- C. The Contractor shall unload, handle, and store pipe and appurtenances in accordance with Section 200.
- D. Proper implements, tools and facilities satisfactory to the Owner and as recommended by the material manufacturer shall be provided and used by the Contractor for the safe and convenient execution of the Work. All pipe, valves, fittings, hydrants and accessories shall be carefully lowered into the trench in such a manner as to prevent damage to the water main materials and any protective coatings and linings.

2.2. PIPE INSTALLATION

- A. Cleaning: All lumps, blisters and excess coatings shall be removed from the bell and plain ends of each pipe. The outside of the plain end and the inside of the bell shall be cleaned and dried, and shall be free from dirt, sand, grit, or any foreign materials before the pipe is installed.
- B. Trenching, bedding, backfilling and compaction shall be in accordance with Section 303.2.2 and Special Provisions.
- C. Pipe Laying:
 1. Pipe shall be laid to a true, uniform line and grade. High points, other than those indicated in the Contract Documents where an air vent assembly is to be placed, shall be avoided.

2. Pipe laying shall be in accordance with the manufacturer's recommendations. Pipe laying shall proceed, bells ahead. Each section of pipe shall be laid to form a close concentric joint with the adjoining section and to prevent sudden offsets in the flow line. Each section of pipe, as it is laid, shall be backfilled as specified in the Contract Documents, at least up to the centerline, before the next joint is made.
3. As the Work progresses, the interior of the pipe shall be cleared of dirt and superfluous material.
4. Trenches and other excavations shall be kept free of water until backfilled. Concrete or masonry Work shall not be constructed in water, nor shall water be allowed to rise over the Work until concrete or mortar has had ample time to set.
5. When Work is not in progress, open ends of pipe and fittings shall be closed, to the satisfaction of the Owner, so that trench water, earth, and other substances will not enter the pipe or fittings.
6. Whenever a pipe requires cutting for the insertion of valves, fittings, closure pieces, or to bring it to the required location, the Work shall be performed in a satisfactory manner so as to leave a beveled end in accordance with the manufacturer's instructions or recommendations. Cuts shall be made at 90° with the centerline of the pipe so that a framing square placed against the side of the pipe will reveal not more than 1/4-inch variation across the diameter of the pipe in any direction. The pipe shall be cut with an abrasive wheel, rotary wheel cutter, guillotine pipe saw, milling wheel saw or other equipment specifically designed for that purpose. The Contractor shall grind smooth cut ends and rough edges and for push-on connections, the cut ends should be beveled slightly. Pipe damaged by the Contractor in cutting shall be replaced at the Contractor's expense
7. Laying of the pipe shall commence immediately after the excavation is started, and every means must be used to keep pipe laying closely behind the trenching. No more than 100 feet of trench may be open ahead of the pipe laying operation, unless otherwise specified. Holes shall be scooped out where the bells occur leaving the entire barrel of the pipe bearing on the pipe bed.
8. Pipe joint assembly practices and joint assembly materials such as lubricants, primers and adhesives shall be in accordance with the manufacturer's recommendations and specifications, and in accordance with ANSI/AWWA C111.
9. Pipe shall not be laid on frozen bedding.

D. Alignment and Grade:

1. The Contractor shall not deviate from the line and grade indicated in the Contract Documents, except with approval of the Owner.
2. Where it is necessary to deflect pipelines to avoid obstructions, the amount of deflection shall not exceed $\frac{1}{2}$ of that recommended by the manufacturer of the pipe. Where necessary to maintain the required line, short sections of pipe and fittings shall be provided.
3. The Contractor shall investigate the proposed location of the main far enough in

advance of the Work to determine where conflicts will occur and to determine joint deflections necessary to clear any obstructions.

E. Polyethylene Encasement:

1. Pipe shall be encased with polyethylene where specified in the Contract Documents
2. In the event that corrosive soils (as defined by Appendix "A" of ANSI/AWWA C105/A21.5) are encountered during excavation (and have not been identified as such in the Contract Documents), the Owner may direct that all, or a portion, of the pipeline be encased.
3. Materials and methods of installation shall be in accordance with ANSI/AWWA C105; Method A, B, or C may be used unless otherwise specified in the Contract Documents. Polyethylene shall be at least 4 mils thick, cross laminated, and shall conform to the requirements of ANSI/AWWA C105/A21.5.
4. A fabric type or padded sling shall be used when handling polyethylene encased pipe to prevent damage to the polyethylene encasement.
5. All seams in the polyethylene encasement shall be sealed completely with approved 2-inch wide plastic adhesive tape.
6. Pull loose tube along pipe barrel up snugly around the pipe and fasten in-place with adhesive tape at 3 foot intervals.
7. Completely cover fittings and connections with film held snugly in place with point tape or strapping.
8. Extreme care shall be taken when backfilling to avoid damaging the polyethylene encasement.

F. Tracer Wire:

All underground non-metallic pipe pressure systems shall be installed with continuous tracer wire, conforming to Section 200, attached every 10 feet to the piping system with plastic strapping. The wire shall terminate above ground at every valve box, tracer wire box, and air vent assembly. The wire shall be of sufficient length to allow the wire to be uncoiled and extended one (1) foot above the finished grade. The tracer wire installation will be considered complete and acceptable for service when the Owner can trace the wire using the locating equipment. Any breaks shall be repaired by the Contractor prior to project acceptance.

G. Subsurface Utility Tape:

All water mains shall be identified by a subsurface utility warning tape, conforming to Section 200, placed at an elevation not less than 6-inches, or more than 12-inches below the proposed finished grade, or directly under the roadway base material if the base material is greater than 12-inches.

2.3. VALVE INSTALLATION

A. Prior to installation, the Contractor shall inspect valves in the presence of the Owner for

- direction of openings, freedom of operation, tightness of pressure containing bolting, cleanliness of valve ports and especially seating surfaces, handling damage and cracks. Valves determined to be defective by the Owner shall be replaced by the Contractor. The Contractor shall operate all valves greater than 3-inches once prior to installation to determine the number of rotations of the operating nut; this number of rotations shall be recorded on the record drawings.
- B. The Contractor shall set and join valves to pipe in accordance with the manufacturer's requirements for the type and class of valve and pipe.
 - C. The valve box shall be centered and set plumb with the top of the box neatly to final grade, unless otherwise directed by the Owner. Shock and stress shall not be transferred from the box to the valve.
 - D. The top of the operating nut shall be less than 36-inches below the rim of the valve box (as measured from final grade). When the distance from the operating nut to the top of the valve box is greater than 36-inches, the Contractor shall install an approved valve stem extension device to result in a distance of 12- to 24-inches from the top of the operating nut to the rim of the valve box.
 - E. Valves shall be set vertical and embedded in accordance with the Standard Details, unless otherwise indicated.

2.4. HYDRANT INSTALLATION

- A. Hydrants shall be installed as indicated in the Contract Documents and Standard Details.
- B. The hydrant shall be plumb with the pumper nozzle facing the curb (or roadway). Nozzles shall be set 18- to 24-inches above the finished grade to the centerline of the nozzle, unless otherwise directed by the Owner. Hydrants shall have a minimum of 18"-24" from back of curb, with a maximum distance of 8 feet.
- C. Newly installed fire hydrants not yet in service shall be covered with a bag (or other Owner approved system), securely tied in place indicating that the hydrant is not usable.
- D. Fire hydrants shall not be installed on water mains less than 6-inches in diameter.

2.5. APPURTEMENT INSTALLATION

All appurtenances (fittings, air vent assemblies, blow-offs, meter settings) shall be installed in accordance with the manufacturer's recommendations and as indicated in the Contract Documents and Standard Details.

2.6. RESTRAINT

- A. Fittings, valves, pipe joints and hydrants shall be restrained as indicated in the Contract Documents and in accordance with Section 200. Alternate methods of thrust restraint other than those specified herein may be used only with the written approval of the Owner.
- B. All exposed piping, flanges, couplings, nuts and bolts shall receive a minimum of two coats of an approved protective coating as directed by the Owner.

2.7. CONNECTIONS TO EXISTING MAINS

- A. The Owner and Contractor shall have a coordination meeting with the Owner's personnel at least 10 Days prior to the planned water main shutdown and provide a written Work Plan. The Owner shall review the Work Plan and either approve it or meet with the Contractor within 3 business days after receipt of the schedule to satisfactorily modify it.
- B. It will be the responsibility of the Contractor to contact all residents, businesses, and fire department 72 hours in advance of interrupting service.
- C. The Contractor shall notify the Owner at least 5 business days in advance of performing the offset/shutdown. Work can be delayed a maximum of 48 hours from the anticipated shutdown if due to inclement weather, and is approved or directed by the Owner. Otherwise, rescheduling and re- notification of customers will be required. Weather delays greater than 48-hours in duration shall require the Contractor to re-notify affected properties as hereinbefore specified.
- D. The Contractor is required to schedule a meeting on site on the morning of a planned nighttime tie-in and shall notify the Owner. At the time of the meeting, the Contractor shall have all materials and equipment necessary for the tie-in on site and assembled for inspection by the Owner.

The following items will be reviewed and discussed at this meeting:

- 1. Site conditions
 - 2. Weather forecasts / weather impacts
 - 3. Work and contingency plans
 - 4. Contact information
 - 5. Emergency equipment
- E. The Owner reserves the right to postpone the scheduled tie-in if:
 - 1. The site or Contractor is not prepared as required in the Work Plan and as agreed upon at the pre-tie-in meeting.
 - 2. The Owner has an emergency in another part of their system.
 - F. Shutdowns shall not begin until all required materials are on-hand and ready for installation and a written Work Plan has been submitted and approved by the Owner.
 - G. The Owner reserves the right to cancel scheduled shutdowns if conditions warrant.
 - H. A decision point will be established by the Owner for the Contractor to cut the active water main. This decision during the tie-in will be based upon the Contractor's progress leading up to the cutting into the active water main. Inadequate progress by the Contractor leading up to this critical decision point may lead to a postponement of the tie-in completion, backfilling the excavation, placing temporary pavement, and rescheduling the remainder of the tie-in work.
 - I. The Contractor shall provide a crew with equipment for each connection point so that multiple connections can be completed simultaneously.
 - J. At a time approved by the Owner, the shutdown period will commence and the Contractor shall proceed with the Work continuously, start to finish, unless otherwise noted, until the Work is completed and the system is tested and ready for operation. If the Contractor completes

all required Work before the specified shutdown period has ended, the Owner may immediately place the existing system back in service. If problems occur, the Contractor along with appropriate staff and equipment to remain on site to be an extension of the Owner's operational response until all operational issues have been resolved to the satisfaction of Owner.

- K. The Owner's personnel shall operate all existing system valves unless otherwise indicated. The Owner shall make every effort to have a complete shutdown. Failure by the Owner to achieve a complete shutdown shall not entitle the Contractor to any additional compensation.
- L. The Contractor is responsible for providing adequate support and restraint, against system pressure of the exposed piping prior to and during startup and final backfill.
- M. The Contractor shall follow the procedures herein for any joints of the new water main and fittings that have not been previously hydrostatically pressure tested:
 - 1. The Owner reestablishes services in the line.
 - 2. One half hour will elapse, after air venting is complete by the Owner.
 - 3. Joints will be visually inspected for signs of leakage by Owner.
 - 4. Any leakage noted shall be corrected to the satisfaction of the Owner.
 - 5. After satisfactory visual testing of exposed joints by the Owner and any corrective action, the Contractor shall wrap the pipe and/or fitting as required and immediately proceed to backfill the pipe and restore to grade conditions or for reestablishment of traffic if in a roadway. Soil backfill compaction tests may be specified by the Owner for work within roadway travel lanes.
 - 6. If specified in the Contract Documents, utility warning tape shall be installed above the connection in accordance with the Bid Documents.
 - 7. Any joints not inspected by the Owner will not be approved and shall be excavated for inspection.
- N. Connection shall be made to the existing main through the installation of a tee in the existing main or by tapping sleeve and valve, as indicated in the Contract Documents. Taps shall be sized based on manufacturer's recommendations, but in no case shall the taps be of equal or larger size than the main.
- O. Careful attention shall be given to the depth of new pipelines at points where tie-ins to existing mains are to be made. The existing main shall be uncovered in the presence of the Owner and the new pipeline set to proper elevation to provide for a perpendicular and level tie-in.
- P. The allowable duration of the water service interruption shall be approved by the Owner prior to the execution of the Work. Restoration of service due to the Contractor taking too much time to complete the connection or the Contractor's lack of proper equipment, personnel, or materials, shall not entitle the Contractor to any claim for additional time or compensation.
- Q. The Contractor shall be responsible for ascertaining the exact location, depth, and joint pattern of existing mains prior to making connections. Prior to cutting into any water mains the Contractor shall have on site all required fittings, pipe, tools, personnel and equipment, and shall satisfy the Owner through field measurements, that his fittings will properly join the existing line. Obstructions within the tie-in length may require special offsets by the Contractor.
 - 1. Other than as specified herein or in the Special Provisions, all materials shall be

installed in accordance with the manufacturer's recommendations including, but not limited to alignment, torque requirements, and tolerances.

2. All materials shall be thoroughly disinfected prior to installation, including the tapping machine.
3. Connections shall only be made in the presence of the Owner.
4. Tie-ins to existing mains shall only be performed after the new main has been satisfactorily pressure tested and chlorinated. The Contractor may not tie-in the new main to the existing main until after the results of the bacteriological tests have been completed and approved by the Owner.

R. Tapping Existing Mains Under Pressure:

1. Tapping sleeves and valves shall be utilized for connecting to existing mains where indicated in the Contract Documents.
2. It shall be the Contractor's responsibility to verify the actual outside diameter of the existing main at the location of the proposed tap in order that the tapping sleeve or couplings to be provided can be properly installed.
3. The centerline of the tapping sleeve and valve assembly shall be located the following minimum distances from existing pipe joints:

<u>Size of Tapping Sleeve</u>	<u>Minimum Recommended Separation from Existing Joint</u>
4-, 6- & 8-inch dia.	3-1/2 feet
10-, 12- & 16-inch dia.	5-1/2 feet
Greater than 16-inch dia.	See Special Provisions
4. In cases where the horizontal alignment as indicated in the Contract Documents would result in a "sleeve to joint" distance less than the minimum stated above, the Owner may direct the Contractor to substitute a MJ x MJ x Flange tee connection using acceptable sleeves and pipe sections.
5. In addition to pressure testing of newly installed pipelines in accordance with Paragraph 2.8 of this Section, the Contractor shall test each tapping sleeve and valve assembly prior to making the tap. Water shall be injected into the body of the sleeve, to a pressure of 150 psig, through the test plugs. If test plugs are not provided in the sleeve, a tapped mechanical joint plug shall be assembled to the valve for testing purposes. Pressure shall be maintained for a one-hour period without evidence of leakage. Upon obtaining a satisfactory test (which shall be witnessed by the Owner), the tapping operation may commence.
6. All installed tapping sleeves shall be restrained in accordance with the Drawings, or as otherwise noted.
7. Upon completion of the tap the Contractor shall save the pipe coupon to show the Owner.
8. For private service connections, Contractor shall follow approved site plan or submit a site plan for approval by the Town. The site plan will show the location of all connections. The Contractor shall notify the Town 48 hours in advance of making connections. Approved materials shall be on-site prior to making connections. A licensed plumber is required for all residential connections unless approved otherwise by the Town. The Contractor shall notify the Town when connection work is complete and leave trench open for inspection.

S. Sleeve-In of Straight Pipe:

1. Sleeve-in connections shall be as indicated in the Contract Documents.
2. Upon completion of the tie-in the connected pipelines shall be thoroughly flushed to remove heavily chlorinated water, assure clarity and air removal. One sample for bacteriological examination shall be collected by the Contractor from the point of discharge of the flushing water.

T. Offsets to Existing Water Main:

1. The Contractor shall comply with the above procedures for connections to existing mains.
2. Prior to performing an offset or cut-in, a trial shutdown will be performed to determine the working conditions to be encountered when the Work is performed.
3. All bends, valves, sleeves, pipe, and fittings shall be fully restrained with retainer glands.
4. The Contractor shall perform cut-in or offset Work at night, unless otherwise indicated. Under most circumstances the hours of operation will be from 12:00 midnight to 6:00 A.M. The excavation for the Work shall be completed no later than 3:30 P.M. on the day the offset or cut-in is to begin to allow for inspection by the Owner.
5. Offsets will not be subjected to pressure testing unless specified in the Contract Documents. After installation and connection to the existing mains, the offset shall be placed in service and left uncovered for visual inspection for at least 2 hours. Visible leaks shall be repaired to the satisfaction of the Owner prior to acceptance of the offset.
6. The materials to be installed and the tools to be used shall be assembled and ready for inspection no later than 3:30 P.M. on the day installation of the Work is to commence. The inside of all water system pipe and fittings to be installed shall be cleaned and swabbed with a chlorine solution of 50 mg/l and ends of lines capped until the time of installation. All visible dirt and foreign materials shall be removed from the interior of the pipe and fittings. Immediately prior to installation of the assembly, the pipe and fittings shall again be swabbed with 50 mg/l chlorine solution. The Contractor shall review in detail his plan of operation with the Owner at the time the excavation and pipe Work are inspected for readiness.
7. Excavation around the existing pipe shall be sufficient to allow the Work to be performed without requiring additional excavation during installation of the offset or cut-in. Excavation shall be of sufficient depth to accommodate a minimum of 8-inches uniform depth of VDOT #57 stone, which shall be placed by the Contractor over the entire bottom of the excavation. In addition, there shall be a minimum of 12-inches clearance between the bottom of the pipe and the top of the VDOT #57 stone.
8. The Contractor shall clean and mark the locations on the existing pipe where the pipe cuts are to be made by 3:30 P.M. on the day the offset or cut-in is to be installed. The Contractor shall measure the outside diameter of the pipe to be cut-in to be sure the proposed pipe and fittings are compatible with the existing pipe to be cut. All

measurements shall be double checked in the presence of the Owner just prior to cutting of the existing pipe.

9. All spoil material not used as backfill shall be removed the same day as excavated. Approved suitable material to be used as backfill shall be stockpiled in the vicinity of the excavation.
10. The Contractor shall have sufficient crews and equipment on hand to perform the Work for each offset. All equipment to be used during the Work, including pump, backup pump, backhoe, at least two pipe saws, fuel, tools, generators, light towers, and similar equipment shall be test run and determined to be in proper running order prior to cutting of the existing pipe. If the Contractor fails to provide adequate equipment in proper running order, the Owner will cancel the Work and the Contractor shall request rescheduling when the deficiencies have been corrected.
11. The Contractor shall have on hand at the site of the cut-in or offset two full circle stainless steel repair clamps and two DIMJ plugs or caps as necessary for each size of pipe to be cut. If plugs or caps are used, appropriate thrust restraint shall be provided by the Contractor.
12. After a cut-in or an offset has begun, the Contractor shall make continuous progress toward restoring the water line to full service. The Contractor shall maintain sufficient crews, equipment, and supplies and shall not leave the work site until the water main Work has been completed and restored to complete operation. The Contractor shall direct his pump discharge in such a manner as to insure drainage away from the excavation so it will not flood streets or adjacent private property.
13. When weather forecasts call for freezing temperatures the night of the cut-in or offset, the Contractor shall have on site sufficient coarse granular sand to spread over all paved areas, sidewalks, and bike paths wetted by the discharge of his pumps and any areas wetted from hydrants flushed to remove air and sediment from the system. During freezing weather, the Contractor shall minimize wetting of paved areas, sidewalks, and bike paths.
14. When bends are used in offsetting around obstructions, a 1-inch corporation stop shall be installed on each side of the offset to provide air release.

2.8. TESTING AND INSPECTION

A. General:

1. All flushing, pressure testing and disinfection procedures shall conform to this Section and the applicable sections of the Virginia Department of Health Waterworks Regulations.
2. The Contractor shall provide the Owner at least 48 hours notice prior to scheduled testing and inspection.
3. Before a Contractor request is made to witness the pressure test, the Contractor shall present a written tie-in plan to the Owner for approval. The tie-in plan shall include a schedule and details of how, where, and what will be done to prepare piping for tie-in.

The plan shall include, as a minimum, pressure testing, flushing, disinfection, sampling, and tie-in details. Details shall include the Contractor's proposed location and method to tie the new pipe to the existing system; the location of the pump, backflow prevention device and gage for the pressure test; the application point, method, injection point, location of the backflow prevention device and the sampling points for disinfection; and, the method and the location of feed water, the location of backflow prevention device, and the sample point locations for the bacteriological sampling.

4. Only properly functioning and clean equipment shall be used for flushing, pressure testing and disinfecting water mains. All gauges used in the pipe testing will have active calibration dates and have been calibrated in accordance with the Contract Documents.
 5. Valves in the existing water system shall be operated only by or in the presence of the Owner.
 6. See the Special Provisions for potential testing modifications, if any, for the specific locality.
- B. Pressure Test:
1. New water mains shall be pressure tested in accordance with ANSI/AWWA C600-Section 5.2, except as herein provided. Water mains shall be filled with clean water and subjected to a pressure of 1.5 times the expected working pressure or 150 psig, whichever is greater, measured at the highest point along the test section. The pressure test shall be of at least two hour duration and any damaged or defective pipe, fittings, valves, or hydrants that are discovered during the pressure test shall be replaced by the Contractor and retested. The Contractor shall furnish all necessary equipment, materials and labor for making the tests as specified. Before applying the specified test pressure, air shall be slowly expelled completely from the pipe, valves, and hydrants. The pressure test shall not be performed against an active valve. Hydrants shall be tested with the main line. Testing shall be performed with laterals and services installed. Plug meter setter for testing.
 2. The Contractor shall test the line prior to contacting the Owner for the formal pressure test. Contractor shall be required to soak mains for 24 hours prior to testing.
 3. Water for the pressure test shall be obtained through a fully valved manifold, with an approved backflow preventer, as indicated in the Standard Details.
 4. The Contractor shall furnish all pumps, fittings, and gauges as necessary to fill the line with potable water, dispel air from the system, and pressurize the pipeline for the tests.
 5. The Owner reserves the right to test gauges to determine their accuracy.
 6. The Contractor shall coordinate with the water system owner for water to be used for the pressure testing.
 7. No pressure drop, no leaks.

9. The Contractor shall provide all necessary temporary restraint and support for testing apparatus during testing at no additional cost to the Owner.
10. The Contractor will be responsible for providing proper safety measures during pressure testing operations.
11. In addition, heat-fusion joined HDPE pipe pressure testing shall be in accordance with ASTM F2164 and shall also comply with the following:
 - a. Before testing, heat fusion joints are to be completely cooled.
 - b. All parts of the test section shall be restrained against movement. Temporarily remove, restrain, or isolate expansion joints and expansion compensators before starting.
 - c. Observe all safety precautions identified in ASTM F2164.
 - d. To compensate for expansion, add make-up water during the initial expansion phase. The quantity of water needed to fill the pipe test section and accommodate expansion (and possible leakage at non-fusion joints and seals) is estimated using:

$$V_{\text{gal}} = 1.015 \times 0.04 \times (ID_{\text{in}})^2 \times L_{\text{ft}}$$

where:

V_{gal} = pipe section volume, gallons
 ID_{in} = pipe inside diameter, inches
 L_{ft} = test section, feet

- e. Allow the test section and the test liquid to equalize to a common temperature.
- f. Initial Expansion Phase:
 - (1) When the test section is completely filled and purged of air, gradually increase the pressure to the required test pressure identified in paragraph 2.8.B.1 above.
 - (2) Add make up water as necessary to maintain the maximum test pressure for 4 hours.
- g. Test Phase:
 - (1) Reduce the test pressure by 10 psi and monitor pressure for 1 hour. Do not increase the pressure or add make up water.

- (2) No visible leakage shall be observed and the pressure shall remain steady (within 5% of the test phase pressure) for the 1 hour test phase period for a passing test.
- h. Retesting - If retesting is necessary, depressurize the test section per ASTM F2164 and correct any faults/leaks. Allow the test section to "relax" for at least 8 hours before repressurizing and repeat the Initial expansion and test phases as indicated above.

C. Leakage Test:

1. The leakage test shall be conducted concurrently with the pressure test. New water mains shall be tested for leakage in accordance with AWWA Standard C600-Section 5.2. Allowable leakage shall not exceed ANSI/AWWA C 600. No leakage shall be allowed for heat-fusion joined HDPE pipe or fPVC pipe. No pipe installations will be accepted if the leakage is greater than the values determined as follows:

The allowable leakage value shall be determined using the equation below, or Table 801-1:

$$L = \frac{SD(P)^{1/2}}{148,000}$$

Where:

L = Allowable leakage, in gallons/hr.

S = Length of pipe tested, in feet

D = Nominal diameter of the pipe, in inches

(P) $^{1/2}$ = Square Root of average test pressure during leakage test, in psig

TABLE 801-1
Leakage Testing Allowance per 1,000 feet of Pipeline (Gallons per Hour)
(Pipe diameters 16-inches and less)
Based on AWWA C600, Table 5A

Avg. Test Pressure psi	Nominal Pipe Diameter, inches							
	3	4	6	8	10	12	14	16
250	0.32	0.43	0.64	0.85	1.07	1.28	1.50	1.71
225		0.41	0.61	0.81	1.01	1.22	1.42	1.62
	0.30							
200	0.29	0.38	0.57	0.76	0.96	1.15	1.34	1.53
175	0.27	0.36	0.54	0.72	0.89	1.07	1.25	1.43
150	0.25	0.33	0.50	0.66	0.83	0.99	1.16	1.32

2. The Contractor shall, at its expense, locate and repair any defective material or workmanship until the excess leakage is reduced below the allowable limits.
3. If a water main or section fails to meet the specified test requirements or has to be repaired, it shall be retested at no additional cost to the Owner.
4. All joints, not subjected to pressure testing, shall be visually inspected under pressure for not less than 30 minutes for leakage.

D. Disinfection:

New, relocated, or repaired water mains shall be disinfected in accordance with AWWA Standard C 651-14, latest revision. The disinfection procedure shall be carried out after completion of construction and immediately before the mains are placed into service. During construction, precautions shall be taken to protect pipe interiors, fittings, and valves against contamination. Cleaning and swabbing of the interior of the pipe may be required if contamination cannot be removed by ordinary flushing and disinfection procedures. The cleaning and swabbing shall be performed with a 5% hypochlorite disinfecting solution, or other disinfecting agent as approved by the Owner. The Contractor shall be responsible for properly treating the discharge during disinfection, testing, and flushing activities in accordance with all environmental regulations required by the locality.

1. Preliminary Flushing:

- a. Water lines shall be flushed every 2,000 feet unless the Owner gives the Contractor written permission for flushing longer lengths of pipeline. No more than 4,000 feet of pipeline shall be flushed at any one time, under any circumstances.
- b. All water mains shall be flushed with potable water prior to disinfection. The flushing velocity shall not be less than 3.0 feet per second (FPS). No site for flushing shall be used unless adequate and satisfactory drainage is present, available and operational. It shall be noted that under no circumstances will preliminary flushing be considered a substitute for preventive measures taken before and during water main construction to minimize contamination. Estimated flow rates to achieve the required 3.0 FPS are as follows:

TABLE 801-2
Minimum Flushing Rate (FR) to Achieve 3.0 FPS
(*Pipe diameters 16-inches and less*)

Pipe Diameter (in.)	Flow (GPM)
6	260
8	470
10	730
12	1060
16	1880

2. Disinfection Methods

a. Tablet/Granular

The tablet method consists of placing calcium hypochlorite granules or tablets in the water main during the installation and then filling the main with potable water to create a chlorine solution. This method may be used only if, in the opinion of the Owner, the pipes and appurtenances have been kept clean and dry during construction. This method may not be used on mains less than 24 inches in diameter nor on solvent-welded plastic pipe.

b. Continuous-Feed Method

The continuous-feed method consists of completely filling the main with potable water, removing air pockets, then flushing the completed main to remove particulates, and refilling the main with potable water that has been chlorinated to 25 mg/l. After a 24-hour retention time in the main, there shall be a free chlorine residual of not less than 10 mg/l.

c. Slug Method

The slug method consists of completely filling the main to eliminate air pockets; flushing the main to remove particulates; and then, slowly flowing through the main a slug of water dosed with chlorine to a concentration of 100 mg/l. The slug shall pass through the main at a slow rate of flow allowing all parts of the main to be exposed to the highly chlorinated water for at least 3 hours.

d. Spray Disinfection Method

The spray disinfection method consists of spraying a 200 mg/l free chlorine solution on all interior surfaces of the main. After 30 minutes the main shall be filled with potable water. This method should only be used on very large diameter mains, where personnel and equipment may safely enter the pipe.

TABLE 801-3
Disinfection Methods Summary

Disinfection Method	Main Diameter Size	Initial Free Chlorine Concentration, mg/l	Min. Contact Time, Hours	Min. 24-Hour, Free Chlorine Residual, mg/l
Tablet/Granular	Less than 24- inches	25	24	0.2
Continuous Feed	General	25	24	10
Spray	Large	200	0.5	----
Slug	Large	100	3.0	50

Acceptable disinfecting solutions shall include chlorine in a liquid form, in calcium hypochlorite granules or in sodium hypochlorite solutions. All hypochlorite shall conform to AWWA Standard B 300, latest revision.

In water distribution systems using chloramines as the disinfectant, water from the distribution system no longer has a free chlorine residual, but instead has a combined chlorine residual. The combined chlorine will exert a free chlorine demand of approximately 5 ppm. Thus, the make-up water (if supplied from the water distribution system) will neutralize approximately 5 ppm of free chlorine. This 5 ppm free chlorine demand must be taken into account in determining the amount of chlorine necessary to achieve a 50 ppm free chlorine residual.

3. Final Flushing:

After the retention period, the heavily chlorinated water shall be flushed from the main

until the chlorine concentration in the water leaving the main is no higher than that generally prevailing in the existing system or less than 1 ppm. In water distribution systems using chloramines as the disinfectant, the heavily chlorinated water shall be flushed until all traces of free chlorine are absent (i.e. free chlorine residual = 0.0 ppm). The flushing shall be conducted in the presence of and only with the approval of the Owner.

4. Point of Discharge:

The Contractor shall discharge the chlorine solution from the water main through available outlets, or through taps in the main installed at the Contractor's expense. The environment to which the chlorinated water is to be discharged shall be inspected by the Contractor. If there is any question that the chlorinated discharge will cause damage to the environment, then a reducing agent shall be applied to the water as it is wasted to thoroughly and completely neutralize the chlorine residual in the water. (See Table 801-4, Amount of Agent Required to Neutralize Various Residual Chlorine Concentrations.) Dechlorination shall be performed in accordance with ANSI/AWWA C655-09. Where necessary, federal, state, and local regulatory agencies should be contacted by the Contractor to determine special provisions for the disposal of heavily chlorinated water.

TABLE 801-4
Amount of Agent Required to Neutralize Various Residual Chlorine
Concentrations for 100,000 Gallons of Water

Residual Chlorine	Sulfur Dioxide (SO ₂)	Sodium Biosulfate	Sodium Sulfite	Sodium Thiosulfate
ppm	LB	LB	LB	LB
1	0.8	1.2	1.4	1.2
2	1.7	2.5	2.9	2.4
10	8.3	12.5	14.6	12.0
50	41.7	62.6	73.0	60.0

To estimate the minimum flushing time and the amount of neutralizing agent needed, use the following, where:

- L = length of pipe being chlorinated, feet
- t = estimated minimum flushing time, seconds
- FR = flow rate, from Table 801-2, as function of pipe diameter, GPM
- V = flushing discharge volume, gallons
- N = estimated amount of neutralizing agent as function of concentration, from Table 801-3, pounds

- a. Determine the estimated minimum flushing time, t, in seconds:

$$t = L/2.5$$

- b. Determine the estimated minimum flushing discharge, V, in gallons:

$$V = \frac{t + 300}{60} \times FR$$

- c. Determine the estimated amount of neutralizing agent, N, in pounds:

$$N = \frac{V}{100,000} \times (\text{Table 801-4 value for given residual chlorine and type of neutralizing agent})$$

5. Bacteriological Tests:

After final flushing and before the water main is placed in service, the Contractor shall collect samples and have the samples tested for bacteriological quality by a State Health Department approved laboratory. The samples shall be collected in sterile containers. Chlorine residual measurements shall be taken and recorded at the time each sample is collected.

For new mains, one of the following two options for the bacteriological testing of total coliform analysis may be used:

Option A – The Contractor shall take an initial set of samples and then resample after a minimum of 16 hours using the sampling site procedures outlined in AWWA C 651-14. Both sets of samples must pass before approval may be granted.

Option B – The Contractor shall allow the main to sit for a minimum of 16 hours without any water use/withdrawals prior to sampling. The Contractor shall then collect, using the sampling site procedures identified in AWWA C 651-14 and without flushing the main, two sets of samples a minimum of 15 minutes apart while the sampling taps are left running. Both sets of samples must pass before approval may be granted.

For new mains, sets of samples shall be collected every 1,200 feet, plus one set from the end of the new main and a minimum of one set for each branch greater than one pipe length.

6. Re-disinfection:

If the initial disinfection produces positive results for coliform, the main shall be re-flushed and the sampling procedure repeated. If these samples are positive for coliform, then the main shall be re-chlorinated and the sampling procedure repeated until satisfactory results are achieved.

7. Supervision:

The disinfection and testing procedure shall be carried out by the Contractor under the supervision of the Owner. Water mains shall be placed in service only after final approval has been issued by the Owner contingent upon test results.

III. MEASUREMENT FOR PAYMENT

A. Water Main, installed

Measurement of the water main will be made along the centerline of the pipeline based upon the linear footage of each size pipe and material type installed and satisfactorily tested, complete in place. No depth measurement will be made for trench excavation and native material backfill. Pipe will be measured through fittings, valves, and casings.

The unit price bid will not include the cost of valves. Payment will include the cost of the following:

1. Backfilling, compacting, and compaction testing
2. Bedding, as detailed in the Contract Documents
3. Coatings
4. Corporation stops
5. Dewatering
6. Disinfection
7. Disposal of surplus material
8. Excavation
9. Heat fusion equipment and any specialized technical operational support required
10. Restoration in right-of-way and easements (not including curb and gutter restoration or pavement restoration, unless otherwise noted)
11. Sampling and flushing
12. Service saddles
13. Shoulder restoration
14. Temporary seeding and stabilization
15. Temporary sheeting and bracing
16. Testing
17. Thrust restraint
18. Tracer wire and marking tape
19. Water main and appurtenances, including fittings.

B. Fire Hydrant, installed complete in place.

Payment will be made at the unit price bid for each fire hydrant (Type I, II, or III) installed and satisfactorily tested and will include the cost of the following:

1. All appurtenances required for satisfactory operation
2. Backfill, compacting and compaction testing
3. Bedding material
4. Blocking, where required
5. Burlap bag
6. Disposal of surplus material
7. Culvert Pipe
8. Dewatering
9. Excavation
10. Extension spools
11. Fire hydrant assembly, including valve, valve box, valve box frame and cover, pipe, and fittings as indicated on the Standard Details
12. Painting
13. Right of way restoration
14. Shoulder restoration
15. Stone
16. Temporary seeding and stabilization
17. Temporary sheeting and bracing
18. Testing
19. Thrust restraint.

C. Water Sampling Stations, installed complete in place.

Sampling stations, when required, shall be at the unit price bid.

D. Gate or Butterfly Valves, installed complete in place.

Payment will be made at the unit price bid for each size gate or butterfly valve installed, complete in place, and satisfactorily tested, and will include the cost of the following:

1. Backfill, compacting and compaction testing
2. Bedding material,
3. Coatings and linings
4. Disposal of surplus material,
5. Excavation,
6. Right of way restoration,
7. Shoulder restoration,
8. Stem extensions,
9. Temporary seeding and stabilization,
10. Temporary sheeting and bracing,
11. Testing,
12. Thrust restraint,
13. Valve, valve box, with frame and cover for each size in accordance with the Contract Documents,
14. Valve wrench.

E. Tapping Sleeve and Valve (TS&V), installed complete in place.

Payment will be made at the unit price bid for each size TS&V installed, in place, and satisfactorily tested, and will include the cost of the following:

1. Backfill, compacting and compaction testing,
2. Bedding material,
3. Coatings and linings,
4. Disposal of surplus material,
5. Excavation,
6. Pressure testing,
7. Right of way restoration,
8. Shoulder restoration,
9. Stem extensions,
10. Tapping sleeve assembly and appurtenance,
11. Temporary seeding and stabilization,
12. Temporary sheeting and bracing,
13. Testing,
14. Thrust Restraint,
15. Valve, valve box, with frame and cover for each size in accordance with the Contract Documents,
16. Valve wrench.

F. Blowoff Assembly, installed complete in place.

Payment will be made at the unit price bid for each blowoff assembly installed and satisfactorily tested and will include the cost of furnishing and installing the blowoff assembly and all required appurtenances, in accordance with the Standard Details, including tap to proposed water main to provide satisfactory operation in accordance with the Contract Documents.

G. Manual Air Vent Assembly, installed complete in place.

Payment will be made at the unit price bid for each manual air vent assembly installed and satisfactorily tested and will include the cost of furnishing and installing the manual air vent assembly in accordance with the Standard Details and all required appurtenances in accordance with the Standard Details, including tap to proposed water main to provide satisfactory operation in accordance with the Contract Documents.

H. Type K Copper (Single or Dual) Service Lines and Meter Box (Jack and Pull Construction), installed complete in place.

Payment will be made at the unit price bid at a unit price for each single or dual service, as indicated on the Bid form, and will include the cost of the following:

1. Backfill, compaction, and compaction testing
2. Clean up and restoration
3. Dewatering
4. Disinfection
5. Excavation of jacking and receiving pits
6. Jack and pull operation
7. Sampling and flushing
8. Temporary sheeting and bracing
9. Testing
10. Type K Copper service lines and all fittings to connect to water main including tapping saddle, curb stop, angle meter valve or meter yoke assembly (as shown on the Standard Detail), for each separate service
11. Meter box and all required appurtenances
12. Reconstructions made to existing private water service lines at the meter box.

I. Type K Copper (Single or Dual) Service Lines and Meter Box (Open Cut Construction), installed complete in place.

Payment will be made at the unit price bid for each single or dual service, as indicated on the Bid form, and will include the cost of the following:

1. Backfill, compaction, and compaction testing,
2. Clean up and restoration,
3. Dewatering,
4. Disinfection,
5. Excavation,
6. Meter box and all required appurtenances,
7. Pavement repair, unless paid under another Bid item,
8. Reconstructions made to existing private water service lines at the meter box,
9. Sampling and flushing,
10. Temporary sheeting and bracing,
11. Testing, and
12. Type K Copper service lines and all fittings to connect to water main including tapping saddle, curb stop, angle meter valve or meter yoke assembly (as shown on the Standard Detail), for each separate service.

J. Private Service Relocations

Measurement and payment will be performed in the same manner as "public" service lines in

the right of way on a unit price bid for each private service, as indicated on the Bid form, and will be installed in accordance with the International Plumbing Code.

K. Polyethylene Encasement installed complete in place.

Payment will be made at the unit price bid per linear foot for polyethylene pipe encasement satisfactorily installed.

L. Connections to existing water mains, complete in place

Connections to existing water mains will be paid for assemblies installed and satisfactorily tested. Payment will include:

1. Backfilling,
2. Bracing,
3. Compaction,
4. Compaction testing,
5. Coordination (including written work schedule and customer notification),
6. Dewatering,
7. Disinfection,
8. Disposal of surplus material,
9. Excavation,
10. Materials,
11. Other site restoration and cleanup as shown in the Contract Documents,
12. Restoration of right of way,
13. Shoulder restoration,
14. Stabilization,
15. Temporary seeding,
16. Testing,
17. Thrust restraint,
18. Temporary sheeting, and
19. Work Plan and all notifications to include re-notifications as necessary.

M. Plugging Existing 2-Inch Water Mains

Plugs for existing 2-inch water mains shall be paid based upon the number of excavations made for plugging. The unit price bid shall include the cost and installation of:

1. Backfilling with suitable material,
2. Compacting,
3. Coarse aggregate fill,
4. Couplings,
5. Cutting the existing main as shown in the Contract Documents, and indicated on the Bid form,
6. Disposing of surplus material,
7. Excavating,
8. Other site restoration and cleanup,
9. Pavement replacement,
10. Plugs,
11. Seeding,
12. Thrust restraint, and
13. Top soiling.

N. Offset of Existing Water Main

Offsets of existing water main shall be paid for at the contract unit price per foot. The unit price shall include:

1. Backfilling with suitable material,
2. Compacting and compaction testing,
3. Connections to existing mains,
4. Coordinating line shutdown,
5. Cutting of existing line,
6. Dewatering,
7. Disinfecting,
8. Disposing of surplus materials,
9. Excavating,
10. Fittings,
11. Furnishing and installing the pipe,
12. Other site restoration and cleanup
13. Pipe bedding,
14. Removing and disposing off-site of old line,
15. Seeding,
16. Temporary sheeting and bracing,
17. Testing,
18. Thrust restraint,
19. Top soiling, and
20. Work Plan and all notifications to include re-notifications as necessary.

O. Cutting in of Tees, Crosses, and Valves into Existing Mains (larger than 2-inches)

Cutting in of Tees, Crosses, and Valves into Existing Mains (larger than 2-inches) shall be paid based upon the number of each tee, cross, or valve cut in. The unit price bid shall not include pipe or valves and valve boxes, which shall be paid for under their respective unit price.

The unit price bid shall include:

1. Backfilling with suitable material,
2. Coarse aggregate fill,
3. Compacting,
4. Cutting-in of any valves at or near the tee or cross,
5. Dewatering,
6. Disposing of surplus material
7. Excavating,
8. Furnishing and installing all fittings such as tees, bends, reducers, sleeves, plugs, as well as other appurtenances,
9. Other site restoration and cleanup,
10. Pavement replacement,
11. Seeding,
12. Temporary sheeting and bracing,
13. Testing,
14. Thrust restraint, and
15. Top soiling.

P. Tracer Wire Box

Payment will be made at the unit price bid for each tracer wire box installed and will include the cost of furnishing and installing the box, lid, riser pipe, aggregate base material, backfilling, compaction, topsoil (if required), and all required appurtenances, in accordance with the Standard Detail.

End of Section

SECTION 802

SANITARY GRAVITY SEWER SYSTEMS

I. GENERAL

1.1. DESCRIPTION OF WORK

The Contractor shall furnish all labor, supervision, material (except as herein provided), tools, equipment, supplies, and services; and, shall perform all Work necessary for the construction of gravity sanitary sewer systems up to 24-inch in diameter. The gravity sanitary sewer systems shall be constructed in accordance with the Contract Documents and the applicable laws, rules, ordinances, standards, and specifications of regulatory agencies.

1.2. SUBMITTALS

Submittals shall be made by the Contractor in accordance with the procedures set forth in Section 105 and as described below:

A. Provide a construction schedule for approval that includes the sequence of installation of casings, pipelines and manholes. Provide a laying schedule (on the Drawings) that show necessary deviations from the Contract Documents due to specific utility conflicts discovered during required exploratory excavations.

B. Submit each manufacturer's and/or supplier's certification(s) attesting that the pipe, gaskets, manholes, castings, and appurtenances meet or exceed the specified requirement. The following information is to be shown on each certificate:

1. Name and location of the work
2. Name and address of Contractor
3. Quantity and date or dates of shipment and/or delivery to which the certificate applies.
4. Name of the manufacturing or fabricating company.
5. Type B manhole coatings shall be warranted for materials and workmanship for a minimum of 5 years.

C. Certification shall be in the form of a letter or company-standard form containing all required data and signed by an officer of the manufacturing, fabricating, or supplying company.

If requested by the Owner, all laboratory test reports shall be provided at no additional cost showing the following information:

1. Date or dates of testing
2. The specified requirements for which testing was performed.
3. Name and location of the testing agency.
4. Results of the test or tests.

D. Manufacturer's catalog cuts, technical data, operation and maintenance data, and/or shop drawings are required for the following gravity sewer system components (shop drawings shall be drawn to a scale sufficiently large to show all pertinent aspects of the item and its method of connection to the Work):

1. Pipe and fittings
2. Manholes
3. Frame and Covers
4. Clean-outs
5. Steps (where required)
6. Manhole Connections

E. Manhole Coatings:

1. Manufacturer's submittals:
 - a. Material Safety Data Sheets (MSDS) for each product used.
 - b. Manufacturer's requirements, including application procedures, shall be in writing.
 - c. Storage requirements including temperature, humidity, and ventilation for coating materials.
 - d. Recommended concrete surface profile (CSP) values, including methods for obtaining the required profile; proposed methods for maintaining all environmental controls and for containing, collecting, and disposing of residuals.
 - e. Manufacturer's certification that materials comply with Federal, State, and Local regulations for VOC (Volatile Organic Compounds).
 - f. Letter(s) with associated product data signed by Manufacturer certifying that submitted products are suitable for application on the surfaces to be coated and for the service conditions.
 - g. Certification that Applicator personnel have been trained and approved in the handling, mixing and application of the products to be used.
 - h. Certification that the equipment to be used for applying the products has been approved and calibrated and Applicator personnel have been trained and certified for proper use of the equipment.
2. Applicator Requirements:
 - a. Two (2) years' experience and five (5) recent references of projects of similar size and scope.
 - b. Applicator shall initiate and enforce quality control procedures consistent with applicable ASTM, NACE, ICRI and SSPC standards and the protective coating manufacturer's recommendations.
 - c. Applicator shall conform to all local, state and federal regulations including those set forth by OSHA, RCRA and the EPA and any other applicable authorities.

3. Prior to substantial completion, the Contractor shall provide to the Owner "Manhole/Structure Protective Coating Post Installation Certification" form (see Section 109) completed by the Applicator and coatings manufacturer which includes the following information:
 - a. All manhole and structures were coated in conformance with the coating manufacturer's recommendations.
 - b. The value of the concrete surface profile of the manhole/structure complied with the coating manufacturer's CSP recommendations.
 - c. Ambient conditions, including temperature and humidity.
 - d. The concrete surface was clean and free of all deleterious materials.
 - e. The concrete moisture levels at the time of coating applications were within acceptable levels as recommended by the coating manufacturer.
 - f. Average and minimum dry film thickness of the coating.
 - g. Recoat intervals.

F. Polymer Concrete Manholes

In addition to the manhole submittal requirements identified above, Polymer Concrete Manholes shall also require the following submittals:

1. Polymer concrete manholes shall be manufactured in accordance with Section 200.
2. Calculations signed and sealed by a Professional Engineer demonstrating the manhole meets the design requirements for its intended location and service duty. As a minimum material properties, polymer mixture, loadings, load combinations and dimensioned assumed.
3. Shop drawings for each manhole including the Owners number, location, rim and invert elevations, dimensions, reinforcing details, manhole sections, bench and invert materials, base units and construction details, and jointing details and materials.
4. Handling and shipping shall be performed in accordance with the manufacturer's instructions.
5. Each manhole shall be marked on the inside and outside with the Manufacturer's name or trademark, manufacturer's location and production date.
6. Certification that the manufacturer of Polymer Concrete manholes has been actively producing polymer concrete manholes for a minimum of 5 years with no more than one year between manholes projects. References demonstrating this requirement shall also be provided.
7. Polymer concrete manholes shall be manufactured by U.S. Composite Pipe, Inc. or Owner approved equal.

II. EXECUTION

2.1. GENERAL

- A. The Contractor shall furnish and install a complete system as shown in the Contract Documents. Pipe shall be laid true to lines and grades except as authorized by the Owner.
- B. The Owner reserves the right to reject defective material shipped to and/or stored on site, and to examine pipe and determine if the pipe is damaged prior to installation.
- C. The Contractor shall unload, handle, and store pipe and appurtenances in accordance with Section 200 of these Standards and the manufacturer's recommendations.
- D. Proper tools and facilities satisfactory to the Owner and as recommended by the material manufacturer shall be provided and used by the Contractor for the safe and convenient prosecution of the Work. All pipe, fittings, manhole sections, frame and covers, and accessories shall be carefully lowered into the trench piece by piece by means of a derrick, ropes, slings, or other suitable tools or equipment in such a manner as to prevent damage to the material and any protective coatings and linings.

2.2. PIPE INSTALLATION

- A. Cleaning: All lumps, blisters and excess coatings shall be removed from the bell and plain ends of each pipe, and the outside of the plain end and the inside of the bell shall be cleaned, dry, and be free from oil, grease, dirt, sand, grit, or any foreign materials before the pipe is installed.
- B. Trenching, bedding, backfilling and compaction shall be in accordance with Section 303.
- C. Pipe Laying:
 - 1. Pipe shall be laid to a true, uniform line and grade. The pipe shall be installed on a straight line between manholes (or to a clean-out box), without dips or bends. Laying of pipe shall be accomplished only after the trench has been dewatered and the foundation and/or bedding has been prepared in accordance with the Standard Details for the type and class of foundation or bedding specified.
 - 2. Pipe laying shall be in accordance with the manufacturer's recommendations. Pipe laying shall proceed upgrade, bells ahead. Each section of pipe shall be laid to form a close concentric joint with the adjoining section and to prevent sudden offsets in the flow line. Each section of pipe, as it is laid, shall be backfilled as specified in the Contract Documents, at least up to the centerline to adequately hold the pipe in place, before the next joint is made.
 - 3. A laser shall be used to maintain line and grade. A ventilating fan may be required to be used in conjunction with the laser beam to preclude fumes or air conditions that may cause refraction. A copy of the certification of the laser calibration shall be provided for each separate job prior to the beginning of pipe installation.
 - 4. As the Work progresses, the interior of the pipe shall be cleared of dirt and superfluous material.

5. Trenches and other excavations shall be kept free of water until backfilled. Concrete or masonry Work shall not be constructed in water, nor shall water be allowed to rise over the Work until concrete or mortar has had ample time to set.
6. When work is not in progress, open ends of pipe and fittings shall be closed so that trench water, earth, and other substances will not enter the pipe or fittings.
7. Whenever a pipe requires cutting to bring it to the required location, the Work shall be performed in a satisfactory manner so as to leave a beveled end in accordance with the manufacturer's instructions or recommendations. Cuts shall be made at 90° with the centerline of the pipe so that a framing square placed against the side of the pipe will reveal not more than 1/4-inch variation across the diameter of the pipe in any direction. The pipe shall be cut with an abrasive wheel, rotary wheel cutter, guillotine pipe saw, milling wheel saw or other equipment specifically designed for that purpose. The Contractor shall grind smooth cut ends and rough edges and for push-on connections; the cut ends should be beveled slightly. Pipe damaged by the Contractor in cutting shall be replaced at the Contractor's expense.
8. Laying of the pipe shall commence immediately after the excavation is started, and every means must be used to keep pipe laying closely behind the trenching. Holes shall be scooped out where the bells occur leaving the entire barrel of the pipe bearing on the pipe bed. No more than 100 feet of trench shall be open in advance of pipe laying, unless approved by the Owner. The excavation of the trench shall be fully completed a sufficient distance in advance of the laying of the pipe.
9. Pipe joint assembly practices and joint assembly materials such as lubricants, primers and adhesives shall be in accordance with the manufacturer's recommendations and specifications.
10. Pipe shall not be laid on frozen bedding.

D. Alignment and Grade:

1. The Contractor shall not deviate from the line and grade indicated in the Contract Documents, except with approval of the Owner.
2. The sanitary sewer system shall be installed according to the following tolerances:
 - a. The maximum deviation of any invert from plan grade shall be within +/- 0.05 feet.
 - b. The total deviation of both inverters at each end of a particular line shall be within +/- 0.08 feet.
 - c. The maximum slope deviation between any two points in the line from the plan slope shall be +/- 0.02 %.

2.3. MANHOLE INSTALLATION

- A. Prior to installation, the Owner shall inspect manholes for direction and sizes of openings, cleanliness, joints, and handling damage and cracks. Manholes determined to be defective by the Owner shall be replaced by the Contractor.

- B. Manholes located within a distance of 250 linear feet of pipe away from a pump station discharge shall be considered to have a higher risk for corrosive degradation. When indicated on the Bid form polymer concrete or non-standard type manholes and frames shall be installed in lieu of standard manholes, frames and coatings unless otherwise approved by the Owner.
- C. Manholes shall be constructed promptly as the sections of the sewer between them are completed.
- D. The Contractor shall join pipe to the manhole in accordance with the Drawings, Standard Details, and the manufacturer's requirements. Pipe stubs shall extend beyond the manhole as indicated in the Contract Documents and shall be sealed with a watertight plug or cap.
- E. Manhole bedding shall be as specified in the Standard Details. Concrete for manhole foundations shall be in accordance with the Standard Details and as specified under Section 502.
- F. The top of all manholes shall be brought to proper grade for receiving frames and covers.
- G. The manhole frame rim shall be free of all dirt and debris prior to the installation of the manhole insert. The insert shall be fully seated around the manhole frame rim to insure against water seepage between the insert and the manhole frame rim. Gasket lubricant, such as used in water and sewer main installation, shall be applied generously on the gasket prior to installing the insert.
- H. Existing manholes and main line cleanouts requiring frame and cover adjustment rings for pavement overlay applications shall be performed in accordance with Section 510.
- I. Manhole Coatings:

(This specification covers the execution processes required for protecting concrete manholes and other underground structures using epoxy-coating systems, per Section 200 and this Section. The Engineer is responsible for determining the level of protection required and is cautioned that the coating system recommendations contained herein may not be suitable for every application. Each project and structure should be evaluated independently and the level of protection determined based on the product, service environment and protection level, as a minimum.)

1. Surface Preparation

Surface preparation is the process by which sound, clean, and suitably roughened surfaces are produced on concrete substrates. This process includes the removal of unsound concrete and bond-inhibiting films, strength verification, opening the pore structure, verification of moisture content, and establishing profiles suitable for the application of the specified protective system.

The Contractor and Applicator must abide by all environmental controls and requirements specified in the Contract Documents during surface preparation and coatings application. Excess dust, noise, vibrations, and the loss from the job site of concrete dust and slurries must be avoided. Slurries must be contained, collected, and disposed of in an Owner approved method. If Contractor and applicator fail to adequately control emissions from the work site, Owner may take all necessary corrective actions and withhold the costs for such from monies due the Contractor.

The Contractor shall abide by all VOSHA and other applicable work area safety and protection requirements during surface preparation activities.

- a. Installation of the epoxy coating shall not commence until the concrete substrate has properly cured and prepared in accordance with coatings manufacturer's recommendations.
- b. All contaminants including: oils, grease, unsound or incompatible existing coatings, waxes, form release agents, curing compounds, efflorescence, sealers, salts, concrete dust, or other contaminants shall be removed.
- c. All concrete that is not sound or has been damaged shall be removed to a sound concrete surface or replaced.
- d. Temperature of the surface to be coated should be maintained between 40° F and 120° F during application. Prior to and during application, care should be taken to avoid exposure of direct sunlight or other intense heat source to the structure being coated. Where varying surface temperatures do exist, care should be taken to apply the coating when the surface temperature is falling versus rising.
- e. Applicator shall inspect all specified surfaces prior to surface preparation. Applicator shall notify the Contractor and the Owner within 24 hours of all manholes/structures:
 - (1) whose concrete is not sound or has been damaged.
 - (2) or are not otherwise suitable for surface preparation.
- f. Once the Applicator and Contractor are in agreement that the surfaces to be coated are in accordance with the product manufacturer's requirements, Contractor shall notify Owner. The Owner, at its discretion, may then perform inspections as necessary to assure that the structure is ready for the application of the coating system.
- g. Should any surface be found to be inadequate for acceptance of coating, or should the structure fail to meet the structural requirements of the referenced specifications, such structures shall be either repaired to the complete satisfaction of the Owner or removed from the project site and replaced with a new structure, all at no expense to the Owner. Replacement structures shall be subject to the same requirements for structural integrity and surface preparation.

2. Application Requirements

- a. Application procedures shall conform to the recommendations of the coating Manufacturer, including material handling, mixing, environmental controls during application, safety, and application equipment.
- b. Unless specified elsewhere herein, the Applicator shall comply with the Manufacturer's most recent written instructions with respect to the following:

- (1) Mixing of all materials.
 - (2) Storage, protection and handling of all materials.
 - (3) Surface preparation has been properly performed and surfaces brought to the appropriate CSP profile.
 - (4) Recoat limitations and cure times.
 - (5) Minimum ambient, substrate and atmospheric temperatures, substrate's degree of dryness, relative humidity, and dew point of air.
 - (6) Application.
 - (7) Final curing.
 - (8) Use of proper application equipment.
 - (9) Cleanup and disposal
- c. The Applicator must follow the minimum and maximum recoat limitation times and related temperature range restrictions between successive lifts, per Manufacturer's stated requirements.
 - d. The applied coating system shall be protected from damage during curing and shall be cured as recommended by the Manufacturer. Ambient conditions shall be controlled and maintained during curing as required by the Manufacturer.
 - e. The Applicator shall be responsible for coating all openings, including the top of manhole cone and pipe penetrations; and, joints (following field application of grouting). Any deficiencies in the finished coating shall be repaired by the Applicator according to the procedures provided by the coating Manufacturer.
 - f. For the Type of Coating specified, surfaces shall be coated to a minimum dry film thickness of:
 - (1) Type A Coating – 40 mils, and
 - (2) Type B Coating – 80 mils.

2.4. TESTING AND INSPECTION

A. General:

- 1. All flushing, air, vacuum, or infiltration testing procedures shall conform to this Section and the applicable sections of the Commonwealth of Virginia *SCAT Regulations, latest edition*.
- 2. The Contractor shall request the Owner at least 48 hours (2 working days) notice to schedule testing and inspection.
- 3. Only properly functioning and clean equipment shall be used for cleaning and testing gravity sewer systems.

4. Connections to existing sewer facilities will be permitted only after satisfactory completion of testing and cleaning, and only when authorized by the Owner.
5. All testing activities require compliance with the Occupational Safety and Health Agency (OSHA) in regard to confined space entry.
6. The Contractor is responsible for repairing any deficient Work at no additional cost to the Owner.

B. Pipe Testing - Gravity Lines:

1. New gravity sewer systems will be tested using the following procedures:
 - a. Visual Test - All manhole covers shall be removed by the Contractor as a prerequisite to conducting the visual test. The Contractor shall certify that all manhole entries are in compliance with confined space entry procedures and mechanical ventilation shall be provided. A visual inspection shall consist of the following:
 - (1) Inspection for visible leaks in lines or manholes
 - (2) Inspection of condition of the grout in the interior joints of manholes
 - (3) Inspection of manhole frames and covers for proper type and installation
 - (4) Inspection to see if lines are free of debris
 - (5) Inspection of manhole benches and inverts
 - (6) Check of alignment and grade by introducing sufficient water into the line to verify the absence of sags, or as directed by the Owner
 - (7) Check that manholes have been completely and properly coated on all surfaces
 - (8) Mirror test the line
 - b. Deflection Test - The entire length of all flexible gravity sanitary sewer lines shall be tested by means of a rigid mandrel to assure that deformation or deflection does not exceed 5 percent of the base inside diameter per ASTM D3034. An Owner-provided mandrel will be manually pulled through the line by the Contractor in the presence of the Owner, no sooner than 30 days after completion of backfill. The mandrel contact length will be equal to the nominal diameter of the pipe. The mandrel, one for each size of pipe, shall be a nine-arm mandrel, with a proving ring sized at 5 percent of the base inside diameter. Contractor is responsible for removal of mandrel if it becomes stuck in the pipe. Lines must be free of debris for this test and the Contractor shall be responsible for installing a string line in the pipe for the test. Any sections that do not pass the test shall be corrected or replaced by the Contractor. Ductile iron pipe will not be required to have a deflection test performed.

c. Leakage Testing

The Contractor shall perform one of the following leakage tests as required by the locality.

