WATER AND SEWER STANDARDS AND SPECIFICATIONS

for

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These standards and specifications supersede all previously published editions.

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Addenda shall be posted (in ascending order) immediately following this title page.

PREFACE

The standards and specifications presented herein are to be used when designing and constructing any water and/or sewer collection facility for Frederick Water.

Deviations from these standards and specifications must be approved in writing.
October 16, 2018  Replace copper setters with yoke bars, other minor edits and revisions
January 18, 2019  Update Section 5 typical details, update approved manufacturers for various water materials
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SECTION 1 – General Terms and Requirements

1. INTERPRETATION OF TERMS

A. “Frederick Water” shall mean the Board of Directors, its employees, or authorized representatives. Frederick Water shall be recognized as the policy making body over facilities herein described.

B. “Owner” or “Developer” shall mean any person(s), group, corporation, or affiliations associated with or responsible for the initiation, design, and/or construction of facilities herein described. These facilities are intended to be under the jurisdiction of, and become a part of, the public utilities system of Frederick Water.

C. "Consultant" shall mean a professional engineer, land surveyor or landscape architect registered to do business in the state of Virginia.

D. "Contractor" shall be any person(s), firm, group, or affiliations charged with the responsibility of constructing the facilities herein described, and subject to the provisions and regulations set forth herein.

2. GENERAL CHARGE OF RESPONSIBILITIES

A. Frederick Water is hereby charged with the responsibilities of (1) reviewing the Consultant’s plans and (2) inspecting the Contractor’s work for compliance to these standards and specifications.

B. Frederick Water and the Owner shall enter into a contract detailing the dedication of the facilities to be constructed according to these standards and specifications. Such contract will be prepared by Frederick Water and shall be executed prior to the installation and inspection of facilities to be owned by Frederick Water.

C. After plans and specifications have been approved, Frederick Water reserves the right to make adjustments in types of materials and methods of construction required should field inspection reveal unforeseen, unfavorable conditions and/or specifications have changed.

D. Frederick Water, or its agent, shall: (1) tap all existing water and forced sewer lines, (2) install ⅝” x ⅜”, ¾”, 1”, 1 ½” and 2” water services that connect to existing lines, (3) install all 4” gravity sewer services that connect to existing lines. All related costs for this work shall be the responsibility of the Contractor and/or Owner.

E. The Owner is hereby charged with the responsibility of employing reliable contractors with sufficient skills and experience to perform all work in an acceptable manner. Failure to do so may result in work stoppage and/or refusal by Frederick Water to accept the project as part of its system.

F. It is the Owner’s responsibility to obtain onsite and offsite easements. A copy of the recorded onsite deed of easement shall be furnished to Frederick Water before substantial completion. A copy of the recorded offsite deed of easement is required before work is to begin on any offsite property.

G. All water and sewer infrastructure installed within a Frederick Water easement shall be deeded to Frederick Water.
H. It is the Owner’s or its Consultant’s responsibility to secure a sewer pump station’s certificate to operate (CTO). It must also prepare and acquire approval of the station’s operation and maintenance (O&M) manual. Both are obtained from the Department of Environmental Quality (DEQ). Before accepting ownership of a project containing a pump station Frederick Water requires: 1) a copy of the CTO and 2) two copies of the approved O&M manual.

I. The Consultant is hereby charged with the responsibility for proper design of the proposed work and submission of the correct number of plans and specifications. The Contractor is hereby charged with the safe and proper construction of the facilities herein mentioned. Any dispute resulting from the interpretation of Frederick Water’s construction standards, and herein described, shall be governed by the final decision of Frederick Water.

J. The Contractor shall contact Frederick Water’s assigned inspector at least 48 hours before beginning work.

K. It is the Contractor’s responsibility to obtain the required Virginia Department of Transportation (VDOT) permits. No work will be accepted by Frederick Water that has not been accepted by VDOT.

3. PROJECT REVIEW

A. Frederick Water participates in the state’s Local Standards and Review Program. The Virginia Department of Health (VDH) administers the water portion of the program and DEQ the sewer. Under this program:

1. All projects must meet Frederick Water’s approval.

2. Projects that contain (a) water lines greater than 12 inches in diameter, (b) water treatment facilities, (c) water storage facilities, or (d) water pumping facilities must also be approved by VDH.

3. DEQ must also approve plans that (a) serve greater than 400 persons or have a design flow greater than 40,000 gpd, (b) have pumping stations, (c) have industrial, commercial or private pre-treatment facilities, (d) contain low pressure collection or forced sewer systems, or (e) contain pipe greater than 12 inches in diameter.

B. Two sets of paper plans and specifications shall be submitted for review. A site plan comment sheet from the Frederick County Department of Planning and Development must accompany each submittal as well as Frederick Water’s plan review checklist.

C. Drawings, specifications, and engineering reports submitted for approval shall be prepared by or under the supervision of, a registered professional engineer or others legally qualified to practice in Virginia.

D. Frederick Water’s goal is to review the plans within 20 working days after receipt.

1. In reviewing the application, Frederick Water shall require such changes as it may consider necessary to (a) meet the requirements of its standards, and (b) permit future extensions.

2. Any changes will be marked on both sets of submitted drawings. One set will be returned (for correction) to the firm submitting the plans. The second set will be retained by Frederick
Water. Re-submittal will again require two sets of drawings and a new comment sheet.

3. When the plans are approved, they will be so stamped and returned.

4. Frederick Water shall then require:
   
a. A set of paper plans containing the cover sheet, site layout sheet, water & sewer plan & profile sheets, detail sheets and other sheets deemed necessary.

   b. Two CD’s of the requested sheets:
      
      1) One CD shall be in PDF format. Each sheet shall be in its own file and be in landscape orientation. Each file shall be titled with the project name and appropriate sheet number.

      2) One CD shall contain a single file in DWG format. All water and sewer features shall be included in the file and shall as well as labels, valves, fittings, etc. The file shall (1) be in state plane coordinate system NAD 83 and (2) be compatible with AutoCAD 2013.

      3) Each of the two CD’s shall be labeled with its format and project name, and placed in its own paper CD envelope.

E. Plans and specifications are valid for the period approved by the Frederick County Planning Department or 5 years from date of approval for projects not requiring Frederick County Planning Department approval. If construction is not in progress at the end of this period, Frederick Water’s approval shall be void. Plans and specifications will have to be submitted as a new project (if deemed necessary by Frederick Water) and conform to the current standards.

F. Plans shall be drawn on sheets measuring no smaller than 24” wide by 36” long.

G. The cover sheet shall contain:

   1. Project title
   2. Vicinity map
   3. Name, address, and telephone number of the Owner
   4. The parcel’s magisterial district and its property identification number(s)
   5. Original seal and the original signature of the registered engineer (following sheets shall bear the imprint or a legible facsimile of s).

H. The plans shall show a north arrow, location of existing structures, proposed and existing underground utilities, curbs, property lines, railroad crossings, culverts, etc.

I. A general layout sheet shall be provided showing streets, lots, and sanitary sewer and water line locations (both on and off site).

J. Profiles of both water and sewer lines are required. The horizontal scale for profiles shall be the same used for the plan, but in no case be smaller than fifty feet to the inch. The vertical scale shall in no case be smaller than ten feet to the inch.

K. A detail sheet containing the appropriate water and sewer drawings and notes shall be provided.

L. The project information (summary) data shall contain the water demand in GPD and the sewer
M. After plans are approved, any changes shall be noted by an encircled (clouded) area.

4. LAYOUTS & EASEMENTS

A. Frederick Water requires that water mains and sewer lines be routed within public or private road right-of-ways. Exceptions to this location requirement may be granted if deemed appropriate by Frederick Water.

1. Water and sewer lines should be installed within the initial phase of the road development and protected under the initial phase of surface treatment. If the water and sewer lines are not placed under the initial phase of surface treatment, the lines shall be placed clearly outside of future phases of the road development.

2. When placed within the travel way, manholes shall be located at crown of pavement if possible. Where separation requirements preclude manholes on crown or centerline, manholes should be placed in the center of the travel lane. Manhole rims shall be flush with road surfaces, which may require use of grate rings with 2 percent slopes.

3. Along median divided roads, water mains and sewer lines will generally be located in medians or outside of the asphalt surfaces but still within the road right-of-way.

B. Maintenance easements shall be required for all water and sewer lines and appurtenances except where installed within a public right-of-way of the Virginia Department of Transportation.

C. The easement document shall contain the appropriate wording plus a plat showing the easement. Both the plat and deed of easement shall be signed by Frederick Water and duly recorded by owner in the Frederick County Clerk's office.

D. Maintenance easements shall not be fewer than 20 feet in width and shall be centered on the main. Combined sewer and water easements shall be 30 feet in width with both mains then ten feet from the edges of the easement.

E. Plans and plats shall have maintenance easements labeled as “Frederick Water easement”.

F. All easements shall have the right of ingress and egress fully provided for in the recorded deed.

G. Ingress and egress easements shall be required for access to all pump station sites. The easement shall be a minimum of 20 feet in width.

H. No building or permanent structure shall be constructed within a maintenance easement. No trees, shrubs, structures, parallel fences, or obstacles shall be placed within an easement.

I. Where deemed necessary by Frederick Water, easements shall extend to adjacent property for orderly extension of service.