(1) Low Pressure Air Test:

- (a) An air test conforming to ASTM Specification F1417, shall be performed on all gravity sewer mains, including service laterals and cleanouts, prior to acceptance. The Contractor is responsible for supplying an air-testing rig and pressure gauge, calibrated to the tenth of a pound, for this test.
- (b) The Contractor shall furnish all the necessary equipment and be responsible for conducting all low-pressure air tests. The Owner shall witness all low-pressure air tests and verify the accuracy and acceptability of the test and the equipment utilized. The Contractor is responsible for any repair work on sections that do not pass the test.
- (c) After a manhole-to-manhole reach of pipe has been backfilled to final grade and prepared for testing, plugs shall be placed in the line at each manhole and secured. Once the plugs are in place and the air hoses connected, the plugs shall be inflated and the sewer line pressurized to the test pressure.
- (d) All plugs shall be installed and properly inflated to prevent blowout. All pressurizing equipment used for low-pressure air testing shall include a regulator or relief valves set no higher than nine (9) pounds per square inch gauge to avoid over-pressurizing and displacing temporary or permanent plugs. No person shall enter a manhole while air is being forced into a pipe with plugs in place or when any pressure remains behind the plugs.
- (e) All plugs shall be capable of resisting internal testing pressures without the aid of external bracing or blocking. If pneumatic plugs are utilized, a separate hose is required to inflate the pneumatic plugs from the aboveground control panel. To facilitate test verification by the Owner, all air used shall pass through a single, aboveground control panel. The above-ground air control equipment shall include a shut-off valve, pressure regulating valve, pressure relief valve, input pressure gauge, and a continuous monitoring pressure gauge having a pressure range from zero (0) to at least ten (10) psig. The gauge dial shall be divided in 0.1 psi or smaller increments. The gauge shall have an accuracy of 0.04 psi. Two separate hoses shall be used (in addition to hose for pneumatic plugs) to: (1) connect the control panel to the sealed line for introducing low-pressure air, and (2) a separate

hose connection for constant monitoring of air pressure build-up in the line.

- (f) All service laterals, clean-outs, stubs, and fittings within the sewer test section shall be properly capped or plugged during construction to prevent air loss that could cause an erroneous air test result.
- (g) Air shall be supplied slowly to the section of the sewer being tested until the internal pressure reaches 4.0 psig greater than the average back pressure of groundwater above the pipe, but not greater than 9.0 psig. The groundwater adjustment shall be calculated by dividing the average vertical height, in feet of groundwater above the invert of the sewer pipe to be tested, by 2.31. The result gives the adjustment in pounds per square inch that must be added.
- (h) After an internal pressure of 4.0 psig (plus required groundwater adjustment) is obtained, allow at least two minutes for air temperature to stabilize.
- (i) After two minutes, the air hose from the control panel to the air supply shall be shut off or disconnected. There shall be no pressure drop, no leaks.
- (j) If the section fails to meet these requirements, the Contractor shall determine at its own expense the source or sources of leakage, and shall repair or replace all defective materials and/or workmanship to the satisfaction of the Owner. The completed pipe installation shall then be retested until the requirements of this test are met.

(2) Infiltration

- (a) Infiltration Test - will be conducted if the Contractor proves to the satisfaction of the Owner that the water table is high enough to conform to the requirements noted below.

The level of the groundwater shall be at least 4 feet above the top of the sewer line along the entire section of the pipeline to be tested. Measurements shall be made every hour for three hours to determine the amount of infiltration

(b) Infiltration shall not exceed 25 gallons per day per mile of sewer per inch of pipe diameter. There shall be no visible leaks.

d. Remote Camera / TV Inspection

Post-Installation TV inspection shall not be completed until all Work, including service laterals, manholes, and main line cleanouts are complete on a section of line. The post-installation TV inspection documentations (tapes, CDs, DVDs, storage portable storage devices, etc.) shall be submitted to the Owner prior to substantial completion, or when requested.

The Contractor shall engage and pay for television inspection for all gravity sewers installed, including service laterals and cleanouts. The Owner shall be present during the inspection. The inspections shall conform to the National Association of Sewer Service Companies (NASSCO) recommended specification for television inspections for main sewers. **Manhole labels provided in video inspection must correspond to the manhole labels shown on the construction documents and record drawings.**

Lines shall be cleaned prior to inspection. Prior to inserting the television camera into the pipeline, the Contractor shall flush and clean the mainline and the laterals. The Contractor shall introduce a minimum of 15 gallons of clear, potable water to each lateral and 1,000 gallons of clear, potable water into the terminal upstream manhole or last access structure on any given gravity sewer branch of the pipeline to be inspected with a television camera. The Contractor shall run the camera within 8 hours after the water has been introduced to the main and laterals. The Contractor is responsible for acquiring, collecting and disposing of the water, at no additional cost to the Owner. TV inspection shall include all joints and manhole inverts. No TV Inspection during cleaning of the lines shall be accepted.

The video inspection equipment shall conform to the requirements of Section 811. A video recording of inspected gravity sewer mains, service laterals, and cleanouts shall be provided to the Owner in electronic format on an Owner approved data transfer format upon completion of the inspection. The format shall comply with the requirements of Section 811. A log of comments made on the video shall be supplied with the associated pipe footage shown.

If the television inspection of the pipe shows poor alignment, displaced or cracked pipe, improper joints or slipped gaskets, the defect(s) shall be corrected and the pipe line re-videoed.

TABLE 802 -1 AIR TEST TABLE (Based on ASTM F1417)

Minimum Test Time in Minutes: Seconds
For Pressure Drop from 3.5 to 2.5 Psig (Minus Groundwater Influence)

Pipe Dia., In.	Minimum Time, Min.	Length for Minimum Time, Ft.	Time for Longer Lengths	Specification Time for Length (L) Shown, Minutes							
				100 Ft	150 Ft	200 Ft	250 Ft	300 Ft	350 Ft	400 Ft	450 Ft
4	3:46	597	0.380L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46

Pipe Dia., In.	Minimum Time, Min.	Length for Minimum Time, Ft.	Time for Longer Lengths	Specification Time for Length (L) Shown, Minutes							
				100 Ft	150 Ft	200 Ft	250 Ft	300 Ft	350 Ft	400 Ft	450 Ft
6	5:40	398	0.854L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	398	1.520L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33

Note: If the groundwater level is 2 ft. or more above the top of the pipe at the upstream end, or if the air pressure required for the test is greater than 9 psi gauge, this air testing practice should not be used. Before this air testing practice is used, the groundwater level should be lowered by pumping or dewatering.

C. Manhole Testing:

1. All manholes shall be vacuum tested by the Contractor prior to acceptance.
 - a. Vacuum Test:
 - (1) The vacuum test shall be in accordance with ASTM C1244.
 - (2) All pipe entries into the manhole shall be plugged. The compression band of the manhole vacuum testing equipment shall be inflated to create a seal between the vacuum equipment base and the top of the manhole.
 - (3) If the Contractor backfills around the manhole prior to testing, ten (10) inches of mercury shall be applied to the manhole. The test duration for a 48-inch diameter manhole is 60 seconds; the test duration for a 60-inch diameter manhole is 75 seconds. There shall be no leakage.
 - b. If any vacuum drop is detected, necessary repairs shall be made and the vacuum test and repairs shall be repeated until the manhole passes the test.
2. Coating systems shall be tested during coating applications and after manholes have been installed.

- a. During coating the Applicator shall regularly perform and record coating thickness using a wet film thickness gauge meeting ASTM D4414 – *Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gauges*, to ensure a monolithic coating and uniform thickness during application. A minimum of three (3) readings per 200 square feet of surface area shall be recorded. Applicator shall submit documentation on thickness readings to the Owner on a daily basis when coating application is underway.
- b. For Type B coatings, the applicator shall perform holiday testing on all coated surfaces in the presence of the Owner. After the coating has dried and set hard to the touch, an induced holiday shall then be introduced on the coated concrete surface and shall serve to determine the minimum/maximum voltage to be used to test the coating for holidays at the particular area.
- c. The spark tester shall be initially set at 100 volts per 1 mil of film thickness applied but may be adjusted as necessary to detect the induced holiday (refer to NACE RPO188-99). All detected holidays shall be marked and repaired by abrading the coating surface with grit disk paper or other hand tooling method. After abrading and cleaning, additional coating material can be hand applied to the repair area. All touch-up and repair procedures shall follow the coating manufacturers recommendations.
- d. After manholes have been installed and all required testing of coatings and assembly have been performed, the Owner will perform a visual test to verify that no damage to the coating system occurred during installation. Any deficiencies in the finished coating shall be marked and repaired by the Applicator according to the procedures provided by the coating Manufacturer.

2.5. CONNECTIONS

General:

- A. All materials shall be installed in accordance with ASTM C-923 and the manufacturer's recommendations and the Standard Details.
- B. Core drilling and flexible pipe-to-manhole connectors shall be used when connecting sewer pipe to existing manholes unless otherwise approved by the Owner. The connector shall be as specified in Section 200. Connectors shall be of a size specifically designed for the class and type of pipe and manhole type.
- C. Connections shall only be made in the presence of the Owner.

2.6. MANHOLE COATINGS WARRANTY

Following the successful application and acceptance of Type B coatings by the Owner, the coatings manufacturer shall warrant all Work against defects in materials and workmanship for a period of five (5) years, unless otherwise noted. Warranty shall begin at the date of substantial completion of the project. Coatings Manufacturer shall, within a reasonable time after receipt of written notice thereof, repair defects in materials or workmanship that may develop during the warranty period. The coatings Manufacturer shall be responsible for all costs necessary and associated with the repair of defects or the repairing of same, including traffic and environmental controls, at his sole expense.

III. MEASUREMENT FOR PAYMENT

A. Gravity Sewer Pipe, installed complete in place.

1. Measurement of the gravity sewer pipe will be made along the centerline of the pipeline, based upon the linear footage and depth of each size pipe and material type installed and satisfactorily tested. Pipe will be measured to the centerline of the manholes or cleanouts.
2. Measurement shall be made at the following depth classifications: 0-6, 6-8, 8-10, 10-12, 12-14, 14-16, 16-18, 18-20, and greater than 20 feet, in accordance with Standard Detail EW_02.
3. Payment will include the cost of the following:
 - a. Backfilling, compacting, and compaction testing,
 - b. Bedding as detailed in the Contract Documents,
 - c. Bypass pumping(up to 2mgd),
 - d. Clearing,
 - e. Connection of existing laterals, manholes connections and drop connections when replacing existing sewer in the same trench,
 - f. Dewatering,
 - g. Disposal of surplus material,
 - h. Excavation (per depth classification),
 - i. Flushing,
 - j. Gravity sewer main and appurtenances,
 - k. Main line fittings,
 - l. Post-installation video inspection,
 - m. Protection of existing utilities,
 - n. Removal and legal disposal of existing sanitary sewer main and structures where indicated in the Contract Documents,
 - o. Restoration in right-of-way and easements (not including curb and gutter restoration or pavement restoration, unless otherwise noted),
 - p. Stripping and stockpiling topsoil,
 - q. Temporary seeding and stabilization,
 - r. Temporary sheeting and bracing,
 - s. Temporary tie-ins of mains and laterals during installation, and
 - t. Testing.

B. Sewer Laterals

1. Measurement of the sewer laterals will be made along the centerline of the pipeline and based upon the linear footage or per each installed. Pipe will be measured from the service cleanout to the centerline of the gravity sewer pipe, manhole or mainline cleanout.
2. The cost of trench excavation and backfill for laterals shall be included in the unit price bid for each type of lateral, per foot or for each as indicated on the Bid form, regardless of the depth. Payment will include:
 - a. Bedding,

- b. Compaction,
- c. Dewatering,
- d. Disposal of surplus materials,
- e. Seeding and stabilization,
- f. Select materials,
- g. The cost of restoration in right-of-way, shoulders, and easements (not including curb and gutter restoration or pavement restoration, unless otherwise noted),
- h. Temporary sheeting and bracing,
- i. Testing, and
- j. Tracer wire.

C. Manholes

1. Standard Depth (0' to 6'):

- a. Measurement of manholes (4- or 5-foot diameter), will be made for each standard depth manhole (0' to 6') installed and satisfactorily tested as measured to the nearest foot from the bottom of the frame and cover to the invert out.
- b. Payment will be made at the unit price bid for each standard depth manhole installed and satisfactorily tested and will include the cost of the following:
 - i. All appurtenances required for satisfactory operation,
 - ii. Coatings (See III.H for Type B Coatings),
 - iii. Dewatering,
 - iv. Disposal of surplus material,
 - v. Excavation, bedding, backfill, and compaction,
 - vi. Invert shaping,
 - vii. Manhole, complete including benches, inverts and troughs, stainless steel insert, frame and cover, and riser (as required),
 - viii. Openings and seals,
 - ix. Precast concrete adjustment ring,
 - x. Restoration in right-of-way, shoulders, and easements (not including curb and gutter restoration or pavement restoration, unless otherwise noted)
 - xi. Seeding and stabilization,
 - xii. Sheetng and shoring,
 - xiii. Steps, unless otherwise noted,
 - xiv. Stone,
 - xv. Stripping and stockpiling of materials, and
 - xvi. Testing,

2. Extra Depth:

- a. Measurement of manholes (4- or 5-foot diameter) in excess of 6-feet in depth will be made based on the vertical feet of manhole installed in excess of 6-feet, measured to the nearest foot from 6 feet below the bottom of the frame and cover to the invert out in depth and satisfactorily tested.

- b. Payment will be made at the unit price bid for each additional vertical foot of manhole (in excess of 6' in depth) installed and satisfactorily tested and will include the cost of the following:
- i. All appurtenances required for satisfactory operation,
 - ii. Backfill,
 - iii. Bedding,
 - iv. Compaction,
 - v. Dewatering,
 - vi. Disposal of surplus material.
 - vii. Excavation,
 - viii. Openings and seals,
 - ix. Sheeting and shoring, and
 - x. Steps, unless otherwise noted.
3. Drop Manhole (Inside or Outside), installed complete in place
Payment will be made at the unit price bid for each type of drop manhole (with a drop either inside or outside the manhole), installed and satisfactorily tested and will include the cost of the following:
- a. All appurtenances required for satisfactory operation,
 - b. Backfill,
 - c. Bedding,
 - d. Compaction,
 - e. Dewatering,
 - f. Disposal of surplus material
 - g. Excavation,
 - h. Inside or outside drop connection including drop pipe, fittings, attachments, and concrete,
 - i. Manhole, complete including benches, inverts and troughs, stainless steel insert, frame and cover, and riser (as required), and
 - j. Sheeting and shoring
4. Non-Standard Manholes
- Measurement shall be made for non-standard, including polymer concrete manholes, measured from the interior base floor to the bottom of the frame. Payment shall be made for each manhole installed or per vertical feet as indicated on the Bid form. The cost shall include:
- a. All appurtenances required for satisfactory operation,
 - b. Backfill,
 - c. Bedding,
 - d. Compaction,
 - e. Dewatering,
 - f. Disposal of surplus material,
 - g. Excavation,
 - h. Invert shaping
 - i. Manhole, complete including benches, inverts and troughs, stainless steel insert, frame and cover, and riser (as required),
 - j. Openings and seals,
 - k. Precast concrete adjustment ring,

1. Restoration in right-of-way, shoulders, and easements (not including curb and gutter restoration or pavement restoration, unless otherwise noted),
 - m. Seeding and stabilization,
 - n. Sheeting and shoring,
 - o. Steps, unless otherwise noted,
 - p. Stone,
 - q. Stripping and stockpiling of materials, and
 - r. Testing.
5. Watertight Manhole Frame and Cover, installed complete in place

Watertight frame and cover assembly, to include dust cover and riser as required, shall be paid at the unit price bid for each.

D. Clean-out and Main Line Clean-out Assemblies

Payment will be made at the unit price bid for each clean-out assembly installed and satisfactorily tested and will include the cost of the following:

1. All appurtenances required for satisfactory operation,
2. Backfill,
3. Bedding,
4. Compaction,
5. Clean-out box with frame and cover,
6. Excavation,
7. Fittings,
8. Furnishing and installing the clean-out,
9. Stone,
10. Temporary seeding and stabilization,
11. Testing, and
12. Tracer wire and marking tape complete in place.

E. Connections to existing manholes, complete in place.

Connections to existing manholes will be paid for each connection installed and satisfactorily tested. Payment will include materials, excavation, backfilling, core drilling, dewatering, testing, repair of existing coating, rubber boot installation, and all other Work incidental to the connection to the existing manhole.

F. Connections from new manholes to existing sanitary sewer, complete in place.

Connections from new manholes to existing sanitary sewer will be paid for each connection installed and satisfactorily tested. Payment will include materials, excavation, backfilling, dewatering, testing, and all other Work incidental to the connection of adjacent, existing sanitary sewer to the proposed manhole.

G. Payment for Manhole and Main Line Cleanout Adjustments Rings, for pavement overlay, shall be in accordance with Section 510.

H. Manhole/Structure Coatings

1. Type B coating systems shall be measured on a vertical foot basis per manhole

diameter or per each structure.

2. Payment will be made based on the unit price bid per vertical foot for Type B coating system applied and the manhole diameter (4 foot or 5 foot), or per each structure as specified on the Bid form. Payment will include the costs associated with the following, plus all incidental items necessary for a complete and Owner approved coating system:
 - a. Applicator fees,
 - b. Clean up and disposal of surplus and excess materials,
 - c. Coating Materials,
 - d. Concrete surface preparation to the required CSP value, to include all environmental controls; containment, collection, and disposal of emissions and slurries; safety and protection; and restoration of affected areas,
 - e. Equipment necessary for the mixing and application of all coating materials,
 - f. Final cleaning of concrete surfaces,
 - g. Handling, storage and protection of all materials,
 - h. Safety equipment, and
 - i. Testing recommended by the coatings manufacturer and required by the Contract Documents
- I. Payment for Sewage Bypass Pumping, if required, shall be considered incidental for flows under 2 MGD in accordance with Section 812 – Bypass Pumping.

End of Section

SECTION 803

SANITARY FORCE MAIN SYSTEMS

I. GENERAL

1.1. DESCRIPTION OF WORK

The Contractor shall furnish all labor, supervision, material (except as herein provided), tools, equipment, supplies, and services; and, shall perform all Work necessary and incidental for the construction of sanitary sewer force main systems less than or equal to 36-inch in diameter. All pipe larger than 16-inch diameter shall be ductile iron, unless modified by Special Provision. The sanitary sewer force main systems shall be constructed in accordance with the Contract Documents and the applicable laws, rules, ordinances, standards, and specifications of regulatory agencies.

1.2. SUBMITTALS

Submittals shall be made by the Contractor in accordance with the procedures set forth in Section 105 and as described below:

A. Submit each manufacturer's, and/or supplier's certification attesting that the pipe, gaskets, castings, and appurtenances meet or exceed the specified requirement. The following information is to be shown on each certificate:

1. Name and location of the work
2. Name and address of Contractor
3. Quantity and date or dates of shipment and/or delivery to which the certificate applies.
4. Name of the manufacturing or fabricating company.

B. Certification shall be in the form of a letter or company-standard form containing all required data and signed by an officer of the manufacturing, fabricating, or supplying company.

If requested by the Owner, all laboratory test reports shall be provided at no additional cost and shall show the following information:

1. Date or dates of testing. Test data should be the most current available and be within 5 years of the Bid opening.
2. The specified requirements for which testing was performed.
3. Results of the test or tests.

C. Manufacturer's catalog cuts, technical data, operation and maintenance data, and/or shop drawings are required for the following sanitary sewer force main system components (shop drawings shall be drawn to a scale sufficiently large to show all pertinent aspects of the item and its method of connection to the work):

1. Air Vent Assemblies
2. Air Vent Assembly Vaults and Boxes
3. Fittings, Sleeves, and Couplings
4. Gauges
5. Pipe
6. Coatings and linings

7. Pipe Restraints
 8. Tapping Sleeves
 9. Tracer Wire and Marking Tape
 10. Valves
 11. Valve Boxes
- D. Ductile Iron Pipelines greater than 16-inch diameter

In addition to the above submittal requirements, pipe diameters greater than 16-inches shall provide the following information:

1. Laying schedule
 - a. Submit a tabulated laying schedule for approval which references stations and invert elevations as shown in the Contract Documents as well as all fittings, valves, bends, outlets, restrained joints, tees, special deflection bells, adapters, solid sleeves and specials, along with the manufacturer's drawings and specifications providing complete details of all items.
 - b. Show pipe class, class coding, station limits and transition stations for various pipe classes.
 - c. The location of all pipes shall conform to the locations indicated in the Contract Documents.
 - d. Each pipe supplied shall be identified with sequential numbering consistent with the laying schedule and marking drawings and each marked pipe will appear on the marking drawings in the identified location for installation.
 - e. Special fittings, bends, and appurtenances requiring specific orientation will be supplied appropriately marked with the words "TOP" in the correct position and in a consistent location.
2. Submit shop drawings for approval before manufacture and shipment including, but not be limited to:
 - a. The grade of material, size, wall thickness of the pipe and fittings and appurtenances;
 - b. The type of fittings and valves;
 - c. The type and limits of the lining, lining reinforcing and coating systems of the pipe and fittings.
 - d. Joint details, methods and locations of supports, and complete information concerning type, size and location of all welds. Shop welds (no field welding will be allowed) will be clearly differentiated and welds will be clearly detailed with preparation procedures for all pipe and parent material comprising each weld. Critical welding procedures will be identified along with methods for controlling welding stresses and distortions. Locations and proposed joint details will also be clearly identified; and,

- e. All other pertinent information for all items to be furnished; product data to show compliance of all couplings, supports, fittings, coatings and related items.
3. Submit anticipated production and delivery schedule.
4. Submit handling procedures for all phases from finished fabrication through delivery including storage, transportation, loading, and unloading. This will include storage at the project site and required protection following installation prior to startup.
5. Prior to shipment of pipe, submit:
 - a. Certified copies of mill tests confirming the type of materials used in the pipe, and shop testing of pipe to show compliance with the requirements of the applicable standards, including hydrostatic tests.
 - b. A certified affidavit of compliance from the manufacturer stating that the pipe, fittings, gaskets, linings and exterior coatings for this project have been manufactured and tested in accordance with AWWA and ASTM standards and requirements specified herein.

E. Work Plan for Tie-ins to Existing Systems

At a minimum the Contractor's Work Plan shall include the following:

1. Schedule:
 - a. Starting date.
 - b. Sequential listing of specific tasks required to complete the tie-in.
 - c. Anticipated duration for each task of the tie-in operation.
2. Testing procedures.
3. Identification of businesses and residences that may be impacted and will require notification.
4. Method of dewatering the existing force main including where the sewage is to be disposed, and provide quantity of wastewater anticipated in dewatering.
5. Method of handling constant flow if valves or line stops do not close completely. The Owner cannot guarantee that full stoppage of flow will be achieved.
6. List of pump stations that must be maintained.
7. Number of pumper trucks, to include total capacity, to be supplied to handle flow at the existing stations and the pipe dewatering operations.
8. Contingency plan for handling flow at the existing pump station if the shutdown hours exceed the anticipated time frame.

9. Contingency plan for meeting a deadline for full traffic to be restored if a roadway is taken out of service or the capacity reduced during the tie-in and the completion schedule cannot be met.
10. Mobile phone contacts for Contractor and Owner personnel, and HRSD, and other identified key stakeholders' personnel, as appropriate.
11. List of equipment and number of crews to verify adequacy of Contractor's ability to work both ends of the tie-in simultaneously and continuously until connections are complete.
12. Stone and other backfill materials to be on-site if rain is forecast and used if a heavy rain event occurs during the tie-in backfill and compaction stage.
13. Confirmation of availability and scheduling of asphalt placement and proper cure time for tie-ins under existing pavement to restore traffic movement.

II. EXECUTION

2.1. GENERAL

- A. The Contractor shall furnish and install a complete piping system as shown in the Contract Documents.
- B. The Owner reserves the right to reject defective material shipped to and/or stored on site, and to examine the same to determine if damage has occurred prior to installation.
- C. The Contractor shall unload, handle, and store pipe and appurtenances in accordance with Section 200 and ANSI/AWWA C600 and AWWA C605.
- D. Proper implements, tools and facilities satisfactory to the Owner and as recommended by the material manufacturer shall be provided and used by the Contractor for the safe and convenient execution of the Work. All pipe, valves, fittings, and accessories shall be carefully lowered into the trench in such a manner as to prevent damage to the force main materials and any protective coatings and linings.

2.2. PIPE INSTALLATION

- A. Cleaning: All lumps, blisters and excess coatings shall be removed from the bell and plain ends of each pipe, and the outside of the plain end and the inside of the bell shall be cleaned and dry, and be free from dirt, grease, oil, sand, grit, or any foreign materials before the pipe is installed.
- B. Trenching, bedding, backfilling and compaction shall be in accordance with Section 303 and the Special Provisions.
- C. Pipe Laying:
 1. Pipe shall be laid to a true, uniform line and grade. High points, other than those indicated in the Contract Documents where an air vent assembly is to be placed, shall be avoided.
 2. Pipe laying shall be in accordance with the manufacturer's recommendations. Pipe

laying shall proceed upgrade, bells ahead. Each section of pipe shall be laid to form a close concentric joint with the adjoining section and to prevent sudden offsets in the flow line. Each section of pipe, as it is laid, shall be backfilled as specified in the Contract Documents, at least up to the centerline, before the next joint is made.

3. As the work progresses, the interior of the pipe shall be cleared of dirt and superfluous material.
4. Trenches and other excavations shall be kept free of water until backfilled. Concrete or masonry work shall not be constructed in water, nor shall water be allowed to rise over the work until concrete or mortar has had ample time to set.
5. When work is not in progress, open ends of pipe and fittings shall be closed, so that trench water, earth, and other substances will not enter the pipe or fittings.
6. Whenever a pipe requires cutting for the insertion of valves, fittings, closure pieces, or to bring it to the required location, the work shall be performed in a satisfactory manner so as to leave a beveled end in accordance with the manufacturer's instructions or recommendations. Cuts shall be made at 90° with the centerline of the pipe so that a framing square placed against the side of the pipe will reveal not more than 1/4-inch variation across the diameter of the pipe in any direction. The pipe shall be cut with an abrasive wheel, rotary wheel cutter, guillotine pipe saw, milling wheel saw or other equipment specifically designed for that purpose. The Contractor shall grind smooth cut ends and rough edges and for push-on connections; the cut ends should be beveled slightly. Pipe damaged by the Contractor in cutting shall be replaced at the Contractor's expense.
7. Laying of the pipe shall commence immediately after the excavation is started, and every means must be used to keep pipe laying closely behind the trenching. No more than 100 feet of trench may be open ahead of the pipe laying operation, unless otherwise specified in the Special Provisions for each locality. Holes shall be scooped out where the bells occur leaving the entire barrel of the pipe bearing on the pipe bed.
8. Pipe joint assembly practices and joint assembly materials such as lubricants, primers and adhesives shall be in accordance with the manufacturer's recommendations and specifications, and in accordance with ANSI/AWWA C111.

D. Alignment and Grade:

1. The Contractor shall not deviate from the line and grade indicated in the Contract Documents, except with approval of the Owner.
2. Where it is necessary to deflect pipelines to avoid obstructions, the amount of deflection shall not exceed 1/2 of that recommended by the manufacturer of the pipe. Where necessary to maintain the required line, short sections of pipe and fittings shall be provided.
3. The Contractor shall investigate the proposed location of the main far enough in advance of the work to determine where conflicts will occur and to determine joint deflections necessary to clear any obstructions.

E. Polyethylene Encasement:

1. Pipe shall be encased with polyethylene where specified in the Contract Documents.
2. In the event that corrosive soils (as defined by Appendix "A" of ANSI/AWWA C105/A21.5) are encountered during excavation (and have not been identified as such in the Contract Documents), the Owner may direct that all, or a portion, of the pipeline be encased.
3. Materials and methods of installation shall be in accordance with AWWA C105; Method A, B, or C may be used unless otherwise specified in the Contract Documents. Polyethylene shall be at least 4 mils thick, cross laminated, and shall conform to the requirements of ANSI/AWWA C105/A21.5.
4. A fabric type or padded sling shall be used when handling polyethylene encased pipe to prevent damage to the polyethylene encasement.
5. All seams in the polyethylene encasement shall be sealed completely with approved 2-inch wide plastic adhesive tape.
6. Pull loose tube along pipe barrel up snugly around the pipe and fasten in-place with adhesive tape at 3 foot intervals.
7. Completely cover fittings and connections with film held snugly in place with point tape or strapping.
8. Extreme care shall be taken when backfilling to avoid damaging the polyethylene encasement.

F. Tracer Wire:

All underground non-metallic pipe pressure systems shall be installed with a continuous tracer wire conforming to Section 200, attached every 10 feet to the piping system with plastic strapping. The wire shall terminate above ground at every valve box, tracer wire box, and air release valve. The wire shall be of sufficient length to allow the wire to be uncoiled and extended one (1) foot above the finished grade. The tracer wire installation will be considered complete and acceptable for service when the Owner can trace the wire using the locating equipment. Any breaks shall be repaired by the Contractor prior to project acceptance.

G. Subsurface Utility Tape:

All force mains shall be identified by a subsurface utility warning tape, conforming to Section 200, placed at an elevation not less than 6-inches, nor more than 12-inches below the proposed finished grade, or directly under the roadway base material if the base material is greater than 12-inches.

2.3. VALVE INSTALLATION

- A. Prior to installation, the Owner shall inspect valves for direction of openings, interior and exterior coating systems, freedom of operation, tightness of pressure containing bolting, cleanliness of valve ports and especially seating surfaces, handling damage and cracks. Valves determined to be defective by the Owner shall be replaced by and at the sole expense of the Contractor. The Contractor shall operate all valves greater than 3-inches once prior to

installation to determine the number of rotations of the operating nut; this number of rotations shall be recorded on the record drawings.

- B. The Contractor shall set and join valves to pipe in accordance with the manufacturer's requirements for the type and class of valve and pipe.
- C. The valve box shall be centered and set plumb with the top of the box neatly to grade of the surface of the existing ground, unless otherwise directed by the Owner. Shock and stress shall not be transferred from the box to the valve.
- D. The top of the operating nut shall be less than 36-inches below the rim of the valve box (as measured from final grade). When the distance from the operating nut to the top of the valve box is greater than 36-inches, the Contractor shall install an approved valve stem extension device to result in a distance of 12- to 24-inches from the top of the operating nut to the rim of the valve box.
- E. Valves shall be set vertical and bedded in accordance with the Standard Details.

2.4. APPURTENANT INSTALLATION

All appurtenances (fittings, air vent assemblies) shall be installed in accordance with the manufacturer's recommendations and as indicated in the Contract Documents and Standard Details.

2.5. RESTRAINT

- A. Fittings, valves, and pipe joints shall be restrained as indicated in the Contract Documents and in accordance with Section 200. Alternate methods of thrust restraint other than specified herein may be used only with the written approval of the Owner.
- B. Concrete and reinforcing shall be in accordance with Section 200. Blocking shall be placed between undisturbed earth and the fitting to be restrained. The blocking shall be in accordance with the Special Provisions and Standard Details, oriented to contain the resultant thrust force and to leave the fitting joints accessible.
- C. All exposed piping, flanges, couplings, nuts and bolts shall receive a minimum of two coats of an approved protective coating.

2.6. CONNECTIONS TO EXISTING MAINS

- A. For pipe diameters larger than 16-inches, connections shall be made in accordance with the Special Provisions.
- B. The Owner and Contractor shall have a coordination meeting with the Owner's personnel at least 10 days prior to the planned force main shutdown and provide a written Work Plan. The Owner shall review the Work Plan and either approve it or meet with the Contractor within 3 business days after receipt of the schedule to satisfactorily modify it.
- C. The Contractor shall notify the Owner at least 5 business days in advance of performing the offset/shutdown. Work can be delayed a maximum of 48 hours from the anticipated shutdown if due to inclement weather, and is approved or directed by the Owner.
- D. The Contractor is required to schedule a meeting on site on the morning of a planned nighttime

tie-in and shall notify the Owner, and HRSD, affected jurisdictions and private utility owners, as appropriate. At the time of the meeting, the Contractor shall have all materials and equipment necessary for the tie-in on site and assembled for inspection by the Owner.

The following items will be reviewed and discussed at this meeting:

1. Site conditions
2. Weather forecasts / weather impacts
3. Work and contingency plans
4. Contact information
5. Emergency equipment

E. The Owner reserves the right to postpone the scheduled tie-in if:

1. The site or Contractor is not prepared as required in the Work Plan and as agreed upon at the pre-tie-in meeting.
2. The Owner or HRSD/impacted jurisdiction (as appropriate) has an emergency in another part of their system.
3. A rain event has occurred in the three (3) days before the scheduled tie-in date or is forecasted in the 24 to 48 hours after the scheduled tie-in date in a portion of the sewer system with historical problems with inflow and/or infiltration.

F. Shutdowns shall not begin until all required materials are on-hand and ready for installation and a written Work Plan has been submitted and approved by the Owner.

G. The Owner reserves the right to cancel scheduled shutdowns if conditions warrant.

H. A decision point will be established by the Owner for the Contractor to cut the active force main. This decision during the tie-in will be based upon the Contractor's progress leading up to the cutting into the active force main. Inadequate progress by the Contractor leading up to this critical decision point may lead to a postponement of the tie-in completion, backfilling the excavation, placing temporary pavement, and rescheduling the remainder of the tie-in work.

I. The Contractor shall provide a crew with equipment for each connection point so that multiple connections can be completed simultaneously.

J. The Contractor is responsible for conveying sewage from all affected pump stations to prevent overflow throughout the entire duration of each shutdown. The fact that a facility served by one of these stations is closed at night is not a guarantee of zero sewage flow.

K. At a time approved by the Owner, the shutdown period will commence and the Contractor shall proceed with the Work continuously, start to finish, unless otherwise noted, until the Work is completed and the system is tested and ready for operation. If the Contractor completes all required Work before the specified shutdown period has ended, the Owner may immediately place the existing system back in service. If problems occur, the Contractor along with appropriate staff and equipment to remain on site to be an extension of the Owner's operational response until all operational issues have been resolved to the satisfaction of Owner.

L. All existing system valves shall be operated by the Owner's personnel unless otherwise indicated. The Owner shall make every effort to have a complete shutdown. Failure by the Owner to achieve a complete shutdown shall not entitle the Contractor to any additional

compensation.

- M. The operation of all existing privately-owned mainline valves, air vents, and pump stations will be performed only by forces of the private utility.
- N. The Contractor is responsible for providing adequate support and restraint, against system pressure of the exposed piping prior to and during startup and final backfill.
- O. The Contractor shall follow the procedures herein for any joints of the new force main and fittings that have not been previously hydrostatically pressure tested:
 - 1. The Owner reestablishes services in the line.
 - 2. One half hour will elapse, after air venting is complete by the Owner.
 - 3. Joints will be visually inspected for signs of leakage by Owner or Owner's Representative.
 - 4. Any leakage noted shall be corrected to the satisfaction of the Owner.
 - 5. After satisfactory visual testing of exposed joints by the Owner and any corrective action, the Contractor shall wrap the pipe and/or fitting as required and immediately proceed to backfill the pipe and restore to grade conditions or for reestablishment of traffic if in a roadway. Soil backfill compaction tests may be specified by the Owner for work within roadway travel lanes.
 - 6. If specified, utility warning tape shall be installed above the connection in accordance with the Contract Documents.
 - 7. Any joints not inspected by the Owner will not be approved and shall be excavated for inspection.
- P. The Contractor shall assist the Owner during the reestablishment of flows as follows:
 - 1. Provide riser pipe, fittings, and sewage containment drums for each control air vent location, and temporary valve at the air release point to vent air.
 - 2. Provide means of electronic communication to coordinate this operation.
- Q. Connection shall be made to the existing main through the installation of a tee in the existing main or by tapping sleeve and valve, as indicated in the Contract Documents. Taps shall be sized based on manufacturer's recommendations, but in no case shall the taps be of equal or larger size than the main.
- R. Careful attention shall be given to the depth of new pipelines at points where tie-ins to existing mains are to be made. The existing main shall be uncovered in the presence of the Owner and the new pipeline set to proper elevation to provide for a perpendicular and level tie-in.
- S. The allowable duration of any service interruption shall be approved by the Owner prior to the execution of the Work. Restoration of service due to the Contractor taking too much time to complete the connection or the Contractor's lack of proper equipment, personnel, or materials, shall not entitle the Contractor to any claim for additional time or compensation.
- T. The Contractor shall be responsible for ascertaining the exact location, depth, and joint pattern of existing mains prior to making connections. Prior to cutting into any force mains the Contractor shall have on site all required fittings, pipe, tools, personnel and equipment, and shall satisfy the Owner through field measurements, that his fittings will properly join the existing line.

1. All materials shall be installed in accordance with the manufacturer's recommendations including, but not limited to alignment, torque requirements, and tolerances.

2. Connections shall only be made in the presence of the Owner.

U. Tapping Existing Mains Under Pressure:

1. Tapping sleeves and valves shall be utilized for connecting to existing mains where indicated in the Contract Documents.
2. It shall be the Contractor's responsibility to verify the actual outside diameter of the existing main at the location of the proposed tap in order that the tapping sleeve or couplings to be provided can be properly installed.
3. The centerline of the tapping sleeve and valve assembly shall be located the following minimum distances from existing pipe joints:

<u>Size of Tapping Sleeve</u>	<u>Minimum Recommended Separation from Existing Joint</u>
4-, 6- & 8-inch dia.	3-1/2 feet
10-, 12- & 16-inch dia.	5-1/2 feet
Greater than 16-inch dia.	See Special Provisions

4. In cases where the horizontal alignment as indicated in the Contract Documents would result in a "sleeve to joint" distance less than the minimum stated above, the Owner may direct the Contractor to substitute a MJ x MJ x Flange tee connection using acceptable sleeves and pipe sections.
5. In addition to pressure testing of newly installed pipelines in accordance with Paragraph 2.7 of this Section, the Contractor shall test each tapping sleeve and valve assembly prior to making the tap. Water shall be injected into the body of the sleeve, to a pressure of 150 psig, through the test plugs. If test plugs are not provided in the sleeve, a tapped mechanical joint plug shall be assembled to the valve for testing purposes. Pressure shall be maintained for a one (1) hour period without evidence of leakage. Upon obtaining a satisfactory test (which shall be witnessed by the Owner), the tapping operation may commence.
6. All installed tapping sleeves shall be restrained in accordance with the Standard Details.
7. Only taps of size equal to the diameter of the branch are acceptable. Upon completion of the tap the Contractor shall save the pipe coupon to show the Owner.

V. Sleeve-In of Straight Pipe:

Sleeve-in connections shall be as indicated in the Contract Documents.

W. Connections to Manholes:

1. The force main shall enter the receiving manhole with its centerline horizontal and

with an invert elevation that will ensure a smooth flow transition to the gravity flow section.

2. In no case shall flow from the force main enter the manhole at a point more than one foot above the flow line.
3. Force main to manhole connections shall be in accordance with the Standard Details.

X. Offsets to Existing Force Main

1. The Contractor shall comply with the above procedures for connections to existing mains.
2. Prior to performing an offset or cut-in, a trial shutdown will be performed to determine the working conditions to be encountered when the Work is performed.
3. All bends, valves, sleeves, pipe, and fittings shall be fully restrained with retainer glands.
4. The Contractor shall perform cut-in or offset work at night, unless otherwise indicated. Under most circumstances the hours of operation will be from 12:00 midnight to 6:00 A.M. The excavation for the Work shall be completed no later than 3:30 P.M. on the day the offset or cut-in is to begin to allow for inspection by the Owner.
5. The materials to be installed and the tools to be used shall be assembled and ready for inspection no later than 3:30 P.M. on the day installation of the Work is to commence. The inside of all pipe and fittings to be installed shall be cleaned and ends of lines capped until the time of installation. All visible dirt and foreign materials shall be removed from the interior of the pipe and fittings. The Contractor shall review in detail his plan of operation with the Owner at the time the excavation and pipe work are inspected for readiness.
6. Excavation around the existing pipe shall be sufficient to allow the Work to be performed without requiring additional excavation during installation of the offset or cut-in. Excavation shall be of sufficient depth to accommodate a minimum of 8-inches uniform depth of VDOT #57 stone, which shall be placed by the Contractor over the entire bottom of the excavation. In addition there shall be a minimum of 12-inches clearance between the bottom of the pipe and the top of the VDOT #57 stone.
7. The Contractor shall clean and mark the locations on the existing pipe where the pipe cuts are to be made by 3:30 P.M. on the day the offset or cut-in is to be installed. The Contractor shall measure the outside diameter of the pipe to be cut-in to be sure the proposed pipe and fittings are compatible with the existing pipe to be cut. All measurements shall be double checked in the presence of the Owner just prior to cutting of the existing pipe.
8. All spoil material not used as backfill shall be removed the same day as excavated and approved select or suitable material to be used as backfill shall be stockpiled in the vicinity of the excavation.
9. The Contractor shall have sufficient crews and equipment on hand to perform the Work for each offset. All equipment to be used during the Work, including pump,

backup pump, backhoe, at least two pipe saws, fuel, tools, generators, light towers, sewage tanker truck(s) and similar equipment shall be test run and determined to be in proper running order prior to cutting of the existing pipe. If the Contractor fails to provide adequate equipment in proper running order, the Owner will cancel the Work and the Contractor shall request rescheduling when the deficiencies have been corrected.

10. The Contractor shall have on hand at the site of the cut-in or offset two full circle stainless steel repair clamps and two DIMJ plugs or caps as necessary for each size of pipe to be cut. If plugs or caps are used, appropriate thrust restraint shall be provided by the Contractor.
11. After a cut-in or an offset has begun, the Contractor shall make continuous progress toward restoring the force main to full service. The Contractor shall maintain sufficient crews, equipment, and supplies and shall not leave the work site until the force main work has been completed and restored to complete operation. The Contractor shall direct his pump discharge in such a manner as to insure drainage away from the excavation so it will not flood streets or adjacent private property, and in accordance with all environmental regulations required by the locality.
12. When weather forecasts call for freezing temperatures the night of the cut-in or offset, the Contractor shall have on site sufficient coarse granular sand to spread over all paved areas, sidewalks, and bike paths wetted by the discharge of his pumps. During freezing weather, the Contractor shall minimize wetting of paved areas, sidewalks, and bike paths.
13. When bends are used in offsetting around obstructions, a 1-inch corporation stop shall be installed on each side of the offset to provide air release.

2.7. TESTING AND INSPECTION

A. General:

1. All flushing and pressure testing shall conform to this Section and the applicable sections of the *Virginia Sewerage Regulations*.
2. The Contractor shall provide the Owner at least 48 hours' notice to schedule testing and inspection.
3. Only properly functioning, calibrated, clean, and approved equipment shall be used for flushing and pressure testing force mains. Pressure gauges shall display readings to 1.0 psi.
4. All valves in the existing sewer system shall be operated only by or in the presence of the Owner or HRSD or private utility, as applicable.
5. See the Special Provisions for potential testing modifications, if any, for the specific locality.

B. Pressure Test:

1. New force mains shall be pressure tested in accordance with ANSI/AWWA C600-

Section 5.2, except as herein provided. Force mains shall be filled with water and subjected to a pressure of 1.5 times the expected working pressure or 150 psig, whichever is greater, measured at the highest point along the test section. The pressure test shall be of at least a two hour duration and any damaged or defective pipe, fittings, or valves that are discovered following the pressure test shall be replaced by the Contractor. The Contractor shall furnish all necessary equipment, materials and labor for making the tests as specified. Before applying the specified test pressure, air shall be slowly expelled completely from the pipe and valves. The pressure test shall not be performed against an active valve.

2. The Contractor shall test the line prior to contacting the Owner for the formal pressure test.
3. Testing shall be performed on each section of pipe between main line valves.
4. Water for the pressure test shall be obtained through a fully valved manifold, with an approved backflow preventer, as indicated in the Standard Details, or other source and procedure approved by the Owner.
5. The Contractor shall furnish all pumps, fittings, and gauges as necessary to fill the line with water, expel air from the system, and pressurize the pipeline for the tests.
6. The Owner reserves the right to test gauges to determine their accuracy.
7. The Contractor shall coordinate arrangements for water to be used for the pressure testing with the Owner.
8. No pressure drop, no leaks.
9. The Contractor shall provide all necessary temporary restraint and support during testing at no additional cost to the Owner.
10. The Contractor will be responsible for providing proper safety measures during pressure testing operations.
11. In addition, heat-fusion joined HDPE pipe pressure testing shall be in accordance with ASTM F2164 and shall also comply with the following:
 - a. Before testing, heat fusion joints are to be completely cooled.
 - b. All parts of the test section shall be restrained against movement. Temporarily remove, restrain, or isolate expansion joints and expansion compensators before starting.

- c. Observe all safety precautions identified in ASTM F2164.
- d. To compensate for expansion, add make-up water during the initial expansion phase. The quantity of water needed to fill the pipe test section and accommodate expansion (and possible leakage at non-fusion joints and seals) is estimated using:

$$V_{\text{gal}} = 1.015 \times 0.04 \times (ID_{\text{in}})^2 \times L_{\text{ft}}$$

where:

V_{gal} = pipe section volume, gallons

ID_{in} = pipe inside diameter, inches

L_{ft} = test section, feet

- e. Allow the test section and the test liquid to equalize to a common temperature.
- f. Initial Expansion Phase:
 - (1) When the test section is completely filled and purged of air, gradually increase the pressure to the required test pressure identified in paragraph 2.7.B.1 above.
 - (2) Add make up water as necessary to maintain the maximum test pressure for 4 hours.
- g. Test Phase:
 - (1) Reduce the test pressure by 10 psi and monitor pressure for 1 hour. Do not increase the pressure or add make up water.
 - (2) No visible leakage shall be observed and the pressure shall remain steady (within 5% of the test phase pressure) for the 1 hour test phase period for a passing test.
- h. Retesting - If retesting is necessary, depressurize the test section per ASTM F2164 and correct any faults/leaks. Allow the test section to "relax" for at least 8 hours before repressurizing and repeat the Initial expansion and test phases as indicated above.

C. Leakage Test:

- 1. Leakage shall be in accordance with VDH requirements, unless stricter provisions are required in the Special Provisions. No leakage shall be allowed for heat-fusion joined HDPE pipe or fPVC pipe.
- 2. The leakage test shall be conducted concurrently with the pressure test.
- 3. Pipe installations shall only be accepted if there are no leaks.

4.

III. MEASUREMENT FOR PAYMENT

A. Ductile Iron, HDPE, fPVC or PVC Force Main, installed complete in place.

1. Measurement of ductile iron, HDPE, or PVC force main will be made along the centerline of the pipeline and based upon the linear footage of each size pipe installed and satisfactorily tested. No depth measurement will be made for trench excavation and native material backfill. Pipe will be measured through fittings or valves. The unit price bid will not include the cost of valves.
2. Payment will include the cost of the following:
 - a. Backfilling, compacting, and compaction testing
 - b. Bedding material, as detailed in the Contract Documents
 - c. Exterior Coatings,
 - d. Dewatering,
 - e. Disposal of surplus material,

- f. Excavation,
- g. Flushing,
- h. Force main, including fittings and appurtenances,
- i. Heat fusion equipment and any specialized technical operational support required
- j. Restoration in right-of-way and easements (not including curb and gutter restoration or pavement restoration, unless otherwise noted),
- k. Shoulder restoration,
- l. Temporary seeding and stabilization,
- m. Temporary sheeting and bracing,
- n. Testing,
- o. Thrust restraint,
- p. Top soiling,
- q. Tracer wire and subsurface marking tape, and
- r. Water for testing

B. Air Vent Assembly, installed complete in place.

Payment will be made at the unit price bid for each manual air release valve installed and satisfactorily tested and will include the cost of furnishing and installing the air vent assembly and all required appurtenances in accordance with the Standard Details, including tap to proposed force main to provide satisfactory operation in accordance with the Contract Documents.

C. Valves, installed complete in place.

Payment will be made at the unit price bid for each size and type of valve installed, in place, and satisfactorily tested, and will include the cost of the following:

- 1. Bedding material
- 2. Coatings and linings
- 3. Stem extensions
- 4. Valve, valve box, with frame and cover for each size in accordance with the Contract Documents
- 5. Valve wrench, if specified

D. Tapping Sleeve and Valve (TS&V), installed complete in place.

Payment will be made at the unit price bid for each size TS&V installed, in place, and satisfactorily tested, and will include the cost of the following:

- 1. Bedding material
- 2. Coatings and linings
- 3. Stem extensions
- 4. Valve, valve box, with frame and cover for each size in accordance with the Contract Documents
- 5. Valve wrench, if specified
- 6. Tapping sleeve assembly and appurtenance
- 7. Pressure testing
- 8. Thrust Restraint

- E. Connections to existing force mains or manholes.
1. Force main connections will be measured based upon each complete in place and satisfactorily tested.
 2. Connections to existing force mains or manholes will be paid for each assembly installed and will include:
 - a. Backfilling,
 - b. Compaction and compaction testing,
 - c. Dewatering,
 - d. Disposal of surplus material,
 - e. Excavation,
 - f. Materials,
 - g. Restoration of shoulders and right of way (not including pavement restoration or curb and gutter, unless otherwise noted),
 - h. Site restoration and cleanup as shown in the Contract Documents,
 - i. Temporary piping, valves, and control air vents,
 - j. Temporary seeding,
 - k. Temporary sheeting and bracing,
 - l. Testing,
 - m. Top soiling,
 - n. Thrust restraint,
 - o. Work Plan and all notifications to include re-notifications as necessary, and
 - p. All other Work incidental to the connection to the existing main or manhole.

F. Interior Pipeline Corrosion Resistant Lining

1. The application of interior coatings for ductile iron pipe as indicated in the Contract Documents and described in Section 200, shall be measured on a linear foot basis for the complete, in-place application and successfully tested.
2. Payment will be made on a unit price basis per linear foot of a specified pipe diameter.

G. Polyethylene Encasement installed complete in place.

Payment will be made at the unit price bid per linear foot for polyethylene pipe encasement satisfactorily installed.

H. Offset of Existing Force Main

Offsets of existing force main shall be paid for at the contract unit price per foot. The unit price shall include the cost of:

1. Backfilling,
2. Bedding,
3. Compacting and compaction testing,
4. Coordinating line shutdown,
5. Cutting of existing line,
6. Dewatering,
7. Disposal of surplus materials,
8. Excavating,

9. Furnishing and installing the pipe and fittings,
10. Restoration of shoulders and right of way (not including pavement restoration and curb and gutter unless otherwise noted),
11. Testing,
12. Temporary piping, valves, and control air vents,
13. Temporary seeding,
14. Temporary sheeting and bracing,
15. Thrust protection,
16. Top soiling,
17. Seeding,
18. Site restoration and cleanup as shown in the Contract Documents,
19. Work Plan and all notifications, including re-notifications, as necessary, and
20. All other Work incidental to the offset.

I. Cutting in of Tees, Crosses, and Valves into Existing Mains (larger than 2-inches)

Cutting in of Tees, Crosses, and Valves into Existing Mains (larger than 2-inches) shall be paid based upon the number of each tee, cross, or valve cut in. The unit price bid shall not include pipe or valves and valve boxes, which shall be paid for under their respective unit price. The unit price bid shall include the cost of:

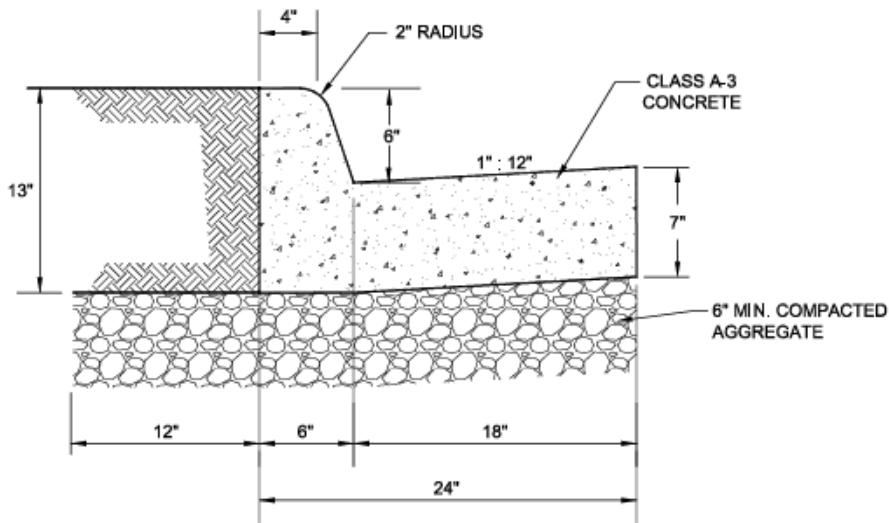
1. Backfilling with suitable material,
2. Coarse aggregate fill,
3. Compacting,
4. Cutting in of any valves at or near the tee or cross
5. Dewatering,
6. Disposing of surplus material
7. Excavating,
8. Furnishing and installing all fittings such as tees, bends, reducers, sleeves, plugs, as well as other appurtenances,
9. Other site restoration and cleanup,
10. Pavement replacement
11. Seeding,
12. Temporary sheeting and bracing,
13. Testing,
14. Thrust protection, and
15. Top soiling.

J. Tracer Wire Box

Payment will be made at the unit price bid for each tracer wire box installed and will include the cost of furnishing and installing the box, lid, riser pipe, aggregate base material, backfilling, compaction, topsoil (if required), and all required appurtenances, in accordance with the Standard Detail.

End of Section

APPENDIX B
Smithfield Standard Details

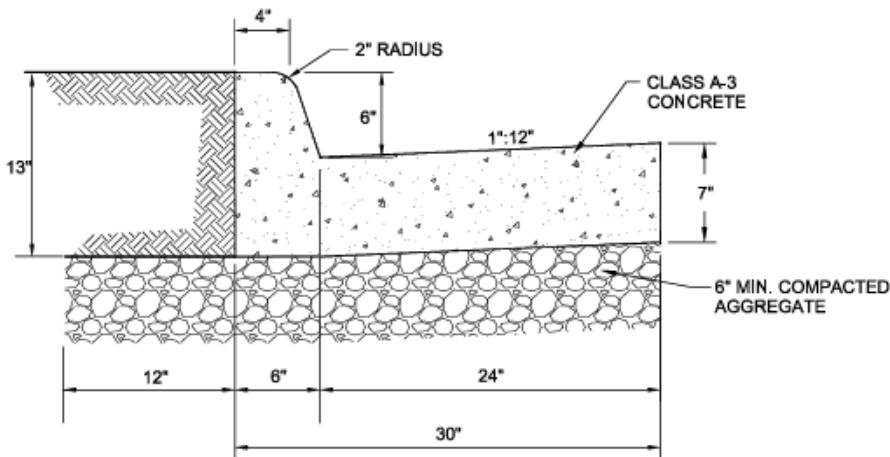

NOTES:

1. CRACK CONTROL JOINTS TO BE PROVIDED AT 10 FT. INTERVALS BY SAWING, SCORING, "LEAVE-IN" INSERTS, OR CUTTER PLATES TO 1-1/2 INCH DEPTH.
2. EXPANSION JOINTS TO BE INSTALLED PER SPECIFICATIONS SECTION 502.
3. AS SOON AS CONCRETE WILL NOT SLUMP, FACE FORMS ARE TO BE REMOVED, IRREGULARITIES REMOVED, A LIGHT BROOM FINISH GIVEN, AND LIQUID MEMBRANE SEAL OR OTHER APPROVED CURING MEDIUM APPLIED.
4. THE CONTRACTOR SHALL PREVENT THE TEMPERATURE AT THE SURFACE OF THE CONCRETE FROM FALLING BELOW 40°F DURING THE FIRST 72 HOURS IMMEDIATELY FOLLOWING CONCRETE PLACEMENT. PROTECTIVE MATERIAL SHALL BE LEFT IN PLACE FOR AN ADDITIONAL 48 HOURS IF FREEZING AIR TEMPERATURES ARE EXPECTED TO CONTINUE.

24" CURB & GUTTER

NOT TO SCALE

REFERENCE 200,502	CATEGORY CONCRETE ITEMS	DATE 6/16	SHEET No. 1 OF 1	DETAIL No. CI_01
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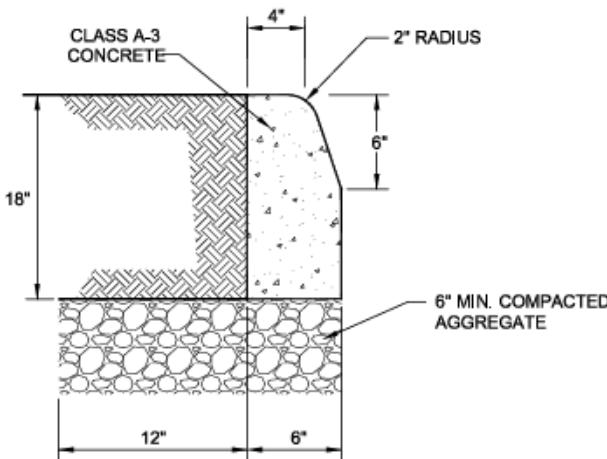
NOTES:

1. CRACK CONTROL JOINTS TO BE PROVIDED AT 10 FT. INTERVALS BY SAWING, SCORING, "LEAVE-IN" INSERTS, OR CUTTER PLATES TO 1-1/2 INCH DEPTH.
2. EXPANSION JOINTS TO BE INSTALLED PER SPECIFICATIONS SECTION 502.
3. AS SOON AS CONCRETE WILL NOT SLUMP, FACE FORMS ARE TO BE REMOVED, IRREGULARITIES REMOVED, A LIGHT BROOM FINISH GIVEN, AND LIQUID MEMBRANE SEAL OR OTHER APPROVED CURING MEDIUM APPLIED.
4. THE CONTRACTOR SHALL PREVENT THE TEMPERATURE AT THE SURFACE OF THE CONCRETE FROM FALLING BELOW 40°F DURING THE FIRST 72 HOURS IMMEDIATELY FOLLOWING CONCRETE PLACEMENT. PROTECTIVE MATERIAL SHALL BE LEFT IN PLACE FOR AN ADDITIONAL 48 HOURS IF FREEZING AIR TEMPERATURES ARE EXPECTED TO CONTINUE.

30" CURB & GUTTER

NOT TO SCALE

REFERENCE 200,502	CATEGORY CONCRETE ITEMS	DATE 6/16	DETAIL No. 1 OF 1
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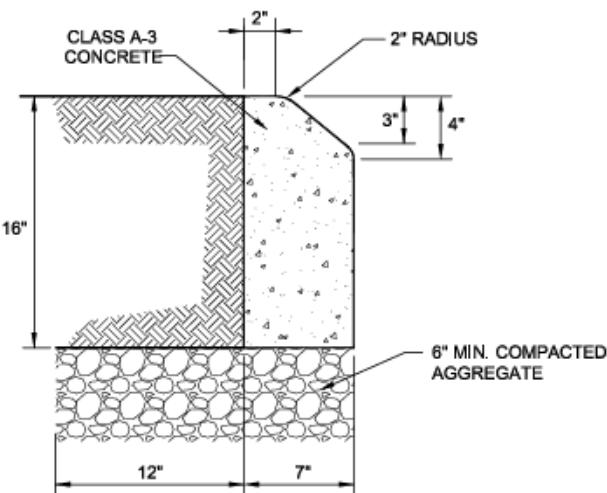
NOTES:

1. CRACK CONTROL JOINTS TO BE PROVIDED AT 10 FT. INTERVALS BY SAWING, SCORING, "LEAVE-IN" INSERTS, OR CUTTER PLATES TO 1-1/2 INCH DEPTH.
2. EXPANSION JOINTS TO BE INSTALLED PER SPECIFICATIONS SECTION 502.
3. AS SOON AS CONCRETE WILL NOT SLUMP, FACE FORMS ARE TO BE REMOVED, IRREGULARITIES REMOVED, A LIGHT BROOM FINISH GIVEN, AND LIQUID MEMBRANE SEAL OR OTHER APPROVED CURING MEDIUM APPLIED.
4. THE CONTRACTOR SHALL PREVENT THE TEMPERATURE AT THE SURFACE OF THE CONCRETE FROM FALLING BELOW 40°F DURING THE FIRST 72 HOURS IMMEDIATELY FOLLOWING CONCRETE PLACEMENT. PROTECTIVE MATERIAL SHALL BE LEFT IN PLACE FOR AN ADDITIONAL 48 HOURS IF FREEZING AIR TEMPERATURES ARE EXPECTED TO CONTINUE.

STANDARD MEDIAN CURB

NOT TO SCALE

REFERENCE 200,502	CATEGORY CONCRETE ITEMS	DATE 6/16	SHEET No. 1 OF 1	DETAIL No. CI_03
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NOTES:

1. CRACK CONTROL JOINTS TO BE PROVIDED AT 10 FT. INTERVALS BY SAWING, SCORING, "LEAVE-IN" INSERTS, OR CUTTER PLATES TO 1-1/2 INCH DEPTH.
2. EXPANSION JOINTS TO BE INSTALLED PER SPECIFICATIONS SECTION 502.
3. AS SOON AS CONCRETE WILL NOT SLUMP, FACE FORMS ARE TO BE REMOVED, IRREGULARITIES REMOVED, A LIGHT BROOM FINISH GIVEN, AND LIQUID MEMBRANE SEAL OR OTHER APPROVED CURING MEDIUM APPLIED.
4. THE CONTRACTOR SHALL PREVENT THE TEMPERATURE AT THE SURFACE OF THE CONCRETE FROM FALLING BELOW 40°F DURING THE FIRST 72 HOURS IMMEDIATELY FOLLOWING CONCRETE PLACEMENT. PROTECTIVE MATERIAL SHALL BE LEFT IN PLACE FOR AN ADDITIONAL 48 HOURS IF FREEZING AIR TEMPERATURES ARE EXPECTED TO CONTINUE.

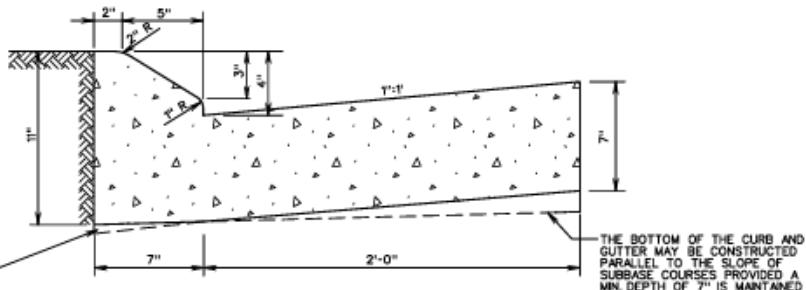
MOUNTABLE CURB

NOT TO SCALE

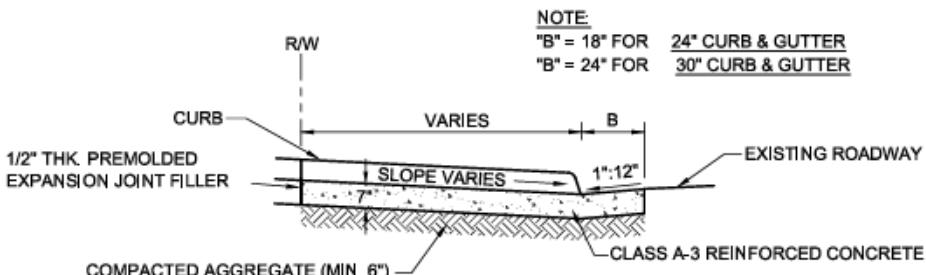
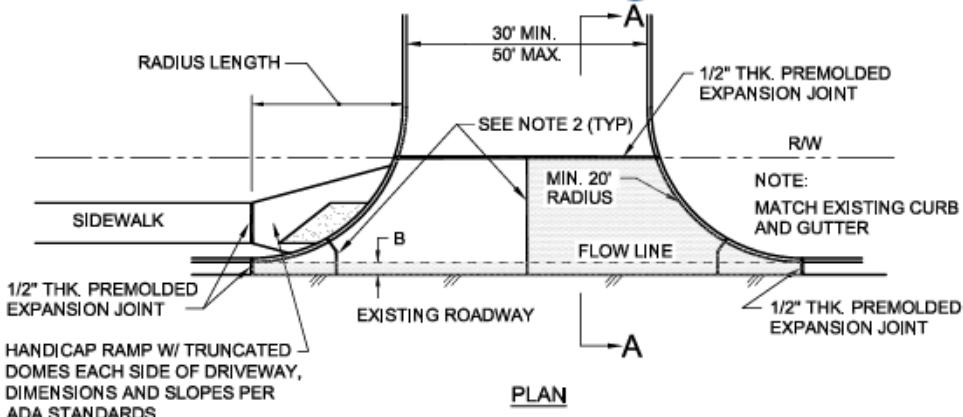
REFERENCE 200,502	CATEGORY CONCRETE ITEMS	DATE 6/16	SHEET No. 1 OF 1	DETAIL No. C1_04
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NOTES:

1. THIS ITEM MAY BE PRECAST OR CAST IN PLACE.
2. CONCRETE TO BE CLASS A3 IF CAST IN PLACE,
4000 PSI IF PRECAST.
3. COMBINATION CURB & GUTTER HAVING A RADIUS
OF 300 FEET OR LESS (ALONG FACE OF CURB) SHALL
BE PAI FOR AS RADIAL COMBINATION CURB &
GUTTER.
4. FOR USE WITH STABILIZED OPEN-GRADED
DRAINAGE LAYER, THE BOTTOM OF THE
CURB AND GUTTER SHALL BE CONSTRUCTED
PARALLEL TO THE SLOPE OF SUBBASE
COURSES AND TO THE DEPTH OF THE
PAVEMENT.
5. ALLOWABLE CRITERIA FOR THE USE OF CG-7 IS BASED
ON ROADWAY CLASSIFICATION AND DESIGN SPEED
AS SHOWN IN APPENDIX A OF THE VDOT ROAD DESIGN
MANUAL IN THE SECTION ON URBAN GS STANDARDS.
6. WHEN THIS STANDARD IS TO BE TIED INTO EXISTING
BARRIER CURB, THE TRANSITION IS TO BE MADE WITHIN
10' OR THE CHANGE IN STANDARDS CAN BE MADE AT
REGULAR OPENINGS.
7. WHEN COMBINATION MOUNTABLE CURB AND GUTTER IS
USED, THE STANDARD ENTRANCE GUTTERS OR STANDARD
CONNECTION FOR STREET INTERSECTIONS ARE TO HAVE
THE MOUNTABLE CURB CONFIGURATION INCORPORATED.



V DOT ROAD AND BRIDGE STANDARDS	COMBINATION 4" CURB AND GUTTER		SPECIFICATION REFERENCE
	SHEET 1 OF 1	REVISION DATE	
201.04			105 502



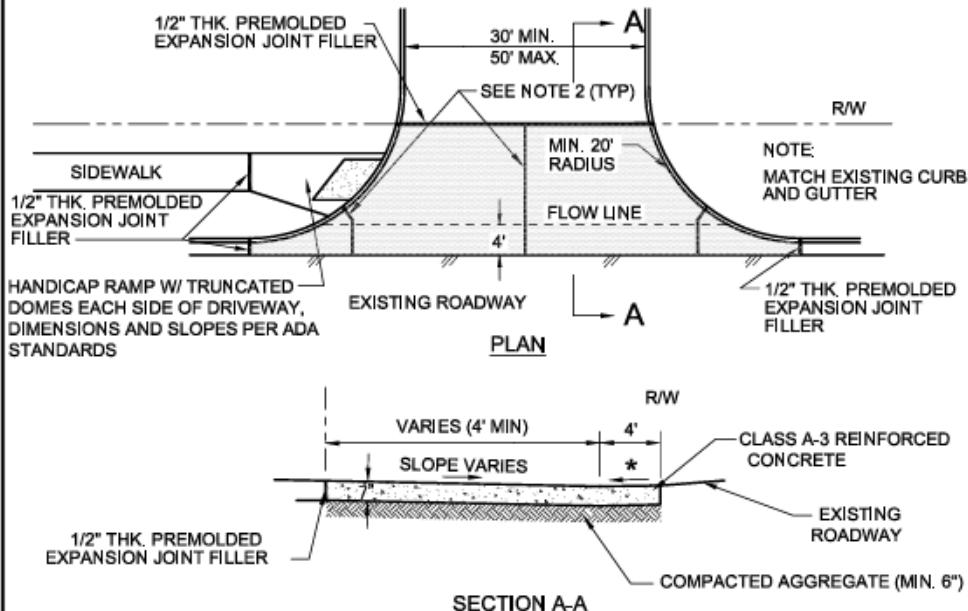
NOTES:

1. STREET APPROACH TO BE POURED MONOLITHICALLY WITH RADIAL CURB.
2. CRACK CONTROL JOINTS TO BE PROVIDED AT ENTRANCE MIDDLE AND AT ENTRANCE DIAGONALS BY SAWING, SCORING, "LEAVE-IN" INSERTS, OR CUTTER PLATES TO 1-1/2 INCH DEPTH.
3. FOR CURBED STREETS WITHOUT SIDEWALKS OR FOR USE WITH OPTIONAL HANDICAP RAMP WHEN DIRECTED BY LOCALITY.
4. WATER METERS AND SEWER CLEANOUTS SHALL NOT BE LOCATED IN DRIVEWAY (ENTRANCE) OR APRON UNLESS AUTHORIZED BY OWNER.
5. CONCRETE REINFORCEMENT METHOD PER CONTRACT DOCUMENTS.

STANDARD COMMERCIAL ENTRANCE

NOT TO SCALE

REFERENCE 200,502	CATEGORY CONCRETE ITEMS	DATE 6/16	SHEET No. 1 OF 1	DETAIL No. CI_05
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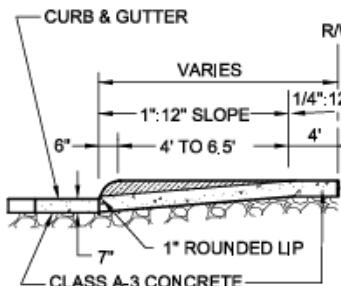
* TO MATCH 24" CURB & GUTTER, SLOPE = 1" : 32"
TO MATCH 30" CURB & GUTTER, SLOPE = 1" : 24"

NOTES:

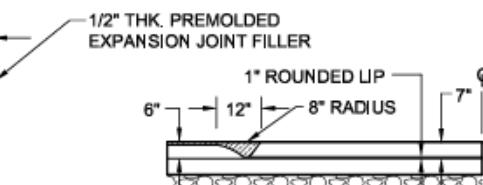
1. FOR USE ON STREETS HAVING A 45 MPH OR GREATER SPEED LIMIT.
2. CRACK CONTROL JOINTS TO BE PROVIDED AT ENTRANCE MIDDLE AND AT ENTRANCE DIAGONALS BY SAWING, SCORING, "LEAVE-IN" INSERTS, OR CUTTER PLATES TO 1-1/2 INCH DEPTH.
3. STREET APPROACH TO BE POURED MONOLITHICALLY WITH RADIAL CURB.
4. FOR CURBED STREETS WITHOUT SIDEWALKS OR FOR USE WITH A HIGH VOLUME ENTRANCE WITH OPTIONAL HANDICAP RAMP WHEN DIRECTED BY LOCALITY.
5. WATER METERS AND SEWER CLEANOUTS SHALL NOT BE LOCATED IN DRIVEWAY (ENTRANCE) OR APRON UNLESS AUTHORIZED BY OWNER.
6. CONCRETE REINFORCEMENT METHOD PER CONTRACT DOCUMENTS.

HIGH TRAFFIC SPEED COMMERCIAL ENTRANCE

NOT TO SCALE

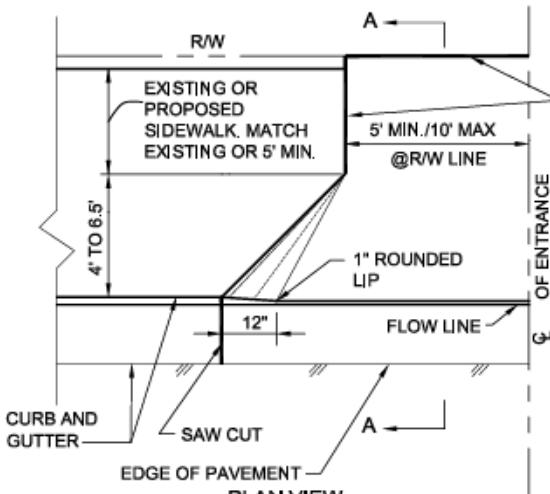


SECTION A-A

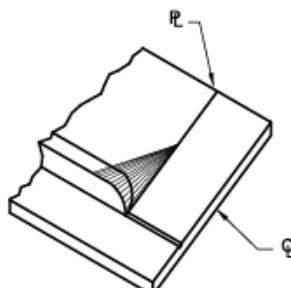


SECTION AT GUTTER LINE

MINIMUM 12' DRIVEWAY



PLAN VIEW



ISOMETRIC VIEW

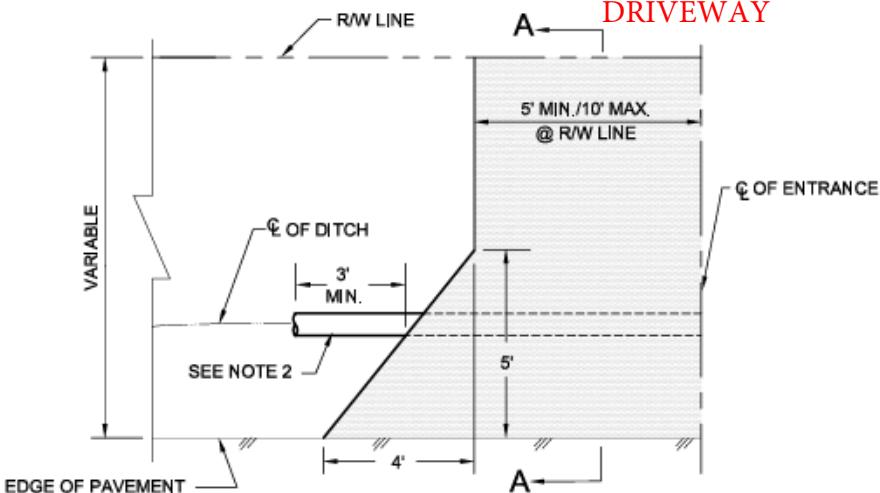
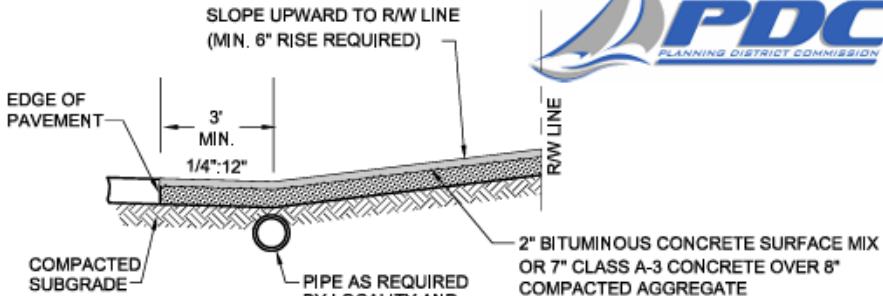
NOTES: (SYMMETRICAL ABOUT G OF ENTRANCE)

1. IF AN EXISTING SIDEWALK IS AFFECTED BY THIS INSTALLATION, IT MUST BE REMOVED TO THE NEAREST JOINT AND REPLACED WITH CLASS A-3 CONCRETE, SEVEN INCHES THICK.
2. A SLOPE OF 1/4":12" (UPWARD) IS REQUIRED FROM TOP OF CURB TO RIGHT-OF-WAY LINE, (ON ENTRANCE OR ON SIDEWALK).
3. ENTRANCES WITHIN TWO FEET OF EACH OTHER, MEASURED AT THE CURB LINE, MAY CONNECT TO SHARE A WIDER APRON DESIGN.
4. WATER METERS AND SEWER CLEANOUTS SHALL NOT BE LOCATED IN DRIVEWAY (ENTRANCE) OR APRON UNLESS AUTHORIZED BY OWNER.

RESIDENTIAL CONCRETE ENTRANCE W/ CURB & GUTTER

NOT TO SCALE

REFERENCE 200,502	CATEGORY CONCRETE ITEMS	DATE 6/16	DETAIL No. 1 OF 1	DETAIL No. C1_07
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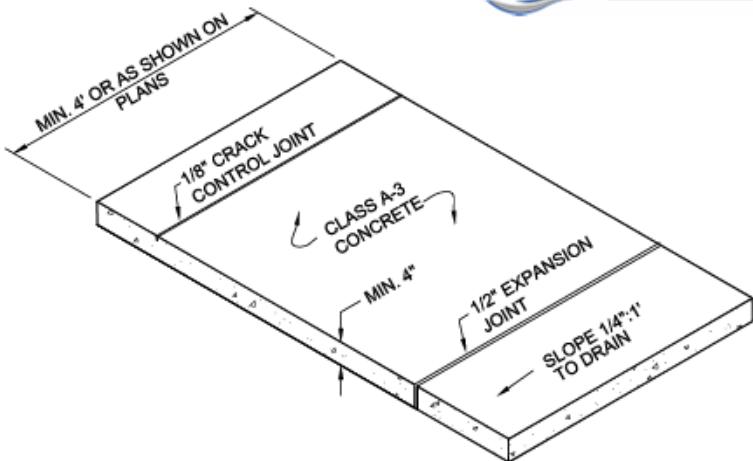
PLAN
(SYMMETRICAL ABOUT C OF ENTRANCE)

NOTES:

1. PIPE LOCATION MAY VARY WITHIN THE RIGHT-OF-WAY AS NECESSARY. THE PIPE SHALL BE INSTALLED TO PROVIDE AND/OR MAINTAIN POSITIVE DRAINAGE.
2. PIPE SHALL EXTEND THREE FEET (MINIMUM) BEYOND FARDEST OUTSIDE EDGE OF ENTRANCE AT CROSSING. PROVIDE COVER OVER PIPE AS SPECIFIED BY ENGINEER.
3. WATER METERS AND SEWER CLEANOUTS SHALL NOT BE LOCATED IN DRIVEWAY (ENTRANCE) OR APRON UNLESS AUTHORIZED BY OWNER.

**RESIDENTIAL ENTRANCE
W/OUT CURB & GUTTER**

NOT TO SCALE



NOTES:

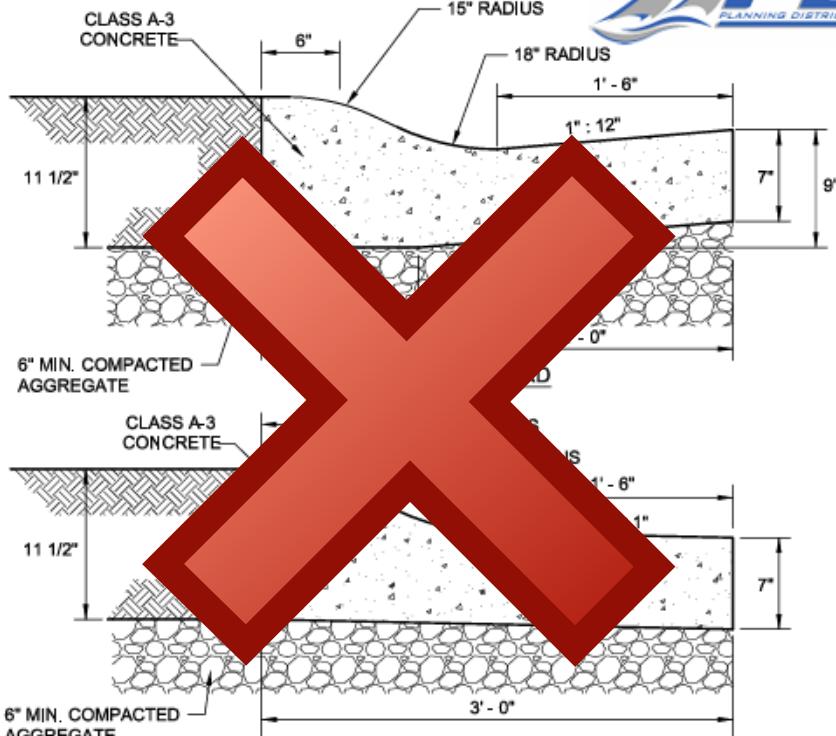
1. CRACK CONTROL JOINTS TO BE PROVIDED AT INTERVALS EQUAL TO THE WIDTH OF THE SIDEWALK BY SAWING, SCORING, "LEAVE-IN" INSERTS, OR CUTTER PLATES AND SHALL EXTEND INTO THE CONCRETE TO 1/4 OF THE DEPTH.
2. EXPANSION JOINTS TO BE INSTALLED AT INTERVALS NOT EXCEEDING 50', AND AT JUNCTION POINTS OF CURBS AND ENTRANCES, AND ON BOTH SIDES OF ALL SIDEWALK SECTIONS CONTAINING UTILITIES. PREMOLDED, 1/2" JOINT FILLER IS TO BE USED EXTENDING FROM BOTTOM OF SLAB TO 1/4" OF ITS TOP SURFACE.
3. AS SOON AS CONCRETE WILL NOT SLUMP, FACE FORMS ARE TO BE REMOVED, IRREGULARITIES REMOVED, A LIGHT BROOM FINISH GIVEN, AND A LIQUID MEMBRANE SEAL OR OTHER APPROVED CURING MEDIUM APPLIED.
4. SIDEWALKS ACROSS ENTRANCES SHALL HAVE A DEPTH OF SEVEN INCHES (7") WITH A MAXIMUM SLOPE OF 1":12".
5. THE CONTRACTOR SHALL PREVENT THE TEMPERATURE AT THE SURFACE OF THE CONCRETE FROM FALLING BELOW 40°F DURING THE FIRST 72 HOURS IMMEDIATELY FOLLOWING CONCRETE PLACEMENT. PROTECTIVE MATERIAL SHALL BE LEFT IN PLACE FOR AN ADDITIONAL 48 HOURS IF FREEZING AIR TEMPERATURES ARE EXPECTED TO CONTINUE.

SIDEWALK DETAIL

NOT TO SCALE

REFERENCE 200,502	CATEGORY CONCRETE ITEMS	DATE 6/16	SHEET No. 1 OF 1	DETAIL No. CI_09
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NOT APPROVED FOR USE IN SMITHFIELD



NOTES:

1. CRACK CONTROL JOINTS TO BE PROVIDED AT 10 FT. INTERVALS BY SAWING, SCORING, "LEAVE-IN" INSERTS, OR CUTTER PLATES TO 1-1/2 INCH DEPTH.
2. EXPANSION JOINTS TO BE INSTALLED PER SPECIFICATIONS SECTION 502.
3. AS SOON AS CONCRETE WILL NOT SLUMP, FACE FORMS ARE TO BE REMOVED, IRREGULARITIES REMOVED, A LIGHT BROOM FINISH GIVEN, AND LIQUID MEMBRANE SEAL OR OTHER APPROVED CURING MEDIUM APPLIED.
4. THE CONTRACTOR SHALL PREVENT THE TEMPERATURE AT THE SURFACE OF THE CONCRETE FROM FALLING BELOW 40°F DURING THE FIRST 72 HOURS IMMEDIATELY FOLLOWING CONCRETE PLACEMENT. PROTECTIVE MATERIAL SHALL BE LEFT IN PLACE FOR AN ADDITIONAL 48 HOURS IF FREEZING AIR TEMPERATURES ARE EXPECTED TO CONTINUE.

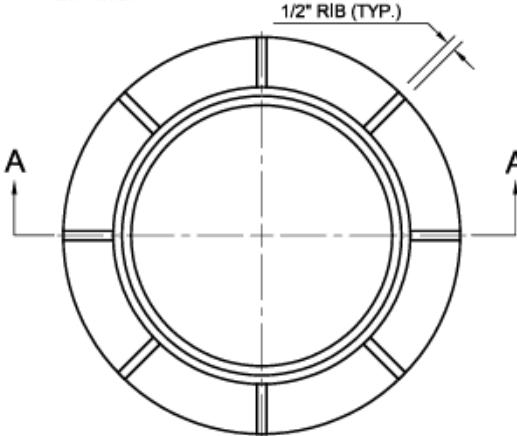
ROLL TOP CURB AND GUTTER

NOT TO SCALE

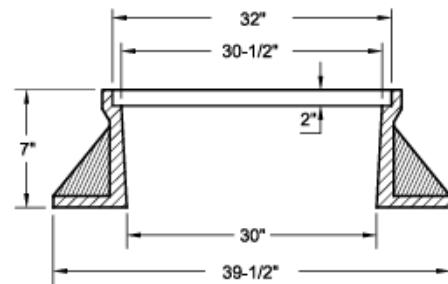
REFERENCE	CATEGORY	DATE	SHEET No.	DETAIL No.
200,502	CONCRETE ITEMS	6/16	1 OF 1	CI_10

NOTES:

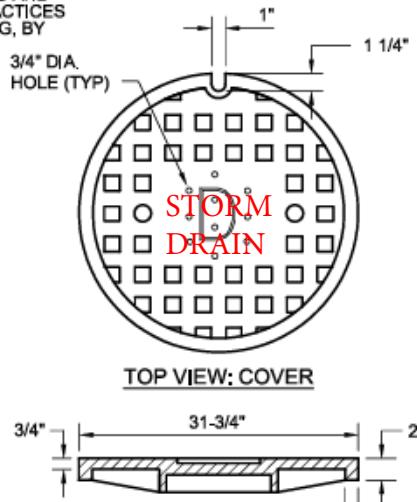
1. CASTING AND COVER TO BE SUPPLIED BY CAPITAL FOUNDRY OF VIRGINIA, INC. OR APPROVED EQUAL.
2. ALL GRAY IRON CASTINGS SHALL CONFORM TO LATEST EDITION OF ASTM A-48, CLASS 30 AND SHALL BE OF UNIFORM QUALITY.
3. ALL CASTING DIMENSIONS SHALL HAVE A TOLERANCE OF $1/8" \pm$.
4. ALL CASTINGS SHALL BE CLEANED BY SHOT BLASTING AND HAND CHIPPING UTILIZING STANDARD INDUSTRY PRACTICES PRIOR TO SHOP APPLICATION OF ASPHALTIC COATING, BY DIPPING.



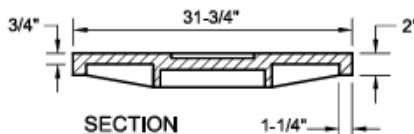
PLAN: CASTING



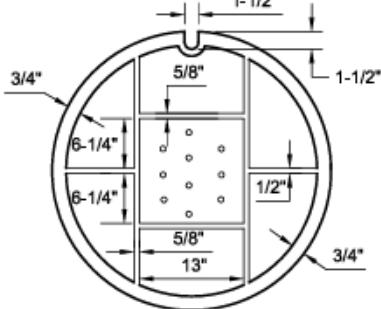
SECTION A-A



TOP VIEW: COVER



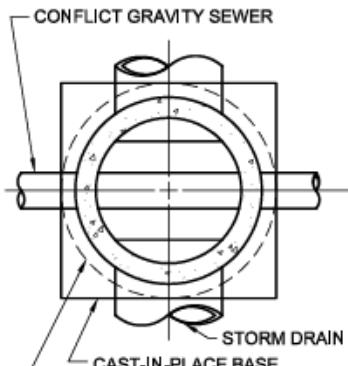
SECTION



BOTTOM VIEW: COVER

**STORM DRAIN
CASTING & COVER (30")**

NOT TO SCALE



SECTION A-A

**PRECAST CONCRETE
ADJUSTMENT RING (TYP)**

RINGS TO BE COVERED AND SEALED
SMOOTH ON ALL INSIDE SURFACES,
3/8" THICK (MIN.) WITH HYDRAULIC
CEMENT HIGH STRENGTH GROUT

FINISHED
GRADE

SEE SANITARY SEWER MANHOLE
CASTING AND COVER (24") DETAILS

MANHOLE CASTING AND ADJUSTMENT RINGS
TO BE SET & EMBEDDED IN BUTYL JOINT
MATERIAL AND CAPPED WITH HYDRAULIC
CEMENT GROUT OVER FRAME FLANGE,
ADJUSTMENT RINGS AND SECTION.

JOINT SEAL TO BE IN ACCORDANCE
WITH SPECIFICATIONS SECTION 200.
GROUT INSIDE AND OUT AFTER
INSTALLATION W/ HYDRAULIC
CEMENT GROUT.

**PRECAST CONCRETE
MANHOLE SECTION (TYP)**

CONFLICT GRAVITY SEWER

PVC

PIPE COUPLING

DUCTILE IRON

SEE NOTE 3

MODIFIED INVERT SHAPING TO
EXTEND DOWN FROM BOTTOM OF
CONFLICT PARALLEL WITH
STORM DRAIN PIPE.

SET DEPTH IN FIELD

3' MIN.

12" MIN.

BASE TO BE 12" FOR POURED IN PLACE
AND 8" FOR PRECAST CONCRETE

6" MIN. COMPACTED #57
STONE (GREATER DEPTHS
MAY BE REQUIRED IN
POOR SOILS)

FLEXIBLE BOOT
CONNECTION PER
SPECIFICATION
SECTION 200.

**MUST BE APPROVED BY
TOWN STAFF PRIOR TO USE**

SEE DS_02, SHEET 2 OF 2 FOR NOTES.

PRECAST CONCRETE CONFLICT MANHOLE

NOT TO SCALE

NOTES:

1. ALL CONFLICT MANHOLES TO BE APPROVED BY THE LOCALITY PRIOR TO THEIR USE.
2. FOR USE ON STORM DRAIN SYSTEMS 36" OR LESS IN DIAMETER AND WHEN THE CONFLICTING GRAVITY SEWER DOES NOT EXCEED 18" IN DIAMETER. ALL OTHER SITUATIONS REQUIRE A SPECIAL DESIGN AND LOCALITY APPROVAL.
3. SHADED AREA MUST EQUAL 1.5 (MIN.) TIMES THE CROSS SECTION AREA OF THE STORM DRAIN.
4. LOWER MANHOLE INVERT BELOW STORM DRAIN INVERT WHEN NECESSARY TO MAINTAIN MINIMUM 12" CLEARANCE UNDER CONFLICT SANITARY SEWER MAIN.
5. PRECAST CONCRETE MANHOLE TO BE IN COMPLIANCE WITH ASTM C-478.
6. WALL THICKNESS TO BE 5" MINIMUM FOR 48" INSIDE DIAMETER MANHOLES AND 6" MINIMUM FOR 60" INSIDE DIAMETER MANHOLES.
7. PROVIDE A MAXIMUM OF TWO LIFT HOLES PER SECTION. PLUG HOLES WATERTIGHT WITH RUBBER PLUGS AND GROUT AFTER INSTALLATION.
8. POURED IN PLACE BASE SLAB: REINFORCE WITH #5 REBAR @ 12" O.C. EACH WAY. ALL REBAR TO HAVE MIN. 1-1/2" COVER. CONCRETE TO BE CLASS A-3.
9. NO SEWER PIPE JOINTS ALLOWED INSIDE CONFLICT MANHOLE.

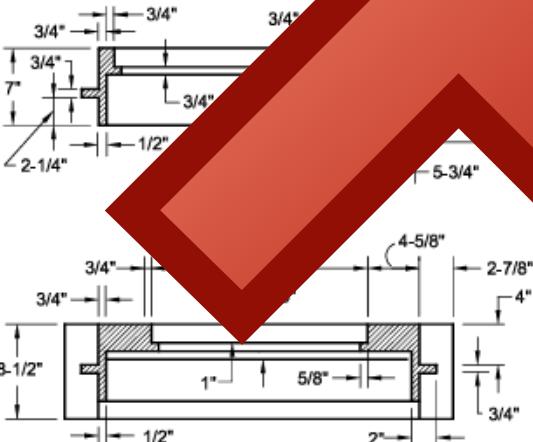
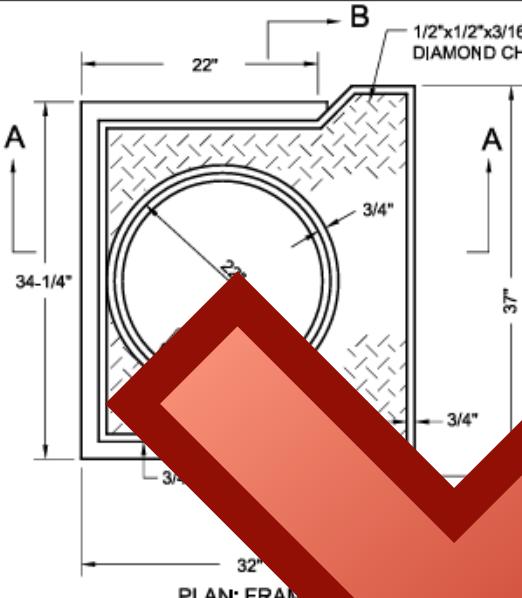
PRECAST CONCRETE CONFLICT MANHOLE

NOT TO SCALE

REFERENCE	CATEGORY	DATE	SHEET No.	DETAIL No.
200,302	DRAINAGE STRUCTURES	6/16	2 OF 2	DS_02



NOT APPROVED FOR
USE IN SMITHFIELD
USE VDOT-DI 3A



SECTION B-B

CURB INLET/CATCH BASIN FRAME AND COVER

NOT TO SCALE

REFERENCE
200-302

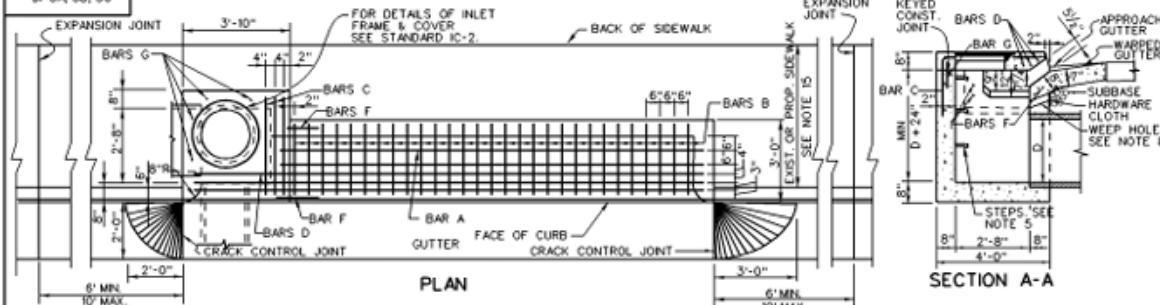
CATEGORY
DRAINAGE STRUCTURES

DATE
6/16

SHEET N
1 OF 1

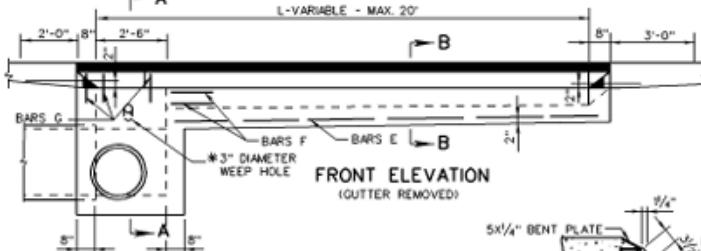
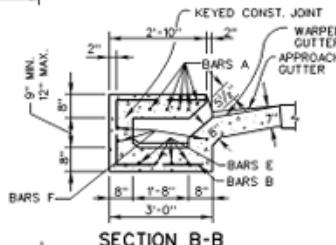
DETAIL No. **DS 03**

DI-3A, 3B, 3C



PLAN

SECTION A-A

FRONT ELEVATION
(GUTTER REMOVED)

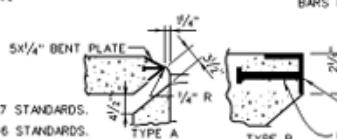
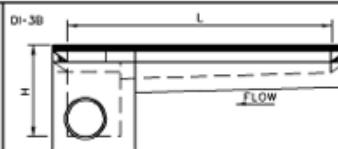
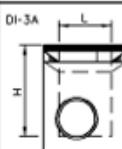
SECTION B-B

TYPE A NOSE DETAIL SHALL BE USED WITH CG-3 & CG-7 STANDARDS.

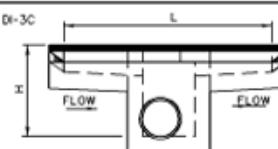
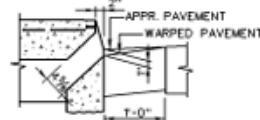
TYPE B NOSE DETAIL SHALL BE USED WITH CG-2 & CG-6 STANDARDS.

GALVANIZED PLATE FOR TYPE A TO BE BENT ON AN ANGLE OF 68° 30' CONNECTORS AND IS TO BE ANCHORED WITH 1/2" X 4" STUD SHEAR WELDED TO BENT PLATE AT 2'C-C.

NOSE DETAILS

L2 1/2" X 2 1/2" - 1/4" GALVANIZED
1/2" X 4" STUD SHEAR CONNECTOR WELDED
TO ANGLE IRON AT 2'C-C.

FOR USE ON GRADES

FOR USE IN SAGS
BOTH SIDES TO BE SYMMETRICALAPPR. PAVEMENT
WARPED PAVEMENT
T-0"

VDOT

ROAD AND BRIDGE STANDARDS

SHEET 1 OF 2

REVISION DATE

08/10

STANDARD CURB DROP INLET

12" - 30" PIPE: MAXIMUM DEPTH (H) = 8'

VIRGINIA DEPARTMENT OF TRANSPORTATION

SPECIFICATION
REFERENCE

233

302

TABLE OF QUANTITIES

DI-3A, 3B, 3C

TYPE	L	AREA OF SLOT	REINFORCING STEEL												WEIGHT Lbs.			
			Concrete		BARS A		BARS B		BARS C		BARS D		BARS E		BARS F			
Ft.	Sq. Ft.	Cu. Yds.	No.	Lin. Ft. *	No.	Lin. Ft. *	No.	Lin. Ft. *	No.	Lin. Ft. *	No.	Lin. Ft. *	No.	Lin. Ft. *	No.	Lin. Ft. *		
DI-3A	2'-6"	1.15	2.26	-	-	-	1	5'-7"	3	3'-2"	-	-	-	-	6	1'-0"	22	
	4'	1.83	2.59	5	1'-6"	2	6'-7" to 6'-10"	3	5'-7"	3	3'-2"	4	1'-6"	3	1'-0"	4	1'-0"	64
	6'	2.75	3.02	5	3'-6"	6	6'-7" to 6'-10"	3	5'-7"	3	3'-2"	4	3'-6"	3	1'-0"	4	1'-0"	111
	8'	3.67	3.46	5	5'-6"	10	6'-7" to 6'-10"	3	5'-7"	3	3'-2"	4	5'-6"	3	1'-0"	4	1'-0"	158
	10'	4.58	3.80	5	7'-6"	14	6'-7" to 6'-10"	3	5'-7"	3	3'-2"	4	7'-6"	3	1'-0"	4	1'-0"	204
	12'	5.50	4.34	5	9'-6"	18	6'-7" to 6'-10"	3	5'-7"	3	3'-2"	4	9'-6"	3	1'-0"	4	1'-0"	251
	14'	6.42	4.78	5	11'-6"	22	6'-7" to 6'-10"	3	5'-7"	3	3'-2"	4	11'-6"	3	1'-0"	4	1'-0"	298
	16'	7.33	5.22	5	13'-6"	26	6'-7" to 6'-10"	3	5'-7"	3	3'-2"	4	13'-6"	3	1'-0"	4	1'-0"	345
	18'	8.25	5.66	5	15'-6"	30	6'-7" to 6'-10"	3	5'-7"	3	3'-2"	4	15'-6"	3	1'-0"	4	1'-0"	391
	20'	9.17	6.09	5	17'-6"	34	6'-7" to 6'-10"	3	5'-7"	3	3'-2"	4	17'-6"	3	1'-0"	4	1'-0"	438
DI-3B	6'	2.75	3.01	10	1'-9"	4	6'-7" to 6'-10"	5	5'-7"	3	3'-2"	8	1'-9"	6	1'-0"	2	1'-0"	111
	8'	3.67	3.45	10	2'-9"	8	6'-7" to 6'-10"	5	5'-7"	3	3'-2"	8	2'-9"	6	1'-0"	2	1'-0"	158
	10'	4.58	3.89	10	3'-9"	12	6'-7" to 6'-10"	5	5'-7"	3	3'-2"	8	3'-9"	6	1'-0"	2	1'-0"	205
	12'	5.50	4.33	10	4'-9"	16	6'-7" to 6'-10"	5	5'-7"	3	3'-2"	8	4'-9"	6	1'-0"	2	1'-0"	252
	14'	6.42	4.77	10	5'-9"	20	6'-7" to 6'-10"	5	5'-7"	3	3'-2"	8	5'-9"	6	1'-0"	2	1'-0"	298
	16'	7.33	5.21	10	6'-9"	24	6'-7" to 6'-10"	5	5'-7"	3	3'-2"	8	6'-9"	6	1'-0"	2	1'-0"	345
	18'	8.25	5.65	10	7'-9"	28	6'-7" to 6'-10"	5	5'-7"	3	3'-2"	8	7'-9"	6	1'-0"	2	1'-0"	392
	20'	9.17	6.09	10	8'-9"	32	6'-7" to 6'-10"	5	5'-7"	3	3'-2"	8	8'-9"	6	1'-0"	2	1'-0"	439
DI-3C																		

NOTES

- DEPTH OF INLET (H) TO BE SHOWN ON PLANS.
- THE "H" DIMENSION SHOWN ON THE STANDARDS AND SPECIFIED ON THE PLANS WILL BE MEASURED FROM THE INVERT OF THE OUTFALL PIPE TO THE TOP OF THE STRUCTURE. PLAN "H" DIMENSIONS ARE APPROXIMATE ONLY FOR ESTIMATING PURPOSES AND THE ACTUAL DIMENSIONS SHALL BE DETERMINED BY THE CONTRACTOR FROM FIELD CONDITIONS.
- WHEN SPECIFIED ON THE PLANS THE INVERT IS TO BE SHAPED IN ACCORDANCE WITH STANDARD ST-1. THE COST OF FURNISHING AND PLACING ALL MATERIALS INCIDENTAL TO THE SHAPING IS TO BE INCLUDED IN THE BID PRICE FOR THE STRUCTURE.
- IN THE EVENT THE INVERT OF THE OUTFALL PIPE IS HIGHER THAN THE BOTTOM OF THE STRUCTURE, THE INVERT OF THE STRUCTURE SHALL BE SHAPED IN ACCORDANCE WITH ST-1 TO PREVENT STANDING OR PONDING OF WATER IN THE STRUCTURE. THE COST OF FURNISHING AND PLACING ALL MATERIALS INCIDENTAL TO THE SHAPING IS TO BE INCLUDED IN THE BID PRICE FOR THE STRUCTURE.
- STEPS ARE TO BE PROVIDED WHEN H IS 4'-0" OR GREATER. FOR DETAILS SEE STANDARD ST-1.
- THIS ITEM MAY BE PRECAST OR CAST-IN-PLACE.
- # 4 X 8" SMOOTH DOWELS AT APPROXIMATELY 12" C-C TO BE PLACED IN ALL AREAS ADJACENT TO ADJUTTING CONCRETE TO PREVENT SETTLEMENT.
- 3" DIAMETER WEEP HOLE TO BE LOCATED TO SUBGRADE SUBBASE, WEEP HOLE WITH 12"X12" PLASTIC HARDWARE CLOTH 1/4" MESH OR EQUIVALENT WIRE, MINIMUM 0.032" DIAMETER, #20 NUMBER 4 MESH HARDWARE CLOTH ANCHORED FIRMLY TO THE OUTSIDE OF THE STRUCTURE.
- ALL REINFORCING STEEL SHALL HAVE A MIN. COVER OF 2".
- ALL REINFORCING STEEL TO BE CUT CLEAR OF ALL OPENINGS BY 2".
- CAST-IN-PLACE CONCRETE IS TO BE CLASS A3 (3000 PSD). PRECAST CONCRETE IS TO BE 4000 PSI.
- LENGTH OF SLOT (L) WILL, IN EVERY CASE, BE SHOWN ON PLANS.
- IF INLET IS CONSTRUCTED IN MEDIUM CURB, CURB AND GUTTER IS TO BE OMITTED (SEE DETAIL).
- STANDARD INLETS MAY BE CONSTRUCTED WITH CONCRETE BLOCKS IN ACCORDANCE WITH THE DETAILS SHOWN ON STANDARD DRAWING DI-MB.
- THIS AREA MAY BE EARTHEN, IN WHICH CASE THE EXPANSION JOINTS WILL APPLY ONLY TO CURB AND GUTTER.
- CONCRETE QUANTITIES SHOWN ARE FOR DEPTH (H) OF 5'-2" WITHOUT PIPES. THE AMOUNT DISPLACED BY PIPES MUST BE DEDUCTED TO OBTAIN TRUE QUANTITIES. FOR INLETS OF DIFFERENT DEPTHS ADD OR SUBTRACT 0.32 CUBIC YARDS OF CONCRETE FOR EACH FOOT OF DEPTH.
- LENGTH OF ANGLE IRON AS SHOWN ON SHEET 1 OF 2 IS TO BE L+16" AT 4.10 LBS./FT..
- * DENOTES LENGTH OF ONE (1) BAR.
- ALL REINFORCING BARS TO BE #5.
- WHEN INLET IS USED IN 4'-0" MEDIUM, BACK OF INLET IS TO BE SHAPED TO CONFORM TO PROPOSED CURB.

SPECIFICATION
REFERENCE

STANDARD CURB DROP INLET

12" - 30" PIPE: MAXIMUM DEPTH (H) - 8'

VIRGINIA DEPARTMENT OF TRANSPORTATION

233
302

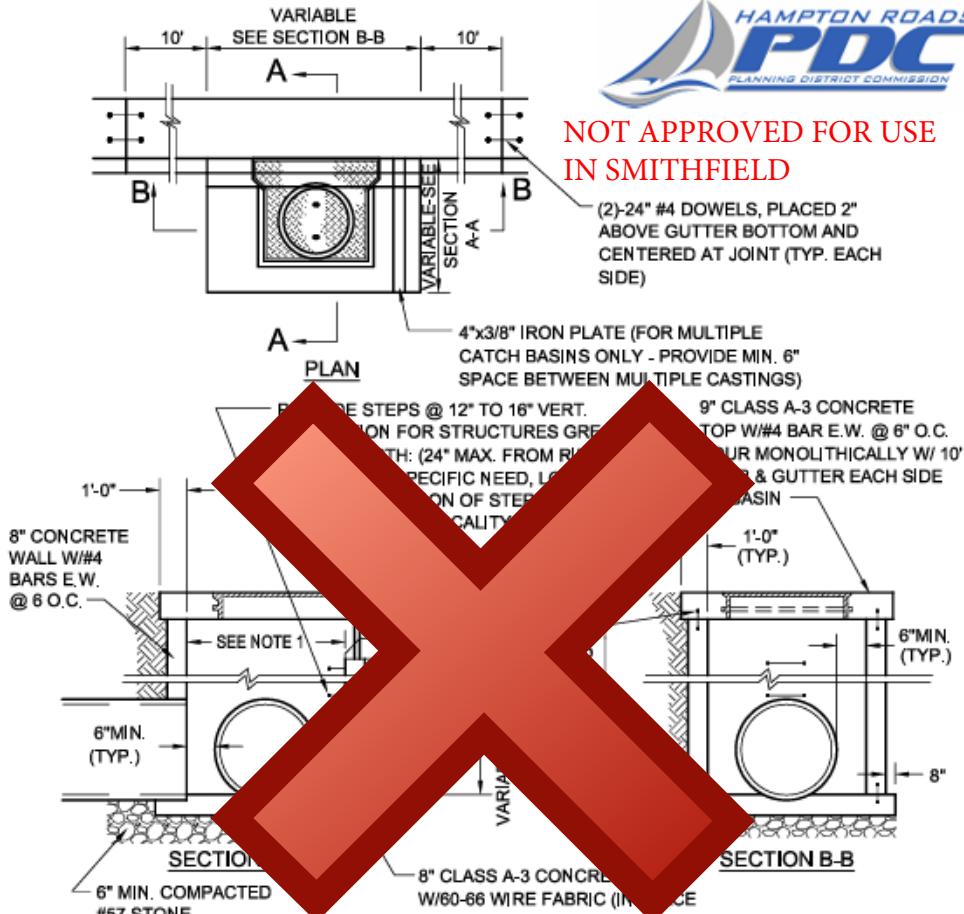
VDOT

ROAD AND BRIDGE STANDARDS

REVISION DATE SHEET 2 OF 2

104.10

NOT APPROVED FOR USE IN SMITHFIELD

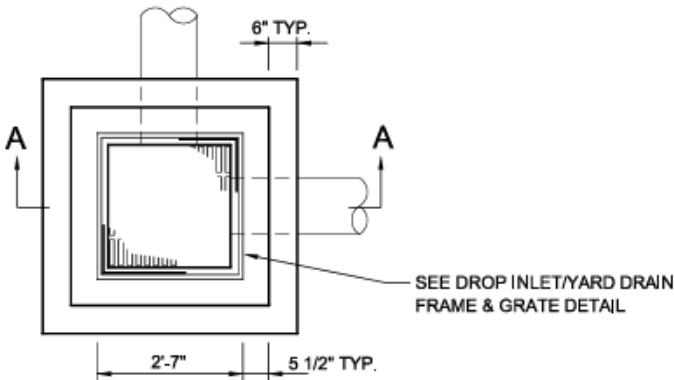


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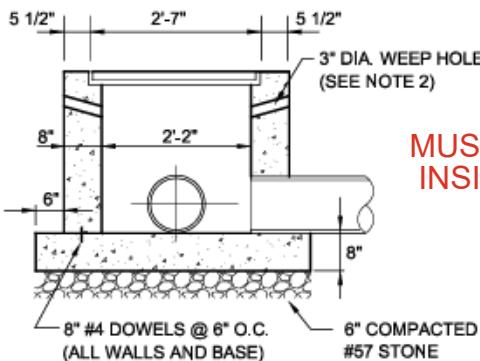
1. THE INTERIOR DIMENSIONS OF THE CATCH BASIN EQUAL 2'-6" FOR PIPE SIZES 12" THRU 18". WHERE THE PIPE SIZE IS 21" THRU 60", THE INTERIOR DIMENSIONS EQUAL 3'-0" OR THE O.D. OF THE PIPE, WHICHEVER IS GREATER, WHEN THE DEPTH DOES NOT EXCEED 4 FEET. IF THE DEPTH IS GREATER THAN 4 FEET, THE INTERIOR DIMENSIONS SHALL BE 4'-0" OR THE O.D. OF THE PIPE, WHICHEVER IS GREATER.
2. REFER TO THE VDOT ROAD AND BRIDGE STANDARDS, LATEST EDITION, - MANHOLE AND INLET SHAPING DETAIL.
3. FOR ALTERNATE PRECAST CONSTRUCTION, REFER TO SECTIONS 200 AND 302.

CURB INLET/CATCH BASIN

NOT TO SCALE



TOP VIEW



SECTION A-A

SEE DS_05, SHEET 2 OF 2 FOR NOTES.

YARD DRAIN

NOT TO SCALE



NOTES:

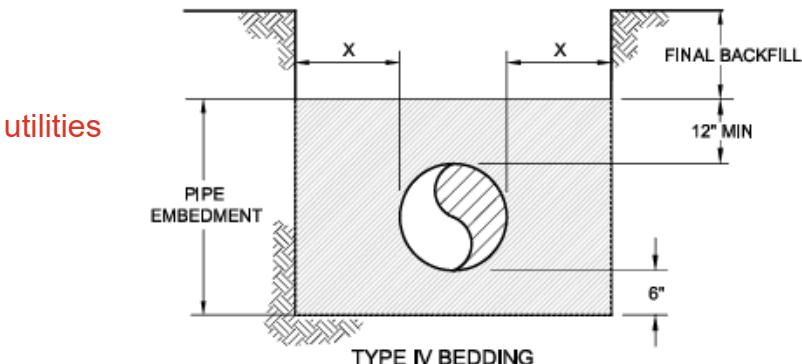
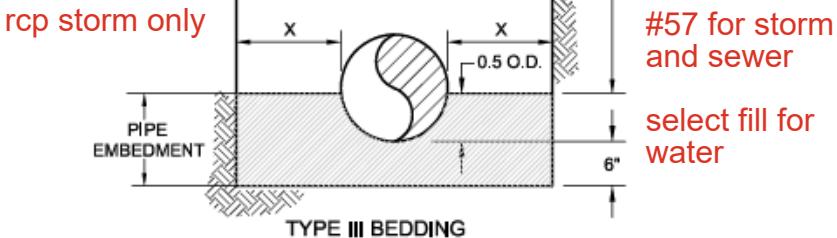
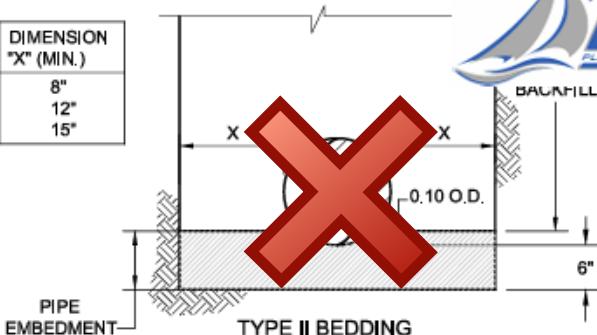
1. 8" CONCRETE WALLS WITH #4 BARS E.W. @ 6" O.C.
2. 3" WEEP HOLE WITH 12"x12" PLASTIC HARDWARE CLOTH, 1/4" MESH OR GALVANIZED STEEL WIRE, MINIMUM WIRE DIAMETER 0.03", NUMBER 4 MESH HARDWARE CLOTH ANCHORED FIRMLY TO OUTSIDE OF STRUCTURE.
3. STEPS THAT ARE ACCESSIBLE SHALL BE REQUIRED FOR DEPTHS OF FOUR FEET OR GREATER. SPECIFIC NEED, LOCATION AND SPECIFICATION OF STEPS TO BE DETERMINED BY LOCALITY.
4. ALL CAST IN PLACE CONCRETE TO BE CLASS A-3.
5. REFER TO THE VDOT ROAD AND BRIDGE STANDARDS, LATEST EDITION, - MANHOLE AND INLET SHAPING DETAIL
6. PRECAST STRUCTURES MAY BE USED WHERE APPROVED BY THE LOCALITY.
7. FOR ALTERNATE PRECAST CONSTRUCTION, REFER TO SECTION 200 AND 302.

YARD DRAIN

NOT TO SCALE

REFERENCE 200,302	CATEGORY DRAINAGE STRUCTURES	DATE 6/16	sheet No. 2 OF 2	DETAIL No. DS_05
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PIPE SIZE	DIMENSION "X" (MIN.)
0"-24"	8"
27"-36"	12"
42"-72"	15"



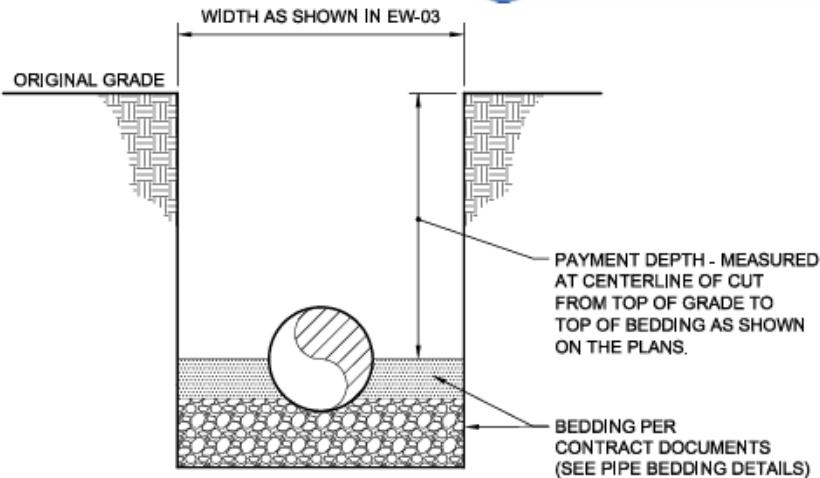
PIPE BEDDING DETAILS

NOT TO SCALE

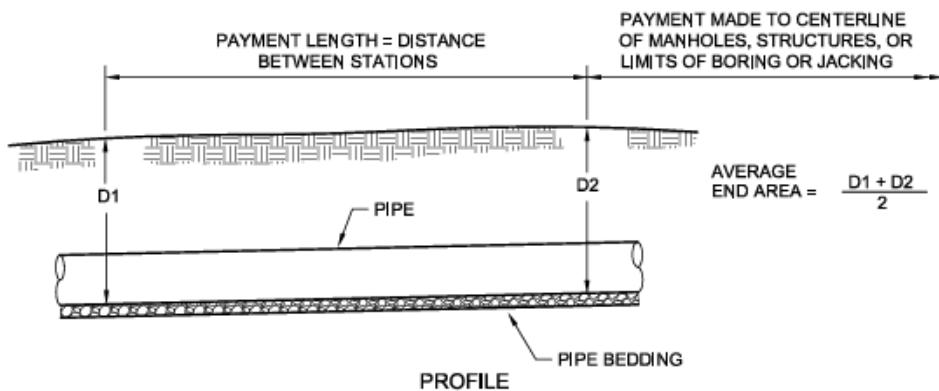


NOTES:

1. THESE BEDDING DETAILS ARE NOT INTENDED FOR THERMOPLASTIC STORM DRAINAGE PIPE
2. BEDDING MATERIAL TO BE APPROVED BY LOCALITY BEFORE USE.
3. TRENCH BOTTOM TO BE FREE OF WATER BEFORE PLACING BEDDING.
4. SHAPE RECESSES FOR BELL OF PIPE BY HAND.
5. BACKFILL ABOVE BEDDING WITH SPECIFIED BACKFILL MATERIAL. SEE SPECIFICATIONS SECTION 303.
6. REFER TO CONTRACT DOCUMENTS FOR TYPE OF BEDDING.
7. MINIMUM TRENCH WIDTH SHALL CONFORM TO PIPE MANUFACTURER'S RECOMMENDATIONS IF MORE STRINGENT.
8. TRENCH BOX OR OTHER SHORING METHODS SHALL NOT DISTURB PIPE EMBEDMENT AND BEDDING MATERIAL AFTER COMPACTION.
9. BEDDING SHALL BE INCLUDED IN THE PRICE OF THE PIPE UNLESS OTHERWISE INDICATED.



SECTION



SEE EW_02, SHEET 2 OF 2 FOR NOTES.

PAYMENT LIMITS
TRENCH EXCAVATION AND BACKFILL

NOT TO SCALE

NOTES:

1. PAYMENTS SHALL BE MADE USING THE AVERAGE END AREA METHOD AT THE UNIT COST PER FOOT, AT AVERAGE DEPTHS, AT 25' STATIONS BASED ON PLAN GRADES.

EXAMPLE: D1 = 10.5 FT., D2 = 7.3 FT.

$$\frac{D1 + D2}{2} = \frac{10.5 + 7.3}{2} = \frac{17.8}{2} = 8.9 \text{ FT.}$$

PAYMENTS WOULD BE MADE AT THE UNIT PRICE BID FOR 8' TO 10' DEPTH FOR THIS 25 FOOT SECTION OF TRENCH EXCAVATION AND BACKFILL.

2. IN THE EVENT THE PAYMENT DEPTH SHALL EQUAL THE UPPER LIMIT OF PAYMENT CLASSIFICATION, PAYMENT WILL BE MADE AT THE LOWEST DEPTH UNIT PRICE (e.g. PAYMENT DEPTH = 10 FT.: PAYMENT WILL BE MADE AT THE UNIT PRICE FOR 8' TO 10' DEPTH, NOT AT THE UNIT PRICE FOR 10' TO 12' DEPTH).
3. FOR PIPE DIAMETERS 36-INCHES AND GREATER, DEDUCT THE DISPLACEMENT VOLUME OF THE PIPE FROM THE CALCULATED TRENCH VOLUME OF SELECT MATERIAL BACKFILL TO BE PLACED.