5. PUMP STATION SITES

A. Frederick Water shall own, in fee simple, all pump station, elevated or ground tank sites.
6. FIRELINES
   A. An exterior fire line pressurized by its own booster pump station shall be privately owned.

7. PROJECT ACCEPTANCE REQUIREMENTS
   A. Substantial completion will be issued when:
      1. The required plans and CDs have been received by Frederick Water.
      2. Frederick Water has received a copy of the recorded easement documents and, if necessary, a copy of the recorded pump station site ownership document.
      3. All tap and/or service fees have been paid.
      4. All approved materials have been installed per Frederick Water’s requirements.
      5. The completed work has been inspected and the system is in working order.
      6. A substantial completion deficiencies and omissions list has been prepared.
   B. A project will be accepted for ownership when:
      1. The items on the deficiency and omission list have been corrected.
      2. Any work that was accepted at substantial completion, but later damaged, has been repaired.
      3. As-built information has been given to Frederick Water's inspector.
      4. All fire hydrants have been painted their proper flow rating colors.
      5. Frederick Water has received a copy of a pump station’s CTO and two copies of its approved O&M manual.
      6. The contract documents have been completed and Frederick Water signs the (1) Affidavit and Waiver of Lien and (2) Bill of Sale.

8. RELEASE OF METERS
   A. Service for residential projects shall be authorized upon substantial completion. Meters may then be installed after: (1) the completion of an application for service, (2) the payment of the required fees, and (3) the meter box assembly being set to the correct grade. A maximum of 90% of the lots/units in a project shall be released under substantial completion. The remaining 10% shall be released upon acceptance. Projects with multiple sections/phases require the correction of the previous section/phase’s deficiency and omission list before the next work is released.
   B. Service for commercial/industrial projects shall be authorized upon the acceptance of the project. Following acceptance, meters may be installed after: (1) the completion of an application
for service, (2) the payment of the required fees, and (3) the meter box assembly being set to the correct grade.

9. **DEDICATION OF UTILITIES**

   A. Frederick Water and Owner shall enter into a contract for the dedication of the water and/or sewer facilities to Frederick Water.

   B. Upon acceptance, the dedication shall be in writing by:

      1. An Affidavit and Waiver of Lien declaring the cost of facilities installed, and
      2. A Bill of Sale being duly recorded by owner in the Frederick County Clerk's office.

10. **WARRANTY**

    A. The Owner will be responsible for any maintenance as a result of construction or material defects of said facilities for one year from the date of final acceptance.
SECTION 2 - Water

PART 1 - DESIGN STANDARDS

Refer to Section 4 for appropriate drawings

1. GENERAL

A. Design standards shall be those set forth in the Office of Drinking Water, Department of Health, Commonwealth of Virginia Waterworks Regulations, Part III, Article 6, except as specified herein.

B. When Frederick Water deems it necessary, it may specify the type of material to be installed and/or the construction method to be used.

   1. All water mains, six (6) inch, eight (8) inch and twelve (12) inch, shall be ductile iron class 52 pipe unless otherwise specified.

   2. All water mains sixteen (16) inch or larger shall be ductile iron class 51 pipe.

2. HYDRAULIC DESIGN/PIPE SIZE

A. When water distribution system extensions are made, the applicant shall first determine the quantity of water required and then obtain the hydraulic gradient available at the point of connection to Frederick Water’s system.

B. Pipe sizing shall be based on carrying capacities. Head losses shall be determined by the Hazen-Williams equation. The “C” value shall be 120 for ductile iron pipe (cement lined).

C. The minimum size main shall be eight inches.

   1. The last 50-feet of a fire hydrant line may have 6” pipe to the hydrant.

   2. A fire service line may have 6” pipe from the tee to the backflow prevention device.

D. Ten inch pipe and 14 inch pipe are not allowed.

E. The water distribution system and any extensions thereof shall be capable of delivering on the day of maximum customer demand, flows required for fire protection to within 300 feet of each building to be served, while maintaining a residual pressure of not less than 20 psi. Flows required for fire protection shall be in accordance with the National Fire Protection Association Standards, and shall not be less than those listed below. Required Flows can be achieved by utilizing multiple hydrants, as long as the 300-foot maximum distance is not exceeded for each fire hydrant utilized.

<table>
<thead>
<tr>
<th>Type of Structure</th>
<th>Required Flows (Gallons Per Minute)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Family Detached</td>
<td>1000</td>
</tr>
<tr>
<td>Multi-Family, Apartments or Townhouses</td>
<td>1250</td>
</tr>
<tr>
<td>Schools</td>
<td>1500</td>
</tr>
<tr>
<td>Industrial or Commercial Facilities</td>
<td>1500</td>
</tr>
</tbody>
</table>
F. Piping shall provide at least a minimum working (under flow) pressure of 20 psi at the service connection based on the applicable fire flow plus the greater of (a) maximum hour flow or (b) maximum day flow. To calculate maximum hour domestic flow use the formula $Q=11.4N^{0.544}$, where $Q$= total gallon per minute and $N$= total residential units. The fire flow plus the maximum hour or maximum day flow shall not result in a residual pressure of less than 20 psi anywhere in the distribution system.

G. Redundant Supply

1. More than one extension from the existing system is typically required to serve a planned development, subdivision, or large site. This requirement ensures the reliability of service, efficient transmission of fire flows, and may be used to reduce the water’s detention time, thereby promoting water quality. Single supplies will be considered in need of reinforcement when serving more than 40 homes or 4 commercial establishments. For all commercial, medical, institutional, or industrial establishments with a heightened need for reliability of service, a redundant supply will be required.

2. The maximum length of permanent dead-end water mains is 500 feet, subject to Frederick Water approval. Where possible, water mains shall be looped to eliminate dead ends, thereby promoting water quality, adding reliability of service, and efficiently conveying fire flows.

3. PIPING AND GATE VALVES

A. All lines (mains and service laterals) shall be laid with a minimum cover of 48 inches.

B. Valves shall be located on distribution and transmission mains at intervals not exceeding 1,000 feet.

C. Valves shall be located on all branches (tee, wye, or cross).

D. A water line that may be extended shall have a gate valve at the end. There shall be one full joint of pipe on each side of the valve.

E. Dead end mains shall not exceed a length of 500 feet.

F. All dead end lines shall terminate with a fire hydrant. A dead-end line in a cul-de-sac shall terminate with a fire hydrant assembly.

G. Fire service lines shall have a gate valve at the main and 10’ off building, and be restrained ductile iron from the tee to the backflow prevention device.

H. Pipeline deflection will only be allowed at joints and at fittings. The length of pipe itself shall not be bent. The maximum deflection limit at a joint (union of two sections of pipe), shall be 12 inches of lateral displacement per 20 feet of pipe. (If laying radius is 200 feet or greater, no bends are needed).

I. The maximum deflection of a fitting (bend) shall be 45 degrees. (Ninety degree bends are not allowed).
4. **FIRE HYDRANTS**

   A. A fire hydrant will only be approved for installation when the hydraulic evaluation verifies that fire flow capacity can be met.

   B. Distance measurements between fire hydrants shall be along the centerline of roadway surfaces or along surfaces meeting the requirements of a fire lane (designated or un-designated). In all cases, access to each hydrant shall be directly from a roadway and/or fire lane. Their placement shall be:

   1. In areas developed with single or duplex residential units, hydrants shall be located so the distance from a hydrant to the building set-back line shall be no greater than 400 feet.

   2. In areas developed with three to five dwelling units per structure, there shall be a hydrant within 300 feet of all units.

   3. In areas developed with six or more dwelling units per structure, there shall be at least two hydrants within 300 feet of all units.

   4. In industrial or commercial developments, there shall be a hydrant within 300 feet of all portions of any structure. Where one hydrant is dedicated to the operation of a standpipe system there shall be at least one other hydrant meeting the distance requirements set forth above; the hydrant dedicated to the operation of the standpipe system shall not be farther than 50 feet from the standpipe.

   C. Wherever possible, a fire hydrant shall be located in the grass strip between the curb and the sidewalk.

5. **SERVICE LATERALS (less meters)**

   A. Service laterals shall be one-inch or two-inch diameter lines and shall include saddle, corporation stop, and meter box assembly or vault.

   B. Water lateral and meter box assembly or vault shall be placed at the center of the lot wherever possible. The meter box shall be set one foot beyond the property line. In cul-de-sacs the meter box shall be set adjacent to the adjoining property line.

6. **METERS**

   A. All domestic service lines and privately owned fire lines shall be metered.

   B. All meters shall have an encoder register for drive-by reading.

   C. Frederick Water shall provide and install meters for one-inch and two-inch service lines.
D. The Owner shall provide and install all three-inch and larger meters. Wherever possible, the meter shall be inside the building. Frederick Water shall review the appropriate mechanical plan sheets to verify layout and material used.

E. Meter size shall be shown on the plans.

7. BACKFLOW PREVENTION ASSEMBLIES

A. Service lines (fire and domestic) shall have an American Society of Sanitary Engineers (ASSE) approved backflow prevention assembly.

B. The backflow prevention device shall be installed:

1. Immediately after the water meter on domestic service lines
2. Immediately after the water meter on privately owned fire service lines
3. Immediately upon entering a building containing a fire service system that does not have a private exterior fire line.

C. Backflow prevention devices shall be used in conjunction with a water meter. These meters shall be provided with an encoder register for drive-by reading.