PAYMENT LIMITS
TRENCH EXCAVATION AND BACKFILL

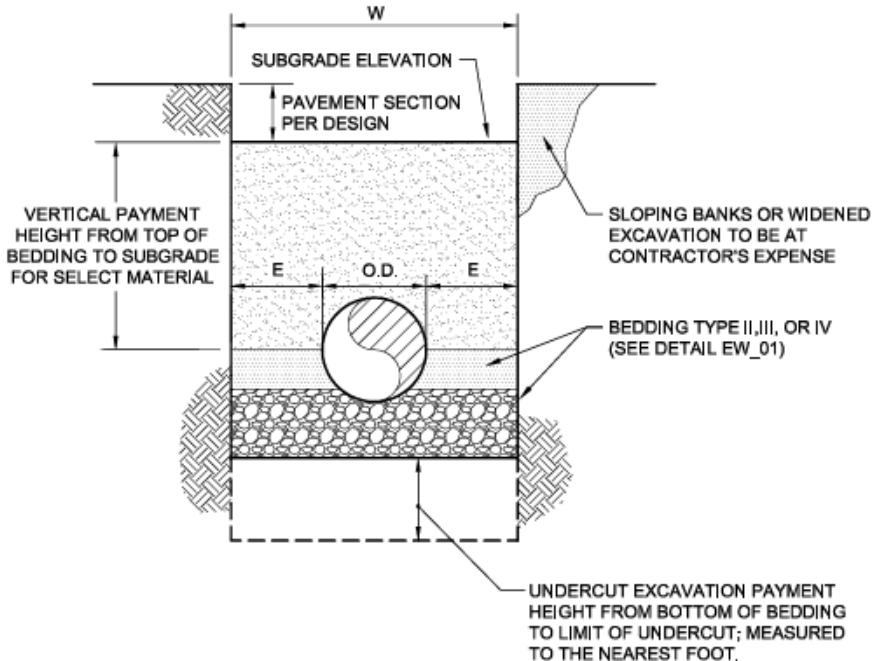
NOT TO SCALE

REFERENCE	CATEGORY	DATE	SHEET No.	DETAIL No.
200,303	EARTHWORK	6/16	2 OF 2	EW_02

PIPE SIZE	DIMENSION "E"
0"-24"	8"
27"-36"	12"
42"-72"	15"

DEPTH (FT.)	DIMENSION "W"
0-4.99	2' OR O.D.+2E
5-9.99	4' OR O.D.+2E
10-13.99	5' OR O.D.+2E
14-20	7' OR O.D.+2E
OVER 20	SPECIAL DESIGN - SEE CONTRACT DOCUMENTS

- WIDTH FOR COMPUTING QUANTITIES OF SELECT FILL AND UNDERCUT (CONTINGENT ITEMS)
- FOR CONTINGENT ITEMS, "W" SHALL BE THE GREATER OF THE TWO DIMENSIONS LISTED.



SEE EW_03, SHEET 2 OF 2 FOR ADDITIONAL NOTES.

TRENCH WIDTH DETAIL FOR PAYMENT OF CONTINGENT ITEMS

NOT TO SCALE



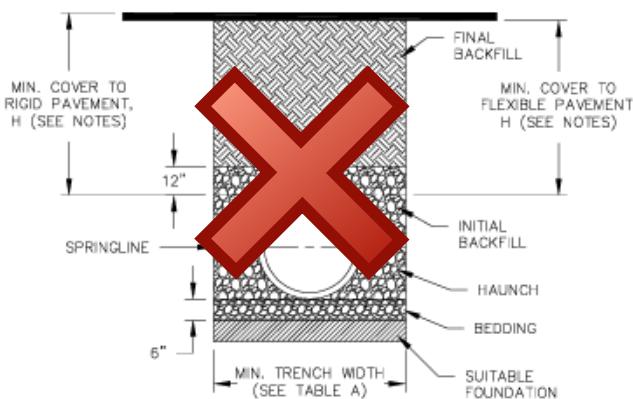
NOTES:

1. "W" = MAXIMUM PAYMENT WIDTH FOR CONTINGENT ITEMS IN TRENCH EXCAVATION.
2. VOLUMES TO BE CALCULATED BY AVERAGE END AREA METHOD AS DESCRIBED IN EW_02 AND WIDTH ("W") AS DETERMINED IN EW_03.
3. NO ADDITIONAL PAYMENT WILL BE MADE FOR EXTRA WIDTH TO ACCOMMODATE MANHOLES OR OTHER APPURTENANCES.
4. MEASUREMENT OF LENGTH TO BE ALONG CENTERLINE OF PIPE FROM START TO FINISH OF CONTINGENT ITEM.
5. CONTINGENT ITEMS INCLUDE SELECT MATERIAL, SELECT BEDDING AND UNDERCUT EXCAVATION.
6. TONNAGE FOR CONTINGENT ITEMS SHALL BE COMPUTED USING THE UNIT WEIGHTS AS SPECIFIED FOR THE TYPE OF MATERIAL WITH VOLUMES DERIVED AS FOLLOWS:
#57 STONE = 100 LBS./CUBIC FOOT
#21A, 21B, OR 26 STONE = 138 LBS./CUBIC FOOT
SAND (VDOT GRADE A) = 110 LBS./CUBIC FOOT

**TRENCH WIDTH DETAIL FOR
PAYMENT OF CONTINGENT ITEMS**

NOT TO SCALE

REFERENCE	CATEGORY	DATE	SHEET No.	DETAIL No.
200,303	EARTHWORK	6/16	2 OF 2	EW_03



HDPE not approved for use in Smithfield ROW

TABLE B - RECOMMENDED MAXIMUM HEIGHT OF COVER

PIPE DIAMETER INCHES	AREA SQ. FT.	MAXIMUM HEIGHT OF COVER FEET
12	0.8	21
15	1.2	21
18	1.8	20
24	3.1	20
30	4.9	19
36	7.1	18
42	7.1	18
48	7.1	17

TABLE C - RECOMMENDED MINIMUM HEIGHT OF COVER DURING CONSTRUCTION

PIPE DIAMETER	MINIMUM COVER HEIGHT DURING CONSTRUCTION
12" TO 30"	18"
36" AND ABOVE	1/2 DIAMETER

TABLE A - RECOMMENDED MINIMUM TRENCH WIDTHS

PIPE DIAM.	MIN. TRENCH WIDTH
4"	21"
6"	23"
8"	26"
10"	28"
12"	30"
15"	34"
16"	39"
24"	48"
30"	56"
36"	64"
42"	72"
48"	80"
54"	88"
60"	96"

TABLE D - MINIMUM RECOMMENDED COVER BASED ON RAILWAY LOADING CONDITIONS **

PIPE DIAM.	COOPER E-80***
UP TO 24"	24"
30"-36"	36"
42"-60"	48"

** COVER IS MEASURED FROM TOP OF PIPE TO BOTTOM OF RAILWAY TIE.

*** E-80 COVER REQUIREMENTS, ARE ONLY APPLICABLE TO ASTM F 2306 PIPE.

TYPICAL TRENCH DETAIL FOR HDPE STORM DRAIN PIPE

NOT TO SCALE

REFERENCE 200, 302, 303	CATEGORY EARTHWORK	DATE 6/16	SHEET No. 1 OF 2	DETAIL No. EW_04
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NOTES:

1. ALL PIPE SYSTEM SHALL BE INSTALLED IN ACCORDANCE WITH THESE SPECIFICATIONS OR AS MODIFIED BY THE OWNER.
2. TRENCH BOX OR OTHER SHORING METHODS SHALL NOT DISTURB THE PIPE BEDDING AND BACKFILL MATERIAL AFTER THEIR COMPACTION.
3. WHERE THE TRENCH BOTTOM IS UNSTABLE, THE CONTRACTOR SHALL STABILIZE TO A DEPTH INDICATED ON THE DRAWINGS OR AS DIRECTED BY THE OWNER. STABILIZATION SHALL BE WITH BEDDING MATERIAL.
4. BEDDING MATERIAL SHALL BE FINE DUSTED STONE OR VDOT AGGREGATE IN CONFORMANCE WITH SPECIFICATIONS AS INDICATED ON THE DRAWINGS OR AS DIRECTED BY THE OWNER. COHESIVENESS SHALL BE AS REQUIRED BY THE OWNER.
5. BACKFILL MATERIAL SHALL BE PLACED IN LAYERS AS INDICATED ON THE DRAWINGS OR AS DIRECTED BY THE OWNER.

 - A. INITIAL BACKFILL: VDOT AGGREGATE IN CONFORMANCE WITH SPECIFICATIONS AS INDICATED ON THE DRAWINGS OR AS DIRECTED BY THE OWNER, SHALL BE PLACED IN LAYERS NOT LESS THAN 12-INCHES ABOVE THE TOP OF THE PIPE. COHESIVENESS SHALL BE IN CONFORMANCE WITH ASTM D2321, LATEST EDITION.
 - B. FINAL BACKFILL: FINAL BACKFILL MATERIAL SHALL BE PLACED IN LAYERS OF 12-INCHES OF BACKFILL UNLESS OTHERWISE INDICATED ON THE DRAWINGS OR AS DIRECTED BY THE OWNER.

6. MINIMUM COVER (H): TRAFFIC APPROPRIATE TO THE LOCALITY, PLACEMENT OF THE PIPE, AND THE BOTTOM OF THE PIPE TO THE SURFACE.
7. NON-ASPHALT COVERS: A MINIMUM COVER IN GRAVEL, DIRT, OR SOIL SHALL BE 12-INCHES FROM THE TOP OF THE PIPE TO THE GROUND SURFACE.
8. ENTRANCES: THE FINISHED COVER IS 9-INCHES FROM THE TOP OF THE PIPE. IF THE PIPE IS LESS THAN OR EQUAL TO 12-INCHES IN PIPE DIAMETERS GREATER THAN 24-INCHES, THE MINIMUM COVER SHALL BE 12-INCHES FROM THE PIPE DIAMETER, WHICHEVER IS GREATER. PLACE THE SURFACE OVER THE TOP OF THE PIPE. IF THE SURFACE WILL BE ASPHALT, A MINIMUM OF 6-INCHES OF SELECT BACKFILL MATERIAL SHALL BE PLACED BETWEEN THE TOP OF THE PIPE AND THE BOTTOM OF THE ASPHALT.

 TYPICAL TRENCH DETAIL FOR HDPE
 STORM DRAIN PIPE

NOT TO SCALE

REFERENCE	CATEGORY	DATE	DETAIL No.
200, 302, 303	EARTHWORK	6/16	2 OF 2 EW_04

REFERENCE 200, 507

STANDARD CHAIN LINK GATE

CATEGORY

DATE 6/16

SHEET No. 1 OF 2

DETAIL No. FE_01

10'-0"

10'-0" MAXIMUM SPACING (TYPICAL)

VARIABLES DOUBLE GATE FOR SINGLE GATE, PLUNGER BAR AND FOUNDATION NOT REQUIRED

4 POINT BARBED WIRE, IF REQUIRED

1 5/8" O.D.

3/8" TRUSS ROD AND TIGHTENER

HEIGHT OF BRACE IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS

3" O.D.

2 1/2" O.D.

CROWN FOR DRAINAGE

2" O.D.

1/2" CLEARANCE

GALV. CHAIN LINK - 2" MESH, 9GG.

TYPICAL CORNER POST

TYPICAL LINE POST

P.C. CONCRETE FILL TYPICAL ALL POST

TYPICAL GATE POST SIZE PER MANUFACTURERS RECOMMENDATIONS

** MIN. DIA. = 4xDIA. OF POST. SIZE OF CONCRETE FILL REQUIRED FOR CORNER POSTS, POSTS AND GATE POST SHALL BE PER MANUFACTURERS RECOMMENDATIONS. GATE POST FOUNDATIONS SHALL BE 3'-6" TO BOTTOM OF POST FOR GATES 12' AND WIDER.

TYPICAL CHAIN LINK FENCE & GATE DETAIL

NOT TO SCALE

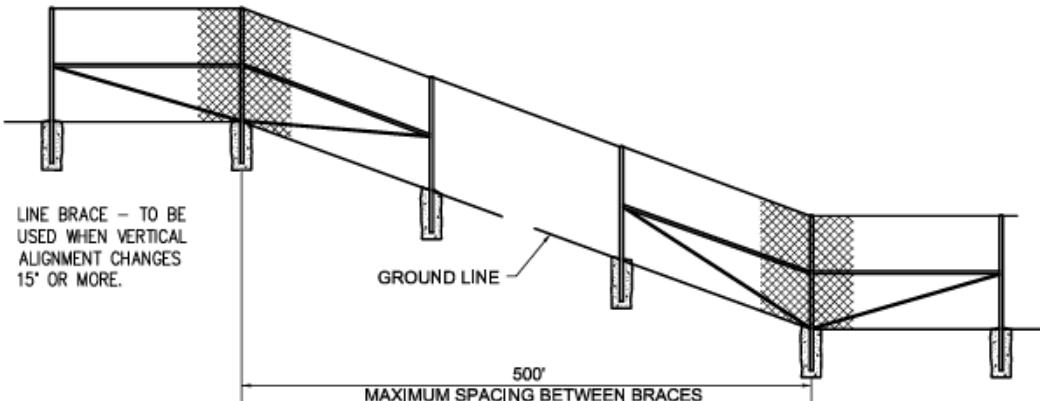
NOTES:

1. FABRIC SHALL BE TIED TO TOP AND BOTTOM OF FRAME WITH 11 GAGE WIRE (MIN.).
2. ALL FOOTINGS SHALL BE CLASS A3 CONCRETE.
3. BARBED WIRE AND EXTENSION POSTS TO BE PROVIDED ONLY WHEN SHOWN ON DRAWINGS OR INDICATED IN SPECIAL PROVISIONS.
4. UNLESS OTHERWISE INDICATED ON DRAWINGS OR IN SPECIAL PROVISIONS, GATE COMPONENTS ARE TO BE GALVANIZED IN ACCORDANCE WITH SECTION 200.
5. FOR GATES 6'-0" IN WIDTH AND WIDER, ROLLED FORMED STEEL SHALL NOT BE USED.

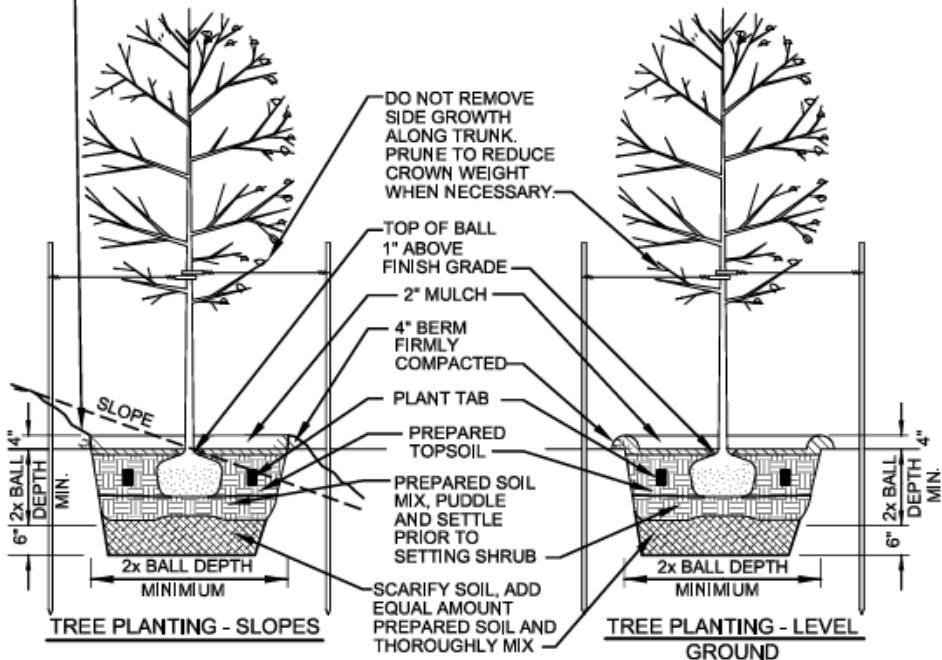
HAMPTON ROADS
PLANNING DISTRICT COMMISSION
PDC

TOP AND BOTTOM
SELVAGE TO BE
BARBED

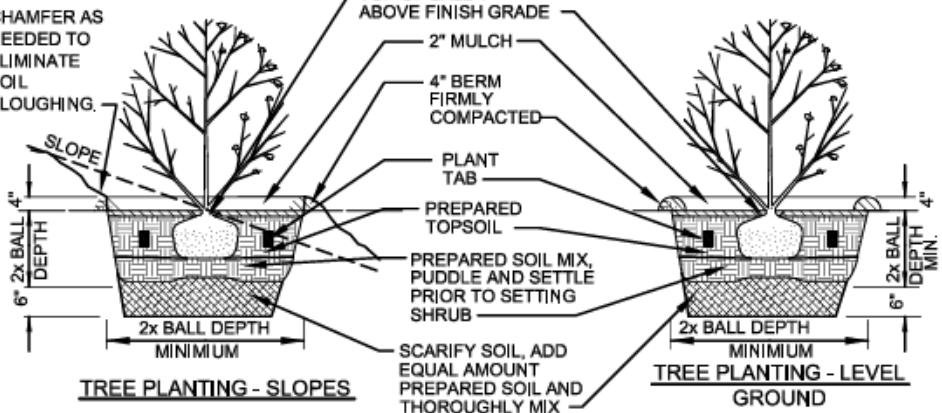
- NOTES:
1. A MOISTURE-EXCLUDING CAP IS REQUIRED ON TUBULAR POSTS.
 2. MATERIAL FOR CAP SHALL CONFORM TO THE ALLOWABLE TYPES FOR OTHER LISTED FILLINGS.
 3. CORNER BRACE - TO BE USED WHEN HORIZONTAL ALIGNMENT CHANGES 15° OR MORE.
 4. SEE END BRACE SHOWN ABOVE FOR BRACE DETAILS.
 5. WIRE FABRIC SHALL HAVE 2" MESH UNLESS OTHERWISE SHOWN ON THE PLANS.

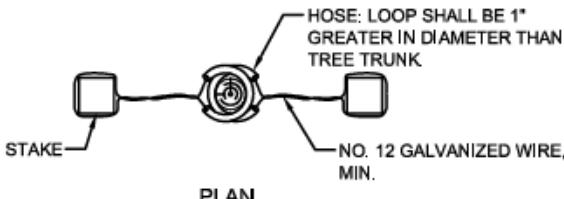
TENSION WIRE #7 GAUGE
GALVANIZED COIL SPRING
WIRE STRETCHED TAUT.HEIGHT OF BRACE IN
ACCORDANCE WITH
MANUFACTURER'S
SPECIFICATIONS#6 GAUGE CLAMPS
TO BE USED TO
ATTACH FABRIC TO
"H" COLUMNS (6
PER POST.)ONE TENSION WIRE
CLIP EACH LINE
POST (#6 GAUGE.)ATTACH FENCE
FABRIC TO TENSION
WIRE WITH
HOG-RINGS
APPROXIMATELY
24" C-C.3/8" MIN. ROUND
ROD WITH TURNBUCKLEGROUND LINE-
2" MAX
CLEARANCE10'-0" TYPICAL SPACING
BETWEEN ALL LINE POST10'-0" TYPICAL SPACING
BETWEEN ALL LINE POST

CHAMFER AS
NEEDED TO
ELIMINATE SOIL
SLOUGHING.

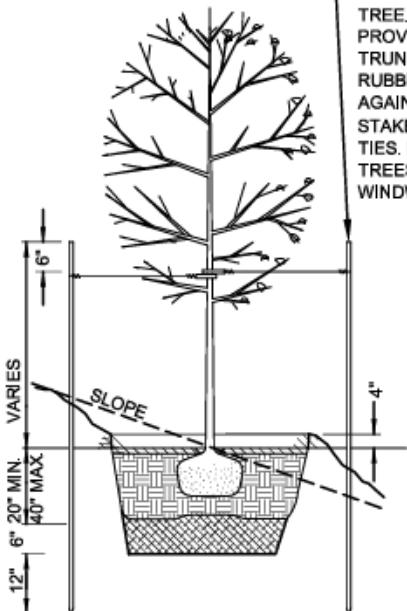


CHAMFER AS
NEEDED TO
ELIMINATE
SOIL
SLOUGHING.

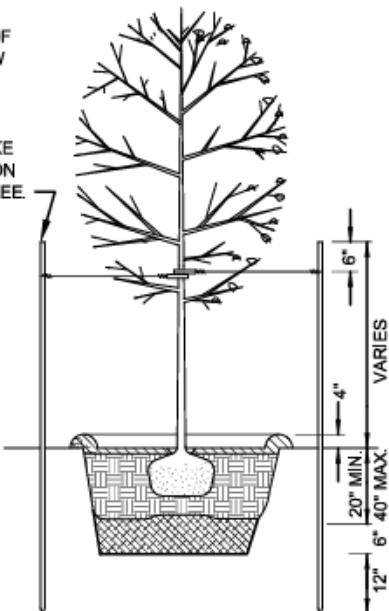




2 STAKES AND TIES. TIE TREE TRUNK 6" ABOVE BENDING MOMENT OF TREE. TIE SHOULD PROVIDE FLEXIBILITY OF TRUNK BUT NOT ALLOW RUBBING OF TRUNK AGAINST STAKE. CUT STAKES OFF 6" ABOVE TIES. FOR SINGLE STAKE TREES, PLACE STAKE ON WINDWARD SIDE OF TREE.



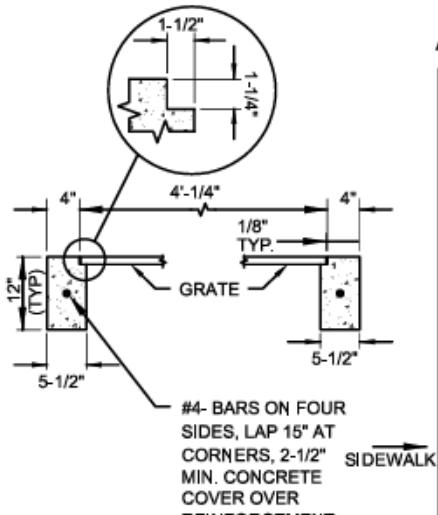
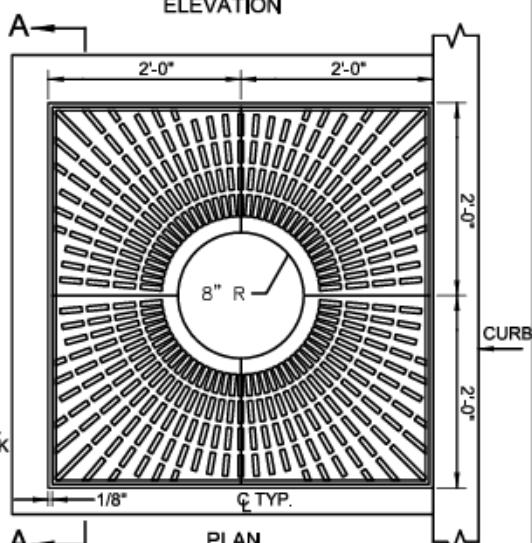
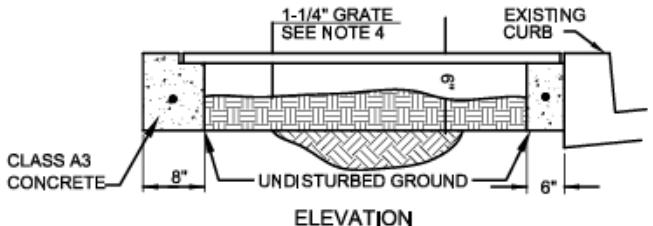
TREE STAKING - SLOPES



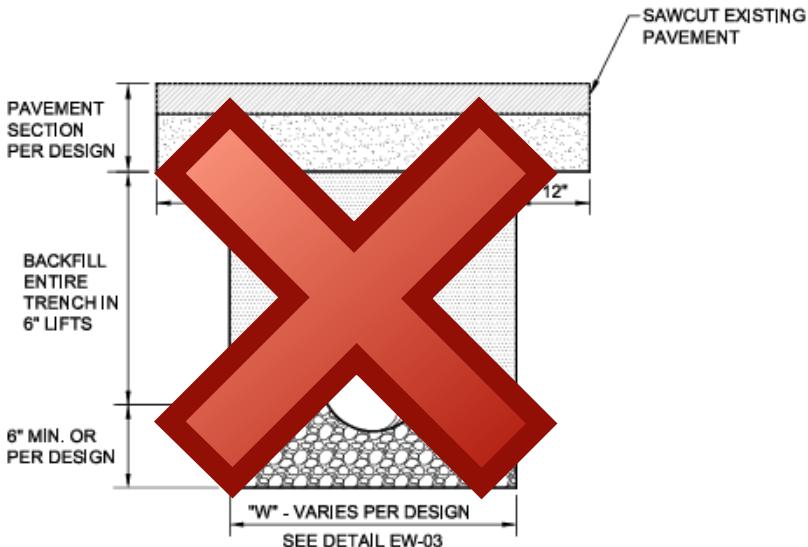
TREE STAKING - LEVEL GROUND


NOTES

1. THE LOCATION AND SPECIES OF EACH TREE SHALL HAVE PRIOR APPROVAL OF THE OWNER.
2. SIDEWALK TO BE REMOVED FOR EACH TREE PLANTING SHALL BE SAW CUT FULL DEPTH.
3. FILL BELOW GRATE WITH 3/4"x #7 OR #78 CLEAN CRUSHED STONE. IF THE GRATE IS USED FOR SECURITY, ALL BOLTS, NUTS AND WASHERS SHALL BE HOT DIPPED GALVANIZED AFTER FABRICATION.
4. GRATE SHALL BE TWO SEPARATE PIECES, 2'x4' IN SIZE, UNLESS OTHERWISE SPECIFIED ON THE PLANS. SLOT OPENINGS IN GRATE DESIGN SHALL HAVE 3/8" MAXIMUM WIDTH. GRATES ARE TO BE DESIGNED IN ACCORDANCE WITH THE LATEST EDITION OF THE UNIFORM BUILDING CODE, WITH A MINIMUM UNIFORM LIVE LOAD OF 250 POUNDS PER SQUARE FOOT IN SIDEWALKS, AND HAVE A METHOD OF SYMMETRICAL INTERIOR EXPANDABLE RINGS/ OPENINGS (DETAILED ON THE PLANS) AS SELECTED AND APPROVED BY THE OWNER.
5. IMMEDIATE NOTIFICATION SHALL BE GIVEN TO THE OWNER OF ANY BELOW GRADE IMPROVEMENTS ENCOUNTERED.

TREE SIZE

SECTION A-A


NOT APPROVED FOR USE IN SMITHFIELD
USE LUP-OC



NOTES:

1. BACKFILL TO BE PLACED AND COMPACTED ACCORDING TO SPECIFICATIONS SECTION 303 AND SECTION 305.
2. BACKFILL MATERIAL PER SPECIFICATIONS SECTION 200.
3. TACK COAT SHALL BE APPLIED ON VERTICAL SURFACES WHERE THE NEW PAVEMENT ABUTS EXISTING PAVEMENT.

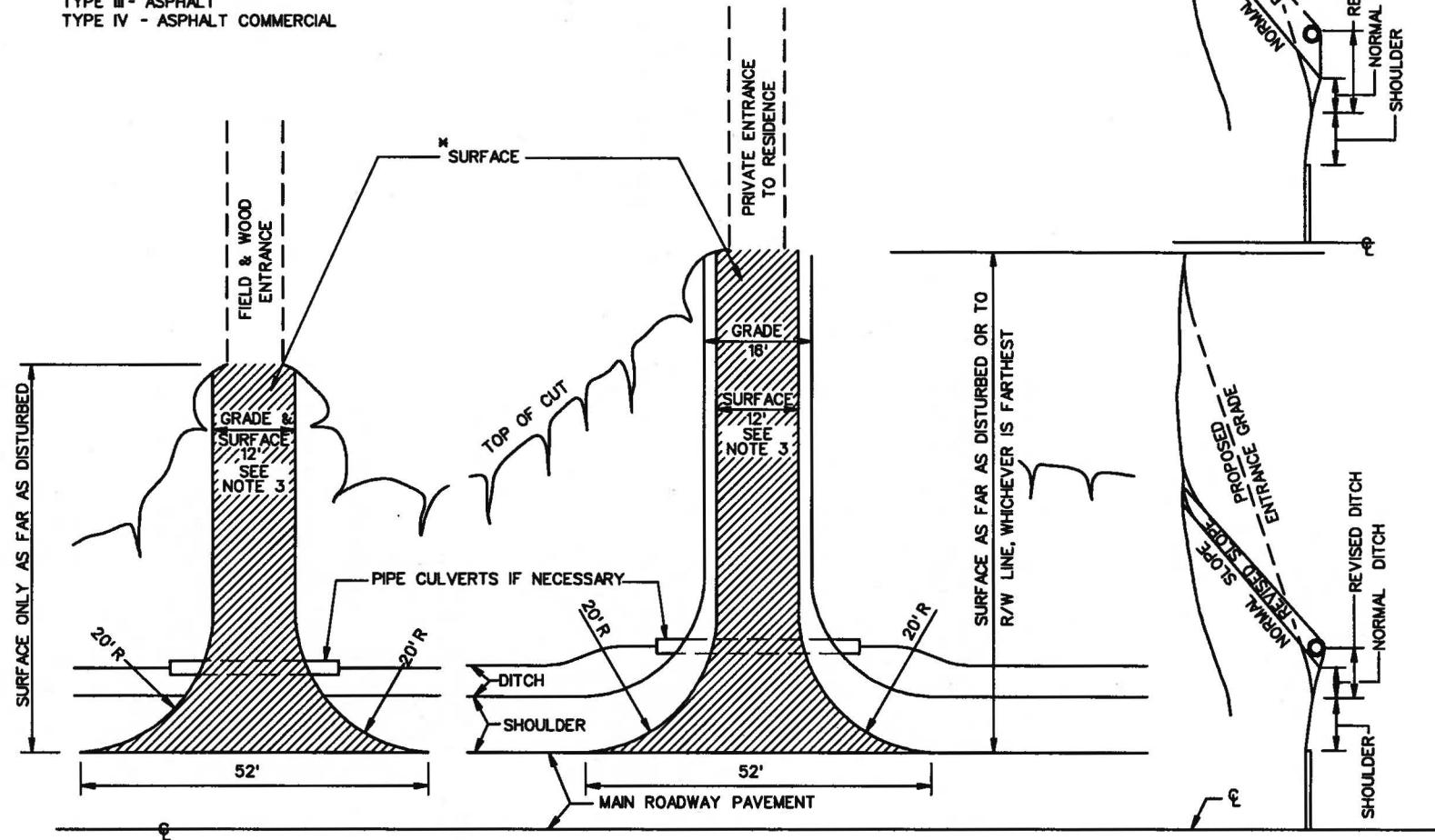
**PAVEMENT PATCHING DETAIL
FOR FLEXIBLE PAVEMENT**

NOT TO SCALE

REFERENCE 200,303,309,310,313,315	CATEGORY ROADWAY CONSTRUCTION	DATE 6/16	SHEET No. 1 OF 1	DETAIL No. RC_01
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* TO BE DETERMINED BY THE EXISTING CONDITIONS
AT THE TIME OF CONSTRUCTION

TYPE I - CRUSHER RUN AGGREGATE
TYPE II - CONCRETE
TYPE III - ASPHALT
TYPE IV - ASPHALT COMMERCIAL



NOTES:

1. ALL ENTRANCE GRADES SHALL START BACK OF THE SHOULDER LINE. IF DRAINAGE IS NECESSARY, THE DITCH MAY BE MOVED BACK TO PROVIDE AT LEAST 9" OF COVER OVER PIPE, AS SHOWN IN THE ALTERNATE METHODS FOR PLACING PIPE UNDER ENTRANCES DIAGRAM.
2. ENTRANCE GRADES ARE TO BE SMOOTHLY TIED INTO THE ROADWAY BY ROUNDING AS NECESSARY.
3. 12' OR EXISTING WIDTH WHICHEVER IS GREATER.
4. LENGTHS OF CULVERTS SHOWN ON ROAD PLANS FOR ENTRANCES ARE APPROXIMATE AND SHALL BE ADJUSTED TO OBTAIN ABOVE ROADWAY WIDTHS.
5. ENTRANCES IN FILL TO BE SAME AS ABOVE EXCEPT LOCATION OF CULVERT (WHEN NECESSARY).

SPECIFICATION
REFERENCE

512

STANDARD PRIVATE ENTRANCES

VIRGINIA DEPARTMENT OF TRANSPORTATION

VDOT
ROAD AND BRIDGE STANDARDS
REVISION DATE 602.02
SHEET 1 OF 1

VDOT Virginia Department
of Transportation
LAND USE PERMIT
LUP-OC
Open-Cut Pavement Restoration Requirements

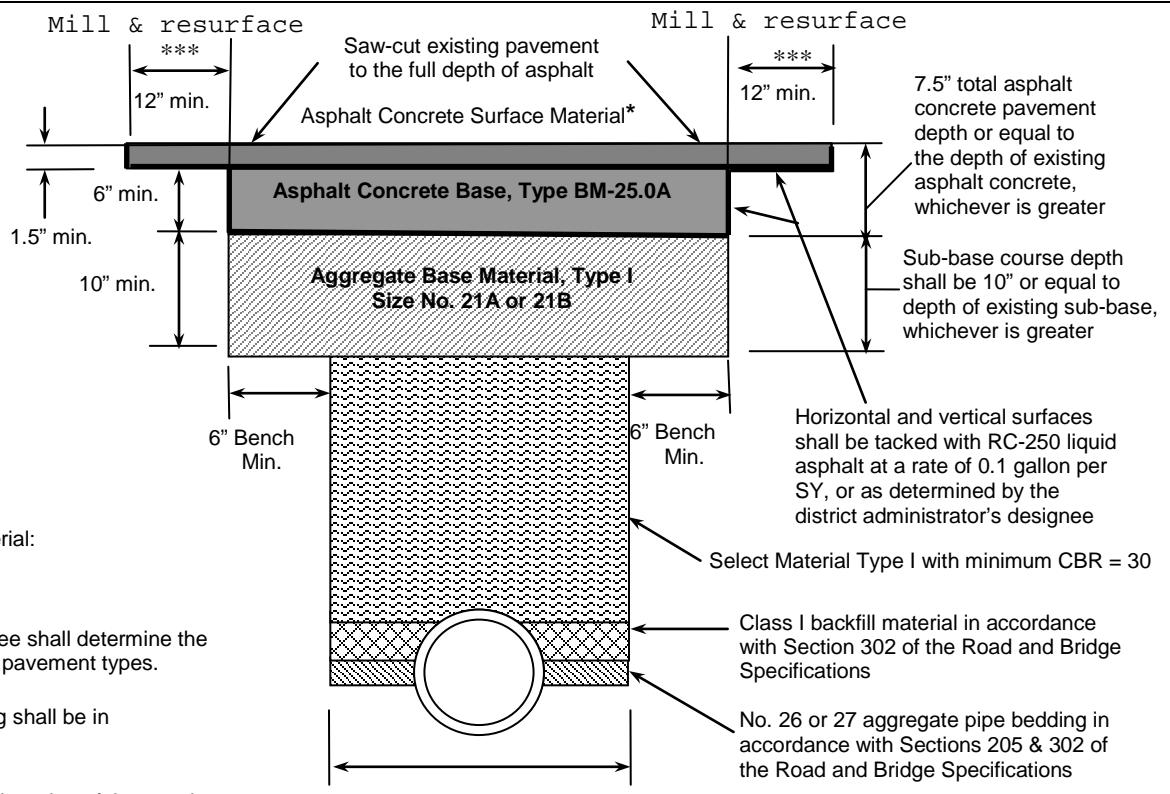
Any of the following provisions that may apply, shall apply:

1. The permittee shall be responsible for the restoration of pavement on state maintained highways in accordance with all applicable sections of the VDOT Road and Bridge Specifications, VDOT Road and Bridge Standards and this document.
2. Whenever existing pavement is permitted to be cut, not over one-half of the roadway width shall be disturbed at one time and the first open cut trench section shall be satisfactorily restored to allow for the passage of traffic prior to the second half of the roadway surface can be disturbed.
3. All trench backfill material shall be Select Material Type I having a minimum CBR of 30 and free from any wood, decaying material, asphalt, concrete, ice, frost, large clods, stone or debris.
4. Trench backfill material shall be compacted to a minimum of 95% of the theoretical maximum density at optimum moisture content, as determined by VDOT testing procedures (VTM1), using mechanical tamping throughout the depth of the trench in 6-inch lifts to ensure that the adequate support is provided for the aggregate sub-base layer is adequately supported.
5. For roadways with a bituminous concrete asphalt pavement section the compacted trench backfill shall be capped with 10 inches (10") of Type I, Size 21-A or 21-B aggregate compacted to 100% of the theoretical maximum density at optimum moisture content covering the entire trench width and a minimum six inch (6") bench on each side of the excavated trench or as determined by the district administrator's designee.
6. A bituminous concrete asphalt base course (BM-25) having a minimum thickness of six inches (6"), or matching the existing base course thickness, shall be placed over the benched aggregate sub-base to the bottom elevation of the existing asphalt concrete surface course.
7. All sides of the excavated trench shall be saw-cut trimmed to neat straight lines and a tack coat of RC-250 liquid asphalt applied at a rate of 0.1 gallon per square yard (or as determined by the district administrator's designee) prior to placing the bituminous concrete asphalt base course (BM-25.0) and/or replacement of the bituminous concrete asphalt surface course (SM-9.5A or SM-9.5D).
8. The existing pavement surface course adjacent to the excavated trench shall be milled and repaved with bituminous concrete asphalt (SM-9.5A or SM-9.5D) having a minimum thickness of 1-1/2 inches (1.5"). This operation shall cover the entire trench width and extend 12 inches (12") beyond the edge of the trench on longitudinal open cuts and 25 feet (25') beyond the trench centerline on perpendicular open cuts, or as determined by the district administrator's designee.
9. Open cuts in surface treated roadway sections with an aggregate base course shall be replaced with the same layer(s) as roadway sections with a bituminous concrete asphalt pavement structure except the sub-base layer (Type I, Size 21-A or 21-B) may be reduced to six inches (6") and the bituminous concrete asphalt base layer (BM-25.0) may be reduced to four inches (4") while maintaining the required six inch (6") bench on both sides of the excavated trench. The surface course restoration material and thickness shall match the existing surface.
10. Replacement of all bituminous concrete asphalt and surface treated courses shall be rolled with equipment having a manufacturer's rating of ten (10) tons until the aggregate is keyed into the bitumen. Where rolling is not possible, a mechanical tamper shall be utilized.
11. Full depth aggregate stone may be placed in the trench daily up to maximum length of 500 feet, at which time either temporary or permanent pavement restoration procedures must be implemented.

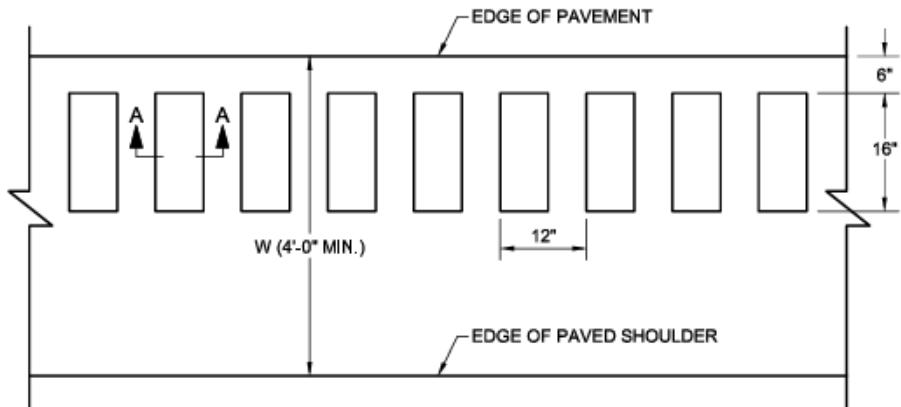
12. Should the application of the bituminous concrete asphalt surface course be delayed due to adverse weather conditions, the contractor shall provide and maintain a temporary pavement section that is acceptable to the district administrator's designee until such time as the appropriate permanent pavement restoration can be achieved.
13. The permittee shall be responsible for any settlement in the backfill or pavement for a period of two (2) years after the completion date of permit and for the continuing maintenance of the facilities placed within the highway right-of-way.
14. A one-year restoration warranty period may be considered, provided the permittee adheres to the following criteria:
 - The permittee retains the services of a professional engineer (or certified technician under the direction of the professional engineer) to observe the placement of all fill embankments, pavement, and storm sewer and utility trench backfill.
 - The professional engineer (or certified technician under the direction of the professional engineer) performs any required inspection and testing in accordance with all applicable sections of VDOT's Road and Bridge Specifications.
 - The professional engineer submits all testing reports for review and approval, and provides written certification that all restoration procedures have been completed in accordance with all applicable sections of VDOT's Road and Bridge Specifications prior to completion of the work authorized by the permit.
15. The district administrator's designee may request and review the backfill compaction test results and/or authorize an inspector to monitor the trench backfill and compaction operations.
16. The use of steel plates to provide a temporary riding surface will not be allowed between November 1 and April 1. The use of steel plates between April 2 and October 31 shall be in accordance with VDOT standards and specifications.
17. Traffic shall be maintained at all times in accordance with the Virginia Work Area Protection Manual and a VDOT approved Maintenance of Traffic (MOT) plan.
18. The permittee shall notify the district administrator's designee a minimum of 72 hours prior to initiating any pavement open cutting operations.
19. The trench to be backfilled shall be made as dry as practicable at the time of backfilling by pumping, bailing, draining, or other approved dewatering method.
20. All asphalt pavement restoration activities shall be in accordance with the Asphalt Pavement Restoration Detail for Open Cut Utility Installations contained herein.

LAND USE PERMIT
LUP-OC
Open-Cut Pavement Restoration Requirements

Asphalt Pavement Restoration Detail for Open Cut Utility Installations

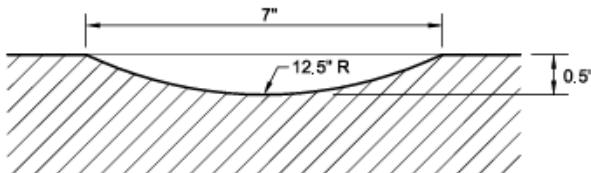


Date: August 27, 2014



W = WIDTH OF PAVED SHOULDER *

PLAN VIEW



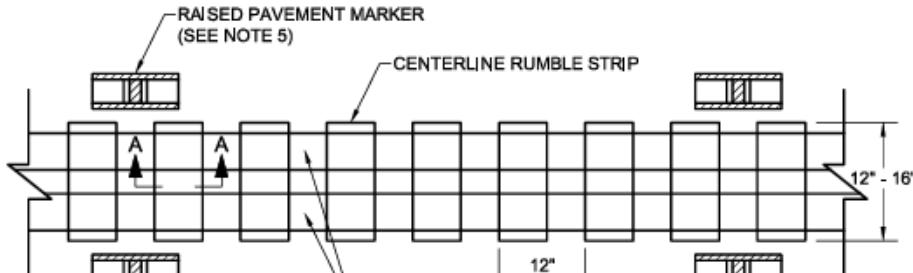
SECTION A-A

NOTES:

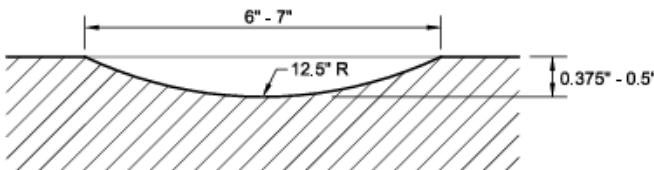
1. RUMBLE STRIPS SHALL BE INSTALLED CONTINUOUSLY AS DIRECTED BY THE OWNER.
 2. RUMBLE STRIPS SHALL NOT BE INSTALLED WITHIN LIMITS OF BRIDGE DRAINAGE APRONS OR SPECIAL DESIGN SHOULDER SLOT INLETS.
 3. RUMBLE STRIPS SHALL BE INSTALLED ON MAINLINE SHOULDERS ONLY.
- * WHERE BICYCLES ARE NOT PROHIBITED, THE MINIMUM WIDTH OF THE OUTSIDE PAVED SHOULDER SHALL BE 8 FT.

CONTINUOUS SHOULDER RUMBLE STRIPS

NOT TO SCALE



PLAN VIEW



SECTION A-A

NOTES:

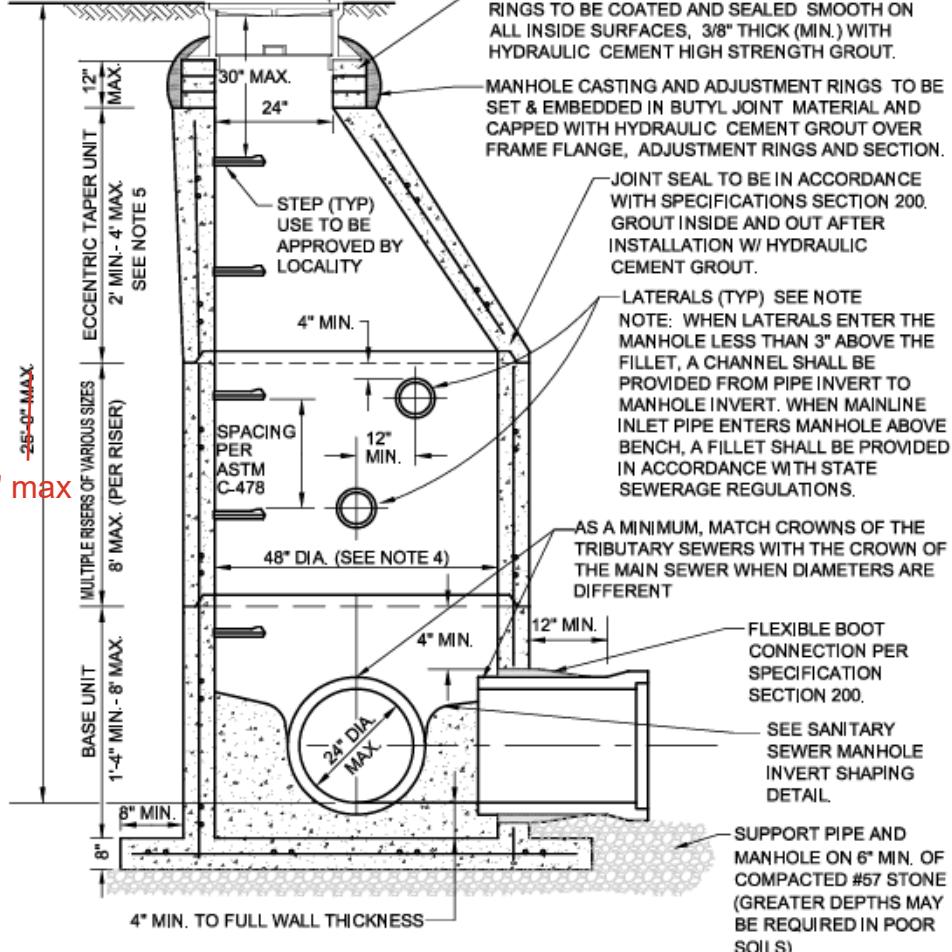
1. CENTERLINE RUMBLE STRIPS SHALL NOT BE INSTALLED WITHIN THE LIMITS OF BRIDGES.
2. CENTERLINE RUMBLE STRIPS SHALL NOT BE INSTALLED ON SUBDIVISION STREETS OR IN NARROW UNMARKED ROAD SECTIONS WITHOUT PAVEMENT MARKINGS.
3. CENTERLINE RUMBLE STRIPS SHALL NOT BE INSTALLED WITHIN THE LIMITS OF CENTER TWO-WAY TURN LANES.
4. CENTERLINE RUMBLE STRIPS SHALL NOT BE INSTALLED IN PASSING ZONES EXCEPT AS DIRECTED BY THE TRAFFIC ENGINEER. THE DEPTH OF CENTERLINE RUMBLE STRIPS IN PASSING ZONES SHALL BE $\frac{3}{8}$ ".
5. USE OF RAISED PAVEMENT MARKERS IS OPTIONAL. SEE VDOT STANDARD PM-9 FOR DETAILS ON RAISED PAVEMENT MARKER PLACEMENT.

CENTERLINE RUMBLE STRIPS

NOT TO SCALE

REFERENCE 200, 315A	CATEGORY ROADWAY CONSTRUCTION	DATE 6/16	DETAIL No. RC_04	SHEET No. 1 OF 1
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SEE SANITARY SEWER MANHOLE
CASTING AND COVER (24") DETAILS



SEE SS_01, SHEET 2 OF 2 FOR NOTES.

STANDARD PRECAST CONCRETE MANHOLE W/ EXTENDED MONOLITHIC BASE

NOT TO SCALE



NOTES:

1. PRECAST CONCRETE MANHOLE TO BE IN COMPLIANCE WITH ASTM C-478.
2. WALL THICKNESS TO BE 5" MINIMUM FOR 48" INSIDE DIAMETER MANHOLES AND 6" MINIMUM FOR 60" INSIDE DIAMETER MANHOLES.
3. INSIDE DIAMETER OF MANHOLE MUST INCREASE TO 60" WHEN MANHOLE DEPTH IS GREATER THAN 12 FEET. 60" DIAMETER TO BE CONTINUOUS UP TO CONE SECTION.
4. MAXIMUM OF FOUR LATERALS PER MANHOLE.
5. IF LATERALS ARE TO ENTER INTO THE ECCENTRIC TAPER UNIT, THEY MUST ENTER ON THE NON-TAPERED SIDE.

13' max depth for sewer

**STANDARD PRECAST CONCRETE
MANHOLE W/ EXTENDED MONOLITHIC BASE**

NOT TO SCALE

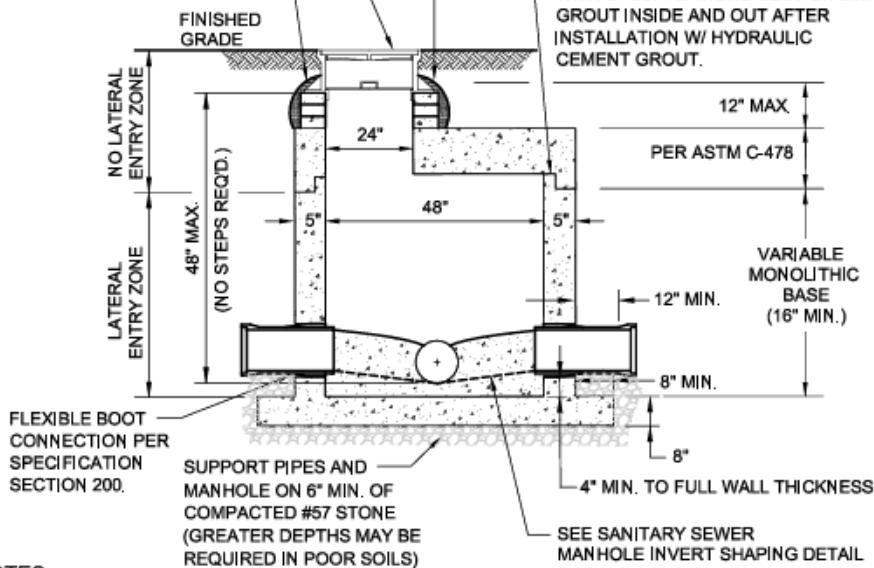
REFERENCE 200,802	CATEGORY SANITARY SYSTEMS	DATE 6/16	DETAIL No. SS_01

SEE SANITARY SEWER
MANHOLE CASTING AND
COVER (24") DETAILS

**PRECAST CONCRETE
ADJUSTMENT RING (TYP)**

RINGS TO BE COATED AND SEALED
SMOOTH ON ALL INSIDE SURFACES,
3/8" THICK (MIN.) WITH HYDRAULIC
CEMENT HIGH STRENGTH GROUT

MANHOLE CASTING AND ADJUSTMENT RINGS
TO BE SET & EMBEDDED IN BUTYL JOINT
MATERIAL AND CAPPED WITH HYDRAULIC
CEMENT GROUT OVER FRAME FLANGE,
ADJUSTMENT RINGS AND SECTION.



NOTES:

1. FLAT TOP CAN BE REPLACED W/ 1'-4" ECCENTRIC SHALLOW CONE IF APPROVED BY LOCALITY.
2. PRECAST MANHOLE TO BE IN COMPLIANCE WITH ASTM C-478.

PRECAST CONCRETE SHALLOW MANHOLE

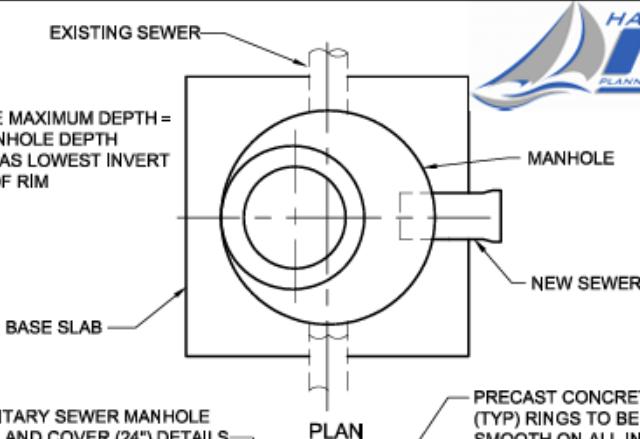
NOT TO SCALE

REFERENCE	CATEGORY	DATE	SHEET No.	DETAIL No.
200,802	SANITARY SYSTEMS	6/16	1 OF 1	SS_02

EXISTING SEWER

NOTE:

MANHOLE MAXIMUM DEPTH =
25'-0" MANHOLE DEPTH
DEFINED AS LOWEST INVERT
TO TOP OF RIM



SEE SANITARY SEWER MANHOLE
CASTING AND COVER (24") DETAILS

PLAN

MANHOLE STEP (TYP)
SPACING PER ASTM C-478

DOGHOUSE TYPE OPENING
RADIUS= 1/2 PIPE O.D. + 2"
TOTAL HEIGHT=PIPE O.D. + 4"

PRECAST CONCRETE
MANHOLE SECTIONS

APPLY WATERSTOP
GROUTING BETWEEN
MANHOLE WALL AND
EXISTING PIPE

CONSTRUCT CONCRETE
CHANNEL AND BENCH IN
FIELD, SEE SANITARY
MANHOLE INVERT SHAPING
DETAIL

FIELD POUR BASE SLAB
UNDER EXISTING SEWER.
REINFORCE W/ #5 REBAR
@ 12" O.C. EACH WAY. ALL
REBAR TO HAVE 1-1/2" MIN.
COVER. CONCRETE TO BE
CLASS A-3.

PRECAST CONCRETE ADJUSTMENT RING
(TYP) RINGS TO BE COATED AND SEALED
SMOOTH ON ALL INSIDE SURFACES, 3/8"
THICK (MIN.) WITH HYDRAULIC CEMENT
HIGH STRENGTH GROUT.

MANHOLE CASTING AND ADJUSTMENT RINGS
TO BE SET & EMBEDDED IN BUTYL JOINT
MATERIAL AND CAPPED WITH HYDRAULIC
CEMENT GROUT OVER FRAME FLANGE,
ADJUSTMENT RINGS AND SECTION.

JOINT SEAL TO BE IN ACCORDANCE
WITH SPECIFICATIONS SECTION 200.
GROUT INSIDE AND OUT AFTER
INSTALLATION W/ HYDRAULIC
CEMENT GROUT.

AS A MINIMUM, MATCH CROWNS OF THE
TRIBUTARY SEWERS WITH THE CROWN
OF THE MAIN SEWER WHEN DIAMETERS
ARE DIFFERENT

12" MIN. FROM INVERT TO TOP
OF FLOOR

4" MIN. TO FULL
WALL THICKNESS

FLEXIBLE BOOT
CONNECTION PER
SPECIFICATION SECTION 200

SUPPORT PIPE AND
MANHOLE ON 6" MIN. OF
COMPAKTED #57 STONE
(GREATER DEPTHS MAY BE
REQUIRED IN POOR SOILS)

SANITARY SEWER STRADDLE MANHOLE

NOT TO SCALE



NOTES:

1. PRECAST MANHOLE TO BE IN COMPLIANCE WITH ASTM C-478.
2. WALL THICKNESS TO BE 5" MINIMUM FOR 48" INSIDE DIAMETER MANHOLES AND 6" MINIMUM FOR 60" INSIDE DIAMETER MANHOLES.
3. INSIDE DIAMETER OF MANHOLE MUST INCREASE TO 60" WHEN MANHOLE DEPTH IS GREATER THAN 12 FEET. 60 INCH DIAMETER TO BE CONTINUOUS UP TO CONE SECTION.