D. Reduced pressure zone backflow prevention assemblies shall only be installed above ground.

8. COMBINATION AIR RELEASE VALVES

A. Air release valves shall be installed at high points.

9. PRESSURE REDUCING VALVES

A. Pressure reducing valves may be required by Frederick Water if line pressure is 90 psi or greater.

10. SURFACE WATER CROSSINGS

A. Provisions for a surface water crossing shall be required for all streams, named or unnamed, shown on a United States Geological Survey US Topo 7.5 - minute map.

B. Valves shall be provided at both ends of the water crossing so that the section can be isolated for tests or repair. The valves shall be easily accessible and not subject to flooding.

C. Permanent taps shall be made for testing, they shall be available at each end of the crossing, be a reasonable distance from each side of the crossing and not subject to flooding sampling and locating leaks.
D. Pipe for above water crossings shall be: (1) adequately supported, (2) protected from freeze damage, (3) accessible for repair or replacement, and (4) above the 100-year flood level.

11. SEPARATION OF WATER MAINS AND SEWERS

A. The following factors shall be considered in providing adequate separation of water mains and sewers:

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

B. Parallel installation

   1. Under normal conditions, water mains shall be laid at least 10 feet horizontally from a sewer or sewer manhole. The distance shall be measured edge to edge.

   2. When local conditions prevent a horizontal separation of 10 feet, the water may be laid closer to a sewer or sewer manhole provided the bottom of the water main shall be at least 18 inches above the top of the sewer. Where this vertical separation cannot be obtained, the sewer shall be constructed of ductile iron class 52, and be pressure tested in place without leakage prior to backfilling. The sewer manhole shall be of watertight construction and tested in place.
C. Crossing Installation

1. Under normal conditions, water lines crossing sewer shall be laid to provide a separation of at least 18 inches between the bottom of the water line and the top of the sewer whenever possible.

2. When local conditions prevent a vertical separation described above, the following construction shall be used:
   a. Sewers passing over or under water mains shall be constructed of ductile iron class 52 pipe.
   b. Water line passing under sewers shall be protected by providing:
      1) A vertical separation of at least 18 inches between the bottom of the sewer and the top of the water line
      2) Adequate structural support for the sewer to prevent excessive deflection of the joints and the settling on and breaking of the waterline
      3) The length of the water line be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewer.

D. No water pipes shall pass through or come in contact with any part of a sewer or storm manhole.

E. Additional separations and clearances are to be furnished as practical to optimize each design. Attention shall be given to locating utilities so as to facilitate their re-excavation. Frederick Water will consider factors such as depth and magnitude of facility in determining the adequacy of each design, and may relax or increase dimensional requirements accordingly. In general, a design is to be sought which minimizes the length of piping and the number of appurtenances, while providing a system which minimizes maintenance costs, and includes loops for redundancy.

12. ADJACENT UTILITIES

A. Wherever possible, other utilities shall be placed no closer than seven feet horizontally or eighteen inches vertically (crossings) to a water line. The distances are to be measured inside edge to inside edge.

B. Where water lines and other utilities cross or where terrain features may dictate, Frederick Water reserves the right to have the other utilities properly identified with a marker or other means of identification specifically approved by Frederick Water.
SECTION 2 - WATER

PART 2 - MATERIAL SPECIFICATIONS
Refer to Section 4 for appropriate drawings

1. APPROVED MATERIALS

A. All materials used in the construction of the water system shall have the approval of Frederick Water. American Water Works Association (AWWA) and American Society for Testing Materials (ASTM) set forth only a set of standards for materials. Since these standards are quite broad, they may or may not meet the requirements or needs of Frederick Water.

B. Materials not listed in these standards and specifications or not currently accepted by Frederick Water shall be approved by Frederick Water before installation.

C. The following approval procedure shall be used:
   1. A cover letter along with two sets of manufacturer's certifications, and shop drawings and/or samples shall be sent to Frederick Water's engineer.
   2. The engineer will issue a letter stating whether the product is acceptable or not.

D. Unapproved materials placed on a job site shall be subject to immediate rejection and barred from any further consideration.

2. PIPE

A. Ductile iron pipe

   1. Ductile iron pipe shall conform to the requirements of AWWA Standard C151. The pipe shall be cement lined in accordance with AWWA Standard C104. Unless otherwise specified, the pipe shall have push-on joints meeting the requirements of AWWA Standard C111. The wall thickness of the pipe shall be Class 52. Pipe shall be manufactured by U.S. Pipe, American Pipe, Clow Water Systems Company.

3. FITTINGS

A. Fittings shall be Class 350 ductile iron. Ductile iron shall conform to ASTM A536-72, minimum grade 70-50-05. Nominal thicknesses of fittings shall be equal to, or exceed, Class 54 ductile iron pipe thicknesses. Radii of curvatures shall conform to AWWA C153-00. Fittings shall be cement lined in accordance with AWWA C104-74. Joints shall conform to the requirements of AWWA Standard C111 and shall be compatible with the type of pipe used. Fittings shall be manufactured by U.S. Pipe, Sigma, or Tyler Pipe.
B. Fittings greater than two inches in diameter shall be mechanical joint if used in a buried installation; flanged if installed above ground or in a vault.

C. Fittings for pipe two inches and smaller are covered under the paragraph for service laterals.

4. **JOINT RESTRAINTS**

A. Glands to restrain MJ fittings and pipe bells to DI pipe shall be EBAA Iron megalug series 1100, Ford uni-flange series 1400.

B. Glands to restrain MJ fittings and pipe bells to PVC pipe shall be EBA Iron megalug series 2000PV, Ford uni-flange series 1500.

C. Glands to restrain PVC pipe bell to spigot shall be EBAA Iron megalug series 6500, Ford uni-flange series 1390.

D. Glands to restrain DI push joint pipe bell to spigot shall be EBBA Iron megalug series 1700, Ford uni-flange series 1450.

5. **GATE VALVES**

A. Flow shut off valves shall be resilient seat gate valves. They shall open left (counterclockwise). Each valve shall be rated at 250 psi working pressure with zero leaks and meet the requirements of AWWA C-515. All ferrous components shall be ductile iron. The wedge shall be ductile iron and be fully encased with EPDM rubber. (Double disc and/or metal style solid wedge designs are not allowed.) The wedge to stem design shall employ an independent stem nut. Valves shall have a double o-ring seal and a minimum stem diameter of \( \frac{5}{8} \) inch. All bolting material shall be 304 stainless steel. Stems shall be bronze. All internal and external surfaces shall be electrostatically coated with a fusion bond epoxy prior to assembly.

1. Valves 16 inches or greater in diameter shall have bevel gearing, flushing ports on each guide channel, and lugs or eyebolts for lifting.

2. Valves for buried installation shall have a 2-inch square operating nut, non-rising stem, and mechanical joint confirming with AWWA Standard C111 unless otherwise specified.

3. Valves for above ground mounting or installed in vaults shall have an outside screw and yoke and flanged ends.

4. Valves six through 12 inches in diameter shall be manufactured by Waterous, Kennedy, American Flow Control, or Mueller.

5. Valves 16 inches or greater in diameter shall be manufactured by American Flow Control.
6. VALVE BOXES

A. Valve boxes for gate valves shall be two-piece cast iron with a 5 ¼” drop lid marked “water”. Boxes shall be screw type adjustable with a 5 ¼” shaft diameter. Adjustment range shall be one foot. The box length shall be determined by depth of bury. The valve box shall be a Tyler 6850 series item number 564-S, or Star Pipe Products VB564SHD.

B. Between the gate valve and valve box shall be installed a Valve Box adaptor II as manufactured by Adaptor, Inc.

C. Roadway boxes shall be used with ball valve curb stops. They shall have a 4 ¼” shaft with a 4¼” drop lid. The box length shall be determined by depth of bury. The roadway boxes shall be Bingham and Taylor item number 143-R, Star Pipe Products item number RWB143RHD, Capitol Foundry of VA item number VB-143R, or Sigma item number SCR VBX.

7. FIRE HYDRANTS

A. Hydrants shall conform to the specifications in AWWA Standard C502 for dry-barrel fire hydrants. Hydrants shall be compression type, with six-inch mechanical joint inlet and minimum bury of 4.5 feet. Unless otherwise specified, hydrants shall be traffic model with a 4 ½” valve opening, one 4 ½” pumper nozzle, and two 2 ½” hose nozzles. All nozzle threads shall be national standard. The operating nut shall be pentagon in shape, 1 ½” point to flat, non-rising and open right (clockwise). Hydrants shall have a finish coat of red paint applied by the manufacturer. Hydrants shall be American-Darling Mark-73, Kennedy K81A or Mueller Super Centurion 250 Model A-421.

B. Fire hydrants shall be painted after installation. The upper barrel shall be safety red. The bonnet and three nozzle caps shall be painted the appropriate flow rating color: safety blue, safety green, safety orange, safety red or safety black. Approved manufactures are Rust Stop, Duron Industrial Coating, The Sherwin Williams Co., X-O Rust.

8. SERVICE LATERALS (less meters)

A. Service saddles shall be Ford style FC202.

B. Corporation stops shall have an inlet threaded in accordance with AWWA Standard C800 and a pack joint outlet. They shall be Ford series FB1000.

C. Ball valve curb stops shall meet AWWA Standard C800-84. They shall have tee head checks in the body that permit a 90 degree turn only.

   1. One-inch ball valve curb stops shall have pack joint ends. They shall be Ford catalog number B44-444.

   2. Two-inch ball valve curb stops shall have female iron pipe threads on both ends. They shall be Ford catalog number B11-777.
3. Ball valve curb stops shall have a two-inch gate valve operating nut. The operating nut shall be a Ford catalog number OT-67.

D. Pipe for service laterals shall be Class 200 (200psi) copper tubing size (CTS) polyethylene tubing (PET or PEX) pipe with stainless steel inserts at all connections. The material shall conform to ASTM specification D2737.

E. Fittings for one-inch or two-inch diameter service laterals shall be pack joint or threaded NIP. The fittings shall be manufactured from AWWA Standard C800 and be red brass of 85,5,5,5 alloy.

F. Meter assembly shall be of the prong yoke bar style with 3/4” iron stakes for stabilization. Yoke bar assemblies for one-inch service lines are to be manufactured by Ford Meter Box Co., Inc., A.Y. McDonald Mfg Co., or Mueller Co. The inlet valve shall be an angle ball valve. The outlet valve shall be an angle dual cartridge check valve with drain. The two independent cartridge check valves shall be mounted in line. They shall be removable through the top of the unit and their removal shall require no special tools. Connections are to be pack joint. All assembly pieces shall be of the same manufacturer.

G. Copper Setters for two-inch service lines shall be Ford Meter Box Co., Inc. catalog no. V8HH77-15BHC-11-77.

H. Meter box for ⅝” x ¾”, ¾”, and 1” meters shall be heavy wall bullet style.

   1. They shall be manufactured from three layered polyethylene and be a molded one piece unit. The material shall be a modified polyethylene with low temperature brittleness exceeding - 76° Fahrenheit.

   2. The box shall have a tapered crown and reach its maximum inside dimension approximately 6 inches below the rim.

   3. The nominal wall thickness shall be a minimum of 0.55 inches.

   4. An insulation layer shall be part of the molded wall and it shall have a minimum thermal transfer value of 4.0 per ASTM C171.

   5. The vertical free standing load shall be a minimum of 25,000 lbs.

   6. There shall be a top flange and a bottom flange.

   7. The box shall have a top lip shelf to accommodate an insulating disc.

   8. The interior shall be white and the exterior black in color.

   9. For ¾” x ¾”, and ¾” meters the box shall have outside dimensions of 18” x 22” x 30”.

  10. For 1” meters the box shall have outside dimensions of 20” x 24” x 30”.

  11. The box shall be manufactured by Carson Industries, LLC or Bingham and Taylor
Corporation, or Ford Meter Box Company.

I. Meter vault for 1 ½” and 2” meters shall be a three foot riser section of a four foot diameter manhole. It shall have two cutouts 180° apart. Each cutout shall be eight inches tall and six inches wide. The riser section shall be covered by a standard manhole flat top with a Certain Teed Rexus 24” manhole cover (reference number CDRU60EH).

J. Meter box covers

1. Meter box covers shall have an actual pit access opening of not less than 15”.

2. For ¾” x ¾” and ¾” meters the cover shall be a 74M52CT by AY McDonald or a C52-T by Ford.

3. For 1” meters the cover shall be a Ford MC-30 frame with a Ford RML-1-T lid in non-traffic areas, a Ford RML-12-T lid in traffic areas.

9. METERS

A. All meters shall have encoder type resistor for automatic meter reading and shall conform to the following:

1. Encoder system shall include the meter, encoder register, and meter interface unit for remote data collection.

2. Encoder shall be absolute type capable of reading the position of each number/wheel. Pulse type encoders and battery powered units are not permitted.

3. Encoder registers shall be hermetically sealed.


B. Frederick Water shall provide and install all meters that are 2 inch and smaller. The meter shall be Neptune with an encoder resistor and a R900 meter interface unit (MIU).

C. Meters larger than 2 inch shall be provided and installed by the Contractor.

1. The meter shall be manufactured by Neptune and have an encoder register and a R900 MIU.

2. The meter shall be compound unless usage justifies a turbine meter. Frederick Water’s Engineer shall determine if a turbine meter is acceptable.

3. Turbine meters shall have a strainer.

D. Fire service meters shall be provided and installed by the Contractor. The meter shall be a stainless steel body Neptune HP Protectus III Fire Service Meter.
10. BACKFLOW PREVENTION ASSEMBLIES

A. Each metered service connection (and its bypass, if applicable) for lines six inches or greater in diameter must have an American Society of Sanitary Engineers (ASSE) approved backflow prevention device installed. Frederick Water shall approve the type of device based on the degree of hazard of the planned use.

1. Metered service lines with a low degree of hazard must be provided with a double check valve backflow prevention assembly that is tagged, stamped or embossed to indicate it does meet ASSE Standard No. 1015. The assembly shall be a Watts Model 709 or Model 774, Ames Model 123 or 456.

2. Metered service lines with a high degree of hazard must be provided with a reduced pressure zone backflow prevention assembly that is tagged, stamped or embossed to indicate it does meet ASSE standard No. 1013. The assembly shall be a Watts Model 909 or Model 994, Ames Model 123 or 456.

B. Each fire line service connection (and its bypass, if applicable) must have an ASSE approved backflow prevention device installed. Frederick Water shall approve the type of device based on degree of hazard of the planned fire service.

1. Fire lines with a low degree of hazard (no additives or antifreeze) must be provided with a detector double check backflow prevention assembly with ASSE Standard No. 1048 identification made part of the device. The assembly shall be a Watts Model 774 DCDA or Model 774 XDCA.

2. Fire lines with a high degree of hazard (additives or antifreeze) must be provided with a reduced pressure detector assembly with A.S.S.E. Standard No. 1047 identification made part of the device. The assembly shall be a Watts Model 909RPDA or Model 995 DCDA.

C. Detector (metered) assemblies mounted inside of structures are required to have an encoder type register for automatic meter reading. Frederick Water may require the readout to be mounted on the outside of the structure at a height and location approved by Frederick Water.

11. FLUSHING ASSEMBLIES

A. See Section 4 for materials required.

12. AIR RELEASE VALVES

A. Air release valves shall be H-TEC model 993 HaVent with 2” MIP connection.

13. PRESSURE REDUCING VALVES

A. Pressure reducing valves, shall be manufactured by Cla-Val Company.
14. **LOCATION MARKERS**

   A. Water location markers shall be ScotchMark Mid-Range markers (wheel) part number 1257.

15. **PIPE CASING**

   A. Casing pipe for water mains shall be sized in accordance with pipe diameter. Casing pipe shall be steel and shall meet ASTM specification A252 Grade 2 or 139 Grade B. See section 4.

   B. Casing pipe for water service laterals shall be PVC and may be SDR21 or SCH40.

       1. For 1” diameter piping, the casing shall be 3” diameter.

       2. For 2” diameter piping, the casing shall be 6” diameter.

16. **CASING SPACERS**

   A. Separation of carrier pipe from casing pipe shall be by stainless steel casing spacers. Spacers shall be by PSI, Inc.

17. **REPAIR CLAMPS**

   A. Repair clamps shall be full circle all stainless steel bands. Cast couplings are not allowed.

       1. Clamps for pipe thru 12 inches in diameter shall be Ford Style FS1 in 20 inch length.

       2. Clamps for pipe greater than 12 inches in diameter shall be Ford Style FS3 in 24 inch length.
SECTION 2 - WATER

PART 3 - CONSTRUCTION STANDARDS
Refer to Section 4 for appropriate drawings

1. GENERAL

A. Installation of water mains and appurtenances shall be to the applicable AWWA standards or the manufacturer’s recommended procedure.

B. All construction shall be in strict accordance with approved plans and specifications. Any deviations or changes shall be submitted to Frederick Water for approval.

C. Frederick Water shall have the required number of plans before construction begins.

D. Frederick Water shall have access to the construction work at any time for inspection of materials and construction methods.

E. All valves, hydrants, and flushing assemblies shall be operated with proper wrenches in the presence of Authority personnel, except in the case of an emergency.

F. Upon substantial completion, Frederick Water will assume responsibility for locating water and sewer lines in response to Miss Utility location requests.

2. TAPPING EXISTING MAINS

A. Connections to existing water mains shall be made by Frederick Water or its agent. They will furnish the material and make the tap. The location of the wet tap shall be coordinated with Frederick Water’s engineering assistant. The Contractor shall make application for and pay the cost of the work. Should water service be disrupted, the Contractor has the responsibility of notifying those customers whose service will be affected.

3. CLEARING

A. The right-of-way shall be cleared of all trees, stumps, shrubs, and other foreign matter for the width of the easement of the mains being constructed. The debris shall be disposed of in an acceptable manner. No debris shall be buried within the right-of-way.

4. EXCAVATION

A. The trench shall be excavated to a depth that will insure a minimum of 48 inches of cover on top of the pipe.

B. Minimum clearance between the side of the trench and pipe shall be eight inches. The width of the trench above the top of the pipe shall be as wide as necessary for sheeting or bracing and the proper performance of the work. All trench walls shall be kept as vertical as possible and still meet OSHA
C. Excavated material suitable for backfilling shall be piled in an orderly manner and be a minimum distance of three feet from the bank of the trench. All excavated material not suitable and/or not required for backfill shall be removed and disposed of in an approved manner.