13' max depth for sewer

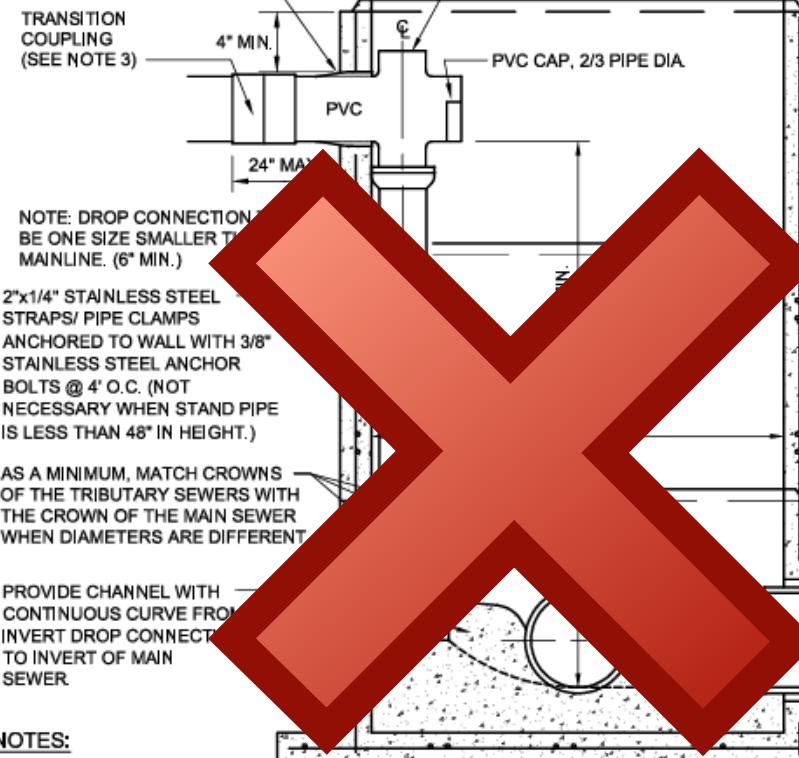
**SANITARY SEWER
STRADDLE MANHOLE**

NOT TO SCALE

REFERENCE 200,802	CATEGORY SANITARY SYSTEMS	DATE 6/16	DETAIL No. SS_03
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FLEXIBLE BOOT
CONNECTION PER
SPECIFICATION
SECTION 200

**NOT APPROVED FOR USE IN SMITHFIELD
USE DETAIL S-3**



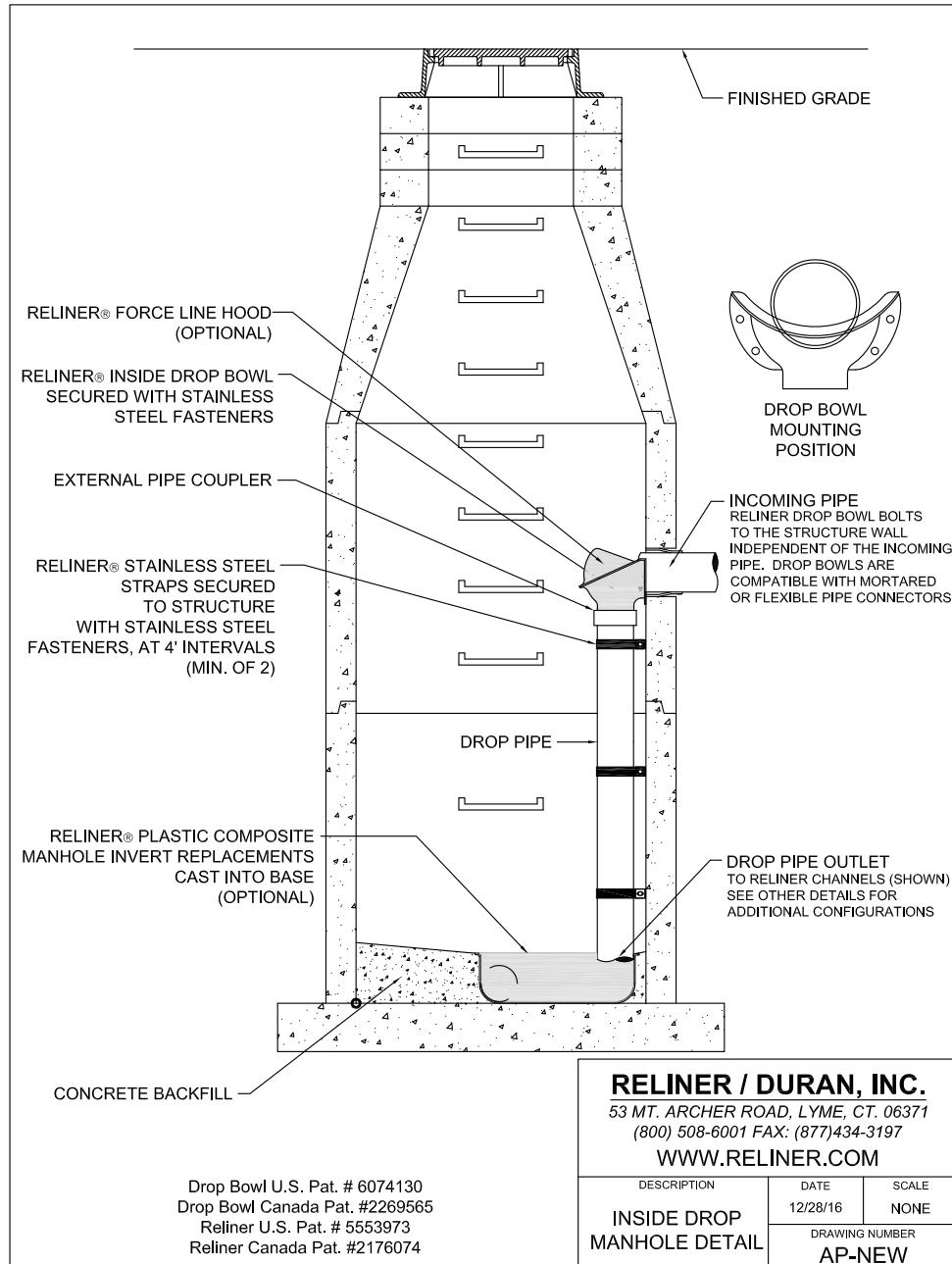
NOTES:

1. INTERIOR DROP TO BE USED IN NEW MANHOLES.
2. SOLVENT WELD JOINTS ON ALL INSIDE PIPING AND FITTINGS.
3. MAINLINE TO PVC DROP CONNECTION SHALL BE MADE WITH APPROVED COUPLING.
4. LOCATION OF DROP CONNECTION SHALL NOT CONFLICT WITH THE LOCATION OF THE MANHOLE STEPS.
5. BOTTOM 90 DEGREE BEND TO BE AT 45 DEGREES WITH RESPECT TO THE DOWNSTREAM FLOW.
6. PRECAST CONCRETE MANHOLE TO BE IN COMPLIANCE WITH ASTM C-478.
7. INTERIOR DROP SHALL BE NO MORE THAN 6 - INCHES FROM MANHOLE WALL.
8. ALL PVC PIPE AND FITTINGS SHALL BE SCHEDULE 40.

SANITARY SEWER INTERIOR DROP MANHOLE

NOT TO SCALE

REFERENCE 200,802	CATEGORY SANITARY SYSTEMS	DATE 6/16	SHEET No. 1 OF 1	DETAIL No. SS_04
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NOTES:

1. INTERIOR DROP TO BE USED IN NEW AND EXISTING MANHOLES.
2. SOLVENT WELD JOINTS ON ALL PIPING AND FITTINGS
3. MAINLINE TO PVC DROP CONNECTION SHALL BE MADE WITH APPROVED COUPLING.
4. LOCATION OF DROP CONNECTION SHALL NOT CONFLICT WITH THE LOCATION OF THE MANHOLE STEPS.
5. BOTTOM BEND TO BE AT 45 DEGREES WITH RESPECT TO THE DOWNSTREAM FLOW.
6. PRECAST CONCRETE MANHOLE TO BE IN COMPLIANCE WITH ASTM C-478.
7. INTERIOR DROP SHALL BE NO MORE THAN 6 INCHES FROM MANHOLE WALL.
8. ALL PVC PIPE AND FITTINGS SHALL BE SCHEDULE 40.
9. RIM AND LID SHALL BE CENTERED OVER THE MANHOLE
10. INSIDE DROP PIPE SHALL EXTEND TO INVERT AND TURN TOWARD THE DIRECTION OF FLOW



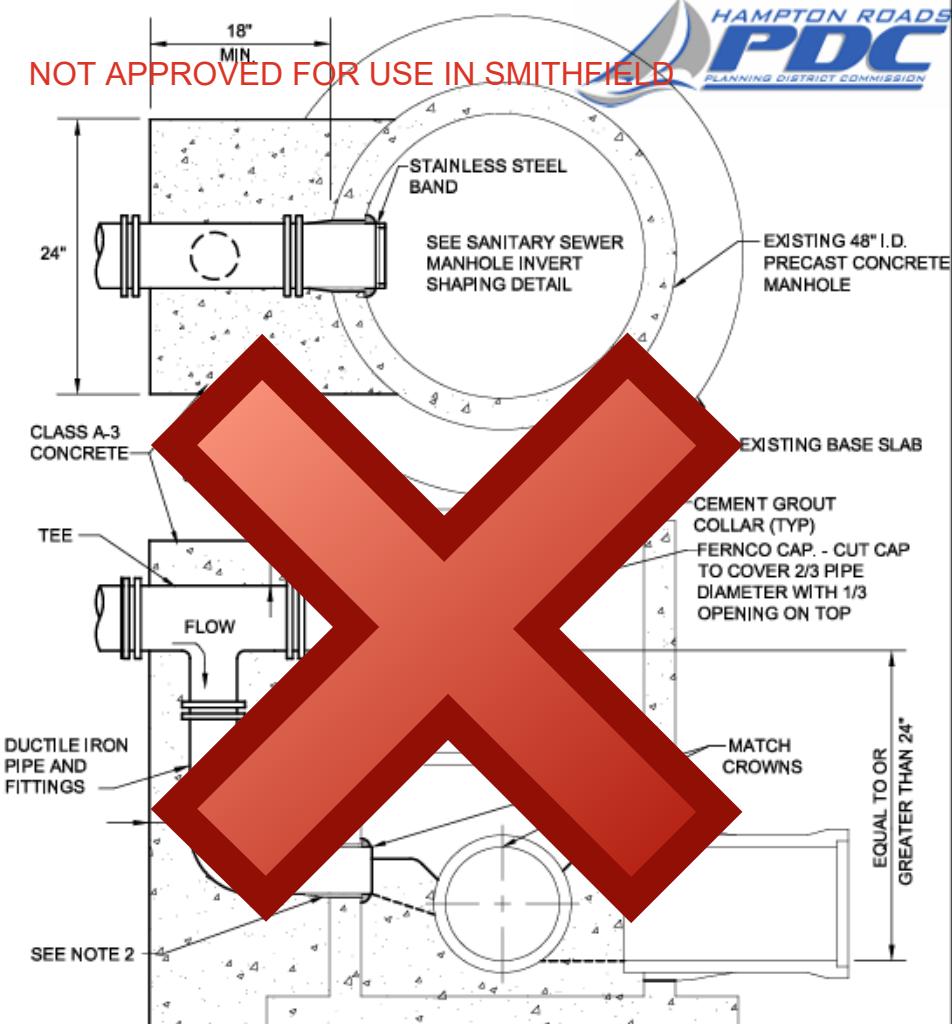
TOWN OF SMITHFIELD
DESIGN AND CONSTRUCTION STANDARDS

SANITARY SEWER INTERIOR
DROP MANHOLE

DWG #: S-3 SCALE: NTS

AUG 2017

NOT APPROVED FOR USE IN SMITHFIELD

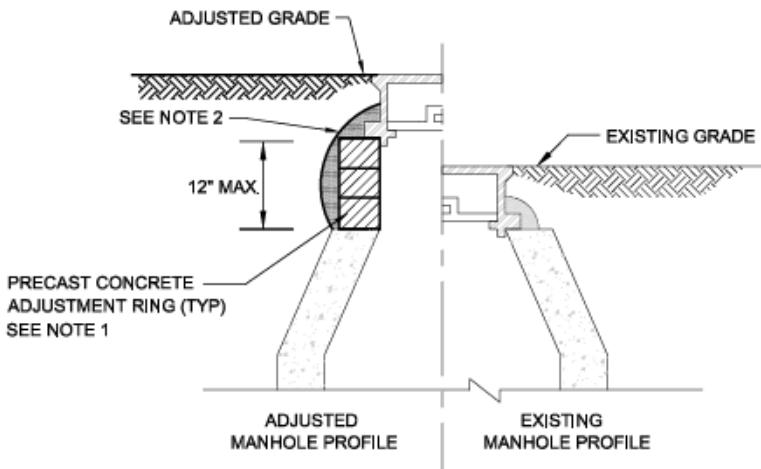


NOTES:

1. PLACEMENT OF DROP NOT TO CONFLICT WITH MANHOLE STEPS.
2. PROVIDE FLEXIBLE BOOT CONNECTION PER SPECIFICATION SECTION 200.

**SANITARY SEWER EXTERIOR DROP MANHOLE
(FOR EXISTING MANHOLE ONLY)**

NOT TO SCALE



NOTES:

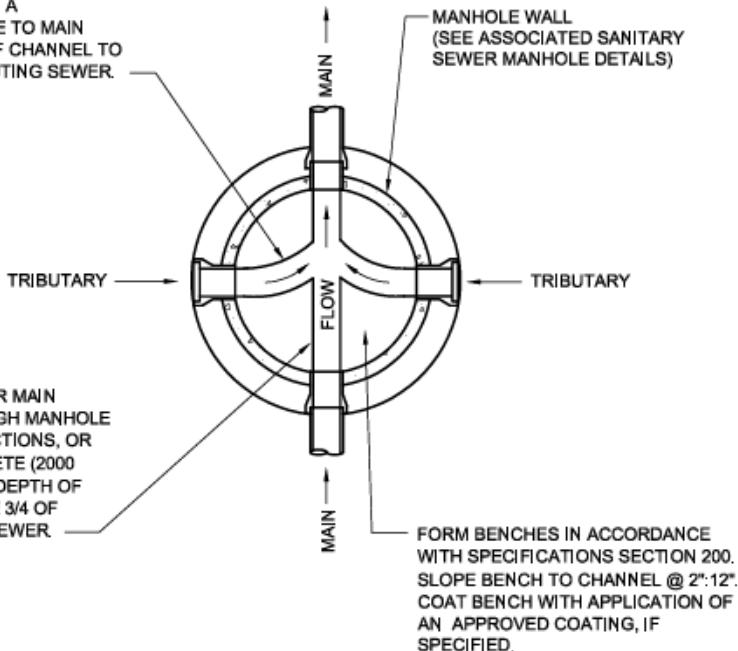
1. RINGS TO BE COATED AND SEALED SMOOTH ON ALL INSIDE SURFACES, 3/8" THICK (MIN.) WITH HYDRAULIC CEMENT HIGH STRENGTH GROUT.
2. MANHOLE CASTING AND ADJUSTMENT RINGS TO BE SET AND IMBEDDED IN BUTYL JOINT MATERIAL AND CAPPED WITH HYDRAULIC CEMENT GROUT OVER FRAME FLANGE, ADJUSTMENT RINGS AND SECTION.
3. FOUNDATION, FOOTING PAD, LOWEST BARREL SECTION OF MANHOLE AND PIPES SHALL REMAIN UNDISTURBED.

SANITARY SEWER MANHOLE ADJUSTMENT

NOT TO SCALE

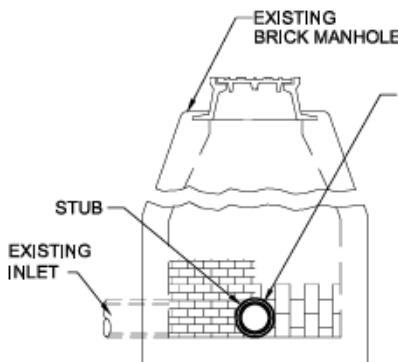
REFERENCE 200,802	CATEGORY SANITARY SYSTEMS	DATE 6/16	SHEET No. 1 OF 1	DETAIL No. SS 06
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FORM TRIBUTARY CHANNELS OF CONCRETE (2000 P.S.I.) (TROWEL FINISH) ON A CONTINUOUS CURVE TO MAIN CHANNEL. DEPTH OF CHANNEL TO BE 3/4 OF CONTRIBUTING SEWER.

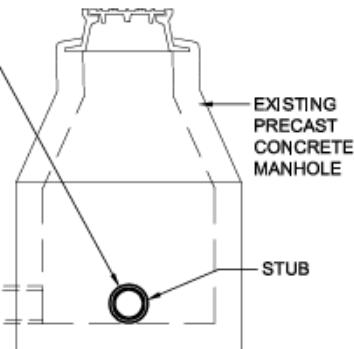
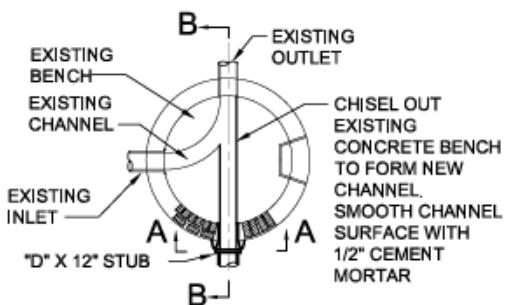
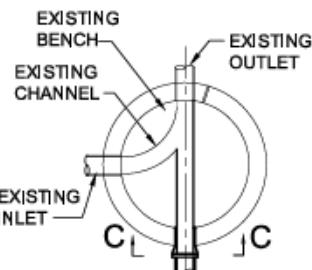
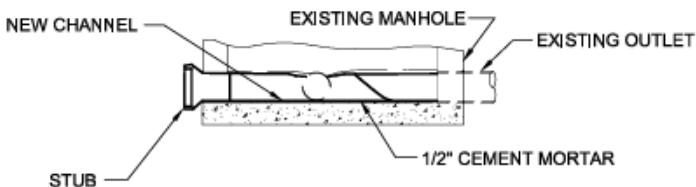


SANITARY SEWER MANHOLE INVERT SHAPING

NOT TO SCALE


SECTION A-A

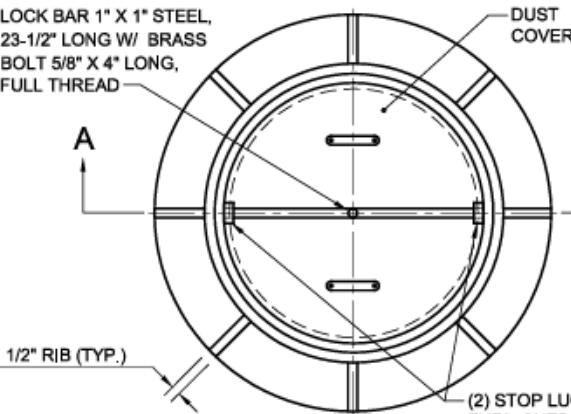
CORE CUT HOLE.
 FASTEN STUB INTO
 HOLE WITH FLEXIBLE
 BOOT CONNECTION PER
 SPECIFICATION
 SECTION 200


SECTION C-C

**BASE PLAN OF
 BRICK MANHOLE**

**BASE PLAN OF
 PRE-CAST MANHOLE**

SECTION B-B

CONNECTION INTO EXISTING MANHOLES

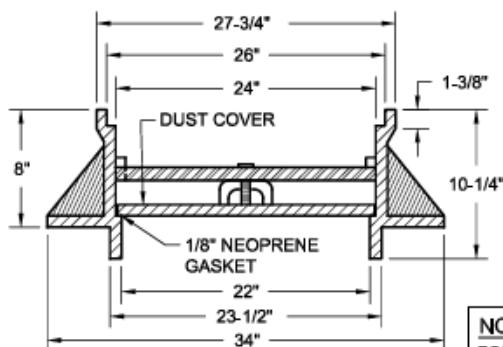
NOT TO SCALE

LOCK BAR 1" X 1" STEEL,
23-1/2" LONG W/ BRASS
BOLT 5/8" X 4" LONG,
FULL THREAD



PLAN: CASTING

NOTE: USE SANITARY SEWER MANHOLE
COVER (24") FOR THIS APPLICATION



SECTION A-A

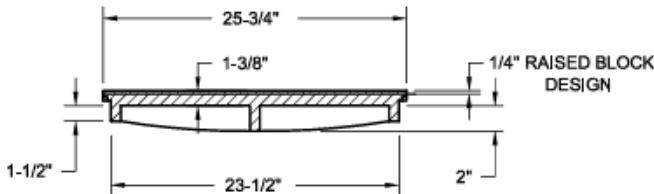
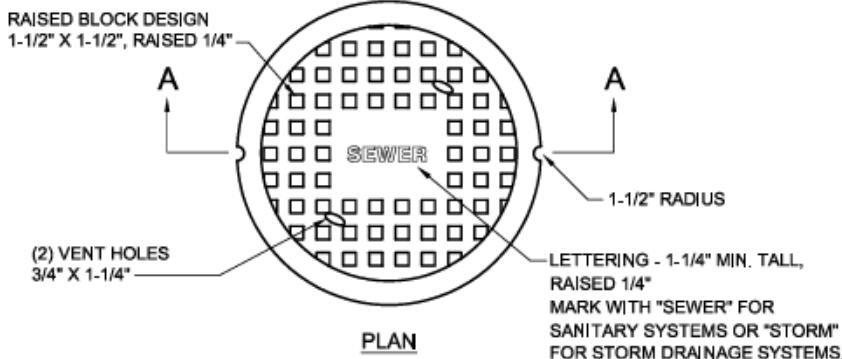
NOTES:

NOTE:
FOR NON-WATERTIGHT APPLICATIONS
DELETE THE LOCK BAR AND NEOPRENE
GASKET

1. MANHOLE CASTING TO BE SUPPLIED BY CAPITAL FOUNDRY OF VIRGINIA, INC. OR APPROVED EQUAL.
2. ALL GRAY IRON CASTINGS SHALL CONFORM TO LATEST EDITION OF ASTM A-48, CLASS 30 AND SHALL BE OF UNIFORM QUALITY.
3. ALL CASTING DIMENSIONS SHALL HAVE A TOLERANCE OF $1/8" \pm$.
4. ALL CASTINGS SHALL BE CLEANED BY SHOT BLASTING AND HAND CHIPPING UTILIZING STANDARD INDUSTRY PRACTICES PRIOR TO SHOP APPLICATION OF ASPHALTIC COATING, BY DIPPING.

SANITARY SEWER MANHOLE CASTING (24")

NOT TO SCALE



SECTION A-A

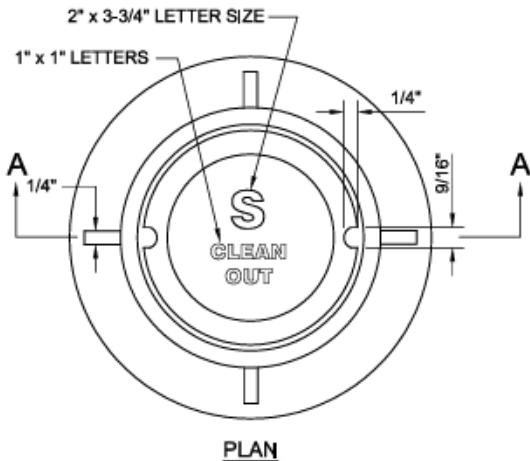
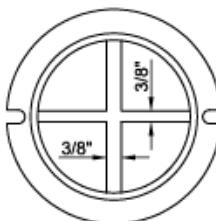
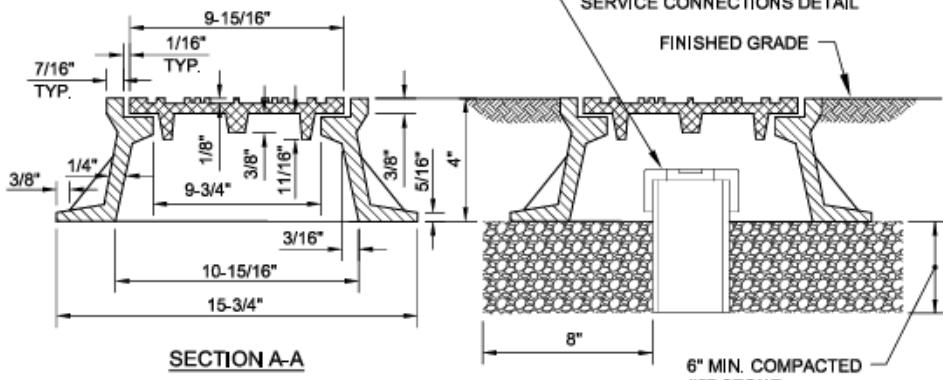
NOTES:

1. MANHOLE COVER TO BE SUPPLIED BY CAPITAL FOUNDRY OF VIRGINIA, INC., OR APPROVED EQUAL.
2. ALL GRAY IRON CASTINGS SHALL CONFORM TO LATEST EDITION OF ASTM A-48, CLASS 30 AND SHALL BE OF UNIFORM QUALITY.
3. ALL CASTING DIMENSIONS SHALL HAVE A TOLERANCE OF $1/8" \pm$.
4. ALL CASTINGS SHALL BE CLEANED BY SHOT BLASTING AND HAND CHIPPING UTILIZING STANDARD INDUSTRY PRACTICES PRIOR TO SHOP APPLICATION OF ASPHALTIC COATING, BY DIPPING.

**SANITARY SEWER
MANHOLE COVER (24")**

NOT TO SCALE

REFERENCE 200,802	CATEGORY SANITARY SYSTEMS	DATE 6/16	SHEET No. 1 OF 1	DETAIL No. SS_10
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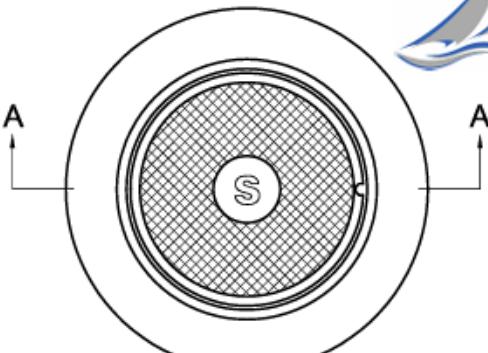

PLAN

BOTTOM VIEW: BOTTOM

SECTION A-A
NOTES:

1. CLEAN OUT FRAME & COVER TO BE SUPPLIED BY CAPITAL FOUNDRY OF VIRGINIA, INC. OR APPROVED EQUAL. **NPN-CW-18**
2. ALL GRAY IRON CASTINGS SHALL CONFORM TO LATEST EDITION OF ASTM A-48, CLASS 30 AND SHALL BE OF UNIFORM QUALITY.
3. ALL CASTING DIMENSIONS SHALL HAVE A TOLERANCE OF $1/8"$.
4. ALL CASTINGS SHALL BE CLEANED BY SHOT BLASTING AND HAND CHIPPING UTILIZING STANDARD INDUSTRY PRACTICES PRIOR TO SHOP APPLICATION OF ASPHALTIC COATING, BY DIPPING.

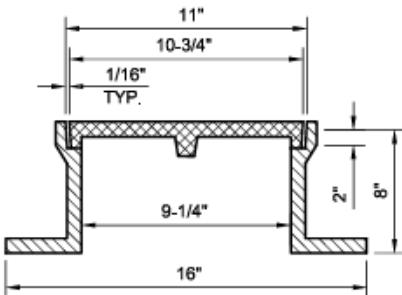
SANITARY SERVICE LATERAL CLEAN OUT FRAME AND COVER

NOT TO SCALE

REFERENCE 200,802	CATEGORY SANITARY SYSTEMS	DATE 6/16	DETAIL No. 1 OF 1	DETAIL No. SS_11
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PLAN



SECTION A-A

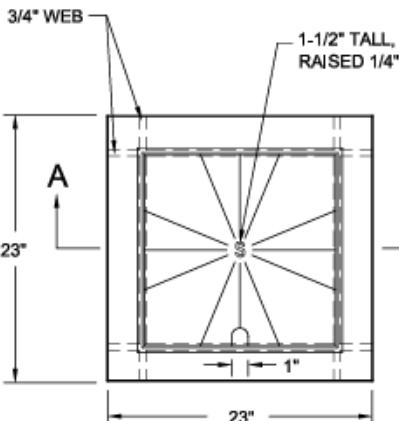
NOTES:

1. CLEAN OUT FRAME & COVER HIGHWAY LOAD RATED FOR USE IN DRIVEWAYS, PARKING LOTS, ETC.
2. CLEAN OUT FRAME & COVER TO BE SUPPLIED BY CAPITAL FOUNDRY OF VIRGINIA, INC. OR APPROVED EQUAL.
3. ALL GRAY IRON CASTINGS SHALL CONFORM TO LATEST EDITION OF ASTM A-48, CLASS 30 AND SHALL BE OF UNIFORM QUALITY.
4. ALL CASTING DIMENSIONS SHALL HAVE A TOLERANCE OF 1/8".
5. ALL CASTINGS SHALL BE CLEANED BY SHOT BLASTING AND HAND CHIPPING UTILIZING STANDARD INDUSTRY PRACTICES PRIOR TO SHOP APPLICATION OF ASPHALTIC COATING, BY DIPPING.

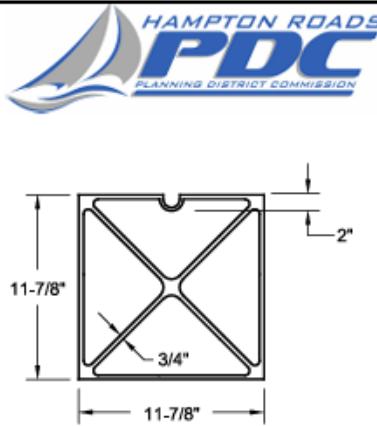
**SANITARY SERVICE LATERAL CLEAN OUT
FRAME AND COVER FOR HEAVY LOADS**

NOT TO SCALE

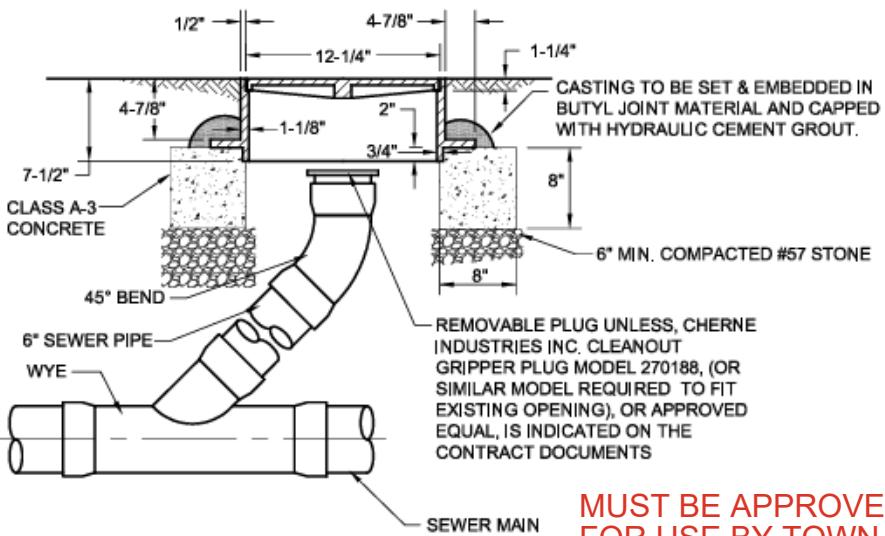
REFERENCE 200,802	CATEGORY SANITARY SYSTEMS	DATE 6/16	SHEET No. 1 OF 1	DETAIL No. SS 12
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PLAN



BOTTOM VIEW: COVER



**MUST BE APPROVED
FOR USE BY TOWN
STAFF**

**SANITARY SEWER MAIN LINE
CLEAN OUT BOX**

NOT TO SCALE



NOTES:

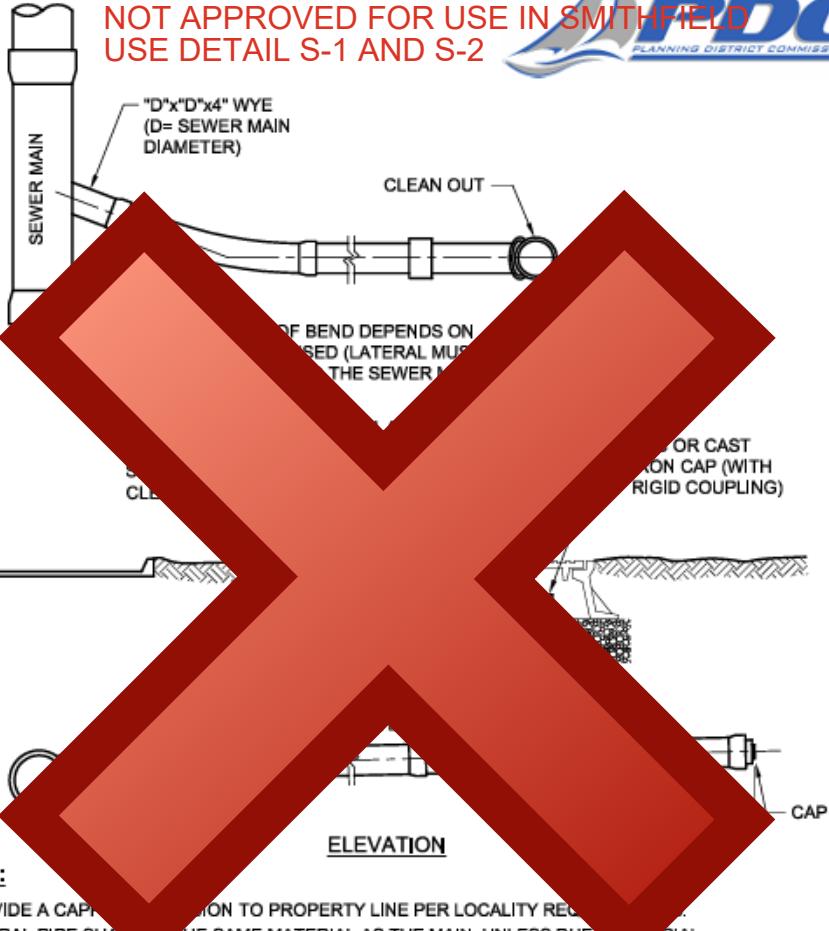
1. CLEAN OUT BOX TO BE SUPPLIED BY CAPITAL FOUNDRY OF VIRGINIA, INC., OR APPROVED EQUAL.
2. ALL GRAY IRON CASTINGS SHALL CONFORM TO LATEST EDITION OF ASTM A-48, CLASS 30 AND SHALL BE OF UNIFORM QUALITY.
3. ALL CASTING DIMENSIONS SHALL HAVE A TOLERANCE OF $1/8'' \pm$.
4. ALL CASTINGS SHALL BE CLEANED BY SHOT BLASTING AND HAND CHIPPING UTILIZING STANDARD INDUSTRY PRACTICES PRIOR TO SHOP APPLICATION OF ASPHALTIC COATING, BY DIPPING.

SANITARY SEWER MAIN LINE
CLEAN OUT BOX

NOT TO SCALE

REFERENCE 200,802	CATEGORY SANITARY SYSTEMS	DATE 6/16	SHEET No. 2 OF 2	DETAIL No. SS_13
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NOT APPROVED FOR USE IN SMITHFIELD
USE DETAIL S-1 AND S-2



NOTES:

1. PROVIDE A CAP OR PLUG AT END OF LATERAL TO PROPERTY LINE PER LOCALITY REQUIREMENT.
2. LATERAL PIPE SHALL BE THE SAME MATERIAL AS THE MAIN, UNLESS DUE TO SPECIAL CIRCUMSTANCES THE LOCALITY REQUIRES THE PIPE TO BE DUCTILE IRON. DUCTILE IRON SHALL REQUIRE A 6" STUB WITH MJ PLUG OR MJ CAP.
3. SEE PLANS FOR LOCATION OF CLEAN OUT.
4. TRACER WIRE SHALL BE INSTALLED CONTINUOUSLY FROM THE MAIN TO THE RIGHT OF WAY LINE DIRECTLY ON TOP OF THE PVC LATERAL. TRACER WIRE SHALL BE ATTACHED TO THE LATERAL.

SANITARY SEWER SERVICE CONNECTION

NOT TO SCALE

REFERENCE 200,802	CATEGORY SANITARY SYSTEMS	DATE 6/16	SHEET No. 1 OF 1	DETAIL No. SS_14
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NOT APPROVED FOR USE IN SMITHFIELD



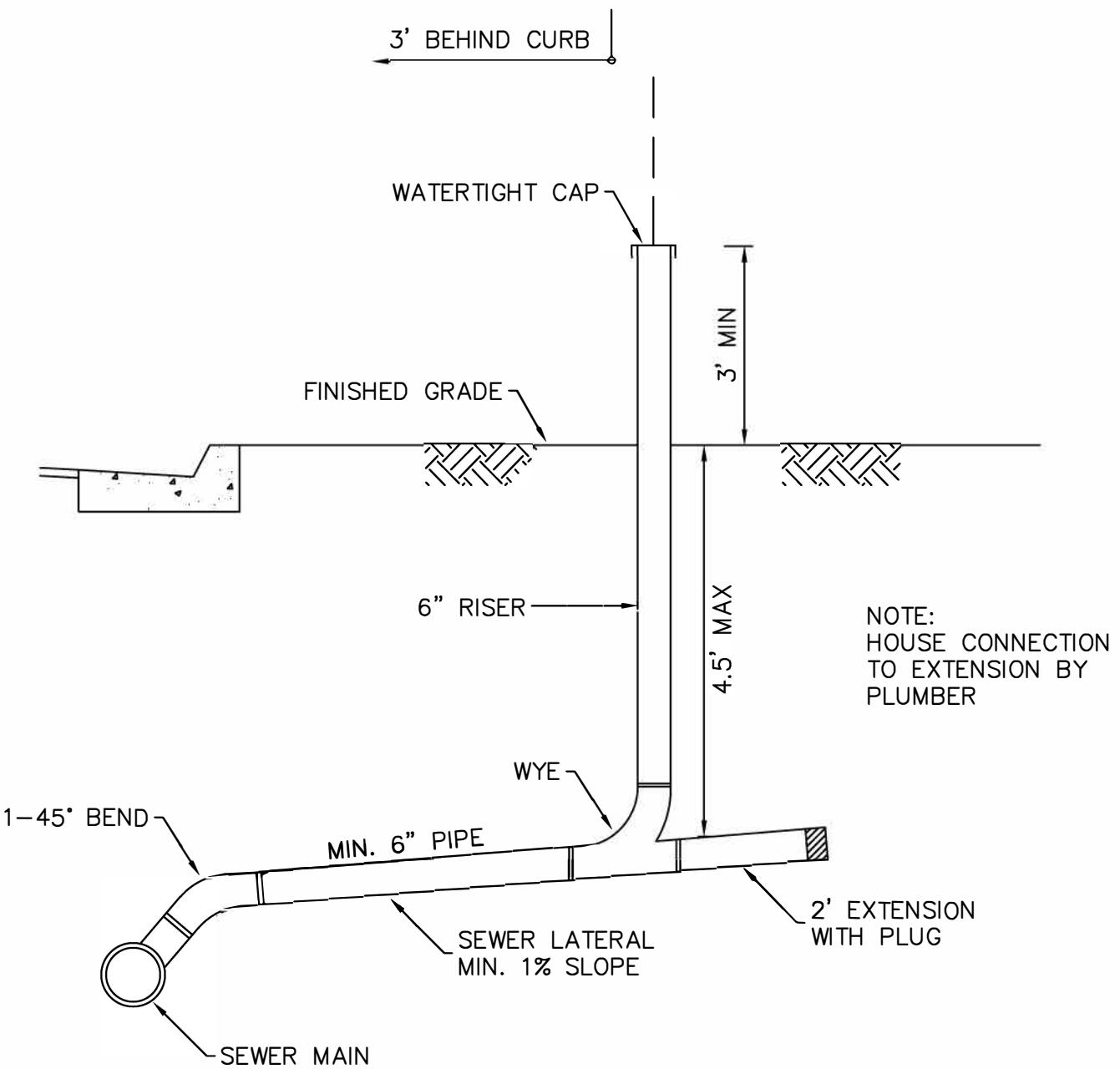
NOTES:

1. DUAL SERVICE CONNECTION TO BE USED ONLY WHERE APPROVED BY THE LOCALITY.
2. LATERAL PIPE SHALL BE PVC, ASTM D-3034, SDR 26, UNLESS DUE TO SPECIAL CIRCUMSTANCES THE LOCALITY REQUIRES THE PIPE TO BE DUCTILE IRON OR PVC C-900.
3. SEE PLANS FOR LOCATION OF CLEAN OUT.
4. REFER TO SANITARY SEWER SERVICE CONNECTION DETAIL FOR VERTICAL PROFILE.

DUAL SANITARY SEWER SERVICE CONNECTIONS

NOT TO SCALE

REFERENCE 200,802	CATEGORY SANITARY SYSTEMS	DATE 6/16	SHEET No. 1 OF 1	DETAIL No. SS_15
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NOTES:

1. BEDDING REQUIREMENT SAME AS SEWER MAIN
2. CLEAN OUT SHALL BE LOCATED 3-FEET TO BEHIND CURB
3. MAXIMUM ALLOWABLE DEPTH OF LATERAL UNDER THE CURB IS 5-FEET. MAXIMUM ALLOWABLE DEPTH OF LATERAL AT THE CLEAN OUT IS 4.5-FEET.
4. SEWER SADDLES SHALL BE ROMAC STYLE CB UNLESS OTHERWISE APPROVED BY PUBLIC WORKS.
5. FOR DUCTILE IRON LATERALS, A TEMPORARY FERNCO FLEXIBLE CAP WITH BAND SHALL BE USED DURING CONSTRUCTION AND TESTING.
6. FOR PVC LATERALS, A TEMPORARY GLUE CAP OR SDR GASKET CAP SHALL BE USED DURING CONSTRUCTION AND TESTING.
7. NO MECHANICAL GRIPPER PLUGS SHALL BE USED.



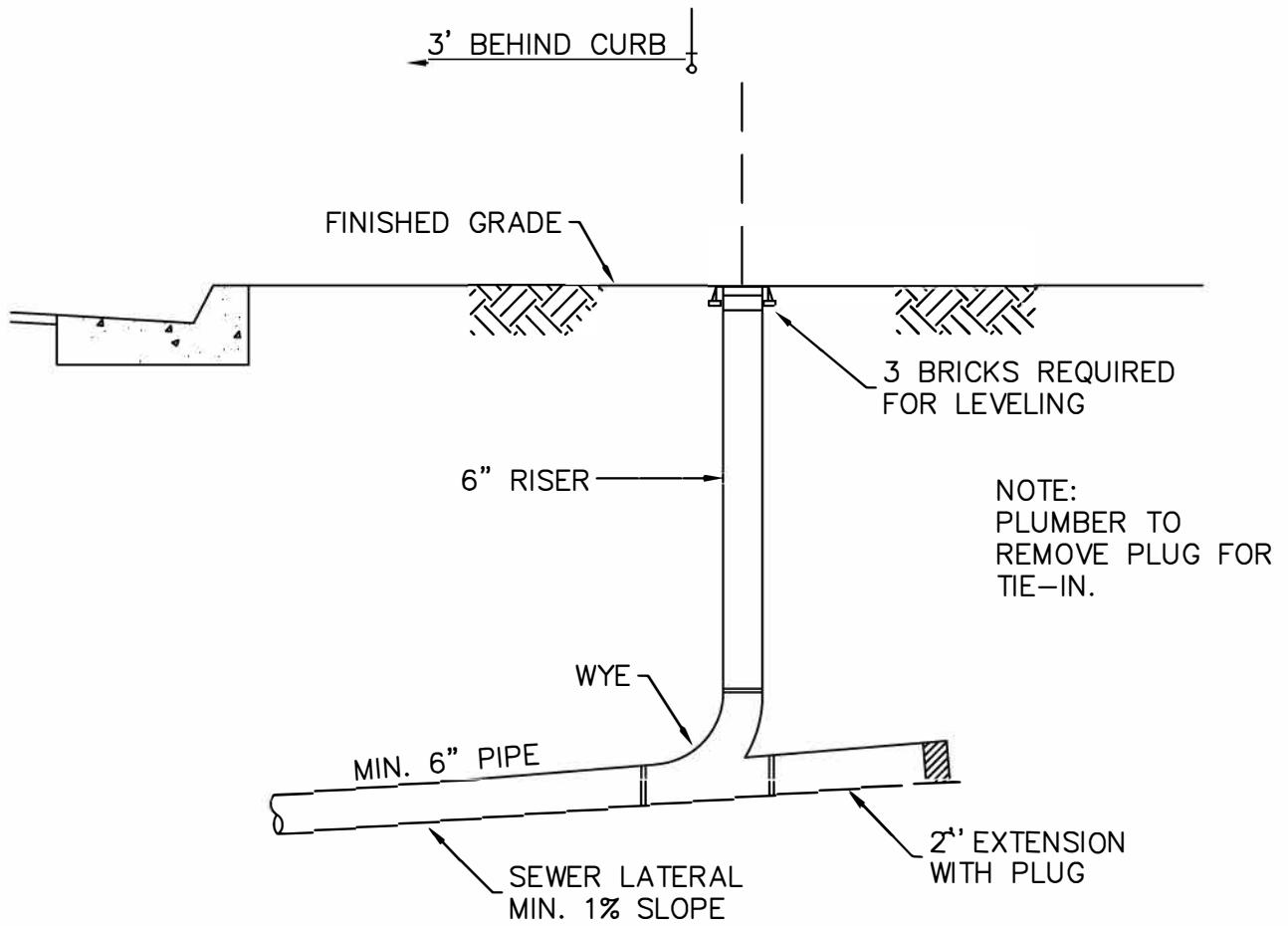
TOWN OF SMITHFIELD
DESIGN AND CONSTRUCTION STANDARDS

SEWER LATERAL BY DEVELOPER

DWG #: S-1

SCALE: NTS

NOV 2022



TOWN OF SMITHFIELD
DESIGN AND CONSTRUCTION STANDARDS

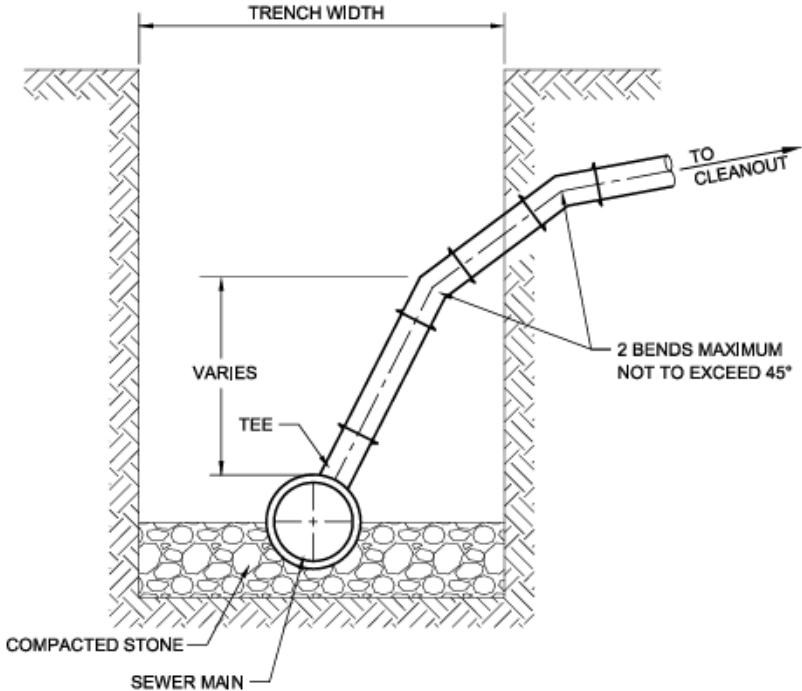
SEWER LATERAL BY PLUMBER

DWG #: S-2

SCALE: NTS

NOV 2022

CONNECTION TO CUSTOMER SIDE LATERAL AT 4.5'



ELEVATION

NOTES:

1. LATERAL MATERIAL TO MATCH SEWER MAIN MATERIAL.
2. TRACER WIRE SHALL BE INSTALLED CONTINUOUSLY FROM THE MAIN TO THE RIGHT-OF-WAY LINE DIRECTLY ON TOP OF THE PVC LATERAL, ATTACHED EVERY 10 FEET.

DEEP SANITARY SEWER SERVICE CONNECTION

NOT TO SCALE

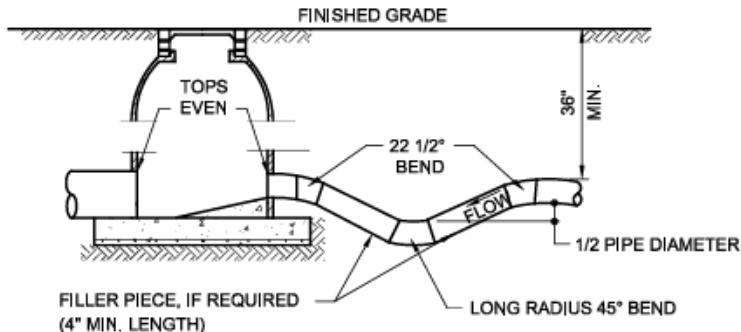
REFERENCE
200,802

CATEGORY
SANITARY SYSTEMS

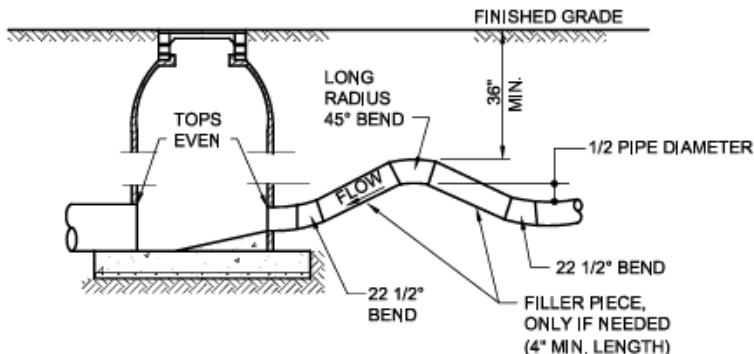
DATE
6/16

SHEET No.
1 OF 1

DETAIL No.
SS_16



FOR DISCHARGE INTO SHALLOW MANHOLE



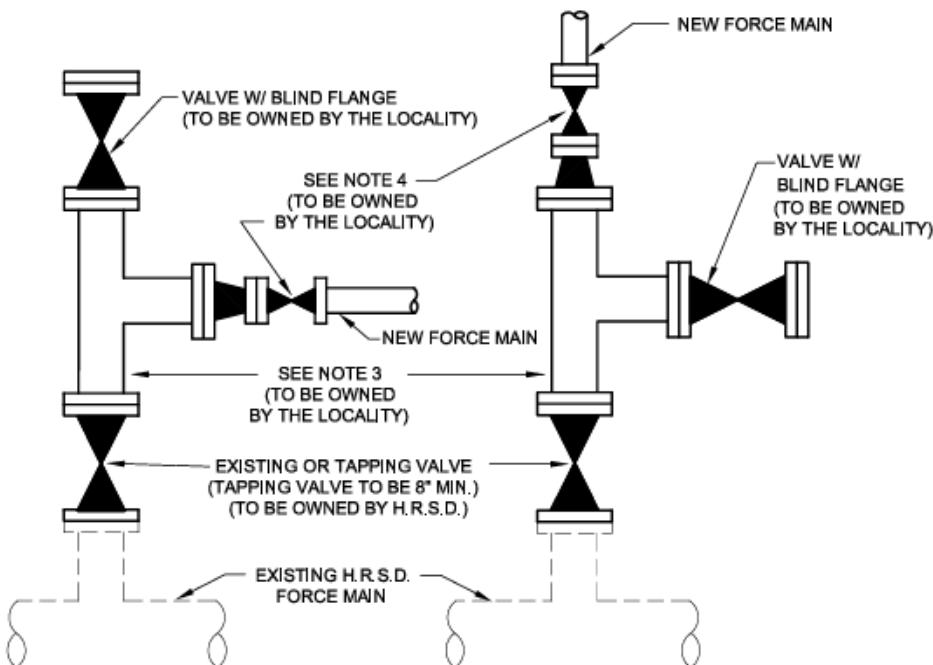
FOR DISCHARGE INTO STANDARD MANHOLE

NOTES:

1. ALL JOINTS MUST BE PROTECTED BY RETAINER GLANDS OR THREADED RODS (GALV.).
2. ALL RESTRAINTS SHALL BE IN ACCORDANCE TO LOCALITY REQUIREMENTS.
3. COAT MANHOLE PER LOCALITY REQUIREMENTS.

FORCE MAIN SAXOPHONE

NOT TO SCALE



CONNECTION
METHOD 1

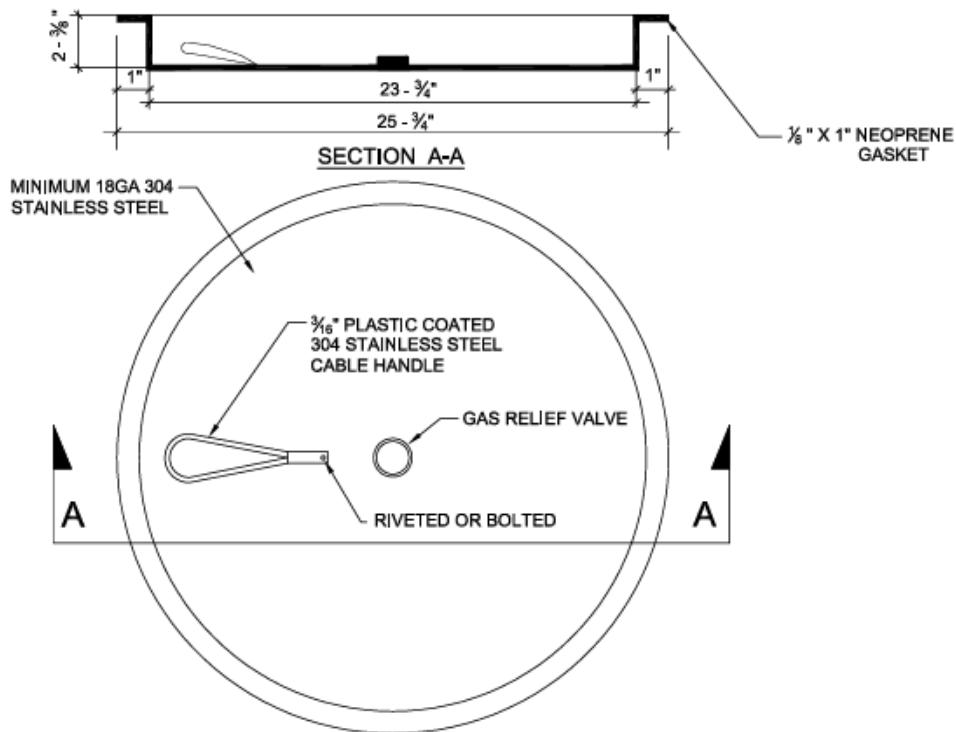
CONNECTION
METHOD 2

NOTES:

1. DIRECTION OF TEE BRANCH TO BE DETERMINED BY THE LOCALITY.
2. TEE AND VALVE TO BE FLANGED.
3. TEE TO BE SAME SIZE AS EXISTING VALVE OR TAPPING VALVE.
4. MINIMUM SIZE VALVE TO BE USED IS 4" WITH NON-RISING STEM AND 2" SQUARE OPERATING NUT.

**FORCE MAIN CONNECTION
TO H.R.S.D. FORCE MAIN**

NOT TO SCALE



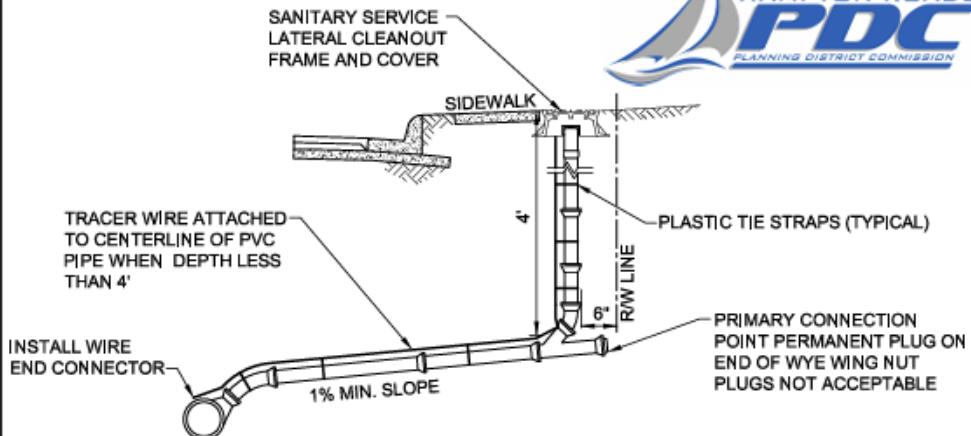
NOTES:

1. ACTUAL DIMENSIONS MUST BE COMPATIBLE WITH MANHOLE CASTING DIMENSIONS.
2. DUST COVER NOT REQUIRED WHEN USING MANHOLE INSERT.
3. GAS RELIEF VALVE SHALL BE CAPABLE OF RELEASING GAS AT A PRESSURE OF 0.5 TO 1.5 PSI AND HAVE A WATER LEAK DOWN RATE NO GREATER THAN 5 GALLONS / 24 HOURS.
4. LOAD TEST STRENGTH MUST EXCEED 3,000 POUNDS.
5. HANDLE MUST BE CAPABLE OF WITHSTANDING A MINIMUM 500 POUND PULL FORCE.

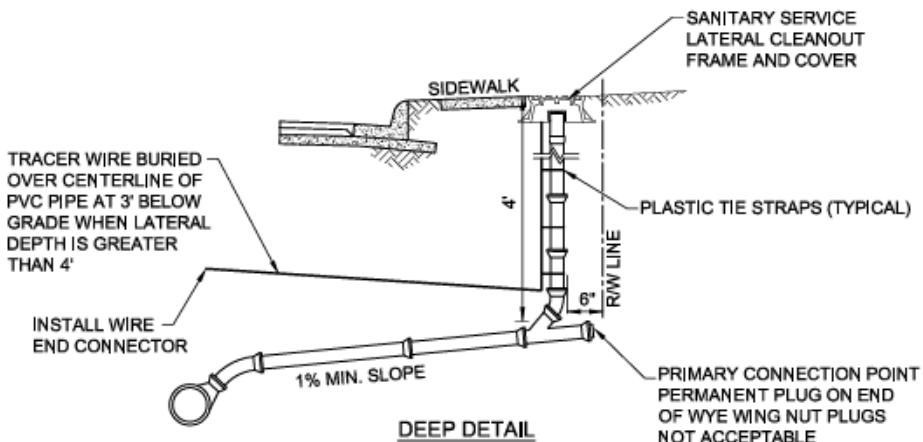
MANHOLE INSERT

NOT TO SCALE

REFERENCE 200	CATEGORY SANITARY SYSTEMS	DATE 6/16	SHEET No. 1 OF 1	DETAIL No. SS_19
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SHALLOW DETAIL



NOTE:

INSTALL DETECTABLE WARNING TAPE CONTINUOUSLY FROM THE MAIN TO THE RIGHT OF WAY LINE DIRECTLY ON TOP OF PVC LATERAL, ATTACHED EVERY 10 FEET.

SANITARY SEWER SERVICE
CONNECTION-ALTERNATE

NOT TO SCALE

NOTES:

1. **TYPICAL LATERAL LAYOUT - (UTILITY CONTRACTOR)**
 SHALL ONLY UTILIZE THE PRIMARY CONNECTION POINT WHEN TYING TO AN EXISTING LATERAL. THE CONNECTION POINT TO THE PRIVATE LATERAL AND TO THE HOUSE LATERAL CLEANOUT SHALL BE MADE WITH SOLID SLEEVES. FERFCO COUPLINGS OR EQUIVALENTS ARE NOT PERMITTED ON THE HOUSE LATERAL CONNECTION OR AT THE CONNECTION POINT TO THE PRIVATE LATERAL, UNLESS THE PRIVATE LATERAL IS VCP (VITRIFIED CLAY PIPE), OR ORANGEBURG PIPE (BITUMINIZED FIBER SEWER PIPE). CLEANOUT RISER ASSEMBLY AND FITTING SHALL BE SAME MATERIAL AS THE SEWER LATERAL (P.V.C. ASTM D-3034 SCHEDULE 26, OR AWWA C900-CLASS 150 (DR-18). D.I.-ANSI/AWWA C150/A21.50-91 CLASS 52).
2. **TYPICAL LATERAL LAYOUT - (PLUMBING CONTRACTOR)**
 THE PLUMBER MAY UTILIZE THE PRIMARY CONNECTION POINT, OR INSTALL AND UTILIZE THE SECONDARY CONNECTION POINT. WHEN INSTALLING THE SECONDARY CONNECTION POINT, THE LATERAL RISER ASSEMBLY, HOUSE LATERAL CLEANOUT AND TRACER WIRE SHALL BE REINSTALLED BY PLUMBING CONTRACTOR PRIOR TO OCCUPANCY. CLEANOUT RISER ASSEMBLY, AND FITTING SHALL BE SAME MATERIAL AS THE SEWER LATERAL (P.V.C. ASTM D-3034 SCHEDULE 26, OR AWWA C900-CLASS150 (DR-18).D.I.-ANSI/AWWA C150/A21.50-91 CLASS 52. ALL CLEANOUT RISER ASSEMBLY FITTING CONNECTIONS AND THE CONNECTION POINT TO THE PRIVATE LATERAL SHALL BE MADE WITH SOLID SLEEVES. FERFCO COUPLING OR EQUIVALENTS ARE NOT PERMITTED ON THE CLEANOUT RISER ASSEMBLY, THE RISER FITTINGS, AND AT THE CONNECTION POINT TO THE PRIVATE LATERAL (RIGHT-OF-WAY LINE OR EASEMENT LIMITS).
3. **TYPICAL LATERAL LAYOUT**
 CLEANOUT RISER ASSEMBLY, HOUSE LATERAL CLEANOUT AND TRACER WIRE SHALL BE INSTALLED PRIOR TO FINAL INSPECTION/ACCEPTANCE. LOCATION OF WYE AND CLEANOUT MAY BE VARIED BY INSPECTOR IF NECESSARY DUE TO UNUSUAL DEPTH OR CONDITIONS. MINIMUM COVER OF 4.0 FEET REQUIRED UNLESS MORE DEPTH IS REQUIRED FOR SERVICE. PERMANENT PLUG SHALL BE INSTALLED IN THE END OF THE CLEANOUT WYE (WING NUT PLUGS ARE NOT ACCEPTABLE).
4. **LATERAL SHALL BE SAME MATERIAL AS SEWER MAIN DUCTILE IRON (D.I.), OR POLYVINYLCHLORIDE (P.V.C.). D.I. SHALL BE ANSI/AWWA C150/A21.50-91 CLASS 52. P.V.C. SHALL BE ASTM D-3034 SCHEDULE 26, OR AWWA C900-CLASS 150 (DR-18).**
5. **TRACER WIRE SHALL BE AWG 10 SOLID COPPER WIRE W/POLYETHYLENE INSULATION. THE TRACER WIRE SHALL BE ATTACHED TO THE LATERAL PIPE WHEN THE DEPTH IS NO GREATER THAN 4.0 FEET (PVC ONLY). THE WIRE SHALL BE BURIED OVER THE CENTERLINE OF THE LATERAL PIPE AT 3.0 FEET BELOW GRADE WHEN THE LATERAL DEPTH IS GREATER THAN 4.0 FEET (PVC ONLY).**

WHEN THE TRACER WIRE IS ATTACHED TO THE LATERAL AND RISER ASSEMBLY, IT WILL BE FASTENED WITH TIE STRAPS OR APPROVED EQUAL.