D. Such grading as necessary shall be done to prevent water from flowing into the trench or other excavations, and any water accumulating therein shall be removed by approved methods.

E. All fill material shall be in place and compacted to finish subgrade before water lines are installed.

5. FOUNDATION IN POOR SOIL

A. Whenever the soil at the trench subgrade is soft, unstable, or saturated with water, such unsuitable material shall be removed and the trench subgrade stabilized with a granular material.

B. Maximum size of granular material shall be two inches. Depth of stabilization shall be as required to construct a firm subgrade for pipe bedding material, but must be at least twelve inches.

C. Concrete arch or cradle bedding shall be provided when necessary.

6. BEDDING

A. Refer to Section 4 for types of bedding.

B. Bedding material shall be an open-graded course stone aggregate meeting Virginia Department of Transportation requirements for sizes number 68, 57 or 78.

C. Standard bedding shall be installed unless poor soil conditions are encountered. There shall be a minimum of twelve inches of stone under the pipe. Stone shall also be backfilled around the pipe and to a height of twelve inches above the top of the pipe.

D. Holes shall be scooped out where joints occur, leaving the entire barrel of the pipe bearing on the bedding.

7. PIPE INSTALLATION

A. Water main center line shall be staked at 100 foot intervals and at all bends.

B. After bedding has been installed, pipe and fittings shall be laid in accordance with the manufacturer's instructions and recommendations. Including but not limited to the use of a torque wrench to verify that torque requirements are met. Damaged or unsound material will be rejected.

C. Pipeline deflection will only be allowed at joints and fittings. The length of pipe itself shall not be
bent. The maximum deflection limit shall be 12 inches of lateral displacement per 20 feet of pipe. (If the radius of curve is 200 feet or greater, no bends are required).

D. Fittings, fire hydrants, and valves shall be restrained per Section 4 requirements.

E. Joint restraints are required if the water line slope is 20% or greater.

F. Joint restraints are required in all fill conditions to minimum of 20' onto original ground.

G. Water lines shall be lowered as needed for the installation of gate valves.

H. At the completion of the work shift, the end of the installed pipe shall be sufficiently plugged to keep out trench waters, soil, or other extraneous material.

I. Refer to Section 4 for drawings of a typical jack and bore road crossing and a typical stream crossing.

8. BACKFILLING

A. Frederick Water’s specified stone aggregate shall be used to a height of twelve inches above the top of the pipe.

B. Above the stone aggregate (or concrete arch) shall be 24 inches of select backfill compacted in six-inch lifts. The maximum particle size of this backfill material shall be one inch. Backfill shall be compacted to 95% of ASTM D-698 maximum density.

C. Above the select backfill, material shall be deposited in lifts not exceeding two feet.

D. Any backfill material used above the pipe bedding shall be free of all organic material, large clods, frozen soil, or other materials difficult to compact.

E. No rock shall be used in the select backfill. Any rock used above the select backfill shall be no longer than six inches in the greatest dimension.

9. GATE VALVES AND VALVE BOXES

A. Valves shall be installed as shown in Section 4.

B. Both sides of a valve shall be restrained.

C. Valves 12 inches and larger shall have an 8" x 8" x 16" solid block under them.

D. Valves 16 inches and greater in diameter, being bevel geared, are installed horizontally. The trench at the valve shall be widened five feet beyond the gearing to provide a work area for repair.

E. Valves set over five feet in the ground shall have extension rods added to bring the operating nut to within three feet of the surface.
F. The valve box shall be placed directly over and centered on the valve with the bottom of the box set at or below the top plate of the valve. The valve box shall be set plumb. The backfill shall be carefully tamped to the surface.

G. Valve boxes in non-paved areas shall be protected by a skid pad of concrete one-foot six-inches in diameter by six-inches thick.

H. A valve box adaptor shall be installed between the gate valve and its valve box.

10. FIRE HYDRANT ASSEMBLIES

A. Hydrant assembly (hydrant and its gate valve) shall be installed as shown in Section 4.

B. Before installing a hydrant, care shall be taken to see that all foreign material is removed from the interior of the barrel.

C. Both hydrant and its valve shall be restrained.

D. The area around hydrants shall be backfilled with stone wrapped with filter fabric to a minimum height of six inches above the top of the base. All backfill around hydrants shall be thoroughly compacted to the surface.

E. The area of hydrant placement shall be free of all obstructions in front of and within three feet of all sides.

F. The pumper nozzle shall face the means of access.

G. After installation, hydrants shall be washed, wire brushed and painted. The entire unit shall first be coated with a rusty metal primer. Then the upper barrel shall be painted safety red and the bonnet and nozzles the appropriate fire flow safety color. The project inspector shall designate the color.

<table>
<thead>
<tr>
<th>Color</th>
<th>Flow Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>249 gpm and below</td>
</tr>
<tr>
<td>Red</td>
<td>250 gpm through 500 gpm</td>
</tr>
<tr>
<td>Orange</td>
<td>501 gpm through 999 gpm</td>
</tr>
<tr>
<td>Green</td>
<td>1000 gpm through 1499 gpm</td>
</tr>
<tr>
<td>Blue</td>
<td>1500 gpm and above</td>
</tr>
</tbody>
</table>

H. Hydrants on privately owned lines shall have the circumference of the flanges that join the bonnet to the upper barrel section painted white.

11. SERVICE LATERAL

A. Service laterals shall be one-inch or two-inch diameter lines and shall include saddle, corporation stop, and meter box assembly or vault.

B. Service laterals shall be installed with a minimum of 48 inches of cover. There shall be six inches of stone under the pipe and meter box and six inches of stone over the top of the pipe.

C. The Contractor shall install service laterals on new lines. Water lines shall be filled and all taps made
under static pressure. A saddle and corporation stop shall be installed, then a drilling machine (with appropriate shell cutter) shall be used to make the tap. (A saddle is required for all taps.)

D. The installation of new services on existing lines shall be done by Frederick Water at time of utility construction. Application for, and installation of the service, shall be early in the project to ensure the work is completed in a cost efficient and timely manner. The location of the tap and the placement of the meter box (vault) are to be coordinated with the Authority’s engineering assistant.

E. Wherever possible, the lateral shall be placed at the center of the lot with the meter box set one foot beyond the property line or far edge of sidewalk.

F. The exact location of water services on new lines shall be coordinated with Frederick Water’s Inspector.

G. Laterals will be continuous (without joints) from the corporation stop to the angle ball inlet valve. A six-foot tail piece shall be installed beyond the meter box. The end shall have a coupling and plastic plug to prevent intrusion of foreign matter.

H. Meter boxes shall be encircled with compacted select backfill to the top of the box.

I. Care shall be taken in compacting trenches to prevent damage to the pipe and strain on the yoke bar. Pipe which is damaged so as to cause a restriction in flow shall be replaced.

J. The end of the lateral shall be marked with a 2” x 4” stake extending from the tail piece to 18 inches above the ground. The top six inches of the 2” x 4” shall be painted blue.

K. Laterals shall be installed as shown in Section 4.

L. Before a permanent meter is set:

1. The frame and cover must be properly aligned with its meter box and yoke bar.

2. The frame and cover must be set to the final grade of the lot.

3. The distance between the top of the cover and the yoke bar must be between 20 and 23 inches.

4. All components of the meter box assembly must be in proper working order. It is the Contractor’s responsibility to have the meter box assembly installed correctly.

12. FLUSHING ASSEMBLIES

A. Assemblies shall be installed as shown in Section 4. They shall be set within one foot of the property line.

13. VAULTS

A. Water meter, pressure reducing valve and combination air release and vacuum valve installation shall be as shown in Section 4.
14. LOCATION MARKERS

A. Location markers (buried transponders) shall be installed 12 inches above the top of the pipe. When pipeline cover is greater than six feet, additional markers shall be installed over the original markers at six foot vertical intervals.

B. They shall be placed at:
   1. Fifty-foot intervals
   2. Each fitting (bend, tee, reducer, etc.)
   3. The end of each joint that is deflected
   4. Any additional location Frederick Water’s engineer or inspector shall direct.

15. RESTORATION

A. Areas that are disturbed during construction shall be returned to conditions at least equal to that which existed prior to the start of work. The ground is to be returned to the same contour as existed before construction. Trees, shrubs, etcetera, in easements are not to be replaced. Disturbed earth surfaces shall be left with ground cover similar to surroundings. Restoration shall commence immediately following the completion of work on any section or division of a project.

16. PRESSURE TESTING

A. Service laterals are to be installed before testing.

B. Lines shall be tested through a fire hydrant, a service connection or a special tap installed for the test.

C. A maximum of one thousand linear feet of line shall be tested at a time.

D. Tests must be conducted in the presence of a Frederick County inspector.

E. All water pipe shall pass a hydrostatic pressure test.
   1. All newly laid pipe, or any valved section thereof, shall be subjected to a hydrostatic pressure of at least 1.5 times the working pressure at the point of testing.
   2. Test pressures shall:
      a. Be a minimum of 150 psi
      b. Not exceed pipe design pressure
      c. Be of at least a two-hour duration
d. Not exceed the rated pressure of the valve.

3. Each valved section of pipe shall be slowly filled with water. The specified test pressure shall then be applied by means of a pump connected to the pipe. The manner of connecting the pump to the piping shall be satisfactory to Frederick Water. The water and container used to pump up the line to be tested shall be properly disinfected.

4. Before applying the specified test pressure, air shall be expelled completely from the pipe, valves, and hydrants.

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

6. There shall be zero leakage during the two-hour test period.

17. DISINFECTION

A. Disinfection testing shall be performed after the line has passed its pressure test.

B. Prior to disinfection, all water mains shall be flushed. All valves and hydrants shall be operated during this operation. Flushing velocities should not be less than 3.0 feet per second.

C. All pipe and equipment shall be disinfected by the continuous feed method or the granular method in accordance with AWWA C-651-86. (The slug method is not allowed.)

1. Continuous Feed Method:
   Potable water shall be introduced into the pipe line at a constant flow rate. Chlorine shall be added at a constant rate to this flow so that the chlorine concentration in the water in the pipe is at least 50 mg/l. The chlorinated water shall remain in the pipe at least 48 hours, after which its chlorine concentration shall be at least 10 mg/l.

   Amount of HTH powder (having 65% available chlorine) required per a 20 foot section of pipe:
   
<table>
<thead>
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<th>8”</th>
<th>12”</th>
<th>16”</th>
<th>18”</th>
<th>20”</th>
<th>24”</th>
</tr>
</thead>
<tbody>
<tr>
<td>number of grams</td>
<td>16</td>
<td>36</td>
<td>64</td>
<td>81</td>
<td>100</td>
<td>144</td>
</tr>
</tbody>
</table>

2. Granular Method:
   Granular calcium hypochlorite shall be added to each section of pipe per table above and introduced into each pipe segment per Frederick Water inspector’s requirements. After completion of the construction, the main shall be filled with water at a velocity of less than one foot per second. A minimum concentration of 50 mg/l of chlorine solution shall be in the system at this time. A concentration of 25 mg/l residual chlorine must be present after 48 hours.

D. All valves and appurtenances shall be operated while chlorinated water is in the pipe line.

E. After the 48 hour minimum retention period, the main shall be flushed of the high chlorine water until the water leaving the system shows a chlorine concentration of no higher than that prevailing
in the water used for flushing. After final flushing, a minimum of two water samples shall be collected at least 16 hours apart for bacteriological tests. The samples shall be collected at regular intervals not to exceed 1,000 feet throughout the length of the pipe. The Contractor shall assist Frederick Water in taking the bacteriological tests. These bacteriological tests shall be analyzed by a state approved Laboratory by Frederick Water. The results of these samples must indicate the absence of coliform contamination.

F. The disinfection tests must be satisfactorily completed prior to placing the line in service.

G. If a disinfection test fails, the chlorination/dechlorinating procedure must be repeated until the required results are obtained.

H. If at any time the water in an existing line becomes contaminated, this piping shall be disinfected as specified for new piping, back to the nearest gate valve or valves, or beyond those points as necessary to include all contaminated piping. On completion of disinfection, the piping shall be flushed thoroughly, and samples shall be taken. The water shall be proven safe for human consumption before acceptance of disinfection.

18. ACCEPTANCE OF WORK

A. Should construction standards and/or tests not be met, Frederick Water shall reject all or any portion of the facilities. Any project or portion of a project rejected by Frederick Water shall not be permitted to receive water from any previously approved system until the rejected system has been repaired so as to meet all standards governing the construction of water systems.

B. All repair methods, other than replacement of the defective areas with new materials, shall be subject to prior approval of Frederick Water.
SECTION 3 – SEWER

PART 1 - DESIGN STANDARDS
Refer to Section 4 for appropriate drawings

1. GENERAL

A. Design standards shall be those set forth in the Virginia Sewage Collection and Treatment (SCAT) Regulations, 9 VAC 25-790, except as specified herein.

B. When Frederick Water deems it necessary, it may specify the type of material to be installed and/or the construction method to be used.

C. Unmetered water, i.e. swimming pool backwash water, condensation, storm water lines (including sump pumps, trash enclosure drains, battery/hydrogen/fuel cell discharge/byproduct, etc.) and shall not be discharged to the sanitary sewer system.

2. CAPACITY

A. The following factors shall be considered in determining capacities of sanitary sewer:

1. Complete development of the upstream watershed. Use the greater value obtained by 1) estimating the tributary population for a period of 50 years hence or 2) assuming the entire watershed to be completely developed according to present or predicted zoning.

2. Population densities of:
   a. Forty persons per acre in industrial areas
   b. Four persons per lot in platted subdivisions
   c. Four persons per unit in multi-family developments and
   d. Ten persons per acre in all other areas.

3. Average daily flows as set forth in 9 VAC 25-790-460, Table 3, of the SCAT regulations, unless actual use figures from similar developments can be shown.

4. Peak design flows of 400 percent of the average design flow of subdivisions and 250 percent of the average design flow for mains or interceptors.

3. HYDRAULIC DESIGN

A. Gravity Sewer

1. Sewers shall have a uniform slope and straight alignment between manholes, and shall achieve total containment of wastewater.

2. Sewers shall be designed to be free flowing with the hydraulic grade below the crown and with hydraulic slopes sufficient to provide an average velocity (when running full) of not
less than 2.0 feet per second when using an "n" value of 0.014 in the Manning formula.

3. The following are minimum slopes:

<table>
<thead>
<tr>
<th>Pipe Diameter</th>
<th>4&quot;</th>
<th>6&quot;</th>
<th>8&quot;</th>
<th>10&quot;</th>
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<td>0.06</td>
<td>0.05</td>
</tr>
</tbody>
</table>

4. Pipe sizes shall not be increased just to take advantage of flatter grades.

5. In cases where sewers are to be constructed on steep grades for which high velocities are indicated, the maximum permissible velocity at average flow (before applying peak flow factor) should not exceed 15 feet per second. Suitable drop manholes shall be provided to break the steep slopes and to limit velocities to not more than 15 feet per second.

6. Where drop manholes are impractical for reduction of high velocity, the sewer shall be of ductile iron.

B. Forced sewer systems (pump station & line) shall meet the design requirements of the Virginia Department of Environmental Quality.

4. COLLECTION SYSTEM

A. Manholes shall be provided at all intersections, changes in grade, alignment, pipe material, or pipe size, and at the termination of a line. Lines installed for future extensions shall also end with a manhole.

1. Manholes shall be provided at intervals not exceeding 400 feet.

2. There shall be a 0.2 foot drop in elevation through the manhole.

3. Manholes for sewer through 15 inches in diameter shall have a four foot inside diameter. Manholes for sewer greater than 15 inches in diameter shall have a minimum inside diameter of five feet.

B. In undeveloped easements, manholes shall, at a minimum, extend 24 inches above grade.

C. Manholes four feet or less in height (invert out to rim) shall be flat tops.

D. All drop manholes shall have the drop on the inside. Drop shall be a minimum of three feet.

E. Existing manholes shall be core drilled for the acceptance of new mains.

F. Standard installation of a new manhole on the existing line shall be cut in.

G. Watertight manhole covers are to be used whenever the manhole tops may be flooded. As a minimum, watertight covers are to be used to the elevation of the 100-year flood plain. If watertight manhole sewer runs are longer than 1,000 feet, ventilation shall be provided.

H. Frederick Water shall connect a new lateral to any existing line or manhole.
I. Wherever possible, sewer laterals shall be ten feet to the right of the water laterals as viewed from the road toward the lot.

J. The use of four inch service lines is limited to single service connection (lateral).

K. Lines of six inch or greater diameter shall be connected to the system only at a manhole.

L. All lines (main and/or lateral) entering a manhole shall have the same crown elevation.

M. Pipe shall be of the same material from manhole to manhole.

N. Generally, the sewer lateral shall be connected to the sewer main. Dead-end manholes may have laterals into them. Laterals that would discharge within ten feet of an inline manhole may be connected to the manhole. In both cases, the crown of the lateral shall be at the crown of the invert in of the main.

O. The tops of the sewers crossing stream shall be at a minimum of one foot below the natural bottom of the stream bed and the pipe shall be cl 52 dip and encased in concrete.

P. The last run of gravity sewer line to a pump station shall be ductile iron pipe. The minimum run shall be one full laying length. Not less than 20 foot with no joints. Last manhole shall be on solid ground.

Q. Gravity sewer lines having a slope 17% or greater shall have concrete anchors installed per drawing in Section 4.

R. A force sewer service lateral may only discharge to a manhole or communal non-gravity line that services other forced sewer laterals.

S. A sanitary forced sewer main line pressurized by its own pump station shall only discharge to a manhole or pump station wet well. Exceptions made on case by case basis per Frederick Water engineer approval.

T. Forced sewer mains connecting to gravity mains require the receiving manhole and three downstream manholes to have Raven coating. Any manhole with a high seasonal water table or requiring water tight frame and cover shall be Raven coated.

U. Forced sewers shall enter the manhole with its center line horizontal and shall have an invert elevation which ensures a smooth flow-transition to the gravity flow section. Special attention shall be paid to the design of the termination in order to prevent turbulence at this point.

V. The first section of forced sewer leaving a suction lift pump station shall be a full laying length of ductile iron pipe and ductile iron pipe minimum 20 foot onto original ground.

W. Pipeline deflection of forced sewer lines will only be allowed at joints and fittings. The length of pipe itself shall not be bent. The maximum deflection limit at a joint (union of two sections of pipe) shall be 12 inches of laterals displacement per 20 feet of pipe. (If laying radius is 200 feet or greater, no bends are needed).