INSTALL DETECTABLE WARNING TAPE CONTINUOUSLY FROM THE MAIN TO THE RIGHT OF WAY LINE DIRECTLY ON TOP OF PVC LATERAL, ATTACHED EVERY 10 FEET.

SANITARY SEWER SERVICE **CONNECTION-ALTERNATE**

NOT TO SCALE

REFERENCE	CATEGORY	DATE	DETAIL No.
200,802	SANITARY SYSTEMS	6/16	2 OF 20 SS 20

NOT APPROVED FOR USE IN SMITHFIELD



BLOCKS AND LETTER
RAISED 1/4"



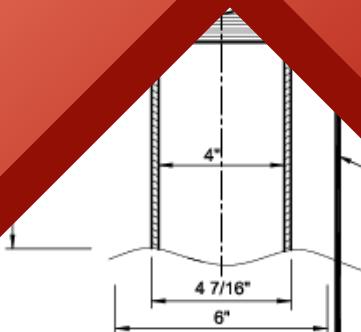
CHERNE INDUSTRIES INC.
CLEANOUT GRIPPER PLUG
MODEL 270188, (OR SIMILAR
MODEL REQUIRED TO FIT
EXISTING OPENING), OR
OWNER-APPROVED EQUAL

STAINLESS STEEL CLAMP

EXPOSED BARE COPPER
WIRE AWG-10 WRAPPED
AROUND CLAMP

4 1/2 INCH

4 1/2 INCH
EXPOSED BARE AWG-10 SOLID
COPPER WIRE
WITH POLYETHYLENE
INSULATION



NOTE:

THE TRACER WIRE POLYETHYLENE INSULATION SHALL ONLY BE REMOVED WHERE THE TRACER
WIRE IS WRAPPED AROUND THE STAINLESS STEEL CLAMP

HOUSE LATERAL CLEANOUT ALTERNATE

NOT TO SCALE

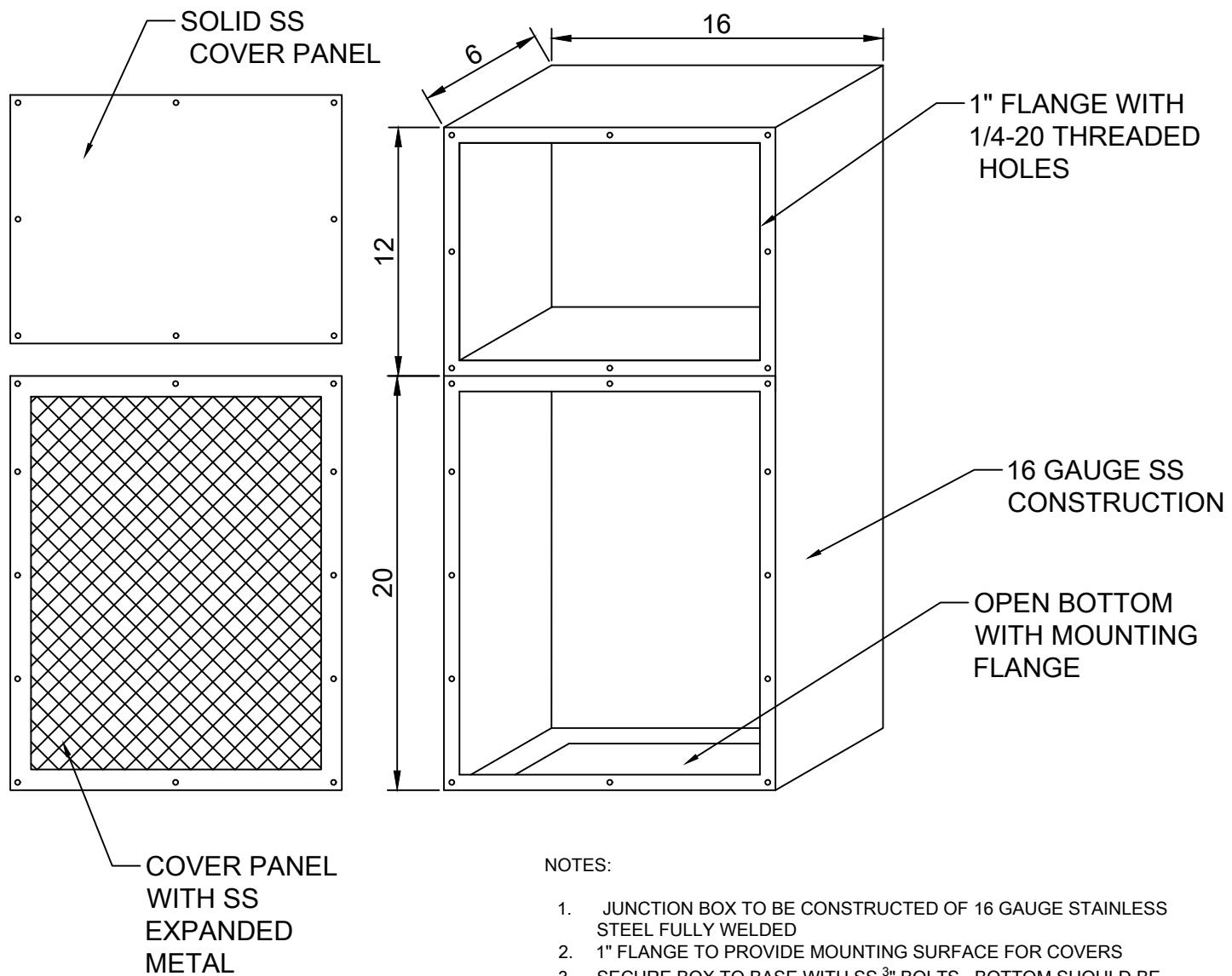
REFERENCE
200,802

CATEGORY
SANITARY SYSTEMS

DATE
6/16

SHEET No.
1 OF 1

DETAIL No.
SS_21

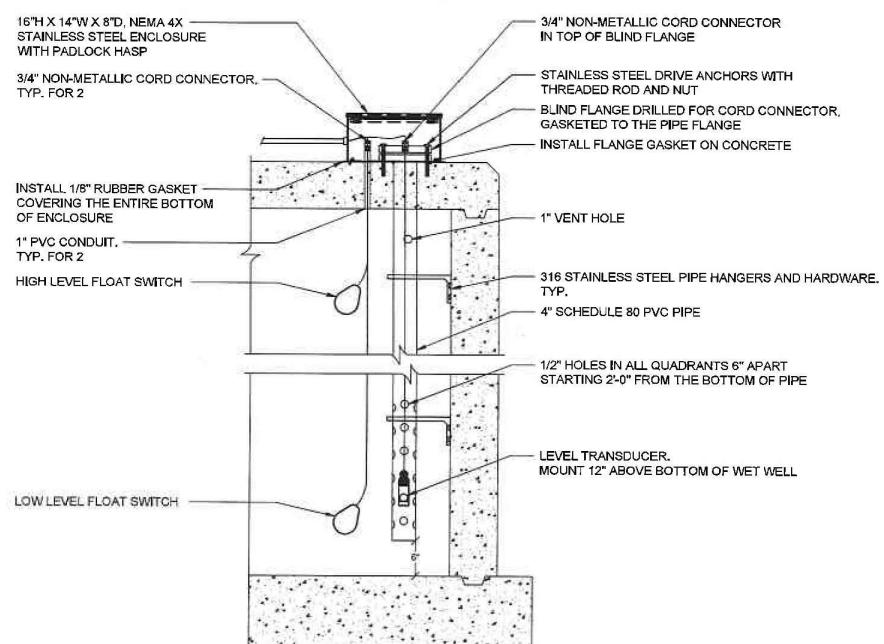
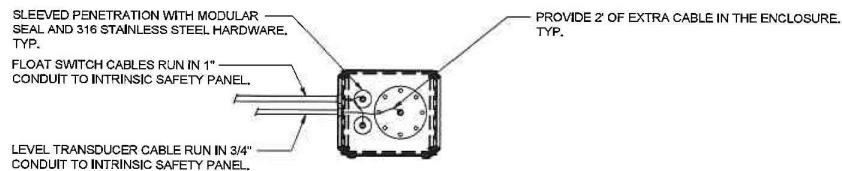


TOWN OF SMITHFIELD
DESIGN AND CONSTRUCTION STANDARDS

JUNCTION BOX DETAIL

DWG #: S-5 SCALE: N.T.S.

DWN BY : TOWN 8/8/2025



WET WELL INSTRUMENTATION
INSTALLATION DETAIL
 NO SCALE



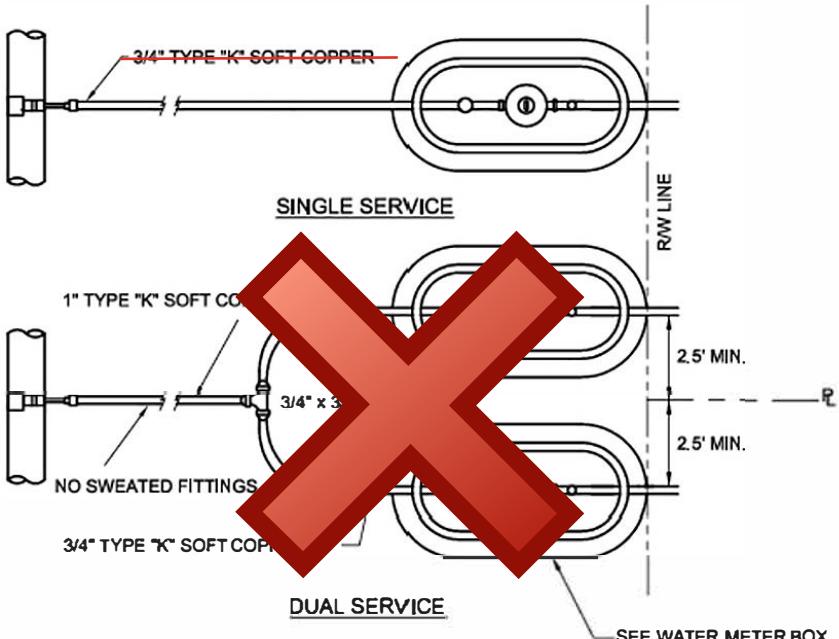
TOWN OF SMITHFIELD
 DESIGN AND CONSTRUCTION STANDARDS

WET WELL INSTRUMENTATION DETAIL

DWG #: S-6	SCALE: NTS
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NOV 2022

1" municipex



dual service not approved for use in smithfield SEE WATER METER BOX DETAILS (TYPE I OR II)

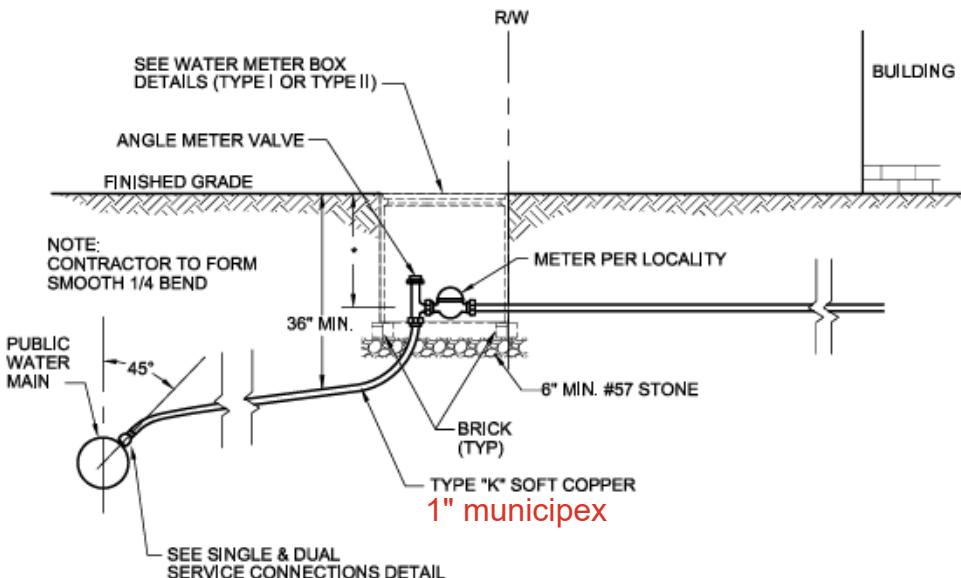
NOTES:

1. DUAL SERVICE REQUIRES PRIOR LOCALITY APPROVAL.
2. CONTRACTOR SHALL USE APPROVED BENDING TOOLS WHEN INSTALLING COPPER PIPE.
3. ~~ALL DUCTILE IRON MAINS, SIX INCHES IN DIAMETER AND LARGER, MAY BE TAPPED WITHOUT SADDLES.~~ WHERE PVC MAINS ARE PERMITTED BY LOCALITIES, THE CONNECTION TO A PVC MAIN MUST BE MADE WITH A TAPPING SADDLE. TAPPING SADDLES SHALL BE AS SPECIFIED IN SECTION 200 AND SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURERS SPECIFICATIONS. ALL SADDLES TO BE STAINLESS STEEL OR EPOXY COATED.
4. INSTALL METER BOX BETWEEN THE CURB AND GUTTER AND THE SIDEWALK METER BOXES SHALL NOT BE INSTALLED IN DRIVEWAY.

**SINGLE & DUAL
SERVICE CONNECTIONS**

NOT TO SCALE

- TYPE I WATER METER BOX: 7.5"-22" AS APPROVED BY LOCALITY
- TYPE II WATER METER BOX: 10.25"-22" AS APPROVED BY LOCALITY



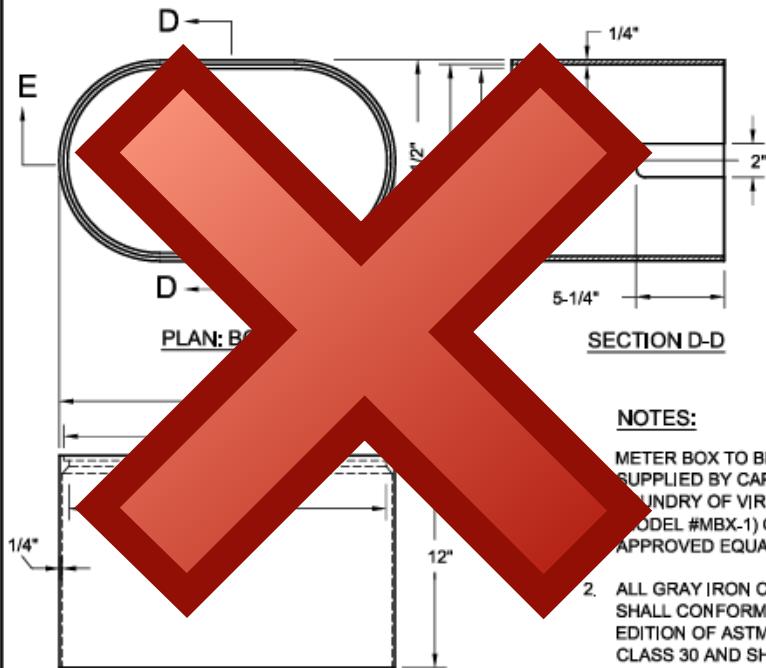
NOTES:

1. ALL DUCTILE IRON MAINS, SIX INCHES IN DIAMETER AND LARGER, MAY BE TAPPED WITHOUT SADDLES. WHERE PVC MAINS ARE PERMITTED BY LOCALITIES, THE CONNECTION TO A PVC MAIN MUST BE MADE WITH A TAPPING SADDLE. TAPPING SADDLES TO BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURERS SPECIFICATIONS. ALL TAPPING SADDLES TO BE STAINLESS STEEL OR EPOXY COATED.
2. METER SHALL BE 5/8" MINIMUM THRU 1" MAXIMUM.
3. INSTALL METER BOX BETWEEN THE CURB & GUTTER AND THE SIDEWALK. METER BOXES SHALL NOT BE INSTALLED IN DRIVEWAYS OR SIDEWALKS.
4. ALL BENDS IN TYPE K COPPER SHALL BE MADE USING AN APPROPRIATE PIPE BENDING TOOL. THERE SHALL BE NO CRIMPS IN THE PIPE LINE.

WATER SERVICE INSTALLATION DETAIL

NOT TO SCALE

REFERENCE 200,801	CATEGORY WATER DISTRIBUTION	DATE 6/16	SHEET No. 1 OF 1	DETAIL No. WD_02
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SECTION E-E

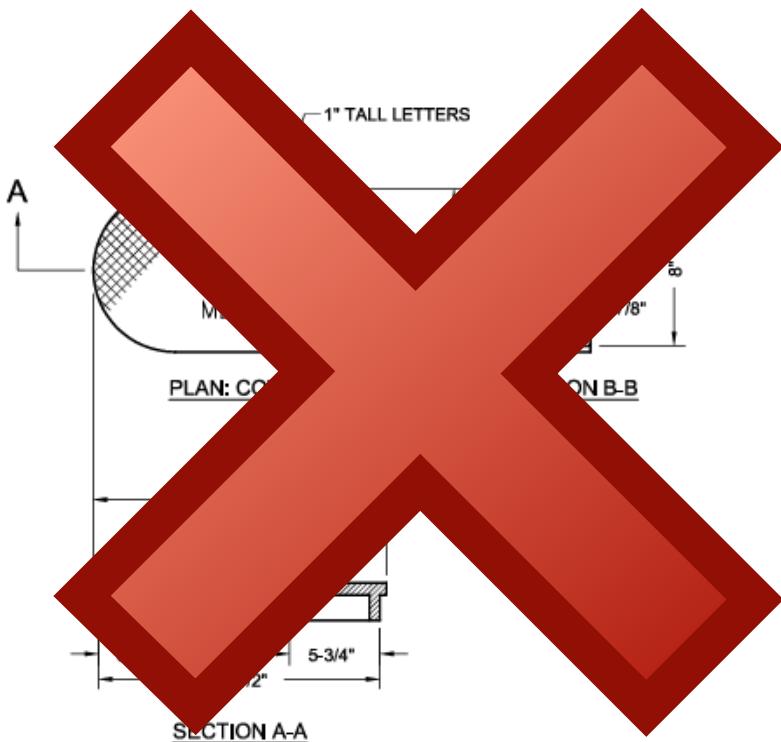
NOT APPROVED FOR USE IN SMITHFIELD
USE DFW 1800F-18-BODY AND DFW
36M-1T DEEP LID

- NOTES:
- METER BOX TO BE SUPPLIED BY CAPITAL MFG. OF VIRGINIA, INC., (MODEL #MBX-1) OR APPROVED EQUAL.
- ALL GRAY IRON CASTINGS SHALL CONFORM TO LATEST EDITION OF ASTM A-48, CLASS 30 AND SHALL BE OF UNIFORM QUALITY.
 - ALL CASTING DIMENSIONS SHALL HAVE A TOLERANCE OF $1/8'' \pm$.
 - ALL CASTINGS SHALL BE CLEANED BY SHOT BLASTING AND HAND CHIPPING UTILIZING STANDARD INDUSTRY PRACTICES PRIOR TO SHOP APPLICATION OF ASPHALTIC COATING, BY DIPPING.

**WATER METER BOX (TYPE I)
(5/8" TO 1" WATER METER ASSEMBLIES)**

NOT TO SCALE

REFERENCE 200,801	CATEGORY WATER DISTRIBUTION	DATE 6/16	SHEET No. 1 OF 2	DETAIL No. WD_03
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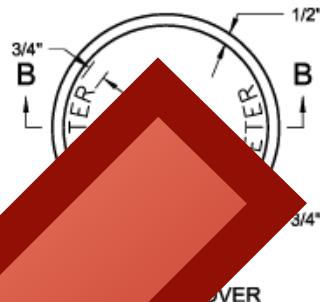
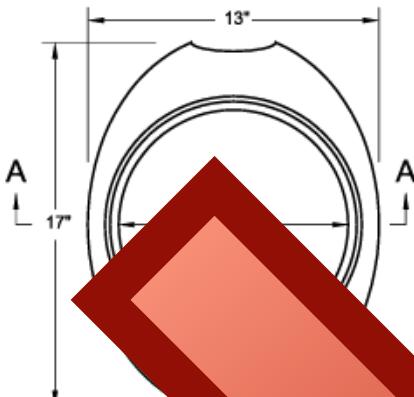


WATER METER BOX (TYPE I)

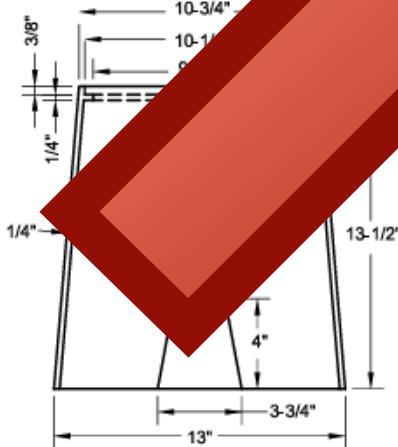
NOT TO SCALE

REFERENCE 200,801	CATEGORY WATER DISTRIBUTION	DATE 6/16	SHEET No. 2 OF 2	DETAIL No. WD_03
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NOT APPROVED FOR USE IN SMITHFIELD



PLAN: BOX



SECTION A-A

BOTTOM VIEW: COVER

SEE WD_04, SHEET 2 OF 2 FOR NOTES.

WATER METER BOX (TYPE II) (5/8" TO 1" WATER METER ASSEMBLIES)

NOT TO SCALE

REFERENCE
200,801

CATEGORY
WATER DISTRIBUTION

DATE
6/16

SHEET No.
1 OF 2

DETAIL No.
WD_04



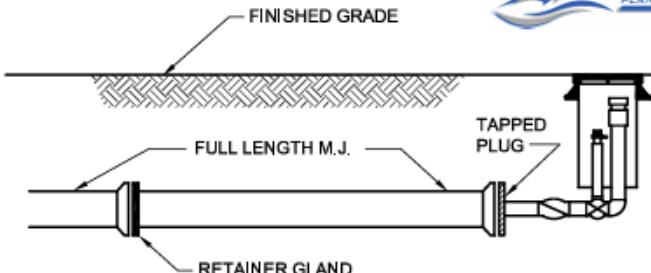
NOTES:

WATER METER BOX (TYPE II)

NOT TO SCALE

REFERENCE 200,801 CATEGORY WATER DISTRIBUTION DATE 6/16 SHEET No. 2 OF 2 DETAIL No. WD 04

- RESTRAINT LENGTHS BASED ON DUCTILE IRON PIPE ONLY. WHEN PVC PIPE OR POLYETHYLENE ENCASEMENT IS USED, RESTRAINT LENGTHS MUST BE RECALCULATED.



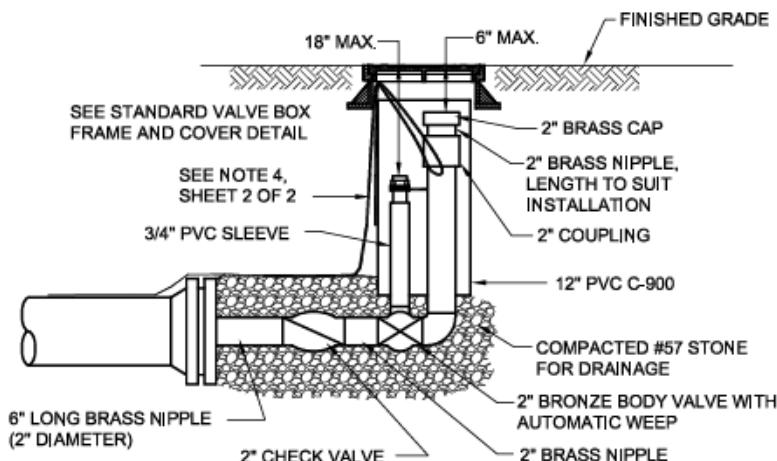
RESTRAINT LENGTHS:

PIPE DIAMETER	LENGTH OF PIPE
4 INCHES	36 FEET
8 INCHES	36 FEET
10-12 INCHES	54 FEET
16 INCHES	72 FEET

RESTRAINT NOTES:

1. SPECIAL DESIGN REQUIRED FOR MAINS GREATER THAN 48" IN DEPTH OR IN SOILS WITH SHEAR STRENGTH LESS THAN 30 LBS/FT.
2. IF THE RESTRAINED JOINTS ARE LESS THAN THE LENGTHS SHOWN, THEN A SPECIAL RESTRAINT DESIGN MUST BE SUBMITTED FOR APPROVAL.

TYPICAL RESTRAINT



BLOW-OFF ASSEMBLY

SEE WD_05, SHEET 2 OF 2 FOR BLOW-OFF ASSEMBLY NOTES.

BLOW-OFF ASSEMBLY

NOT TO SCALE

REFERENCE
200,801

CATEGORY
WATER DISTRIBUTION

DATE
6/16

SHEET No.
1 OF 2

DETAIL No.
WD_05



End of the line requires a GIL, if in the middle of the line

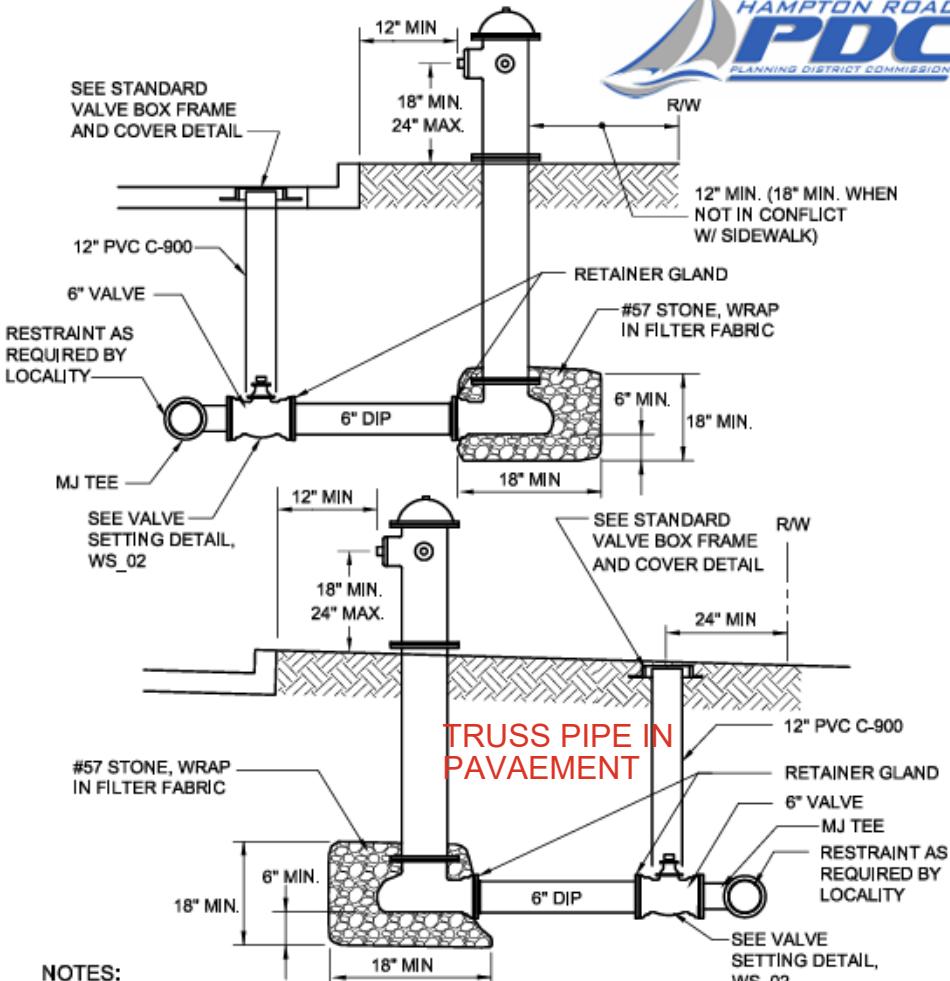
NOTES: then a Ford is required.

1. BLOW-OFF ASSEMBLY TO BE SUPPLIED BY GIL INDUSTRIES (MODEL: SLIM LINE 2" FLUSHING HYDRANT) OR APPROVED EQUAL.
2. A BLOW-OFF IS TO BE USED ON PIPE SIZES 10" IN DIAMETER OR LESS.
3. A FIRE HYDRANT IS TO BE USED AS A BLOW-OFF ASSEMBLY FOR PIPE SIZES 12" OR GREATER.
4. PLASTIC COATED 10 GAUGE SOLID COPPER TRACER WIRE TO BE ATTACHED WITH PLASTIC STRAPPING EVERY 10 FEET OF LENGTH. WIRE TO BE LOOPED THROUGH VALVE BOX AND EXTEND 12 INCHES ABOVE FINISHED GRADE AND COILED BACK INTO VALVE BOX.

BLOW-OFF ASSEMBLY

NOT TO SCALE

REFERENCE	CATEGORY	DATE	SHEET No.	DETAIL No.
200,801	WATER DISTRIBUTION	6/16	2 OF 2	WD_05



NOTES:

1. HYDRANT TO BE SET WITH BREAKABLE COUPLING APPROXIMATELY 3" ABOVE FINISHED GRADE.
 2. STEAMER NOZZLE IS TO FACE ROADWAY UNLESS OTHERWISE NOTED.
 3. TRACER WIRE REQUIRED.
 4. ALL VALVES TO BE MJ.
 5. WHEN FIRE HYDRANT IS TO BE INSTALLED WITHIN EXISTING OR PROPOSED VDOT RIGHT-OF-WAY, HYDRANTS SHALL BE LOCATED IN ACCORDANCE WITH VDOT REQUIREMENTS.
 6. HYDRANT(S) SHALL BE PAINTED IN ACCORDANCE WITH LOCALITY REQUIREMENTS.

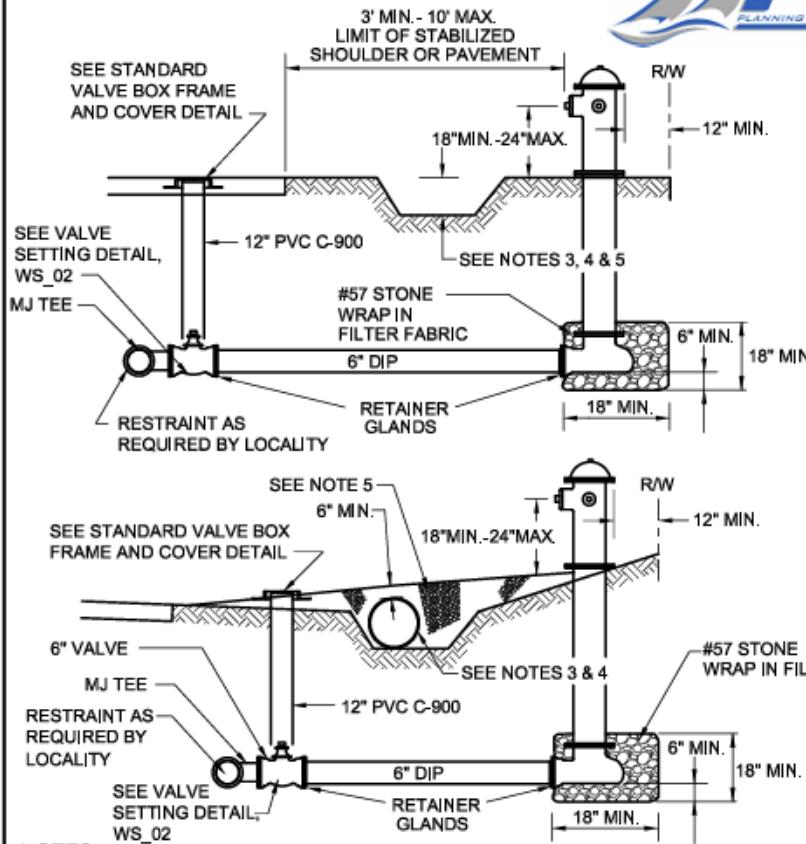
ALL HYDRANTS OPEN LEFT

ALL HYDRANTS OPEN LEFT

FIRE HYDRANT SETTING (TYPE I)

NOT TO SCALE

REFERENCE 200.801	CATEGORY WATER DISTRIBUTION	DATE 6/16	SHEET No. 1 OF 1	DETAIL No. WD 06
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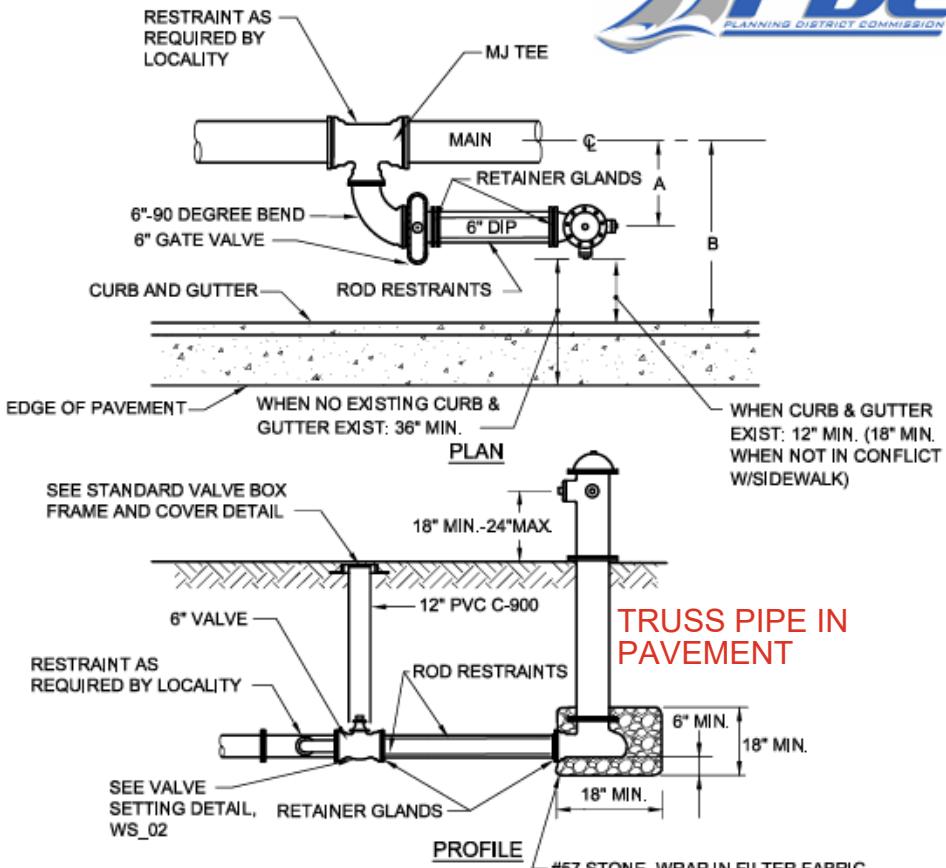
NOTES:

1. HYDRANT TO BE SET WITH BREAKABLE COUPLING APPROXIMATELY 3" ABOVE FINISHED GRADE.
2. STEAMER NOZZLE IS TO FACE ROADWAY UNLESS OTHERWISE NOTED.
3. CULVERT PIPE IS REQUIRED IF DITCH DEPTH (EDGE OF PAVEMENT TO BOTTOM OF DITCH) IS 18" OR MORE, OR HYDRANT VALVE FALLS WITHIN DITCH SLOPE.
4. SIZE OF CULVERT PIPE (RCP) IS TO BE APPROVED BY LOCALITY.
5. PROVIDE 6" MIN. COVER ON CULVERT. FILL DITCH WITH SELECT MATERIAL APPROVED BY THE LOCALITY. MINIMUM SURFACE WIDTH SHALL BE ACCORDANCE WITH LOCALITY REQUIREMENTS
6. ALL VALVES TO BE MJ.
7. WHEN FIRE HYDRANT IS TO BE INSTALLED WITHIN EXISTING OR PROPOSED VDOT RIGHT-OF-WAY, HYDRANTS SHALL BE LOCATED IN ACCORDANCE WITH VDOT REQUIREMENTS.
8. HYDRANT(S) SHALL BE PAINTED IN ACCORDANCE WITH LOCALITY REQUIREMENTS.

FIRE HYDRANT SETTING (TYPE II)

NOT TO SCALE

REFERENCE 200,801	CATEGORY WATER DISTRIBUTION	DATE 6/16	SHEET No. 1 OF 1	DETAIL No. WD_07
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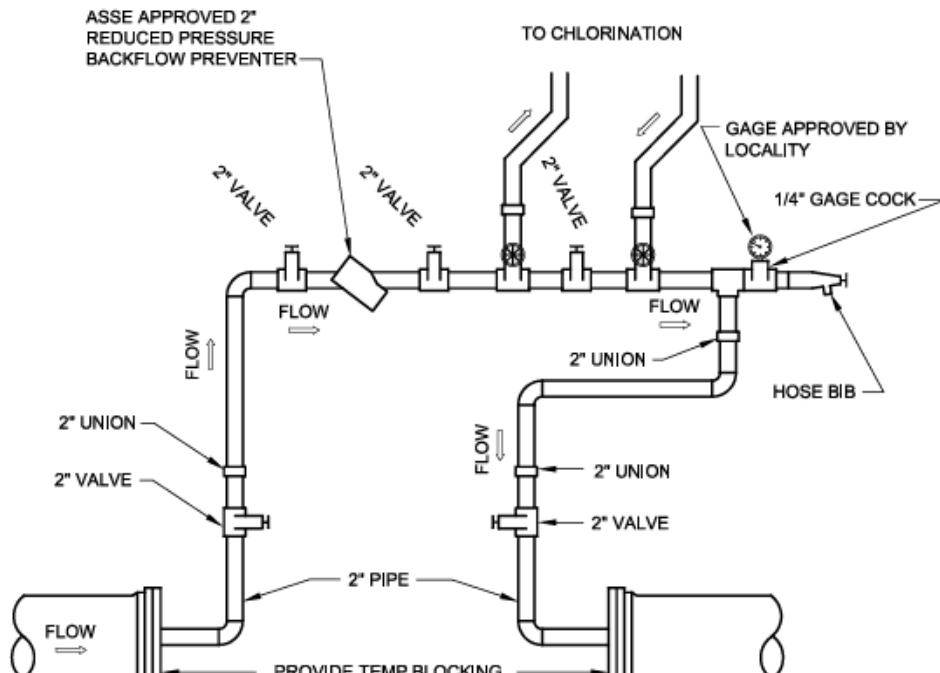


NOTES:

1. HYDRANT TO BE SET WITH BREAKABLE COUPLING APPROXIMATELY 3" ABOVE FINISHED GRADE.
2. STEAMER NOZZLE IS TO FACE ROADWAY UNLESS OTHERWISE NOTED.
3. ALL VALVES TO BE MJ.
4. WHEN FIRE HYDRANT IS TO BE INSTALLED WITHIN EXISTING OR PROPOSED VDOT RIGHT-OF-WAY, HYDRANTS SHALL BE LOCATED IN ACCORDANCE WITH VDOT REQUIREMENTS.
5. HYDRANT(S) SHALL BE PAINTED IN ACCORDANCE WITH LOCALITY REQUIREMENTS.

FIRE HYDRANT SETTING (TYPE III)

NOT TO SCALE



DISTRIBUTION SYSTEM SUPPLY

 PIPELINE BEING CHLORINATED
 AND TESTED

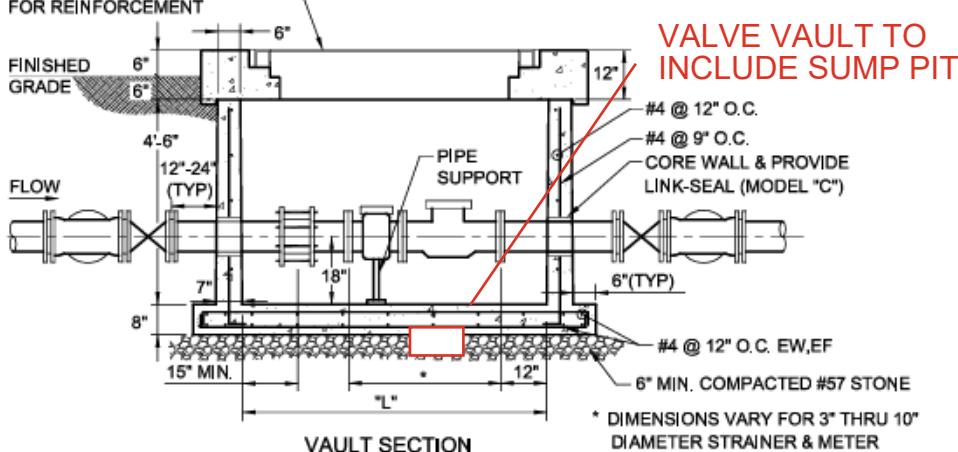
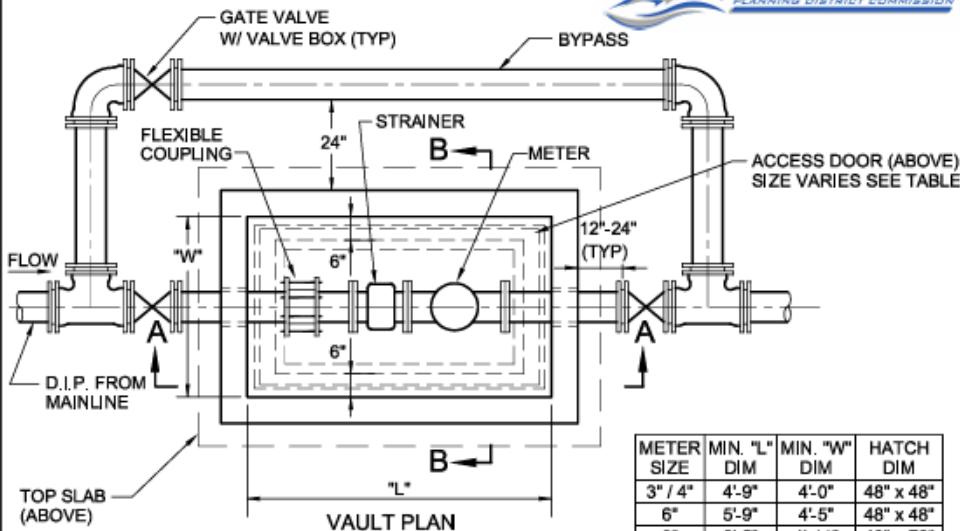
NOTES:

1. ALL VALVES TO BE 2" BALL VALVES.
2. ALL PIPING SHALL BE PROTECTED FROM THE WEATHER DURING FREEZING CONDITIONS.
3. BACKFLOW PREVENTER SHALL BE INSTALLED AND TESTED IN ACCORDANCE WITH THE LOCALITY'S APPROVED CROSS CONNECTION CONTROL PROGRAM.
4. THE RPZ SHALL NOT BE INSTALLED IN A PIT OR AREA SUBJECT TO FLOODING.

TEMPORARY MANIFOLD FOR TEST AND CHLORINATION

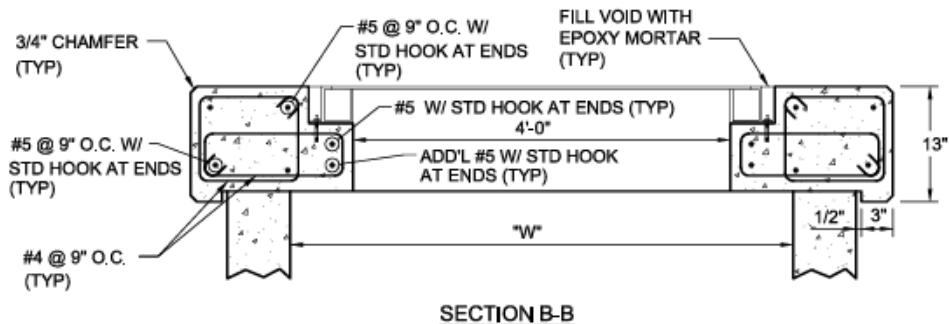
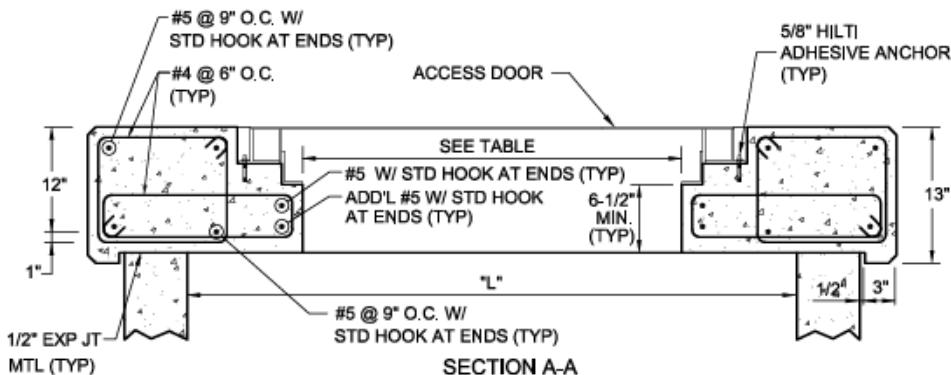
NOT TO SCALE

REFERENCE (NONE)	CATEGORY WATER DISTRIBUTION	DATE 6/16	DETAIL NO. 1 OF 1	WD_09
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CONCRETE VAULT- H20 LOADING (3" THRU 10" WATER METER ASSEMBLIES)

NOT TO SCALE



CONCRETE VAULT- H20 LOADING (3" THRU 10" WATER METER ASSEMBLIES)

NOT TO SCALE

NOTES:

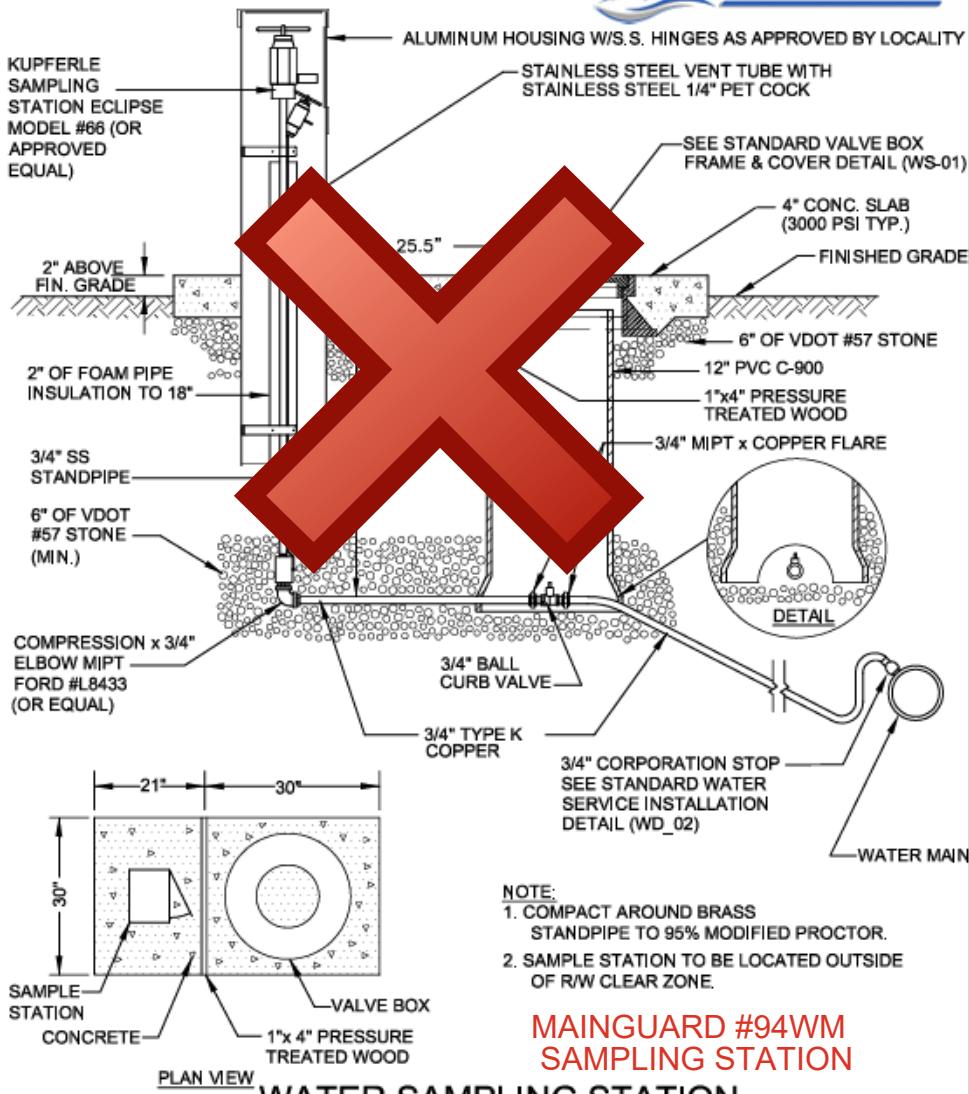
1. FLOOR OF VAULT TO BE SLOPED 1/4" PER FOOT TO A 6"X6" (3" DEEP) SUMP IN RIGHT BACK (PROPERTY SIDE) CORNER OF VAULT.
2. REDUCERS AS APPROPRIATE TO BE PLACED OUTSIDE THE BYPASS PIPING.
3. FLANGE ADAPTERS TO BE USED TO CONNECT METER TO PIPE.
4. METER, PIPE SUPPORT, AND DOOR KEY TO BE SUPPLIED BY THE CONTRACTOR AND DELIVERED TO THE OWNER.
5. ALL PIPES TO BE DUCTILE IRON, CLASS 53.
6. TWO 1-5/8" DIAMETER HOLES ARE TO BE DRILLED IN THE LEFT FRONT CORNER OF LID FOR REMOTE READ EQUIPMENT.
7. RECESSED LIFTING ANCHORS SHALL BE PROVIDED AT EACH CORNER OF VAULT LID.
8. VAULT DOORS SHALL CENTERED OVER METER LOCATION TO PROVIDE VERTICAL CLEARANCE ABOVE METER AND ASSOCIATED FITTINGS SO THAT THE ASSEMBLY CAN BE LIFTED STRAIGHT OUT OF THE VAULT WITHOUT TILTING. VAULT DOORS SHALL OPEN PARALLEL TO THE INTERIOR WATER LINE PIPING.
9. BILCO JD-AL H20 DOUBLE DOOR HATCH (OR APPROVED EQUAL) CENTERED.
10. INTERIOR AND EXTERIOR COATING PER LOCALITY REQUIREMENTS.

**CONCRETE VAULT- H20 LOADING
(3" THRU 10" WATER METER ASSEMBLIES)**

NOT TO SCALE

REFERENCE 200,801	CATEGORY WATER DISTRIBUTION	DATE 6/16	SHEET No. 3 OF 3	DETAIL No. WD_11
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NOT APPROVED FOR USE IN SMITHFIELD



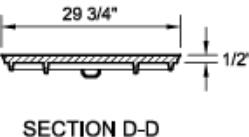
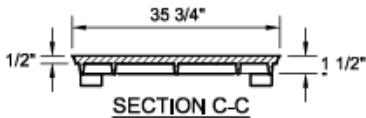
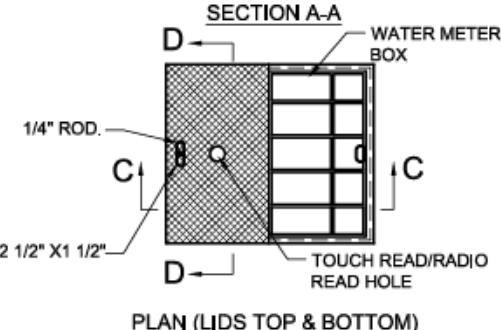
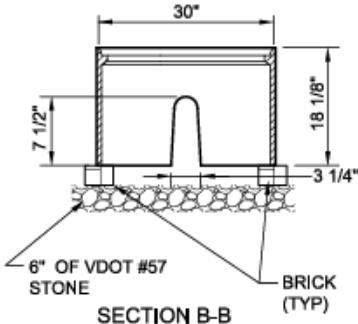
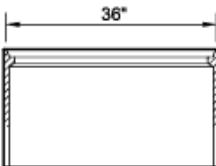
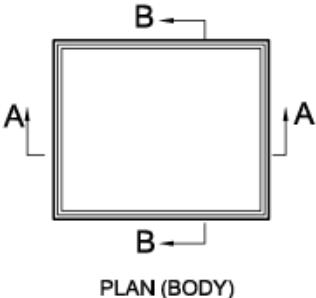
NOTE:

1. COMPACT AROUND BRASS STANDPIPE TO 95% MODIFIED PROCTOR.
2. SAMPLE STATION TO BE LOCATED OUTSIDE OF R/W CLEAR ZONE.

MAINGUARD #94WM
SAMPLING STATION

WATER SAMPLING STATION

NOT TO SCALE



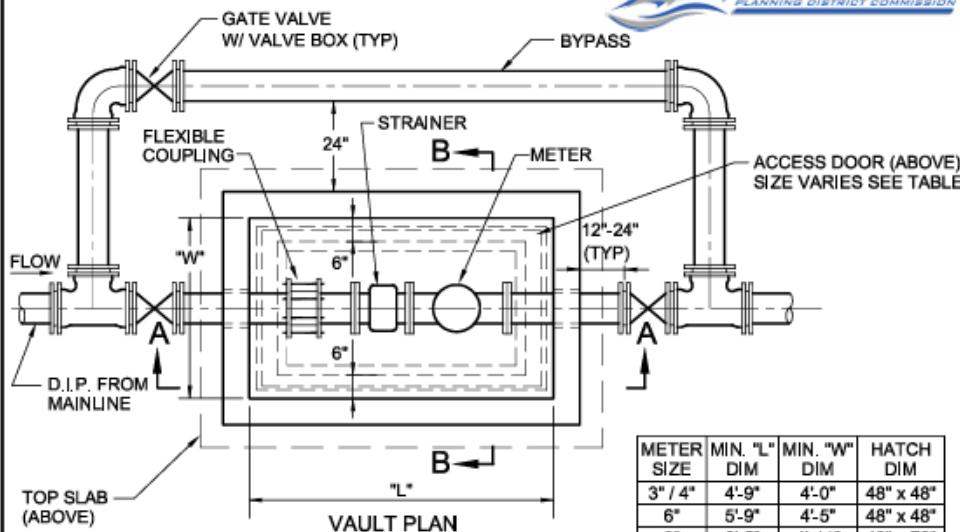
ROW
DFW A4C-24-1 BODY
DFW A4C-1 LID

NOTES:

1. METER BOX TO BE SUPPLIED BY CAPITOL FOUNDRY OF VIRGINIA, INC. (MODEL MBX-1836) OR APPROVED EQUAL.
2. INTERIOR AND EXTERIOR OF METER BOX SHALL HAVE A BITUMASTIC COATING 16-20 MILS THICK.
3. PROVIDE A HOLE IN LID FOR TOUCH READ/RADIO READ CAPABILITY. COORDINATE TOUCH READ/RADIO READ REQUIREMENT WITH THE INDIVIDUAL LOCALITY.

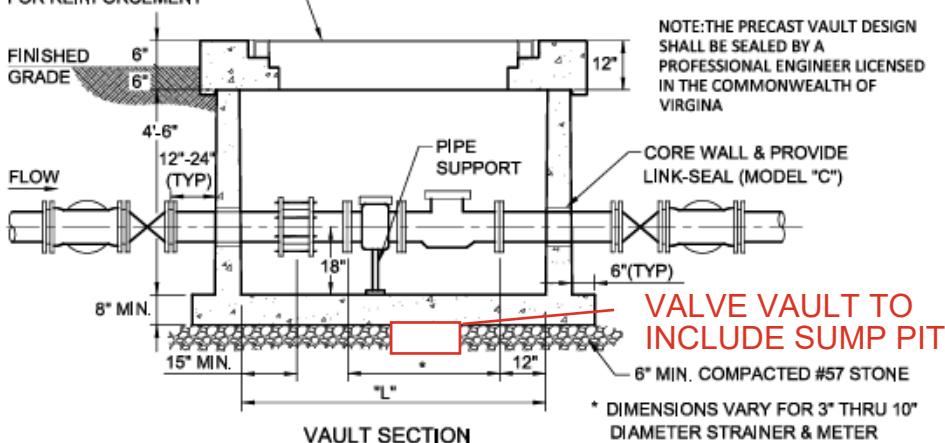
LARGE WATER METER BOX (1 1/2" THROUGH 2-INCH)

NOT TO SCALE



METER SIZE	MIN. "L" DIM	MIN. "W" DIM	HATCH DIM
3" / 4"	4'-9"	4'-0"	48" x 48"
6"	5'-9"	4'-5"	48" x 48"
8"	6'-5"	4'-11"	48" x 72"
10"	7'-8"	5'-1"	48" x 72"

REFER TO SECTIONS A-A & B-B
FOR REINFORCEMENT

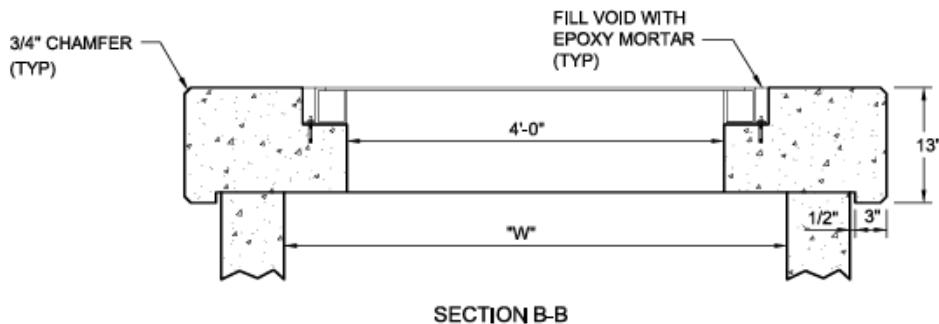
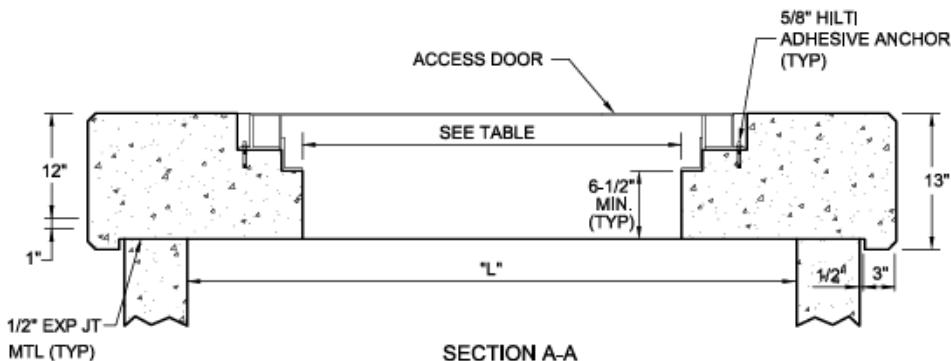


* DIMENSIONS VARY FOR 3" THRU 10"
DIAMETER STRAINER & METER

PRECAST VAULT- H20 LOADING

(3" THRU 10" WATER METER ASSEMBLIES)

NOT TO SCALE



**PRECAST CONCRETE VAULT- H20 LOADING
(3" THRU 10" WATER METER ASSEMBLIES)**

NOT TO SCALE



NOTES:

1. FLOOR OF VAULT TO BE SLOPED 1/4" PER FOOT TO A 6"X6" (3" DEEP) SUMP IN RIGHT BACK (PROPERTY SIDE) CORNER OF VAULT.
2. REDUCERS AS APPROPRIATE TO BE PLACED OUTSIDE THE BYPASS PIPING.
3. FLANGE ADAPTERS TO BE USED TO CONNECT METER TO PIPE.
4. METER, PIPE SUPPORT, AND DOOR KEY TO BE SUPPLIED BY THE CONTRACTOR AND DELIVERED TO THE OWNER.
5. ALL PIPES TO BE DUCTILE IRON, CLASS 53.
6. TWO 1-5/8" DIAMETER HOLES ARE TO BE DRILLED IN THE LEFT FRONT CORNER OF LID FOR REMOTE READ EQUIPMENT.
7. RECESSED LIFTING ANCHORS SHALL BE PROVIDED AT EACH CORNER OF VAULT LID.
8. VAULT DOORS SHALL BE CENTERED OVER METER LOCATION TO PROVIDE VERTICAL CLEARANCE ABOVE METER AND ASSOCIATED FITTINGS SO THAT THE ASSEMBLY CAN BE LIFTED STRAIGHT OUT OF THE VAULT WITHOUT TILTING. VAULT DOORS SHALL OPEN PARALLEL TO THE INTERIOR WATER LINE PIPING.
9. BILCO JD-AL H20 DOUBLE DOOR HATCH (OR APPROVED EQUAL) CENTERED.
10. INTERIOR AND EXTERIOR COATING PER LOCALITY REQUIREMENTS.
11. THE PRECAST VAULT DESIGN SHALL BE SEALED BY A PROFESSIONAL ENGINEER LICENSED IN THE COMMONWEALTH OF VIRGINIA.

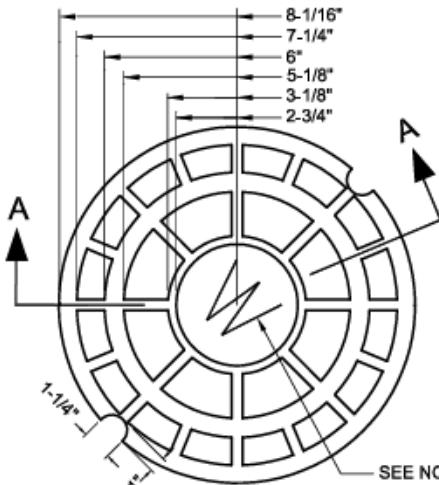
PRECAST CONCRETE VAULT- H20 LOADING (3" THRU 10" WATER METER ASSEMBLIES)

NOT TO SCALE

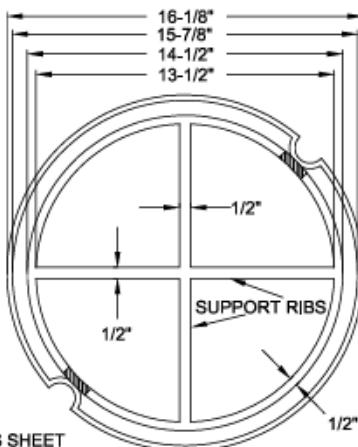
REFERENCE 200,801	CATEGORY WATER DISTRIBUTION	DATE 6/16	SHEET No. 3 OF 3	DETAIL No. WD_15
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NOTE:

MARK WITH A "W" FOR WATER DISTRIBUTION SYSTEMS OR "S" FOR SANITARY SYSTEMS. TOP & BOTTOM OF LETTER DESIGNATION TO BE IN LINE WITH NOTCHES.

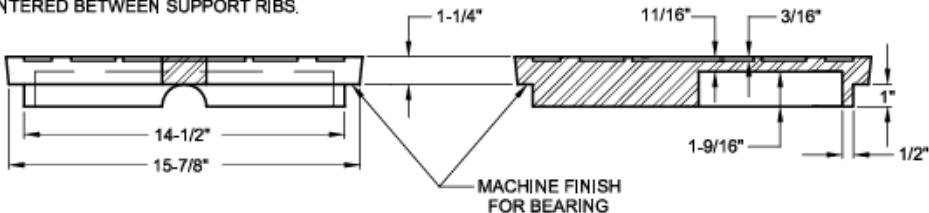


COVER: TOP



COVER: BOTTOM

BOTTOM SUPPORT RING TO BE
NOTCHED DIRECTLY UNDER PICK HOLE
ON BOTH SIDES. NOTCHES TO BE
CENTERED BETWEEN SUPPORT RIBS.



SIDE VIEW

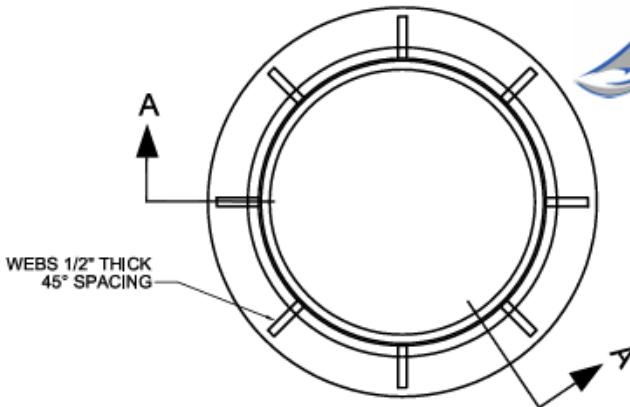
SECTION A-A

SEE WS_01, SHEET 2 OF 2 FOR NOTES & FRAME DETAILS.

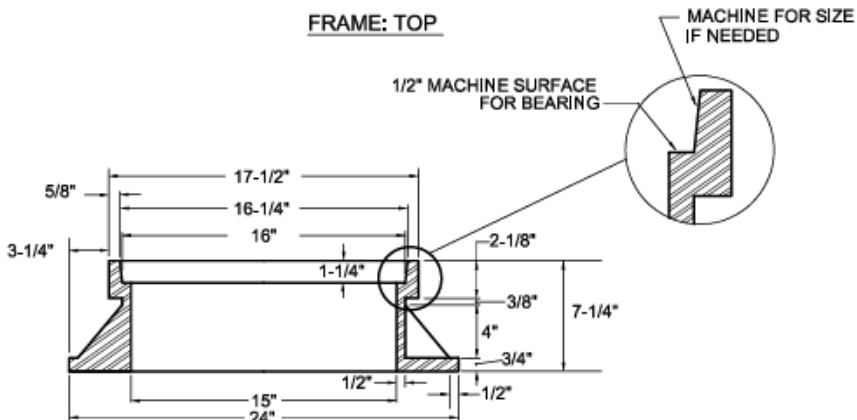
STANDARD VALVE BOX FRAME AND COVER

NOT TO SCALE

REFERENCE	CATEGORY	DATE	SHEET No.	DETAIL No.
200,801,803	WATER & SANITARY	6/16	1 OF 2	WS_01



FRAME: TOP



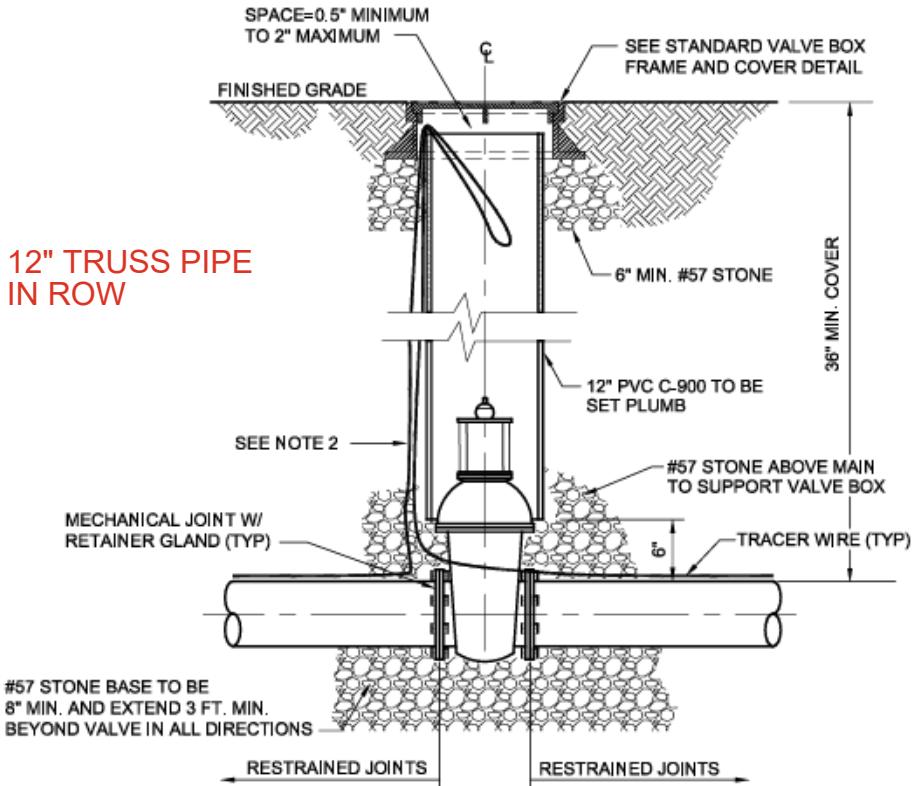
NOTES:

1. VALVE BOX FRAME AND COVER TO BE SUPPLIED BY CAPITAL FOUNDRY OF VIRGINIA, INC., MODEL #NPN-15*N, 160 LBS., OR APPROVED EQUAL.
2. ALL GRAY IRON CASTINGS SHALL CONFORM TO LATEST EDITION OF ASTM A-48, CLASS 30 AND SHALL BE OF UNIFORM QUALITY.
3. ALL CASTING DIMENSIONS SHALL HAVE A TOLERANCE OF $1/8" \pm$.
4. ALL CASTINGS SHALL BE CLEANED BY SHOT BLASTING AND HAND CHIPPING UTILIZING STANDARD INDUSTRY PRACTICES PRIOR TO SHOP APPLICATION OF ASPHALTIC COATING, BY DIPPING.

STANDARD VALVE BOX FRAME AND COVER

NOT TO SCALE

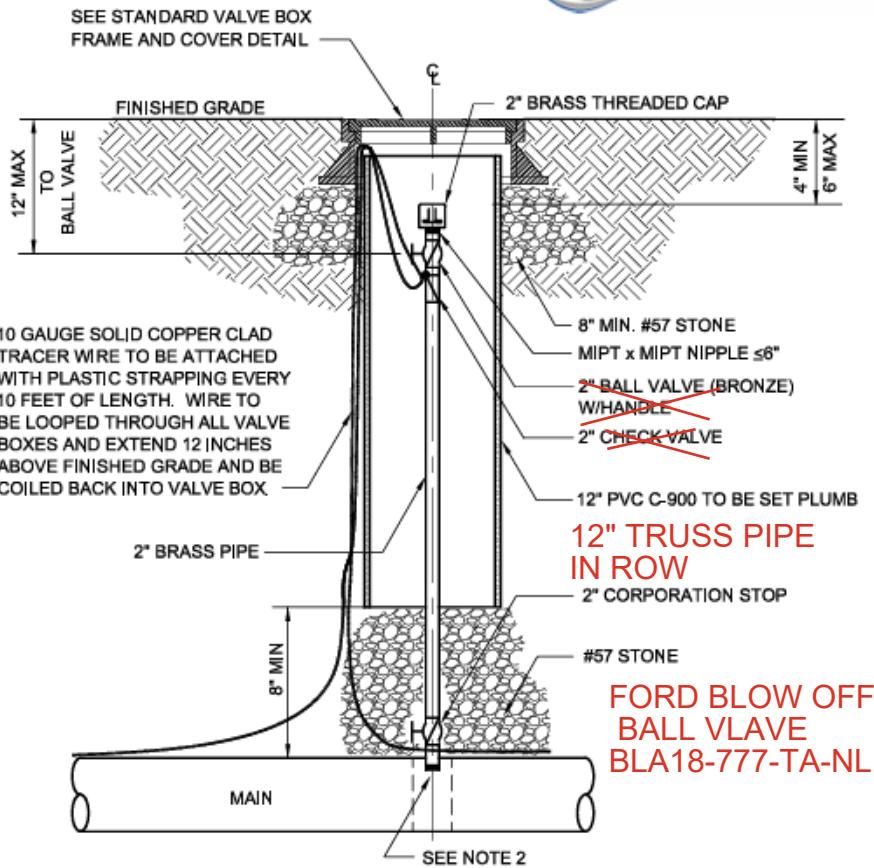
REFERENCE 200,801,803	CATEGORY WATER & SANITARY	DATE 6/16	SHEET No. 2 OF 2	DETAIL No. WS_01
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1. OPERATING NUT SHALL BE 12 TO 24 - INCHES BELOW THE TOP RIM OF THE VALVE BOX IF OPERATING NUT IS GREATER THAN 36" BELOW TOP OF VALVE BOX FRAME, A VALVE STEM EXTENSION MAY BE INSTALLED. THE EXTENSION SHALL REPLACE OR BE SECURELY ATTACHED TO THE NORMAL 2 INCH SQUARE OPERATING NUT, SHALL BE AT LEAST AS STRONG AS THE VALVE STEM, AND SHALL BE COATED IN ACCORDANCE WITH AWWA C550. VALVE STEM EXTENSIONS MUST BE APPROVED BY THE LOCALITY.
2. PLASTIC COATED 10 GAUGE SOLID COPPER TRACER WIRE TO BE ATTACHED WITH PLASTIC STRAPPING EVERY 10 FEET OF LENGTH. WIRE TO BE LOOPED THROUGH VALVE BOX AND EXTEND 12 INCHES ABOVE FINISHED GRADE AND COILED BACK INTO VALVE BOX.

VALVE SETTING DETAIL

NOT TO SCALE



FITTING	INLET THREAD	OUTLET THREAD
CORPORATION STOP	AWWA/CC	FEMALE IRON PIPE
BALL VALVE	FEMALE IRON PIPE	FEMALE IRON PIPE
THREADED CAP	FEMALE IRON PIPE	N/A

MANUAL AIR VENT ASSEMBLY

NOT TO SCALE

NOTES:

1. 2" BRASS PIPE AND FITTINGS SHALL BE USED FOR AIR RELEASE ASSEMBLY.
2. SADDLES ARE REQUIRED ON ALL PIPE DIAMETERS FOR ALL PIPE MATERIALS.
3. ALL BRASS FITTINGS SHALL HAVE IRON PIPE THREADS.
4. BRASS PIPE SHALL HAVE MALE IRON PIPE THREADS AT EACH END.
5. THE CORPORATION STOPS SHALL BE MANUFACTURED WITH AWWA/CC TAPERED INLET THREADS.
6. CORPORATION STOPS JOINING TO EXISTING GALVANIZED PIPING OR PROPOSED BRASS PIPE SHALL HAVE FEMALE IRON PIPE THREADS.
7. FOR CORPORATION STOPS JOINING TO GALVANIZED OR BRASS PIPING, USE FORD METER BOX CO., MODEL FB1600.
8. REFER TO DETAIL WS_02.

MANUAL AIR VENT ASSEMBLY

NOT TO SCALE

REFERENCE 200,801,803	CATEGORY WATER & SANITARY	DATE 6/16	SHEET No. 2 OF 2	DETAIL No. WS_03
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SEE STANDARD VALVE BOX
FRAME AND COVER WS-01
Cov Shall Have S on Lid

FINISHED GRADE

8" MIN #67

4" MAX

BERMAD ARV M
WW 2" C5000PS

Threaded Searge and
Wastewater A.R. Valve
SW-2-C50-SP-P-S-NP-NSF

12" PVC TRUSS

2" BRASS PIPE

#57 STONE

Ford
BLA 18-777-7A-NL
2" ANG OFF set
BALL Valve

2" Brass
Nipple

2" BRASS
90° BEND

#57
stone

FB 1600-7 NL
8" Ball Corp CC

MAIN

AUTOMATIC AIR VENT

NOT TO SCALE

OPTION 1
 SEE "AIR VENT
 ASSEMBLY" WS_03
 (NOTE CONNECTION
 BETWEEN CASING AND
 CARRIER PIPE)

2" BRASS
 PIPE
 1" PRE-MOLDED
 FIBER CAULKING
 BETWEEN PIPE
 AND BRICK

NEOPRENE
 END SEAL OR 8"
 BRICK TO SEAL
 ANNULAR SPACE
 AT CASING ENDS. IF
 BRICK, COAT
 SURFACE WITH
 BITUMASTIC

G DRAINAGE
 DITCH

STEEL CASING
 (FOR LENGTH SEE
 CONTRACT DOCUMENTS)

FINISH
 GRADE

OPTION 2
 2" STAINLESS
 STEEL PIPE

G DRAINAGE
 DITCH

BIRD SCREEN

SEE NOTE 4

A

BRICK AND MORTAR
 CAP 4" MIN. THICKNESS

DUCTILE IRON
 CARRIER PIPE

RESTRAINED
 MECHANICAL
 JOINT (TYP)

SECTION

STAINLESS STEEL
 CASING SPACER
 (OR AS APPROVED
 BY LOCALITY)

TOP OF PAVEMENT

STEEL CASING

DUCTILE IRON
 CARRIER PIPE

STAINLESS STEEL
 CASING SPACER
 (OR AS APPROVED
 BY LOCALITY)

SECTION A-A

SEE WS_04, SHEET 2 OF 2 FOR NOTES.

STEEL CASING DETAIL

NOT TO SCALE

STEEL CASING PIPE SELECTION CHART

DUCTILE IRON PIPE SIZE	4"	6"	8"	12"	16"	24"	30"	36"
STEEL CASING PIPE SIZE (O.D.)	12"	18"	18"	24"	30"	42"	48"	54"

NOTES:

1. ALL JOINTS INSIDE OF CASING PIPE AND ONE JOINT BEYOND SHALL BE RESTRAINED MECHANICAL JOINTS OR AS APPROVED BY LOCALITY.
2. INSTALL CASING PIPE AS SHOWN ON DRAWINGS OR MIN. 5 FT. BEYOND EDGE OF PAVEMENT.
3. STAINLESS STEEL SPACERS
SPACERS SHALL BE BOLT-ON STYLE WITH A TWO PIECE SHELL MADE FROM T-304 STAINLESS STEEL OF A MINIMUM 14 GAUGE THICKNESS. THE SHELL SHALL BE LINED WITH A RIBBED PVC SHEET OF A 0.090" THICKNESS THAT OVERLAPS THE EDGES. RUNNERS MADE FROM UHMW POLYMER, SHALL BE ATTACHED TO RISERS AT APPROPRIATE POSITIONS TO PROPERLY LOCATE THE CARRIER WITHIN THE CASING AND TO EASE INSTALLATION. RISERS TO BE MADE FROM T-304 STAINLESS STEEL OF A MINIMUM 14 GAUGE THICKNESS AND SHALL BE ATTACHED TO THE SHELL BY MIG WELDING. ALL WELDS SHALL BE FULLY PASSIVATED. ALL FASTENERS SHALL BE MADE FROM T-304 STAINLESS STEEL. CASING SPACERS SHALL BE MODEL CCS AS MANUFACTURED BY CASCADE WATERWORKS MANUFACTURING COMPANY OF YORKVILLE, IL., MODEL SSI AS MANUFACTURED BY ADVANCE PRODUCTS & SYSTEMS, INC. OF LAFAYETTE, LA., OR APPROVED EQUAL.
4. SPACER WIDTH AND PLACEMENT INTERVALS
IN ALL INSTANCES SPACER SHOULD BE PLACED TO SUPPORT THE CARRIER WITHIN TWO FEET OF THE END OF EACH PIPE JOINT. CONSULT SPACER MANUFACTURER FOR RECOMMENDATIONS ON SPACER WIDTH AND ADDITIONAL PLACEMENT INTERVALS.

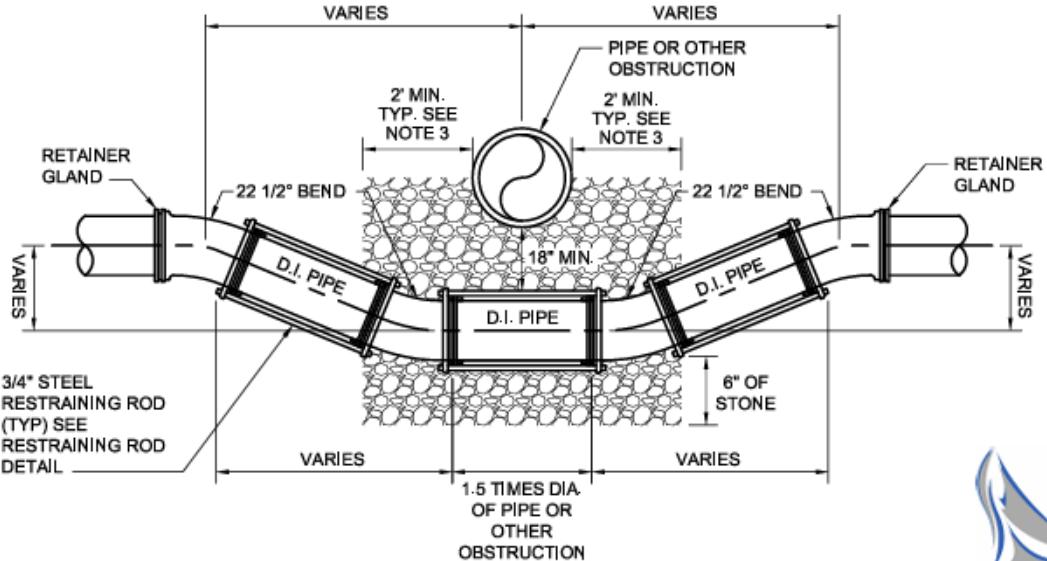
STEEL CASING DETAIL

NOT TO SCALE

REFERENCE 200,801-804	CATEGORY WATER & SANITARY	DATE 6/16	SHEET No. 2 OF 2	DETAIL No. WS_04
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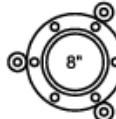
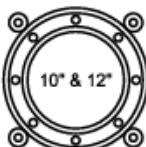
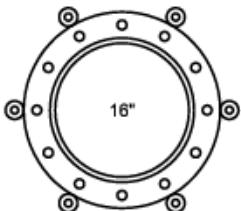
OBSTRUCTION BY-PASS UNIFORM OFFSET

NOT TO SCALE

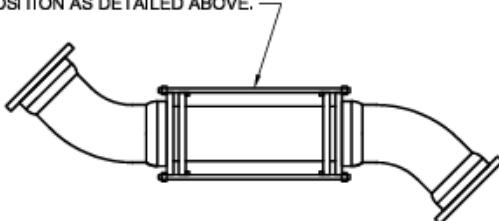


NOTES:

1. SEE PLANS FOR OFFSET DIMENSIONS. NON-UNIFORM OFFSET REQUIRES SPECIAL DESIGN.
2. SEE SPECIFICATION SECTION 200 FOR OTHER ALLOWABLE METHODS OF RESTRAINT.
3. BEDDING MATERIAL SHALL BE PLACED A MINIMUM OF 2 FEET BEYOND EACH PIPE AND PROJECT OUTWARD FROM THE CROSSING ALONG BOTH PIPES.



3/4" STEEL RESTRAINING RODS
POSITION AS DETAILED ABOVE.



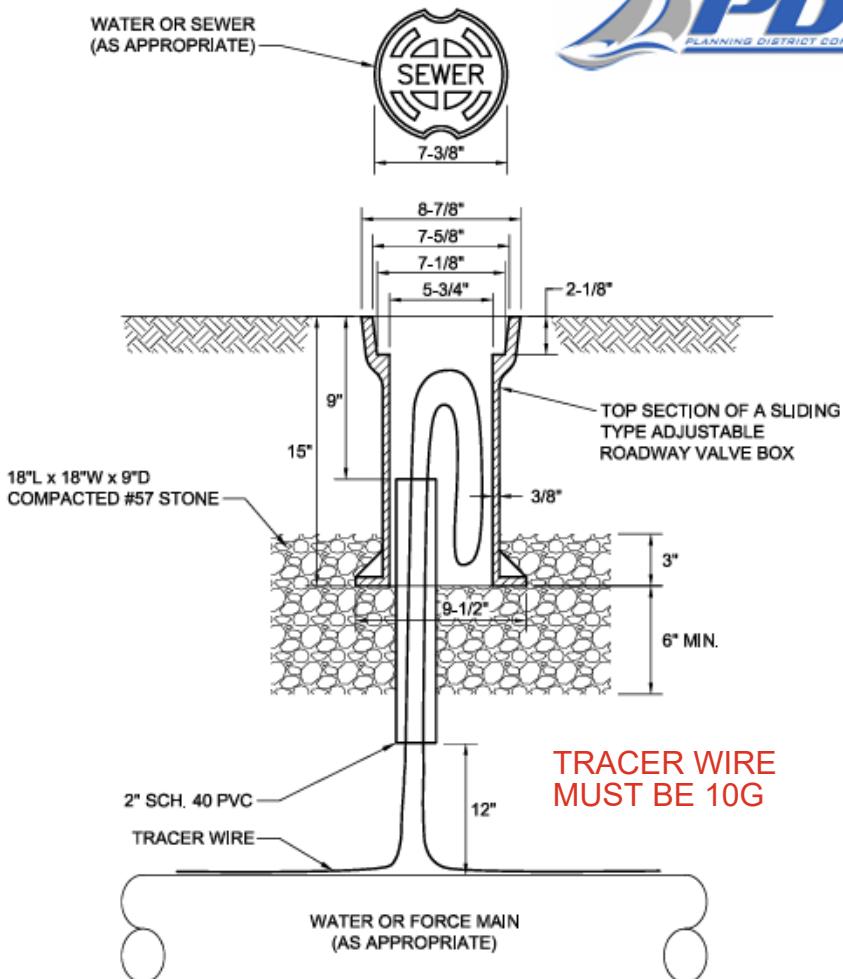
NOTES:

1. BOLT HOLES ARE SHOWN AS NORMALLY PROVIDED IN MECHANICAL JOINT FITTINGS, i.e. STRADDLING THE VERTICAL AXIS WHEN FITTING IS POSITIONED FOR A HORIZONTAL CHANGE OF DIRECTION. FITTINGS WITH BOLT HOLES OTHERWISE ORIENTED SHOULD NOT BE USED IN RODDED ASSEMBLIES.
2. 3/4" TIE BOLTS AND THREADED RODS SHALL HAVE A MINIMUM YIELD STRENGTH OF 11,000 lbs EACH.
3. ALL RODS AND FASTENERS SHALL BE GIVEN TWO COATS OF BITUMINOUS PAINT AFTER ASSEMBLY.

RESTRAINING ROD DETAIL

NOT TO SCALE

REFERENCE 200,801,803	CATEGORY WATER & SANITARY	DATE 6/16	DETAIL NO. 1 OF 1	DETAIL NO. WS 07
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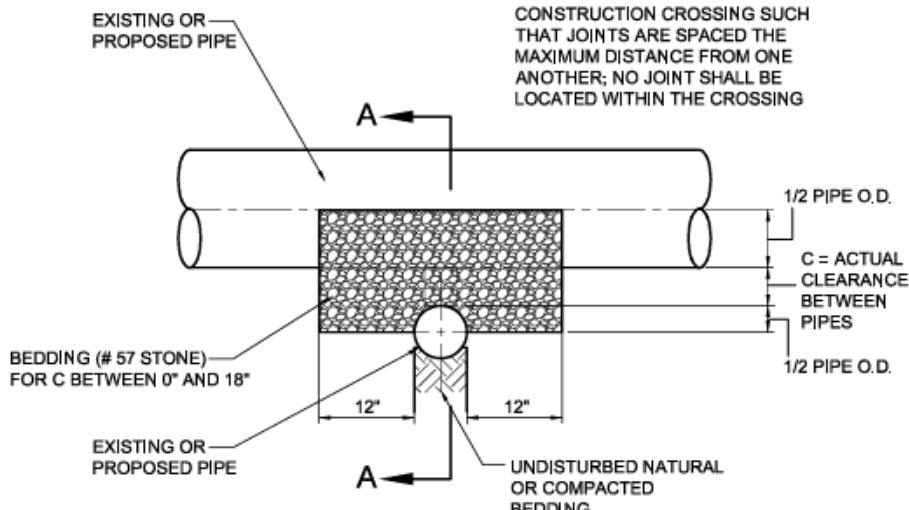
NOTES:

1. WIRE SHALL BE LOOPED THROUGH THE VALVE VAULT AND EXTEND 24 INCHES ABOVE FINISHED GRADE AND COILED BACK INTO THE VALVE VAULT.

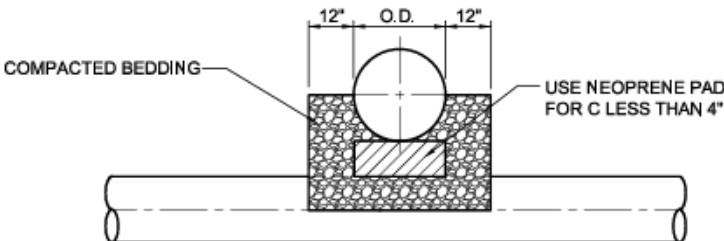
TYPICAL TRACER WIRE BOX INSTALLATION

NOT TO SCALE

REFERENCE 200, 801, 803	CATEGORY WATER & SANITARY	DATE 6/16	Sheet No. 1 OF 1	Detail No. WS_08
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SAND TO BE USED AROUND WATER LINE



SECTION A-A

NOTE:

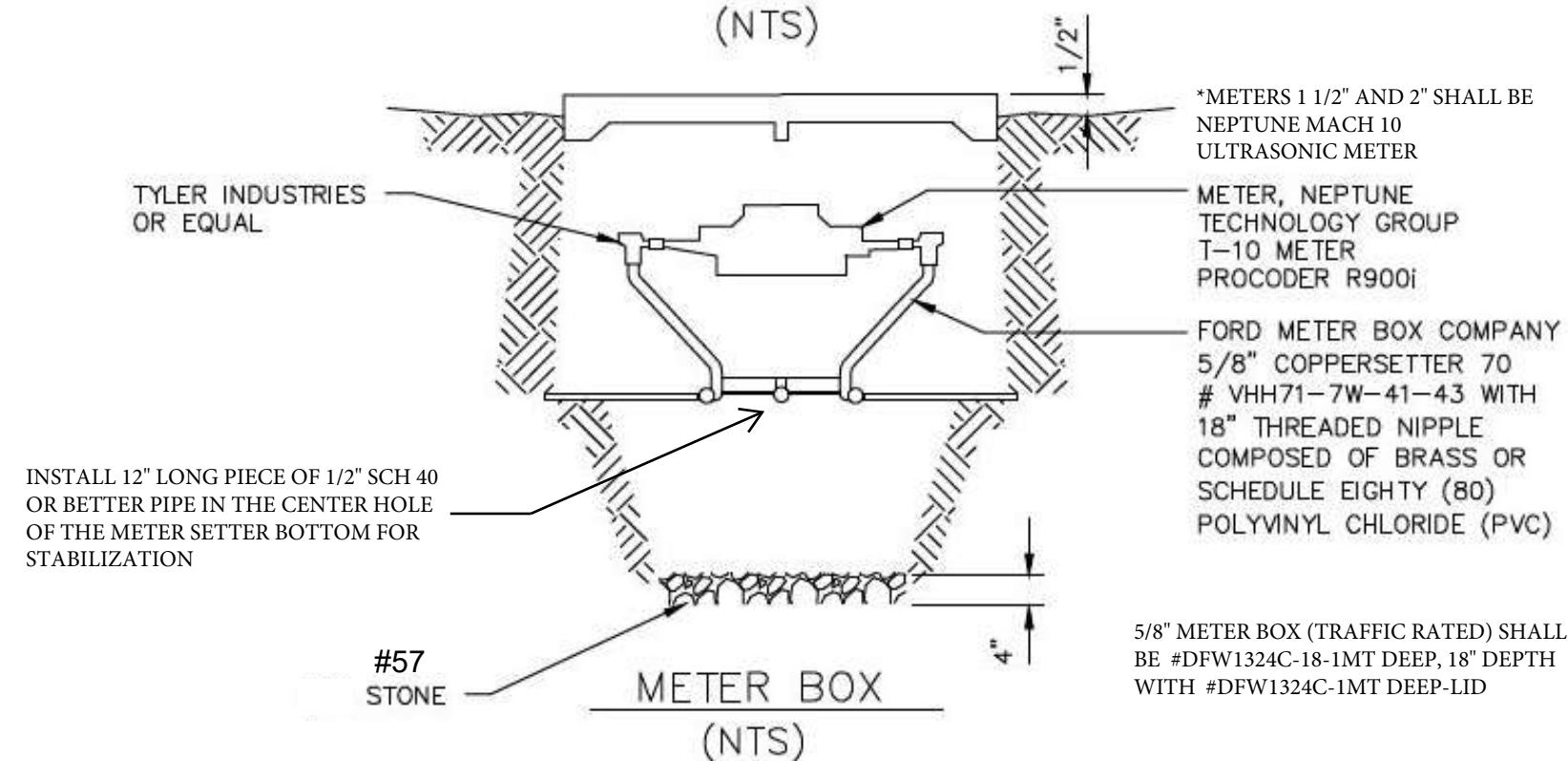
1. USE OF THIS DETAIL MUST BE APPROVED BY THE LOCALITY.

PIPE CROSSING

NOT TO SCALE

NOTE: THE WATER SUPPLY LINES FROM THE WATER MAIN TO THE WATER METERS SHALL BE OF TWO-INCH (2") OR LESS IN DIAMETER MUNICIPEX PIPE, WITH TEN (10) GAUGE TRACER WIRE.

SERVICE CONNECTION



NOTE: THE COPPERSETTER MUST BE CONTAINED IN AN EIGHTEEN INCH (18") CARSON METER BOX (ITEM NUMBER 1520). AN EPOXY-COATED SERVICE SADDLE WITH "CC" THREADS AND STAINLESS STEEL STRAPS MUST BE USED. MUNICIPEX PIPE TWO INCHES (2") OR LESS IN DIAMETER, WITH TEN (10) GAUGE TRACER WIRE.

ADDITIONAL ACCESSORIES

WATER METER SHALL BE 5/8" NEPTUNE TECHNOLOGY GROUP MODEL T-10 PROCODER R900i
CORPORATION STOPS SHALL BE 1" BALL CORPORATION STOP PART #FB600-4-NL BY THE FORD METER BOX COMPANY, INC. CONTRACTOR SHALL USE SWIVEL EIGHT BEND PART #LA04-44S-NL BY THE FORD METER BOX COMPANY

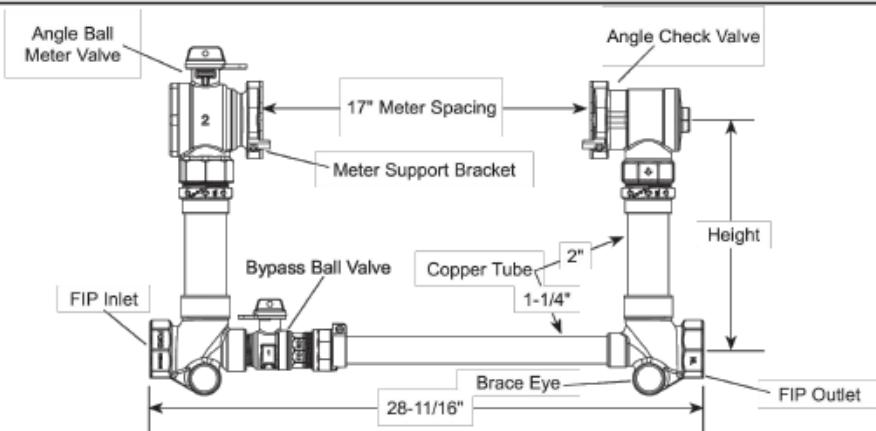
SUBMITTAL INFORMATION

70 Series Coppersetter - (VBH77-xxB-11-77-NL style)



ANGLE BALL VALVE BY ANGLE CHECK VALVE (2" METER)

FEMALE IRON PIPE THREAD INLET AND OUTLET



SERVICE LINE CONNECTION		HEIGHT	APPROX. WT. LBS.	CATALOG NUMBER	✓ SUBMITTED ITEM(S)
FIP INLET	FIP OUTLET				
2"	2"	12"	32	VBH77-12B-11-77-NL	
		15"	33	VBH77-15B-11-77-NL	
		18"	34	VBH77-18B-11-77-NL	
		21"	34	VBH77-21B-11-77-NL	
		24"	35	VBH77-24B-11-77-NL	
		27"	35	VBH77-27B-11-77-NL	
		36"	38	VBH77-36B-11-77-NL	
		42"	40	VBH77-42B-11-77-NL	

FEATURES

- All brass that comes in contact with potable water conforms to AWWA Standard C800 (ASTM B584, UNS C89833)
- The product has the letters "NL" cast into the main body for lead-free identification
- Brass components that do not come in contact with potable water conform to AWWA Standard C800 (ASTM B62 and ASTM B584, UNS C83600, 85-5-5-5)
- Certified to NSF/ANSI/CAN Standard 61 and NSF/ANSI/CAN Standard 372 where applicable
- Copper conforms to ASTM B75 or B88, UNS C12200
- All Ford® Setters are assembled with lead-free solder
- 2-1/8" copper risers provide more flow capacity
- Bracing eyes are standard
- Meter support brackets are standard
- Optional High Bypass - add "HB" following the height. Example: VBH77-12HB-11-77-NL
- Padlock wing is standard on all angle meter ball valves or key valves

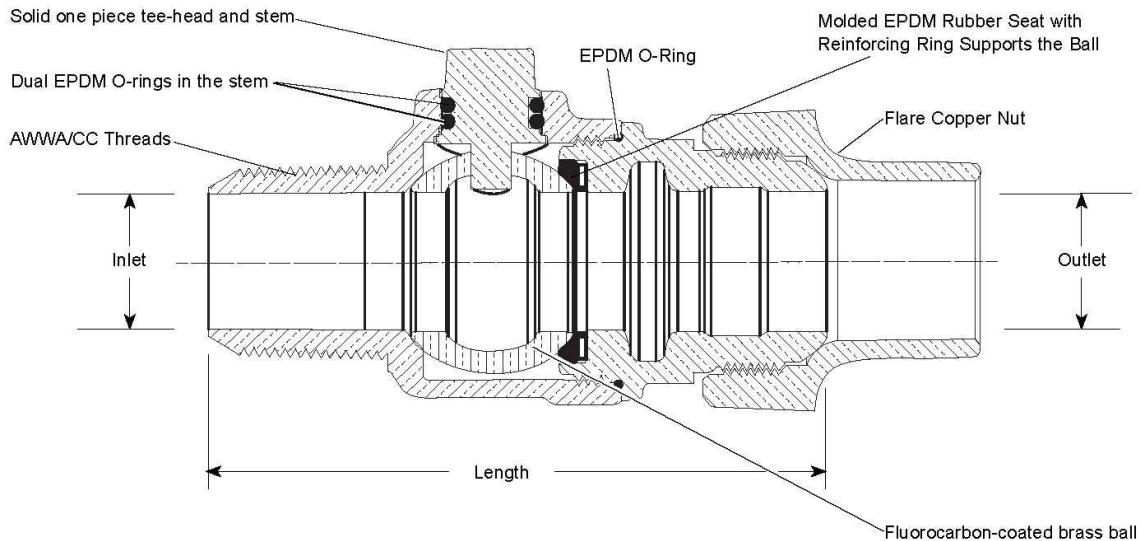
The Ford Meter Box Company considers the information in this submittal form to be correct at the time of publication. Item and option availability, including specifications, are subject to change without notice. Please verify that your product information is current. Our standard warranty applies.



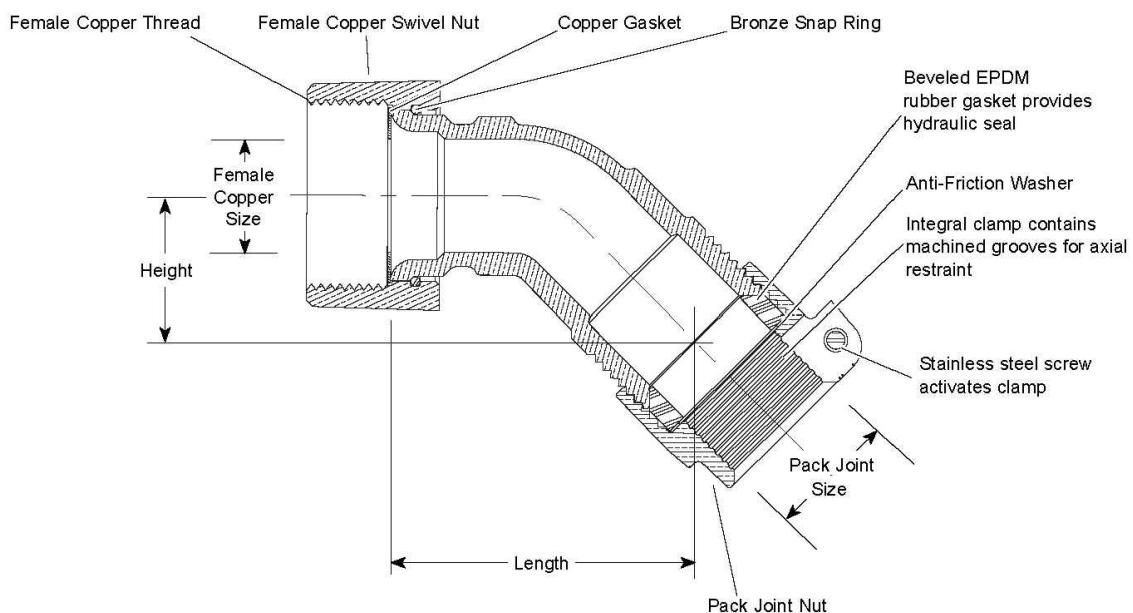
The Ford Meter Box Company, Inc.
P.O. Box 443, Wabash, Indiana U.S.A. 46992-0443
Phone: 260-563-3171 / Fax: 800-826-3487
Overseas Fax: 260-563-0167
www.fordmeterbox.com

Submitted By:

AWWA/CC TAPER THREAD INLET BY FLARE COPPER OUTLET



**BALLCORP CORPORATION STOP
(FB600-x-NL style)
FORD METER BOX COMPANY**



**SWIVEL EIGHTH BEND
(LA04-xxS-NL style)
FORD METER BOX COMPANY**



**TOWN OF SMITHFIELD
DESIGN AND CONSTRUCTION STANDARDS**

**CORPORATION STOP AND
SWIVEL EIGHTH BEND**

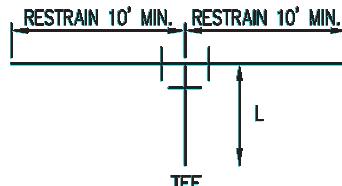
DWG #: W-8A

SCALE: NTS

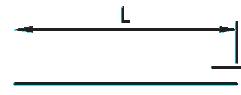
NOV 2022



HORIZONTAL/VERTICAL BEND



TEE



PLUG & VALVES



REDUCER

NOTE: L = CORRESPONDING LENGTH BELOW (FT)

MINIMUM RESTRAINED JOINT LENGTHS (L)

FITTING	11.25"	22.5"	45"	90"	PLUG/VALVE	REDUCER	TEE
4" HORIZONTAL BEND	2'	4'	7'	17'	—	—	—
6" HORIZONTAL BEND	2'	5'	10'	24'	—	—	—
8" HORIZONTAL BEND	3'	6'	13'	31'	—	—	—
10" HORIZONTAL BEND	4'	8'	16'	38'	—	—	—
12" HORIZONTAL BEND	4'	9'	18'	44'	—	—	—
4" VERTICAL BEND	5'	10'	22'	—	—	—	—
6" VERTICAL BEND	7'	15'	31'	—	—	—	—
8" VERTICAL BEND	9'	19'	40'	—	—	—	—
10" VERTICAL BEND	11'	23'	48'	—	—	—	—
12" VERTICAL BEND	13'	26'	56'	—	—	—	—
4" PLUG/VALVE	—	—	—	52'	—	—	—
6" PLUG/VALVE	—	—	—	74'	—	—	—
8" PLUG/VALVE	—	—	—	96'	—	—	—
10" PLUG/VALVE	—	—	—	115'	—	—	—
12" PLUG/VALVE	—	—	—	135'	—	—	—
12x12	—	—	—	—	—	—	104'
12x10	—	—	—	—	—	40'	77'
12x8	—	—	—	—	—	72'	48'
12x6	—	—	—	—	—	98'	11'
12x4	—	—	—	—	—	117'	5'
10x10	—	—	—	—	—	—	84'
10x8	—	—	—	—	—	39'	57'
10x6	—	—	—	—	—	71'	22'
10x4	—	—	—	—	—	94'	5'
8x8	—	—	—	—	—	—	65'
8x6	—	—	—	—	—	40'	33'
8x4	—	—	—	—	—	69'	5'
6x6	—	—	—	—	—	—	43'
6x4	—	—	—	—	—	38'	8'
4x4	—	—	—	—	—	—	22'

NOTES:

1. LOOSED WATER SYSTEMS SHALL HAVE RESTRAINT PROVIDED ON BOTH SIDES OF ALL VALVES AND FITTINGS.
2. LENGTHS SHOWN ABOVE ARE MINIMUM REQUIREMENTS. CONDITIONS WORSE THAN THE DESIGN PARAMETERS INDICATED, WHETHER ANTICIPATED DURING DESIGN OR ENCOUNTERED DURING CONSTRUCTION, WILL REQUIRE SUBMITTAL OF DESIGN CALCULATIONS FOR SMITHFIELD REVIEW AND APPROVAL.
3. DEPTH OF BURY ON LOW SIDE OF VERTICAL BENDS ASSUMED AS 6 FEET.
4. COMPUTATIONS BASED ON FORD METER BOX UNIFLANGE PIPE THRUST RESTRAINT PROGRAM V.3.00.
5. GATE VALVES CALCULATED AS DEAD END FITTING TYPE
6. PIPE SIZES LARGER THAN 12" SHALL HAVE THE RESTRAINED LENGTH CALCULATED AND APPROVED BY SMITHFIELD THEN PLACED ON THE PLANS. THE DESIGN PARAMETERS SHOWN SHALL BE THE MINIMUM CONDITIONS.

DESIGN PARAMETERS:

TEST PRESSURE = 150 PSI

PIPE MATERIAL = PVC

TRENCH TYPE IV

SOIL TYPE = ML

DEPTH OF BURY = 3'

SAFETY FACTOR = 1.5



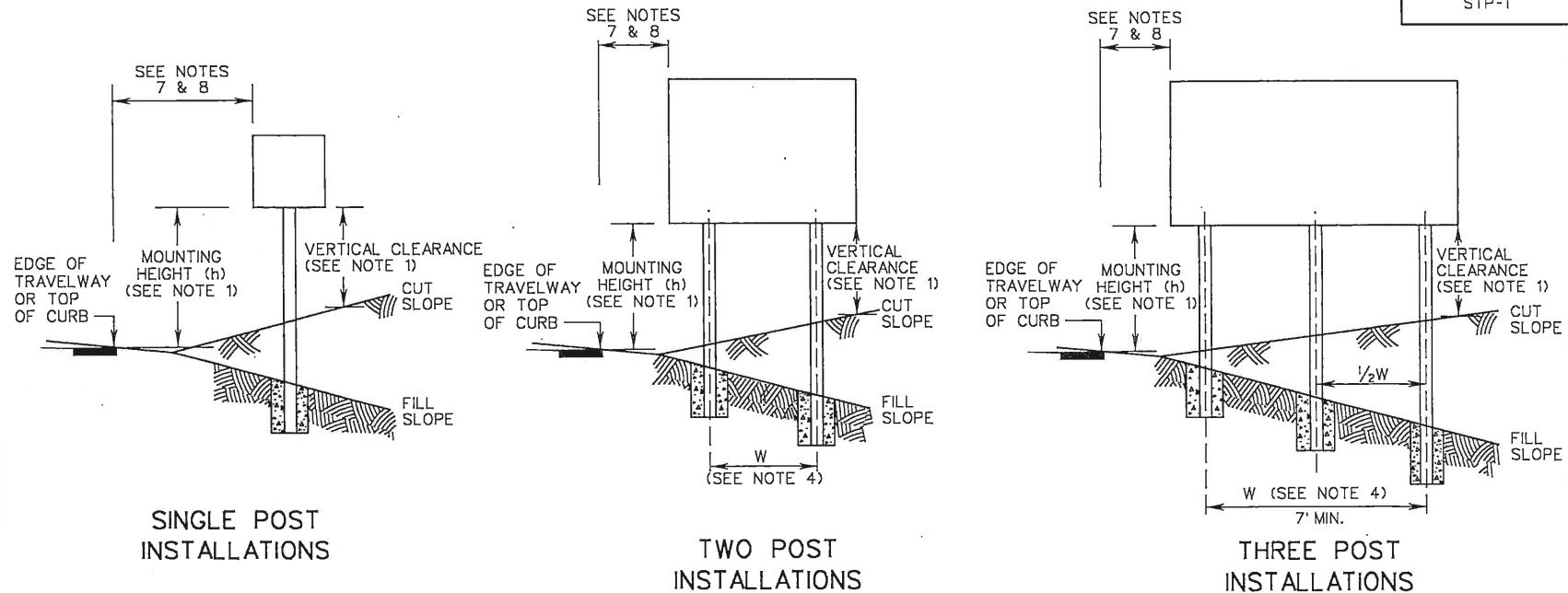
TOWN OF SMITHFIELD
DESIGN AND CONSTRUCTION STANDARDS

JOINT RESTRAINT TABLE

DWG #: JR-1 SCALE: N.T.S

DWN BY: TOWN

AUG 2017

**NOTES:**

1. FOR ALL SIGNS EXCEPT STREET NAME SIGNS:
 - A. MINIMUM MOUNTING HEIGHT (h) SHALL BE IN ACCORDANCE WITH THE "MINIMUM MOUNTING HEIGHT" TABLE ON THIS SHEET.
 - B. MAXIMUM MOUNTING HEIGHT (h) FOR THE BOTTOM-MOST SIGN PANEL(S) SHALL BE 8 FEET, EXCEPT WHEN NECESSARY TO ACHIEVE MINIMUM VERTICAL CLEARANCE BEHIND SIGN PANEL AS PER NOTE 1C.
 - C. MINIMUM VERTICAL CLEARANCE (DISTANCE BETWEEN BOTTOM OF SIGN PANEL AND FINISHED GRADE BEHIND THE PANEL) SHALL BE 7 FEET FOR ANY PORTION OF THE SIGN WITHIN THE CLEAR ZONE. THIS MINIMUM VERTICAL CLEARANCE MAY BE REDUCED TO 5 FEET FOR EITHER OF THE FOLLOWING CONDITIONS:
 - WHEN SIGNS OR PORTIONS OF SIGNS ARE LOCATED MORE THAN 10 FEET UP A CUT SLOPE GREATER THAN 3:1, OR
 - WHEN THE SIGN IS LOCATED AT LEAST THE MINIMUM DISTANCE BEHIND CURB, BARRIER, OR GUARDRAIL AS PER NOTES 7 AND 8.
2. MOUNTING HEIGHT (h) FOR STREET NAME SIGNS SHALL BE BETWEEN 8'-6" AND 9'-0".
3. A SECONDARY SIGN IS CONSIDERED TO BE A SIGN MOUNTED BELOW ANOTHER SIGN, EXCEPT A ROUTE MARKER WITH AN AUXILIARY PLATE IS CONSIDERED TO BE A SINGLE SIGN. A SECONDARY SIGN SHALL NOT BE MOUNTED LOWER THAN 7 FEET ABOVE A PEDESTRIAN SIDEWALK OR PATHWAY IF IT WILL PROJECT INTO THE PEDESTRIAN FACILITY.
4. W = (0.60) X (SIGN PANEL WIDTH)
5. SQUARE TUBE SIGN POSTS REQUIRING A BREAKAWAY SUPPORT SYSTEM SHALL BE AN FHWA APPROVED BREAKAWAY SUPPORT SYSTEM CONFORMING TO AASHTO'S STANDARD SPECIFICATIONS FOR STRUCTURAL SUPPORTS FOR HIGHWAY SIGNS, LUMINARIES AND TRAFFIC SIGNALS.
6. FOR SIGNS LOCATED IN AREAS WHERE PEDESTRIAN MOVEMENTS ARE LIKELY TO OCCUR OR ON-STREET PARKING IS PERMITTED, THE HEIGHT FROM THE LOWEST PORTION OF THE SIGN PANEL TO THE FINISHED SURFACE SHALL HAVE A MINIMUM CLEARANCE OF 7 FEET.
7. THE LATERAL CLEARANCE TO THE SIGN PANEL SHALL BE A MINIMUM OF 2 FEET FROM THE FACE OF CURB OR 4 FEET FROM FACE OF BARRIER, IF PRESENT.
8. UNLESS OTHERWISE APPROVED BY THE ENGINEER, SIGNS PLACED BEHIND GUARDRAIL SHALL BE LOCATED SUCH THAT THE NEAR SIDE EDGE OF THE SIGN PANEL IS OUTSIDE OF THE GUARDRAIL DEFLECTION DISTANCE.

SIGN TYPES	MINIMUM MOUNTING HEIGHT (h) (SEE NOTE 1)		
	FREEWAYS, EXPRESSWAYS, AND FULL CONTROL ACCESS HIGHWAYS		OTHER HIGHWAYS
DIRECTIONAL SIGNS	7'	5'	7'
ROUTE MARKERS, WARNING AND REGULATORY SIGNS	7'	5'	7'
SECONDARY SIGNS (SEE NOTE 3)	5'	4'	7'

SPECIFICATION REFERENCE	A COPY OF THE ORIGINAL SEALED AND SIGNED DRAWING IS ON FILE IN THE CENTRAL OFFICE.		V DOT ROAD AND BRIDGE STANDARDS
	SQUARE TUBE SIGN POST	VIRGINIA DEPARTMENT OF TRANSPORTATION	
700	REVISION DATE 01/15	SHEET 1 OF 12	1321.10

TABLE 1
FOR HAMPTON ROADS DISTRICT (SEE NOTE 5)

SIZE OF POST	CENTROID (FT)	MAXIMUM AREA (TOTAL OF SIGN PANELS) (FT ²)			COMMENTS
		SINGLE-POST	TWO-POST	THREE-POST	
2 INCH 14 GA.	8	5.8			TYPE A, TYPE D, OR TYPE F FOUNDATION AS SPECIFIED IN THE CONTRACT DOCUMENTS.
	9	5.1			
	10	4.6			
	11	4.2			
	12	3.8			
	13	3.5			
	14	3.3			
2½ INCH 12 GA.	8	11.8	23.6		SINGLE POST: TYPE A OR TYPE E FOUNDATION. MULTI-POST: TYPE B OR TYPE C FOUNDATION. AS SPECIFIED IN THE CONTRACT DOCUMENTS.
	9	10.5	21.0		
	10	9.4	18.8		
	11	8.6	17.2		
	12	7.8	15.6		
	13	7.2	14.5		
	14	6.7	13.5		
2½ INCH 10 GA.	8	13.6	27.2	40.8	TYPE B OR TYPE C FOUNDATION AS SPECIFIED IN THE CONTRACT DOCUMENTS.
	9	12.1	24.2	36.3	
	10	10.9	21.8	32.7	
	11	9.9	19.8	29.7	
	12	9.1	18.2	27.3	
	13	8.4	16.8	25.2	
	14	7.8	15.6	23.4	
2½ INCH 10 GA. WITH 2½ INCH 10 GA. INNER POST (SEE NOTE 1)	8	23.9	47.8	71.7	TYPE B OR TYPE C FOUNDATION AS SPECIFIED IN THE CONTRACT DOCUMENTS.
	9	21.2	42.4	63.6	
	10	19.1	38.2	57.3	
	11	17.4	34.8	52.2	
	12	15.9	31.8	47.7	
	13	14.7	29.4	44.1	
	14	13.6	27.2	40.8	

NOTES:

1. THE INNER POST SHALL BE 6 FEET IN LENGTH.
2. CENTROID SHALL BE DETERMINED IN ACCORDANCE WITH PCS-1.
3. MINIMUM COLD FORMED YIELD STRENGTH SHALL BE:
14 GA. AND 12 GA. = 60 KSI
10 GA. = 55 KSI
4. FOLLOW SIGN BRACING DETAILS (SEE SHEET 11 OF 12) FOR MAXIMUM SIGN PANEL WIDTHS AND SIGN BRACING SPACING.
5. TABLE 1 SHALL BE USED FOR THE HAMPTON ROADS DISTRICT, EXCEPT THE CITY OF EMPORIA AND COUNTIES OF GREENSVILLE, SUSSEX, AND SOUTHAMPTON SHALL USE TABLE 2.

VDOT ROAD AND BRIDGE STANDARDS SHEET 2 OF 12 1321.11	A COPY OF THE ORIGINAL SEALED AND SIGNED DRAWING IS ON FILE IN THE CENTRAL OFFICE. SQUARE TUBE SIGN POST VIRGINIA DEPARTMENT OF TRANSPORTATION	SPECIFICATION REFERENCE
		700

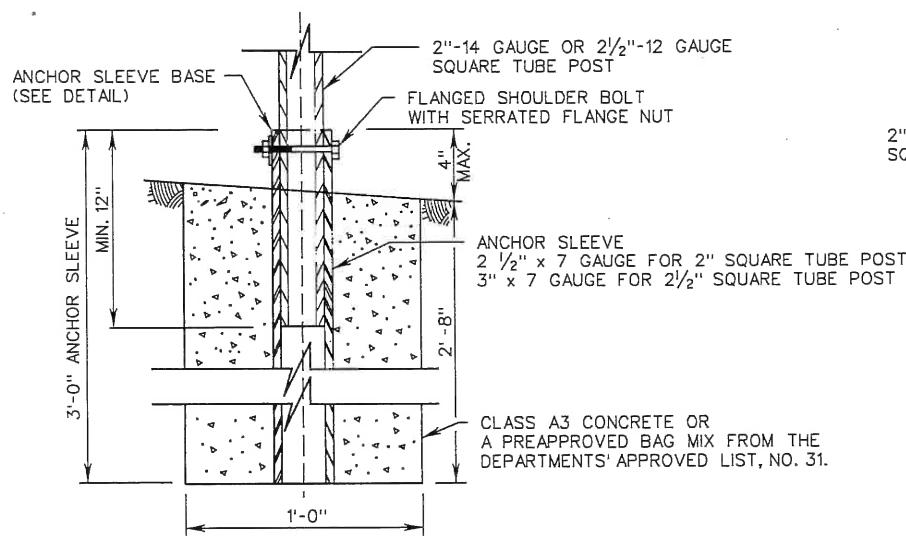
TABLE 2
FOR BRISTOL, SALEM, LYNCHBURG, RICHMOND,
FREDERICKSBURG, CULPEPER, STAUNTON, AND NORTHERN
VIRGINIA DISTRICTS (SEE NOTE 5)

SIZE OF POST	CENTROID (FT)	MAXIMUM AREA (TOTAL OF SIGN PANELS) (FT ²)			COMMENTS
		SINGLE-POST	TWO-POST	THREE-POST	
2 INCH 14 GA.	8	10.7	21.4		TYPE A, TYPE D, OR TYPE F FOUNDATION AS SPECIFIED IN THE CONTRACT DOCUMENTS.
	9	9.5	19.0		
	10	8.5	17.0		
	11	7.7	15.4		
	12	7.1	14.2		
	13	6.5	13.0		
	14	6.1	12.2		
2½ INCH 12 GA.	8	21.5			TYPE A OR TYPE E FOUNDATION.
	9	19.1			
	10	17.2			
	11	15.6			
	12	14.3			
	13	13.2			
	14	12.3			
2½ INCH 10 GA.	8	24.8	49.6	74.4	TYPE B OR TYPE C FOUNDATION AS SPECIFIED IN THE CONTRACT DOCUMENTS.
	9	22.0	44.0	66.0	
	10	19.8	39.6	59.4	
	11	18.0	36.0	54.0	
	12	16.5	33.0	49.5	
	13	15.2	30.4	45.6	
	14	14.1	28.2	42.3	
2½ INCH 10 GA. WITH 2½ INCH 10 GA. INNER POST (SEE NOTE 1)	8	43.4	86.8	130.2	TYPE B OR TYPE C FOUNDATION AS SPECIFIED IN THE CONTRACT DOCUMENTS.
	9	38.6	77.2	115.8	
	10	34.7	69.4	104.1	
	11	31.6	63.2	94.8	
	12	28.9	57.8	86.7	
	13	26.7	53.4	80.1	
	14	24.8	49.6	74.4	

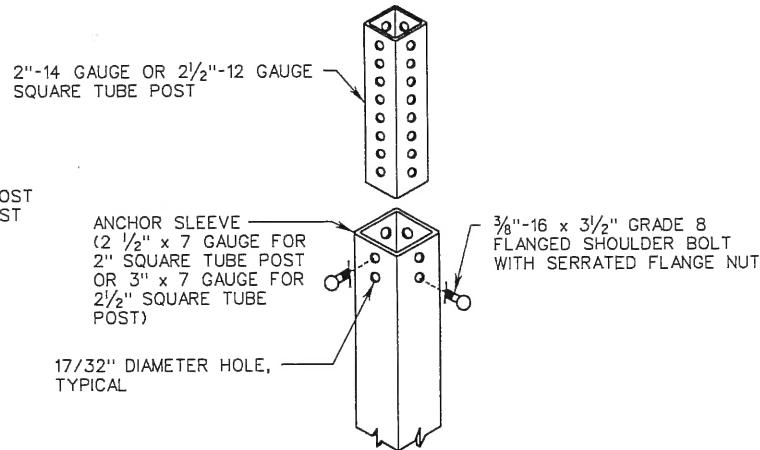
NOTES:

1. THE INNER POST SHALL BE 6 FEET IN LENGTH.
2. CENTROID SHALL BE DETERMINED IN ACCORDANCE WITH PCS-1.
3. MINIMUM COLD FORMED YIELD STRENGTH SHALL BE:
14 GA. AND 12 GA. • 60 KSI
10 GA. • 55 KSI
4. FOLLOW SIGN BRACING DETAILS (SEE SHEET 11 OF 12)
FOR MAXIMUM SIGN PANEL WIDTHS AND SIGN BRACING
SPACING.
5. TABLE 2 SHALL ALSO BE USED FOR THE CITY OF
EMPIORIA AND COUNTIES OF GREENSVILLE, SUSSEX, AND
SOUTHAMPTON IN HAMPTON ROADS DISTRICT.