X. The maximum deflection of a fitting (bend) shall be 45 degrees. (Ninety degree bends are not
Y. Forced sewer mains shall have section isolation valves at intervals not exceeding 1,000 feet.

Z. Joint restraints are required if the forced sewer slope is 20% greater.

AA. Sewer mains connecting to the Frederick-Winchester Service Authority’s trunk line shall have a metering station just prior to the tie-in.

1. No upstream manhole shall be located closer than 50 feet from the metering station.

2. Uniform alignment should be maintained from upstream manhole through flume to downstream entry point at trunk main or downstream manhole.

3. Pipe slope to station should not exceed 2.50% and downstream slope should be equal to or greater than upstream line slope to maintain free flow condition on downstream side of flume.

4. Transitions upstream and downstream of flume should be smooth and uniform and per flume manufacturer’s requirements.

5. Metering station shall be located outside of the 100 year floodplain.

5. DEPTH OF BURY

A. Gravity sewers located in rights-of way or areas subject to wheel loads shall have a minimum of six feet of cover above the top of the pipe. Gravity sewers in easements not subject to wheel loads shall have a minimum of three feet of cover above the top of the pipe. Where conditions dictate that the cover be less, ductile iron pipe shall be required.

B. Sewers with cover 20’ or greater shall be constructed with ductile iron pipe.

C. Forced sewer lines shall be laid with a minimum cover of 48 inches.

6. PUMP STATIONS

A. Pump stations are not permitted in areas that could be served by gravity sewer.

B. Pump stations shall be protected from 100-year floods and be designed to remain fully operational during 25-year floods.

C. Pump stations shall be surrounded by a 100 foot diameter buffer zone of controlled use.

D. Data and design calculations for pump stations and force mains shall be shown on the plans. Pump station capacity calculations, design elements, pump choice, station schedule and electrical data are to be given. Data and calculations for the total dynamic head (TDH) shall be shown and the TDH plainly noted. See Section 4.

E. Pump stations shall have three-phase 208 volt power to the site.
F. All pump stations shall have an onsite stand-by generator manufactured by Kohler and sized appropriately for full functionality of the pump station.

G. Pumps shall be wet-well mounted suction lift unless station is low volume.

H. Two spare impellers, and one spare vacuum pump shall be provided for suction lift pump stations.

I. Submersible grinder pumps may be used if:
   1. Discharge pipe diameter is 3 inches or less
   2. The total dynamic head is 80 feet or less
   3. The peak design flow is 70 gpm or less.

J. A third (spare) pump shall be provided with each submersible grinder pump station.

K. The contractor shall furnish and install a complete and fully functional Supervisory Control and Data Acquisition (SCADA) system conforming to the most recent version of the Frederick Water Supervisory Control and Data Acquisition (SCADA) specifications. A mag meter and discharge pipe pressure transducer is also required. A stainless steel enclosure for all SCADA equipment is required with enough additional space to accommodate a 110V heater and a thermostat controlled exhaust fan. All SCADA programming shall be provided to FW on a disc or flash storage media. A copy of any required programming software shall also be provided.

L. Under certain circumstances, Frederick Water may require a redundant, stand-alone SCADA system. In those instances, in addition to the SCADA per Frederick Water SCADA specifications, the Contractor shall provide all labor, materials, equipment and incidentals required to furnish, install, calibrate, test, start-up and place in satisfactory operation a complete Cloud based Supervisory Control and Data Acquisition (SCADA) System. The unit shall have an internal battery backup power supply. The system shall consist of three sub-systems: a Central Server, a web-based user interface and the Remote Terminal Units (RTU's) of various sizes. The redundant SCADA system shall be manufactured by High Tide Technologies, LLC,

M. The access road to the site shall be 12 feet wide minimum. It shall have an eight-inch 21B aggregate base with a three compacted inches IM-19 surface. Longitudinal slope shall not exceed 10%. Consideration shall be given to vactor truck access during inclement weather and snow removal. Other specific requirements may be identified during site plan review.

N. A six-foot high fenced-in area (50’ x 50’ minimum) with a 12 foot double drive gate shall be required at all pump stations. Vactor truck turn around shall also be provided within fenced in area of pump station or immediately outside of the fence. The fenced in area of a pump station shall have eight-inches 21B aggregate base with a three compacted inches IM-19 surface. Longitudinal slope shall not exceed 3%. Consideration shall be given to vactor truck access during inclement weather and snow removal. Other specific requirements may be identified during site plan review.

O. Pump stations shall be installed per drawing in Section 4.

P. For pump stations serving institutional or residential facilities such as schools and hotels, a Muffin Monster type grinder shall be provided immediately upstream of the pump station wet well in
order to protect the pumps from rags and other fibrous materials. Further details on grinder requirements can be obtained from the Frederick Water Engineer.

Q. All pump stations shall have bypass/emergency pumping connections per Section 4.

7. GENERATORS

A. Generators shall be manufactured by Kohler.

B. The generator shall have sufficient rating to start and run both pumps simultaneously or the pump station shall have a time delay mechanism or soft start function to start the second pump within 30-seconds of the first pump starting when required (lag pump on condition).

C. There shall be a base mounted fuel tank with sufficient capacity to operate the generator at 100% of its rating for 24 hours.

D. The engine shall run on diesel fuel.

E. The generator shall produce three phase 120/208 volts at 60hz.

F. There shall be an automatic transfer switch.

G. The stand-by generator shall have:
   1. Vibration insulators
   2. Battery charger
   3. Engine block heater
   4. Outdoor weather housing with
      a. Fixed air intake & exhaust louver
      b. Lockable access doors.

H. The generator shall have its own disconnect.

I. The unit shall contain an engine mounted thermal circulation immersion water heater with an adjustable thermostat switch.

8. SEWER NEAR WATER MAINS

A. Wherever possible, sewer lines shall be laid at least ten feet horizontally from any water line. The distance shall be measured edge-to-edge. Should conditions prevent this separation, the sewer line shall be ductile iron.

B. Sewers crossing under water lines shall be laid to provide a separation of at least 18 inches between the bottom of the water line and the top of the sewer. When conditions prevent this vertical separation, the water line shall be constructed of one full joint ductile iron pipe minimum.

C. Sewers crossing over water lines shall be laid to provide a separation of at least 18 inches between the top of the water line and the bottom of the sewer. Adequate structural support shall be provided for the sewer to prevent damage to the water main. Regardless of separation, sewer lines crossing over water lines shall be ductile iron (manhole to manhole). The sewer line shall be pressure tested in place, without leakage, prior to backfilling. The section of sewer pipe crossing the water line shall
be centered at the point of crossing so that its ends are equidistance from the water.

D. When it is impossible to obtain proper horizontal and vertical separation, both the water and sewer shall be constructed of ductile iron pipe. The sewer segment (manhole to manhole) shall be pressure tested in place, without leakage, prior to backfilling. A hydrostatic test shall be conducted, per Frederick Water requirements, with a minimum test pressure of 30psi.

E. No water pipe shall pass through or come in contact with any part of a sewer manhole. Whenever possible, manholes shall be at least ten feet horizontally from a water main. The distance shall be measured edge-to-edge. When proper separation cannot be obtained, manholes must be of watertight construction and tested in place.

9. ADJACENT UTILITIES

A. When necessary and allowed by Frederick Water, other utilities shall be placed no closer than seven feet horizontally or eighteen inches vertically (crossing) to a sewer line. The distances are to be measured inside edge to inside edge.

B. Frederick Water easements shall not have other utilities installed on them except for perpendicular crossings.

C. Where sewer lines and other utilities cross or where terrain features may dictate, the other utilities shall be properly identified with a marker or other means of identification specifically approved by Frederick Water.
SECTION 3 – SEWER

PART 2 - MATERIAL SPECIFICATIONS
Refer to Section 4 for appropriate drawings

1. APPROVED MATERIALS

A. All materials used in the construction of the sewer system shall have the approval of Frederick Water. American Water Works Association (AWWA) and American Society for Testing Material (ASTM) set forth only a set of standards for materials. Since these standards are quite broad, they may or may not meet the requirements or needs of Frederick Water.

B. Materials not listed in these standards and specifications or not currently accepted by Frederick Water shall be approved by Frederick Water before installation.

C. The following approval procedure shall be used:
   1. A cover letter along with two sets of manufacturer’s certifications, and shop drawings and/or samples shall be sent to Frederick Water engineer.
   2. After his review, the engineer will issue a letter stating whether the product is acceptable or not.

D. Unapproved materials placed on a job site shall be subject to immediate rejection and barred from any further consideration.