SPECIFICATION REFERENCE	A COPY OF THE ORIGINAL SEALED AND SIGNED DRAWING IS ON FILE IN THE CENTRAL OFFICE. SQUARE TUBE SIGN POST	VDOT	
		ROAD AND BRIDGE STANDARDS	
700		REVISION DATE 01/15	SHEET 3 OF 12 1321.12

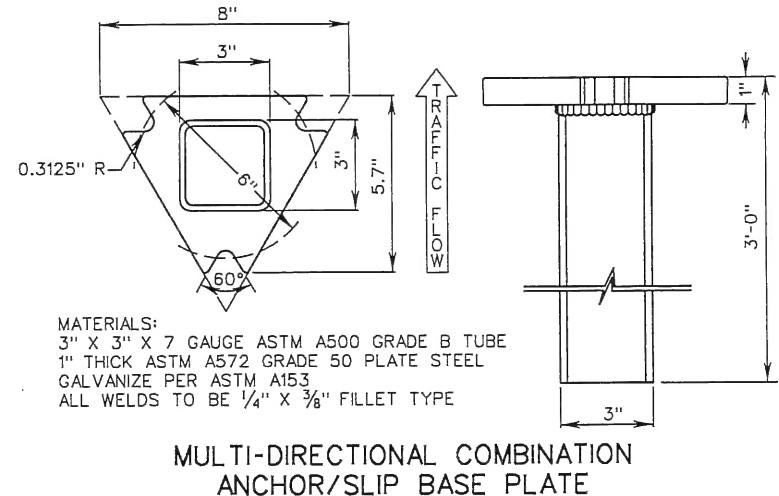
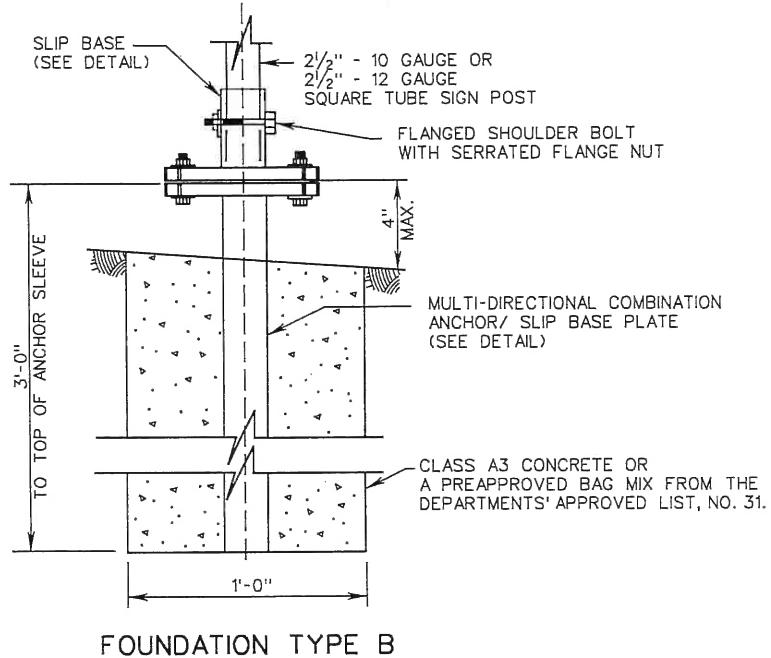


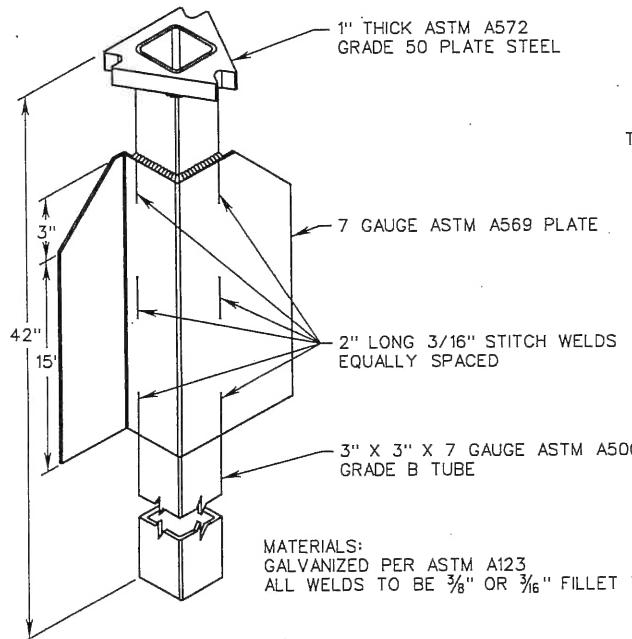
FOUNDATION TYPE A



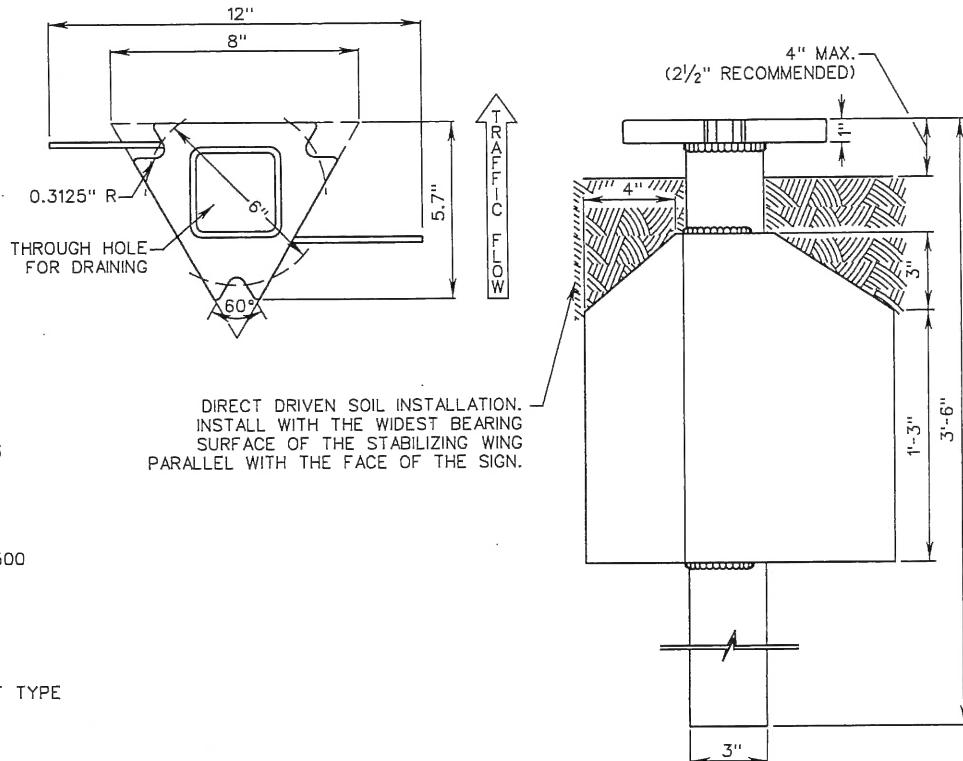
ANCHOR SLEEVE BASE DETAIL

VDOT ROAD AND BRIDGE STANDARDS SHEET 4 OF 12 1321.13	A COPY OF THE ORIGINAL SEALED AND SIGNED DRAWING IS ON FILE IN THE CENTRAL OFFICE. SQUARE TUBE SIGN POST FOUNDATION TYPE A DETAILS VIRGINIA DEPARTMENT OF TRANSPORTATION	SPECIFICATION REFERENCE
		700





FOUNDATION TYPE C

8" TRIANGULAR MULTI-DIRECTIONAL
COMBINATION ANCHOR/SLIP BASE PLATE - SOIL

ROAD AND BRIDGE STANDARDS

SHEET 6 OF 12 REVISION DATE

1321.15

A COPY OF THE ORIGINAL SEALED AND SIGNED DRAWING IS ON FILE IN THE CENTRAL OFFICE.

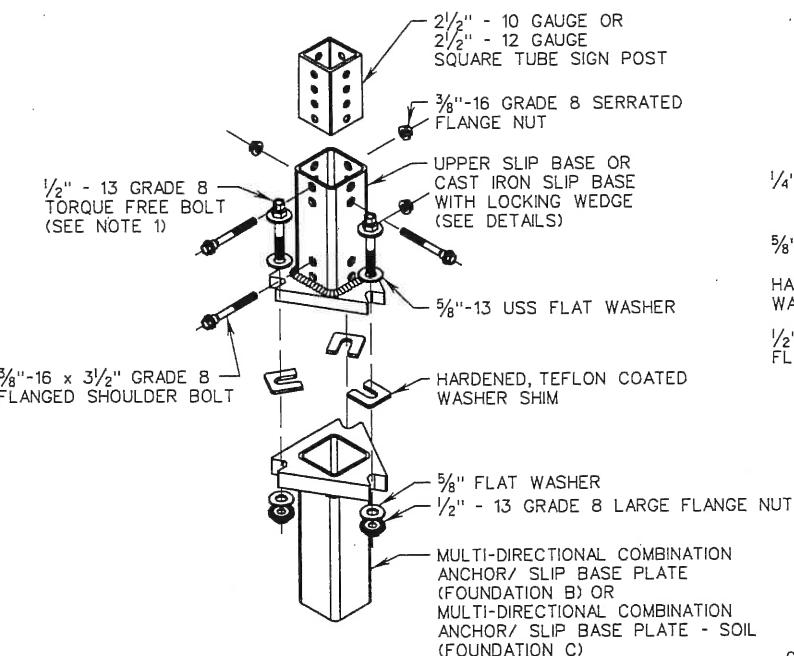
SQUARE TUBE SIGN POST

FOUNDATION TYPE C DETAILS

VIRGINIA DEPARTMENT OF TRANSPORTATION

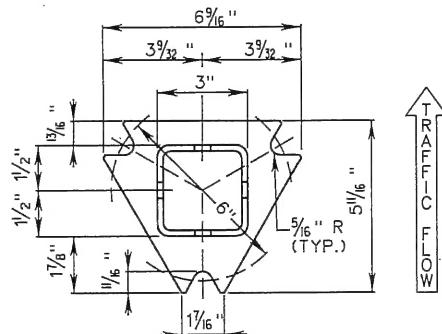
SPECIFICATION
REFERENCE

700



SLIP BASE BREAKAWAY DETAIL

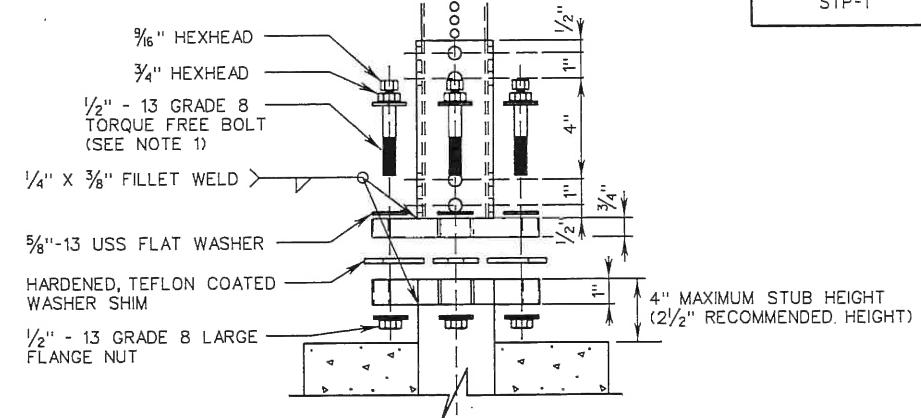
MATERIALS:
TUBE RECEIVER -
3" x 3" x 7 GAUGE
ASTM A500
GRADE B TUBE
PLATE - ASTM
A572 GRADE 50



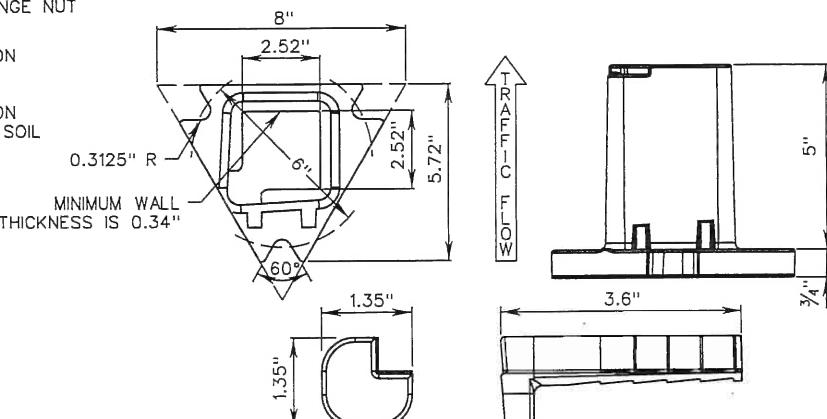
TOP POST RECEIVER/
FOR 2 $\frac{1}{2}$ " SQUARE POST

NOTES:

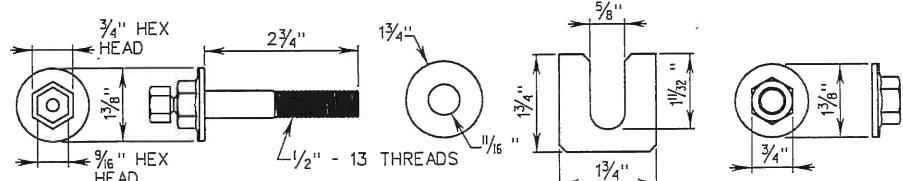
1. TIGHTEN THE TORQUE FREE BOLT USING THE LARGER $\frac{3}{4}$ " HEX HEAD, THEN LOOSEN THE BOLTS BY THREE COMPLETE TURNS USING THE $\frac{3}{4}$ " HEX HEAD. RETIGHTEN EACH TORQUE BOLT USING THE SMALLER $\frac{5}{16}$ " HEX HEAD UNTIL THE $\frac{5}{16}$ " HEX HEAD TWISTS OFF.



SLIP BASE BREAKAWAY PROFILE DETAIL

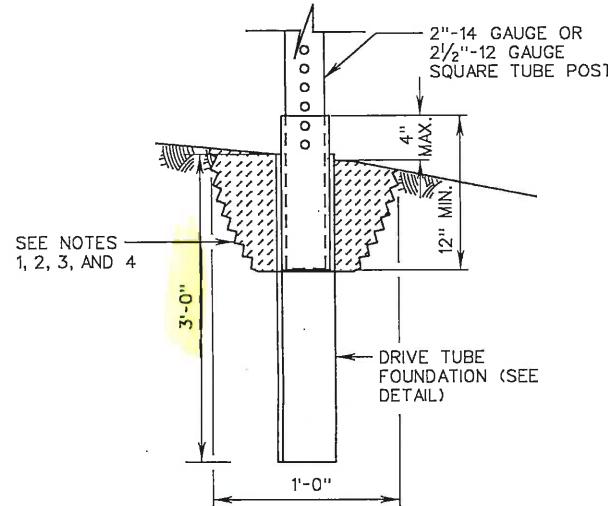


REDI-TORQUE MULTI-DIRECTIONAL BOLT ON SAE1035 STEEL
FORGING SLIP BASE TOP FOR 2½" SQUARE POST WITH
CAST IRON LOCKING WEDGE

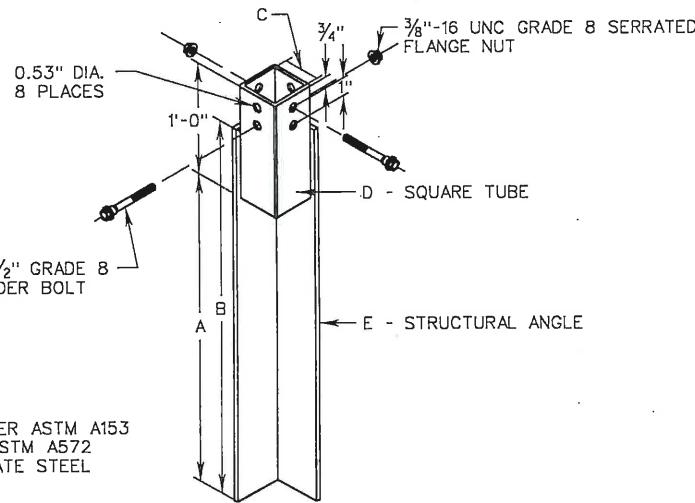


TORQUE FREE MATCH PLATE HARDWARE

SPECIFICATION REFERENCE	A COPY OF THE ORIGINAL SEALED AND SIGNED DRAWING IS ON FILE IN THE CENTRAL OFFICE. SQUARE TUBE SIGN POST FOUNDATION TYPE B AND C DETAILS VIRGINIA DEPARTMENT OF TRANSPORTATION	VDOT	
		ROAD AND BRIDGE STANDARDS	
700		REVISION DATE	SHEET 7 OF 12
		NEW 01/15	1321.16



FOUNDATION TYPE D AND E



DRIVE TUBE FOUNDATION DETAIL

MATERIALS:
GALVANIZED PER ASTM A153
3/16" THICK ASTM A572
GRADE 50 PLATE STEEL

NOTES:

1. EXCAVATE TO A DEPTH OF NO LESS THAN 8" AND NO GREATER THAN 12" PRIOR TO INSTALLATION OF DRIVE TUBE FOUNDATION.
2. THE EXCAVATED AREA SHALL BE BACKFILLED WITH A CEMENTITIOUS MATERIAL AND SHALL BE TAPPED WITH EACH 6" LIFT.
3. THE SQUARE TUBE POST SHALL BE INSERTED INTO THE SLEEVE OF THE DRIVE TUBE FOUNDATION A MINIMUM OF 12".
4. DRIVE CAP SHALL BE UTILIZED FOR INSTALLATION OF DRIVE TUBE FOUNDATION. WHEN USING A POWER DRIVER, A SHANK SHALL ALSO BE REQUIRED.

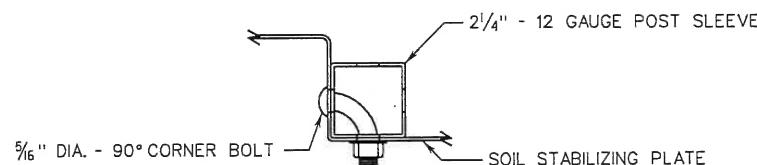
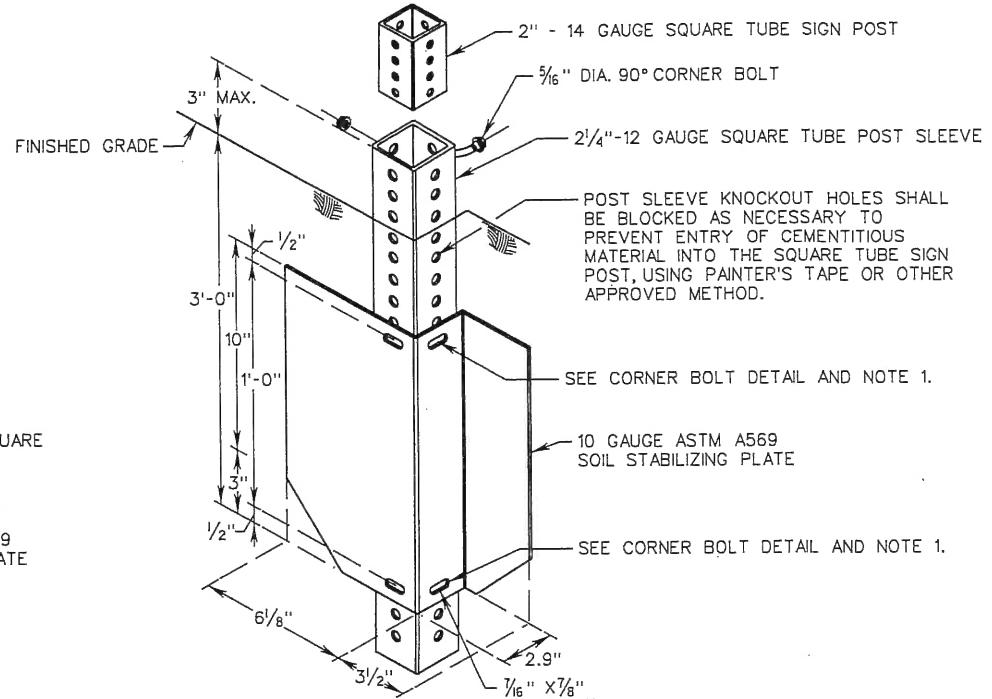
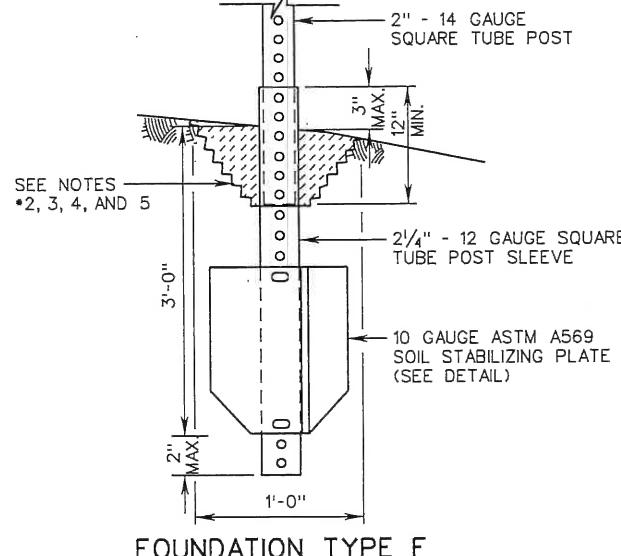
DRIVE TUBE FOUNDATION TABLE			
FOUNDATION TYPE	SIZE OF POST	DRIVE TUBE FOUNDATION DIMENSION	
TYPE D	2 INCH 14 GA.	A	27"
		B	36"
		C	2 1/8"
		D	2 1/2" X 2 1/2" X 3/8" ASTM A500 GRADE B
		E	2 1/2" X 2 1/2" X 3/8" ASTM A36
TYPE E	2 1/2 INCH 12 GA.	A	27"
		B	36"
		C	2 5/8"
		D	3" X 3" X 3/8" ASTM A500 GRADE B
		E	3" X 3" X 3/8" ASTM A36

A COPY OF THE ORIGINAL SEALED AND SIGNED DRAWING IS ON FILE IN THE CENTRAL OFFICE.

SPECIFICATION
REFERENCESQUARE TUBE SIGN POST
FOUNDATION TYPE D AND E DETAILS

VIRGINIA DEPARTMENT OF TRANSPORTATION

V DOT ROAD AND BRIDGE STANDARDS	SHEET 8 OF 12	REVISION DATE	A COPY OF THE ORIGINAL SEALED AND SIGNED DRAWING IS ON FILE IN THE CENTRAL OFFICE.	
			08/17	700



CORNER BOLT DETAIL

NOTES:

1. CORNER BOLTS SHALL BE $5/16$ " DIA. TRUSS HEAD BOLT WITH SERRATED FLANGE NUT. TWO CORNER BOLTS WILL BE REQUIRED TO CONNECT THE $2\frac{1}{4}$ " POST SLEEVE TO THE SOIL STABILIZING PLATE.
2. EXCAVATE TO A DEPTH OF NO LESS THAN 8" AND NO GREATER THAN 12" PRIOR TO INSTALLATION OF SOIL STABILIZING PLATE FOUNDATION.
3. THE EXCAVATED AREA SHALL BE BACKFILLED WITH A CEMENTITIOUS MATERIAL AND SHALL BE TAPPED WITH EACH 6" LIFT.
4. THE 2" SQUARE TUBE POST SHALL BE INSERTED INTO THE $2\frac{1}{4}$ " POST SLEEVE A MINIMUM OF 12".
5. DRIVE CAP SHALL BE UTILIZED FOR INSTALLATION OF DRIVE TUBE FOUNDATION. WHEN USING A POWER DRIVER, A SHANK SHALL ALSO BE REQUIRED.

SPECIFICATION
REFERENCE

A COPY OF THE ORIGINAL SEALED AND SIGNED DRAWING IS ON FILE IN THE CENTRAL OFFICE.

SQUARE TUBE SIGN POST

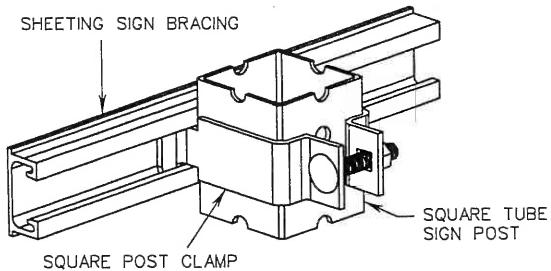
700

FOUNDATION TYPE F DETAILS

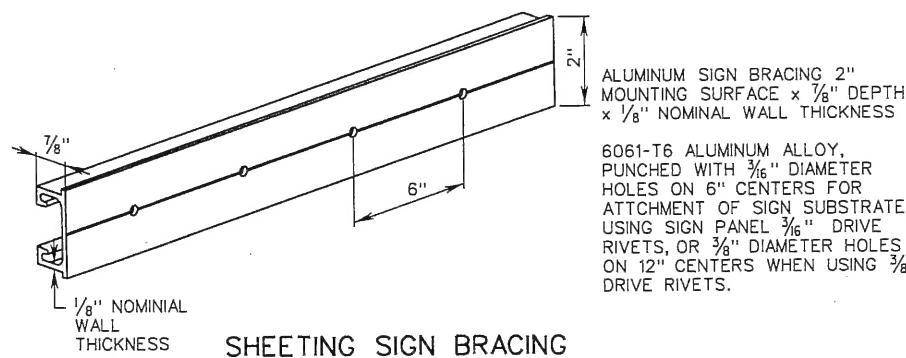
VIRGINIA DEPARTMENT OF TRANSPORTATION

VDOT	
ROAD AND BRIDGE STANDARDS	
REVISION DATE	SHEET 9 OF 12
NEW 01/15	1321.18

STP-1

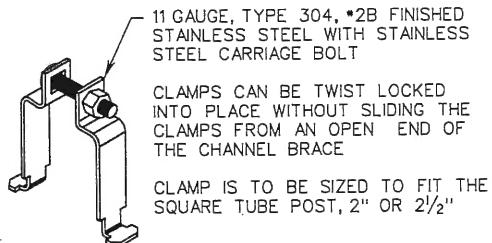


**SQUARE POST CLAMP & BRACE
(CONNECTING JUNCTION)**



NOTES:

1. SEE SHEET 12 OF 12 FOR SIGN PANEL ATTACHMENT DETAILS.

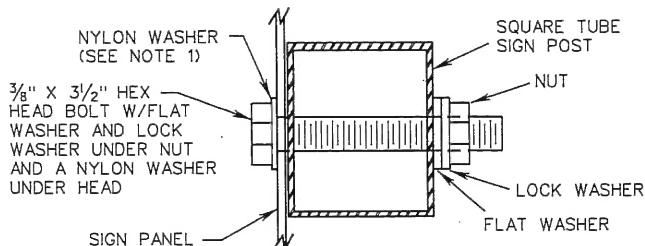


SQUARE POST CLAMP DETAIL

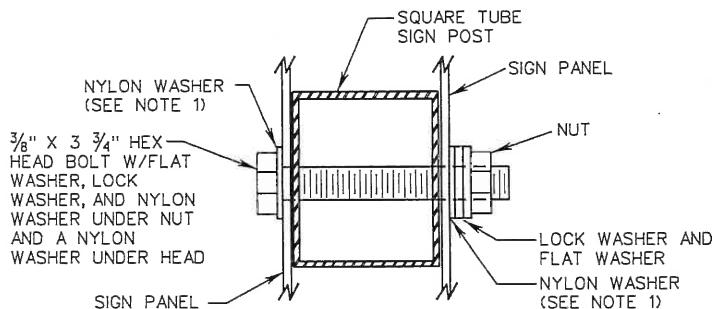
A COPY OF THE ORIGINAL SEALED AND SIGNED DRAWING IS ON FILE IN THE CENTRAL OFFICE.

VDOT ROAD AND BRIDGE STANDARDS		SQUARE TUBE SIGN POST SIGN BRACING DETAILS <small>VIRGINIA DEPARTMENT OF TRANSPORTATION</small>	SPECIFICATION REFERENCE
SHEET 10 OF 12	REVISION DATE 08/17		700

STP-1

SIGN POSTS NOT REQUIRING BRACING

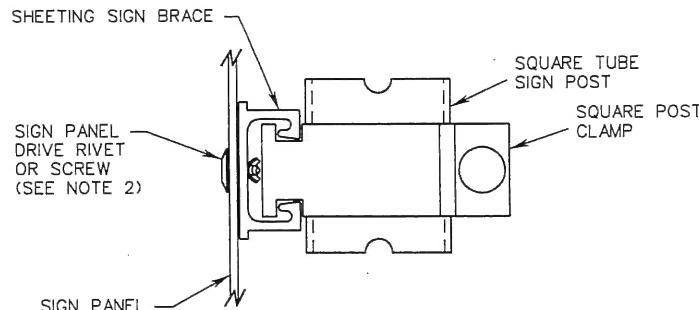
SINGLE SIGN PANEL DETAIL



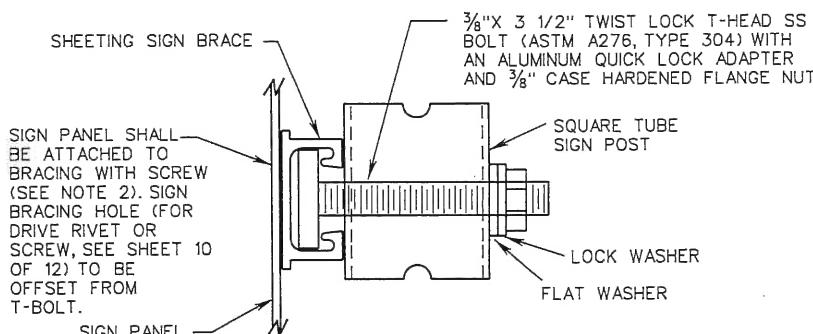
BACK-TO-BACK SIGN PANEL DETAIL

NOTES:

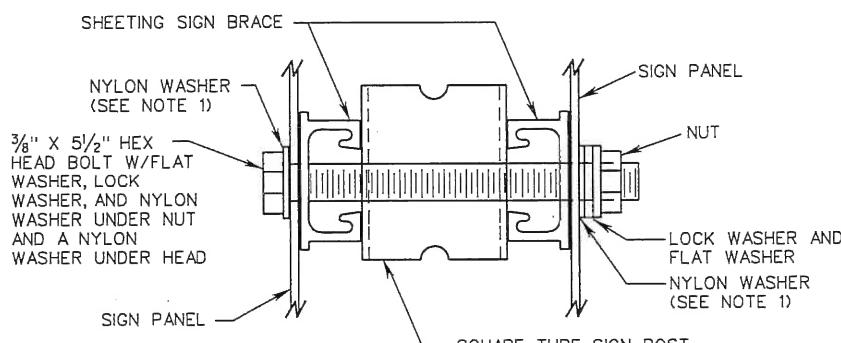
1. NYLON WASHER SHALL BE $\frac{1}{16}$ " THICK MINIMUM WITH AN OUTSIDE DIAMETER OF 1" AND AN INSIDE DIAMETER OF $\frac{7}{16}$ ".
2. DRIVE RIVET SHALL BE $\frac{3}{16}$ " OR $\frac{3}{8}$ " ALUMINUM FLAT HEAD RIVET WITH STEEL PINS AND NYLON OR RUBBER WASHER.
3. THE HEADS OF ALL DRIVE RIVETS AND HEX HEAD BOLTS SHALL BE POWDER COATED TO MATCH THE COLOR OF THE SIGN SHEETING.
4. DRIVE RIVET SHALL NOT BE USED FOR SIGNS WITHOUT BRACING.

SIGN POSTS REQUIRING BRACING

SINGLE SIGN PANEL DETAIL



SINGLE SIGN PANEL ALTERNATE METHOD DETAIL



BACK-TO-BACK SIGN PANEL DETAIL



ROAD AND BRIDGE STANDARDS

SHEET 12 OF 12

REVISION DATE

1321.21

A COPY OF THE ORIGINAL SEALED AND SIGNED DRAWING IS ON FILE IN THE CENTRAL OFFICE.

**SQUARE TUBE SIGN POST
SIGN PANEL ATTACHMENT DETAILS**

VIRGINIA DEPARTMENT OF TRANSPORTATION

SPECIFICATION
REFERENCE

700

APPENDIX C

Smithfield Water and Sanitary Sewer System Design Checklist

TOWN OF SMITHFIELD
WATER AND SANITARY SEWER SYSTEM DESIGN CHECKLIST

Project Name: _____

Project Address: _____

Developer: _____

Architect/Engineer: _____

Phone: _____ Fax: _____ E-mail: _____

Plan Preparer Signature: _____ Date: _____

Submittal # (Circle): 1 2 3 4 5

NOTE: This checklist shall be completed and accompany each water and sanitary sewer pipeline design submittal. The checklist shall be signed by the plan preparer certifying compliance of the design with the Town of Smithfield and HRPDC standards as well as the requirements of this checklist. This checklist serves only as a guide for the preparer in developing the construction drawings and is not intended to be all encompassing. It is the responsibility of the engineer and/or surveyor to ensure the plans and calculations comply with all governing regulations, standards and specifications. Plans submitted without a completed checklist will be returned without review. Any applicant response indicating "No" shall be explained on this checklist with the reason for noncompliance.

I. GENERAL:

YES NO N/A

- | | |
|--|---|
| 1. Developer's/Applicant's name, contact person(s), street address, phone number and fax number on title sheet. | <input type="radio"/> <input type="radio"/> <input type="radio"/> |
| 2. Engineer's/Surveyor's firm, address, phone number and fax number on title sheet. | <input type="radio"/> <input type="radio"/> <input type="radio"/> |
| 3. North arrow and graphic scale bars provided on all applicable plan sheets. | <input type="radio"/> <input type="radio"/> <input type="radio"/> |
| 4. Utility plan <u>clearly</u> depicts all existing and proposed site features, including contours. Legend provided on the plan which correctly reflects the development plan. | <input type="radio"/> <input type="radio"/> <input type="radio"/> |
| 5. An overall utility plan provided for large development areas and subdivisions, or where deemed necessary by the Town of Smithfield. | <input type="radio"/> <input type="radio"/> <input type="radio"/> |

		YES	NO	N/A
6.	All existing and proposed rights-of-way and/or easements properly shown, labeled, dimensioned and, where applicable, recordation referenced. Refer to the Smithfield Design Standards Section 2.6 for Town easement requirements.	0	0	0
7.	Town of Smithfield standard General Notes for Water Distribution and Sanitary Sewer Systems (current edition) included in their entirety on the plan. Refer to Smithfield Design Standards Section 6.1.	0	0	0
8.	All plan sheets sealed, signed and dated by engineer and/or surveyor overseeing the design. Refer to Smithfield Design Standards Section 1.2 for sealing requirements.	0	0	0
9.	Vertical and horizontal datum established in accordance with Smithfield Design Standards Section 1.3. Clearly reference the Town monument or benchmark specifically used for the project. TBM established on-site			
10.	Date of plan submittal and/or revision noted on the cover. Professional seal date shall reflect the plan submittal date.	0	0	0
11.	Plan and profiles developed at a maximum scale of 1"=40' horizontal and 1"=4' vertical. Plan and profile horizontal scales shall be the same. Profile vertical scale shall be a tenth of the horizontal scale. Sheet size no larger than 24x36 shall be submitted.	0	0	0
12.	A minimum horizontal separation of ten (10) feet, edge to edge, maintained between sanitary sewer lines and water lines, water service connections and sanitary sewer laterals, unless approved otherwise by the Town of Smithfield.	0	0	0
13.	Provide call-outs, either individually or tabularized for all facility features, clearly referencing or labeling applicable Town and HRPDC details for the project (i.e. Typical Water Service Installation, HRPDC WD_02). Only provide those sanitary sewer or water system details on the plan which are either required by other regulatory agency review or have been modified from the standards.	0	0	0
14.	Provide profiles for all water and sanitary sewer mains. to include stub-outs for future extensions. All utility crossings (water, sanitary sewer, storm, etc.) shall be shown on the profile.	0	0	0
15.	Engineer's/Surveyor's letter of response provided indicating how and where on the plans each Town of Smithfield comment has been addressed.	0	0	0
16.	Miss Utility notation provided, including phone number.	0	0	0
17.	Existing and proposed street names (label as "Public" or "Private" where applicable), lot and parcel numbers clearly labeled on the plans.	0	0	0
18.	Existing water or sanitary sewer mains previously abandoned and/or removed are clearly labeled on the plan. Provide notes describing how existing facility is to be abandoned (i.e. grouted/plugged, etc).	0	0	0
19.	Plat provided to the Town for review and approval prior to recordation. Refer to Section 4 of this checklist.	0	0	0
20.	Proposed Town utility lines are shown with reference distances from curb & gutter, edge of pavement, right-of-way, etc.	0	0	0

		YES	NO	N/A
21.	A minimum cover of 36-inches provided over all Town water and sanitary sewer force mains.	0	0	0
22.	Existing utilities size and, if known, material shown and labeled. Test hole data provided on plans and in report format.	0	0	0
23.	Proposed utility pipe lengths and structures shown on the Water and Sanitary Sewer System Data Sheets agree with the plan.	0	0	0
24.	Bore pit data such as bore location; length of bore; pit location and dimensions; casing diameter and thickness; and casing stationing and inverts are shown and labeled.	0	0	0
25.	All water service and/or sanitary sewer service lines are extended perpendicular from the respective main and are located within the right-of-way or a dedicated Town of Smithfield Utility Easement (except in cul-de-sacs).	0	0	0
26.	Sanitary sewer and water mains within fill areas are designed in accordance with Smithfield Design Standards Section 2.34.	0	0	0
27.	Transformer locations have been shown on the site plan and maintain required clearances from Town of Smithfield utilities.	0	0	0
28.	Items pertinent to the Utility Plans and Profiles (i.e. Smithfield General Notes, HRPDC/Smithfield detail tabularized references, thrust restraint lengths, etc) are required on the Utility Plans and/or Profiles. If not, a note shall be provided on each Utility Plan and profile sheet referencing where these items are located.	0	0	0
29.	The plan revision block shall indicate all plan revisions/amendments made after plan approval. This shall include clearly indicating the plan revision/amendment by "clouding" the area.	0	0	0
30.	Include proposed street lighting and landscaping on the Utility plan. Locations shall agree with the Landscaping and Lighting Plans. Minimum clearance requirements with Smithfield infrastructure are met.	0	0	0
31.	Plat provided for extinguishment/abandonment of any existing Town of Smithfield Utility Easement (refer to Smithfield Design Standards Section 2.6).	0	0	0
32.	Location of all existing private utilities (gas, power, CATV, Tele, etc) are shown on the plan.	0	0	0
33.	Geotechnical report and sealed design calculations provided for pipe bridges.	0	0	0
34.	Roadway baseline geometry indicated on the plans. Required to confirm pipe deflections do not exceed HRPDC/Smithfield requirements.	0	0	0
35.	Provide a note on each Utility Plan Sheet indicating the plan sheet where the associated profile(s) can be found.	0	0	0
36.	All private underground storage tanks shall have leak monitors and secondary containment unit as required by Virginia State DEQ Regulations	0	0	0

II. Sanitary Sewer System:

YES NO N/A

1.	Hydraulic Analysis shall be provided for all sanitary sewer force mains.	0	0	0
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		YES	NO	N/A
2.	A completed Sanitary Sewer System Data Sheet submitted in accordance with Smithfield Design Standards Section 2.10B.	0	0	0
3.	Plan clearly shows and describes proposed sanitary sewer connections to existing sewer.	0	0	0
4.	Sanitary sewer service provided to each lot or parcel.	0	0	0
5.	Required spacing of manholes and pipe slopes have been maintained. Refer to Smithfield Design Standards Section 2.15 and 2.18	0	0	0
6.	Pipe material (PVC or DIP), size, slope, direction of flow and length clearly labeled on plans. Structure inverts correctly calculate based on data shown.	0	0	0
7.	Force main and/or pump station plans submitted to the Department of Environmental Quality (DEQ), Office of Wastewater Engineering for approval. DEQ approval is required prior to Town of Smithfield approval. Refer to Smithfield Design Standards Section 1.2 for other regulatory submittal requirements. (A copy of the engineers DEQ transmittal must be attached to this checklist when submitted.) Certification provided SCAT regulations are met if not reviewed by DEQ	0	0	0
8.	Show and label existing septic system locations. Applicant shall coordinate this with the local Department of Health records.	0	0	0
9.	Manhole structure minimum slope difference between invert in and invert out elevation is maintained. Refer to Smithfield Design Standards Section 2.17.	0	0	0
10.	Manholes greater than 10 feet deep and interior drop manholes are shown and labeled on the plan as 60" diameter.	0	0	0
11.	Proper vertical separation provided between sanitary sewer facilities and other utilities. Refer to Smithfield Design Standards Section 2.23	0	0	0
12.	Manual air vent assemblies installed at all high points along force mains.	0	0	0
13.	Internal drop connections shown and labeled on the plan when a vertical drop exceeds 2 feet.	0	0	0
14.	The engineer/surveyor has field verified the inverts of the existing manhole(s).	0	0	0
15.	Ground coverage over sanitary sewer pipe meets minimum depth criteria. Refer to Smithfield Design Standards Section 2.21	0	0	0
16.	All sanitary sewer lines are designed with the entry into the manhole at an angle of 90-degrees or greater to the downstream line, unless otherwise approved by the Town.	0	0	0
17.	Sanitary sewers positioned at all manhole junctions in accordance with Smithfield Design Standards Section 2.17 Minimum elevation difference across manhole from inlet to outlet shall be 0.1 feet.	0	0	0
18.	All gravity sanitary sewer lines and force mains located within roadways shall be located at the quarter point.	0	0	0
19.	Force main thrust restraint requirements clearly shown and labeled on the plans or as a minimum, references by note Smithfield standard detail JR-1 on <u>each</u> applicable profile	0	0	0

		YES	NO	N/A
20.	Pump stations designed in accordance to Smithfield Standards and Specifications.	0	0	0
21.	Grease trap locations and size clearly identified on the plan. Refer to Smithfield Design Standards Section 2.26 for requirements.	0	0	0
22.	Calculations submitted for proposed force main and low pressure lines substantiating pipe size and velocity.	0	0	0
23.	Plans submitted to Hampton Roads Sanitation District (HRSD) for review and approval, when necessary. (The engineer shall prepare HRSD flow certificates for Smithfield signature and make the submission to HRSD).	0	0	0
24.	All pipe between manholes are of a like material and class.	0	0	0
25.	Baseline stationing provided on the plan and profile for cross-referencing.	0	0	0
26.	Provide inverts of all sanitary sewer laterals connecting directly into a manhole as part of the structure description.	0	0	0
27.	Design data shown on the plan(s) and profile(s) agree (i.e. inverts, line size, pipe material, etc).	0	0	0
28.	Termination of proposed utilities for future extension/phases is clearly shown on the plan and profile.	0	0	0
29.	HRSD approval has been obtained for any waste flow containing chemicals discharging into the Town of Smithfield or HRSD sanitary sewer system.	0	0	0
30.	Provide sanitary sewer manhole depth as part of the structure description.	0	0	0
31.	Sanitary sewer laterals shall not connect to the mainline within 5-feet of a manhole. Laterals upstream and within 5-feet of the manhole shall connect directly into the manhole where necessary.	0	0	0
32.	Sanitary sewer lateral mainline connections are not located beneath drainage piping.	0	0	0
33.	Shallow sanitary sewer manhole (HRPDC detail SS_03) locations clearly labeled on the plan.	0	0	0
34.	Where force mains connect into a gravity sanitary sewer system, plan identifies those manholes requiring epoxy coating and the type of coating required (refer to Smithfield Design Standards Section 2.18G).	0	0	0
35.	Existing sewer manholes shall be vacuum tested at proposed connection points and shall be witnessed by the Town of Smithfield. Note provided on the plan.	0	0	0
36.	Grinder pump locations indicated on the plan.	0	0	0
37.	System capacity calculations or hydraulic modeling provided to support Flow Acceptance process for all proposed extensions and existing receiving systems.	0	0	0

III. Water Distribution System:

		YES	NO	N/A
1.	Hydraulic Analysis submitted in accordance with Smithfield Design Standards Section 2.9	0	0	0
2.	A completed Water Data Sheet submitted in accordance with Section 2.10B.	0	0	0
3.	Plan clearly shows and describes proposed water system connection(s) to the existing system.	0	0	0
4.	Proposed fire hydrant locations meet the conditions of Smithfield Design Standards Section 2.28F & 2.28G and/or as specified by the Town of Smithfield Fire Department.	0	0	0
5.	Water service provided to each lot or parcel.	0	0	0
6.	Proper vertical separation provided between water main and other utilities. Refer to Smithfield Design Standards Section 2.23	0	0	0
7.	Manual air vent assemblies installed at all high points along water mains. System designed to minimize manual air vents required (i.e. slight adjustment to pressure pipeline profile)	0	0	0
8.	All waterlines located within roadways shall be at the quarter point.	0	0	0
9.	Dead-end waterlines provided with a blow-off assembly.	0	0	0
10.	Valve locations do not exceed 800 feet. Required valving at intersections shall be two (2) at each tee intersection and three (3) at crosses.	0	0	0
11.	Water main sizes shown on the plans meet the conditions set forth in Smithfield Design Standards Section 2.2 and agree with the Hydraulic Analysis.	0	0	0
12.	Water meters shown and labeled, including proposed size. Provide calculations in accordance with Smithfield Design Standards Section 2.10A.5.b substantiating the proposed meter(s) sizing.	0	0	0
13.	Plan and profile show all fittings, water meters, fire hydrants and valves including sizes. Each appurtenance is properly labeled with stationing annotated for all sheets.	0	0	0
14.	Water main stubs for future extensions are designed as specified in Smithfield Design Standards Section 2.8	0	0	0
15.	Location of water meter boxes and service lines maintain a minimum 18-inch horizontal edge-to-edge clearance from driveways and/or drive paths, sidewalks, bike paths, curbing and adjacent water meter boxes.	0	0	0
16.	Submittal provided to the Virginia Department of Health (VDH) for review and approval in accordance with Smithfield Design Standards Section 1.2. VDH approval is required prior to Town approval. (A copy of the engineers VDH transmittal must be attached to this checklist when submitted.)	0	0	0
17.	For waterline tie-ins, the existing valve(s) to be used for shut-off is shown and labeled on the plan.	0	0	0

		YES	NO	N/A
18.	Irrigation proposed for the development has been addressed according to Town Standards Section 2.9J.	0	0	0
19.	Proposed water production facilities or modifications thereto shall be submitted separately to the Chief Engineer of Water for review and approval.	0	0	0
20.	A backflow prevention device is provided on domestic and fire service connections in accordance with Town Standards Section 2.31 and the Commonwealth of Virginia, State Board of Health Waterworks Regulations.	0	0	0
21.	Waterline thrust restraint requirements clearly shown and labeled on the plans or as a minimum, references by note Smithfield standard detail JR-1 on <u>each</u> applicable profile sheet.	0	0	0
22.	Waterline sizes meet the requirements of Town Standards Section 2.2.	0	0	0
23.	Waterline fittings, bends and service line connections are not located beneath drainage piping.	0	0	0
24.	Where meter vaults are proposed, a detail shall be provided on the Utility Plans meeting the requirements of the HRPDC Detail. This shall include labeling line sizes, fittings and the required meter size/type (i.e. Neptune Tru/Flo Compound Meter, Turbine Meter, Protectus III, etc). Show and label valving on the vault bypass line.	0	0	0
25.	Culvert size, length and invert are shown on the plan where required.	0	0	0
26.	Water Sample Station(s) shown and labeled where required by Smithfield.	0	0	0
27.	The Applicant shall contact Smithfield if the development will likely have finished floors less than 70-feet in elevation. Depending on project location, Smithfield system pressures may exceed 80-psi at the service tap for these properties. If so, the development shall comply with the Uniform Statewide Building Code and requirements shall be clearly noted on the plan.	0	0	0

IV. Site Plan/Subdivision Plat Submittals:

	YES	NO	N/A
1. All subdivision plats proposing Smithfield Utility Easements shall include the following note on the plat: “Easements denoted as “Smithfield Utility Easements” are for the exclusive use of the Town and the property owner. Other utility service providers desiring to use these easements with the exception of perpendicular utility crossings must obtain authorization for access and use from Smithfield and the property owner. Additionally, Smithfield shall not be held responsible for any damage to improvements within this easement, from any cause”.	0	0	0
2. The following note shall be included on all subdivision plats: “ Any existing unused well(s) shall be abandoned in accordance with State Private Well Regulations and Town of Smithfield Code”.	0	0	0
3. Add a note on the plat which clearly states whether or not the parcel(s) are served by Public Water and/or Public Sewer.	0	0	0
4. For family subdivisions, clearly show the location of all existing water and sanitary sewer service connections, if any. Any services requiring abandonment/relocation shall be done in accordance with the Smithfield requirements.	0	0	0
5. Proposed easement widths and locations agree with the approved subdivision or site plan and meet the requirements of the Smithfield Criteria Section 2.5.	0	0	0
6. All proposed subdivision grinder pump locations shall be clearly identified on the plat and meet the conditions of Smithfield Criteria Section 2.35.	0	0	0
7. All professional seals and certificates on the plat are signed and dated.	0	0	0
8. Existing Smithfield easements are shown and a reference provided where recorded.	0	0	0

V. Geo-Thermal Wells:

1. All subdivision and site plans proposing geo-thermal wells shall include the system requirements as outlined in Section 2.36 .1 Smithfield Design Standards.	0	0	0
2. A detail of the proposed geo-thermal well is included on the plans and shows all necessary information.	0	0	0
3. If the proposed geo-thermal well is within 1500 feet radius of a public water well or otherwise a potential influence to a public well, are the requirements of Section 2.36.1 Smithfield Design Standards met by the plans.	0	0	0

APPENDIX D

Smithfield Water and Sanitary Sewer Master Plan Guidelines

TOWN OF SMITHFIELD
WATER AND SANITARY SEWER MASTER PLAN GUIDELINES

The guidelines below are general in nature and are provided to assist the Designer in developing Master Utility Plans. These guidelines are not intended to be all encompassing. Smithfield's review of the Master Utility Plan may require additional items be addressed which are not noted below. It is recommended the Applicant meet with Smithfield to discuss the project and layout of public utilities prior to developing the Master Utility Plan.

GENERAL:

- 1. Proposed subdivision/development layout shown. Any development Phasing/Sections clearly delineated on the plan.
- 2. Plan provided at a legible scale.
- 3. Existing contours shown and labeled.
- 4. North arrow and graphic scale bar provided.
- 5. Developer's and Engineer's contact information provided on the plan.
- 6. Existing Smithfield Utilities shown and size labeled. Proposed connection point(s) identified.
- 7. Source of mapping identified on the plan (County GIS, aerial mapping, physical survey, etc).
- 8. Existing Smithfield Lift Stations and Well Facility locations identified on the plan.
- 9. Master Utility Plan submitted to DEQ and/or VDH where required (refer to Smithfield Design Standards Section 1.2).
- 10. Property lines, existing right-of-ways and adjoining parcels shown.

SANITARY SEWER SYSTEM MASTER PLAN:

- 1. Gravity sewer and/or force main system layouts shown and agree with calculations/hydraulic modeling. Pipe sizes and direction of flow indicated.
- 2. Sanitary Sewer Summary table provided on the plan with Phases/Sections tabulated individually. Table shall include the number of dwelling units, commercial/retail square footage, the per unit flow multiplier (per Smithfield Design Standards Table 2.1), duration, the Average Daily Flow (GPD) and the Peaked Flow (GPM). Totals (#units, sewer flow, etc) shall be provided at the bottom of the Summary Table.
- 3. Peaked Flows are shown cumulative along the sewer network. The composite flow at the discharge point shall equal the Sanitary Sewer Summary Table flow.
- 4. Manholes shown at key locations with reference label. Structure rim and invert elevations provided.
- 5. Manhole spacing and minimum pipe slope meet Smithfield requirements.
- 6. Sewer collection and/or force mains sized to accommodate future system extension.
- 7. Any manholes exceeding 10-feet in depth are clearly identified on the plan (refer to Smithfield Design Standards Section 2.18).

- 8. Lift Station location(s) and size coordinated with the Chief Engineer of Wastewater.
- 9. Existing sewer collection systems checked to confirm the number of ERC's proposed do not exceed system capacity.
- 10. Sewer bridges identified on the plan.
- 11. Lots requiring grinder pumps are identified with "GP". Typically up to 5% of the total # of proposed lots to be served by grinder pumps, unless approved by the Chief Engineer of Wastewater.
- 12.. Invert of existing manhole(s) proposed for connection field verified.
- 13. Calculations provided for force main and low pressure lines substantiating required pipe size and velocity.
- 14. Sanitary sewer system designed in accordance with Smithfield Design Standards 2.11 E thru H.

WATER SYSTEM MASTER PLAN:

- 1. Water Distribution system layout shown. Pipe sizes, node labeling and pipe segment labeling agree with the hydraulic modeling.
- 2. Water Demand Summary table provided on the plan with Phases/Sections tabulated individually. Table shall include the number of dwelling units, commercial/retail square footage, the per unit flow multiplier, duration, the Average Daily Demand (GPM), Max Day Demand (GPM), Peak Hour (GPM), proposed irrigation requirements and required fire flow at each node. Totals (#units, demands, etc) shall be provided at the bottom of the Summary Table. Node demands listed agree with the hydraulic model.
- 3. Pump location and reservoir identified on the plan and agrees with the fire flow test performed.
- 4. Any reduction in required fire flows (per Smithfield Design Standards Section 2.12) shall be approved by the Fire Department prior to Smithfield approval of the Master Plan. A maximum single flow from any fire hydrant shall not exceed 1,000 gpm.
- 5. Hydraulic modeling provided in accordance with Smithfield Design Standards Section 2.9 and sealed by a Licensed Professional Engineer registered in the Commonwealth of Virginia.
- 6. System design considers possibility of system extension to adjoining parcels.
- 7. System looped (either internal to the site or connection to existing mains) to eliminate dead-end lines where feasible.
- 8. Waterline sizes meet conditions of Smithfield Design Standards Section 2.2.
- 9. Water Sample Stations identified.
- 10. If irrigation is not proposed for the development, a note shall be added to the Master Plan clearly stating this.

APPENDIX E
Right of Way Easement Permit Application



TOWN OF SMITHFIELD

310 Institute Street, P.O. Box 246 • Smithfield, VA 23431
(757) 365-4200 • Fax (757) 365-0215

Right of Way / Easement Permit Application No. RW-EP: _____

TYPE OR PRINT CLEARLY

APPLICANT:

Applicant Name _____

Filing date _____

Address _____

Permit Term needed _____ days

City _____ State _____ Zip Code _____

Total fees enclosed \$ _____

Contact Phone Number _____

Method of Payment Check C.C. Cash

Email Address _____

The estimated cost of this work is \$ _____

Location of Proposed Work (Address and Tax Map Number) _____

Between _____ and _____

Name _____

Permittee Job No.: _____

Amount:\$ _____

Account # _____

Obligation Amount (120% of estimated cost) \$ _____

Bond LC Check Not Applicable

Required Documents for Submission:

Itemized Cost Estimate.....

Plan or Sketch of Proposed Work.....

Minimum of 3 references for any / all contractor(s) and subcontractor(s).....

A copy of the applicant's Class A Highway / Heavy Utility Contractor's License.....

Request Permission: To perform the following work and/or activity (s): _____

_____ as per attached plans.

All applicable items on this form must be completed before your request can be considered. Recheck information furnished to avoid delay. Prepayment Required - make Remittance payable to the Town of Smithfield.

Application is hereby made for permit as shown on the accompanying plan or sketch, and all required materials and documents have been provided as described above. Said work and or activity(s) will be done under and in accordance with the rules and regulations of the Commonwealth Transportation Board of Virginia, in so far as said rules are applicable thereto and any agreement between the parties herein before referred to. Where applicable agreements may be attached and made a part of the permit assembly including any cost responsibilities covering work under permit. Applicant agrees to maintain work in a manner as approved upon its completion. Applicant also hereby agrees and is bound and held responsible to the owner for any and all damages to any other installations already in place as a result of work covered by resulting permit. Applicants to whom permits are issued shall at all times indemnify and save harmless the Commonwealth Transportation Board members of the Board, the Commonwealth, and all Commonwealth employees, agents, and officers, from responsibility, damage, or liability arising from the exercise of the privileges granted in such permit to the extent allowed by law. In consideration of the issuance of a permit the applicant agrees to waive for itself, successors in interest or assigns any entitlements it may otherwise have or have hereafter under the Uniform Relocation and Assistant Act of 1972 as amended in the event the Town or its successor, chooses to exercise its acknowledged right to demand or cause the removal of any or all fixtures, personality of whatever kind or description that may hereafter be located, should this application be approved.

Signature of Applicant _____ Title _____ Date _____

TOWN USE ONLY

Permit Fee \$100.00 R/W-Easement Inspection Fee \$ _____ Utility Inspection Fee \$ _____

Receipt is hereby acknowledged of CHECK , C.C. or CASH , in the amount of \$ _____

Signed _____, Town Representative _____ Date _____