2. PIPE

A. Polyvinyl chloride (PVC)

   1. Gravity

      a. Pipe four inches through 15 inches in diameter shall meet the requirements of ASTM D-3034. The wall thickness of the pipe shall be SDR26 and its outside diameter that of SDR35 (a.k.a. SDR 26 heavy wall sewer, SDR 35 heavy wall, SDR 35/26).

      b. Pipe sizes 18 inches through 27 inches shall: 1) meet the requirements of ASTM F-679, 2) have a minimum pipe stiffness of 46, and 3) meet T1 wall thickness requirements for materials with minimum cell classification of 12454. Its outside diameter shall be that of SDR 35.

      c. Pipe 30 inches in diameter shall 1) meet the requirements of ASTM F-679, 2) have a minimum pipe stiffness of 46, and 3) have a minimum wall thickness of 0.853. Its outside wall diameter shall be that of ductile iron pipe.

      d. Pipe greater than 30 inches in diameter shall be considered on a per project basis.

      e. Pipe shall be manufactured by CertainTeed, Johns-Mansville or North American.
2. Forced Sewer
   a. Pipe 1 ½” and 2” shall be 200 psi copper tube size polyethylene tubing.
   b. 3” through 12” in diameter shall meet the requirements of (1) ASTM D2241 for pipe, (2) ASTM D3139 for push-on-joints, and (3) ASTM F477 for gaskets. The PVC compounds shall conform to material code PVC 1120 of ASTM resin specification D1784. The pipe shall have (1) a class 200 pressure rating, (2) with an outside diameter in iron pipe size, and (3) a wall thickness in SDR-21.
   c. Pipe 14” through 24” in diameter shall meet the requirements of (1) ASTM D2241 for pipe, (2) ASTM D3139 for push-on joints, and (3) ASTM F477 for gaskets. The PVC compounds shall conform to material code PVC 1120 of ASTM resin specification D1784. The pipe shall have (1) a class 200 pressure rating, (2) with an outside diameter in AWWA C905 ductile iron pipe size, and (3) a wall thickness in DR-21.
   d. Pipe shall be manufactured by ETI, CertainTeed, Johns-Mansville.

B. DUCTILE IRON

Ductile iron pipe shall conform to the requirements of AWWA Standard C151. The pipe shall be cement lined in accordance with AWWA Standard C104. Unless otherwise specified, the pipe shall have push-on joints meeting the requirements of AWWA Standard C111. The wall thickness of the pipe shall be Class 52. Pipe shall be manufactured by American Pipe Co., or Griffin Pipe.

3. MANHOLES

A. Manholes shall be wet cast precast concrete conforming to ASTM C478 with eccentric cones and extended bases. Concrete shall conform to the requirements of ASTM C150. Joints shall conform to ASTM C990-06. Gaskets shall be either O-ring or profile with the former conforming to ASTM C3 and the latter to ASTM C443.

B. Manholes for sewer through 15 inches in diameter shall have a four foot inside diameter. Manholes for sewer greater than 15 inches shall have a minimum inside diameter of five feet.

C. Walls shall be a minimum of five inches thick and the base a minimum of eight inches thick.

D. The diameter of the extended base shall be 12 inches greater than the outside of the barrel section.

E. There shall be a 0.20 foot drop in elevation through the manhole.

F. Manhole steps shall be steel reinforced polypropylene.

G. Precast inverts are required.

H. The exterior (to include adjustment rings) shall be covered with a black asphalt gilsonite paint such as LN-12 manufactured by Seaboard Asphalt Products Company.
I. Pipe shall be secured to the entry hole by a lock joint flexible manhole sleeve as manufactured by Core and Seal Co.

J. Joints between sections shall be sealed with (2) one-inch nominal size butyl joint sealant on both horizontal surfaces. The butyl sealant shall be CS102 by Concrete Sealants, Inc.

K. Joint(s) between the top section (cone or flat top), grade ring(s) (if needed) and frame shall be sealed by use of one inch nominal size butyl joint sealant. The frame and grade rings shall be bolted to the top section by ¾” diameter concrete anchor bolts.

L. Drop manholes shall use the Reliner brand inside drop bowl.

4. MANHOLE FRAMES AND COVERS

A. Manhole frames and covers shall conform to ASTM A-48. The frame shall be drilled to permit using 3/4-inch diameter wedge anchor bolts to secure it to the manhole. Four such bolts shall be used per frame. The words "Sanitary Sewer" shall be cast into the cover so as to be plainly visible. The minimum clear frame opening shall be 24 inches. Covers shall be solid with two pick.

B. Standard manhole frames and covers shall be:

   1. East Jordon Iron Works, Inc., catalog number 00154510 frame and the 00154523 cover lettered "SANITARY SEWER" are required and shall be dipped 1545Z1 (frame) and 1544C (cover)

   2. Capitol Foundry of VA, Inc., item #MH1214* dipped

C. Watertight manhole frames and covers shall be:


   2. Capitol Foundry of VA, Inc., item #MH1678*JC-WT dipped

5. FITTINGS

A. Gravity sewer lines having 15 feet or less cover shall have PVC fittings that are the same SDR rating as the pipe used.

B. Gravity sewer lines having cover greater than 15 feet shall have coal tar epoxy lined, ductile iron fittings. The fittings shall be manufactured by The Harrington Corp. (HARCO).

C. Fittings used in sewer force mains shall be Class 350 ductile iron conforming to ASTM A536-72, minimum grade 70-50-05. Normal thickness of fittings shall be equal to, or exceed, Class 54 ductile iron pipe thicknesses. Fitting shall be cement lined in accordance with AWWA C504-74. Radii of curvatures shall conform to AWWA C153-00. They shall be mechanical joint if buried and flanged if used in vault or pump station piping.
6. **PINCH VALVES AND PLUG VALVES**
   A. Pinch valves or Full Port Plug valves are required for all sanitary force main applications. Gate valves are not acceptable. Pinch valves are NOT suitable for buried installation.

7. **VALVE BOXES**
   A. Valve boxes for gate valves shall be two piece cast iron with a 5 1/4" drop lid marked "sewer". Boxes shall be screw type adjustable with a 5 1/4" shaft diameter. Adjustment range shall be one foot. The box length shall be determined by depth of bury. The valve box shall be a Tyler 6850 Series item number 564-S, Star Pipe Products item number VB564SHD.
   B. Between the gate valve and valve box shall be installed a Valve Box Adaptor II as manufactured by Adaptor, Inc.
   C. Roadway boxes shall be used with ball valve curb stops. They shall have a 4 ¼" shaft with a 4 ¼" drop lid. The box length shall be determined by depth of bury. The roadway boxes shall be Bingham and Taylor item number 143-R, Star Pipe Products item number RWB143RHD, or Capitol Foundry of VA item number VB-143R.

8. **COMBINATION AIR RELEASE AND VACUUM VALVES**
   A. Sewage combination air release and vacuum valves shall be H-TEC Model 986 –stainless steel.

9. **JOINT RESTRAINTS**
   A. Glands to restrain MJ fittings and pipe bells to DI pipe shall be EBAA Iron megalug series 1100, Ford uni-flange series 1400.
   B. Glands to restrain MJ fittings and pipe bells to PVC pipe shall be EBAA Iron megalug series 2000PV, Ford uni-flange series 1500.
   C. Glands to restrain PVC pipe bell to spigot shall be EBAA Iron megalug series 6500, Ford uni-flange series 1390.
   D. Glands to restrain DI push joint pipe bell to spigot shall be EBBA Iron megalug series 1700, Ford uni-flange series 1450.

10. **GRAVITY SEWER LATERALS (4")**
    A. Wyes shall be used to connect the four-inch lateral to the sewer main.
    B. Materials shall be as specified in Section 4.

11. **FORCED SEWER LATERALS (2")**
    A. Saddles for PVC pipe shall be Ford style FS202.
B. Corporation stops shall have an inlet threaded in accordance with AWWA Standard C800 and a male iron pipe outlet. It shall be a Ford Series FB400.

C. The connection at the property line will contain a two-inch ball valve with two-inch square operating nut. The valve shall be a Ford Series B11 777.

12. CLEANOUTS

A. Materials shall be as specified in Section 4.

13. NEW LINES INTO EXISTING MANHOLES

A. The connection between the pipe and manhole will be made by Kor-N-Seal.

14. PUMP STATIONS

A. Wet wells shall be wetcast precast concrete manholes. Concrete shall conform to ASTM C150. Joints shall be O-ring conforming to ASTM C361. There shall be no steps in the wet well. Joints between sections shall be sealed with (2) one-inch nominal size butyl joint sealant on both horizontal surfaces. The butyl sealant shall be CS102 by Concrete Sealants, Inc.

B. Suction lift station wet wells shall be a minimum eight foot inside diameter. Walls, base and flat top shall be a minimum of nine inches thick.

C. Grinder station wet wells shall be six foot inside diameter. Walls shall be a minimum of seven inches thick and the base a minimum of eight inches thick.

D. Anti-flotation collars are required.

E. Bolts securing piping shall be stainless steel.

F. The exterior of the wet well shall be covered with a black asphalt gilsonite paint such as LN-12, manufactured by Seaboard Asphalt Products Company. Interior of wet well shall have Raven coating. The nearest three (3) gravity sewer manholes upstream of pump station wet wells shall have Raven coating.

G. Pipe shall be secured to the entry hole by a lock joint flexible manhole sleeve as manufactured by Core and Seal Co.

H. Each sewage pump shall have an hour meter which shall record accumulated running time. Meter shall be Model HTT-1000 by high tide technologies, LLC

I. Level transducer is required with mercury float switches as backup.

J. Alarm light shall be Edwards model No. 50-R and the horn shall be Edwards model No. 876-N5.

K. There shall be a Sweet Air™ ABS four-inch mushroom vent in the wet well. It shall be vented
to the atmosphere and contain activated carbon media.

L. Lockset for door shall be Kwik Set 980S, W/26D finish (Grade 1, single cylinder with thumb latch deadbolt).

M. The pumps shall be protected from low voltages, short circuits and overloads on all three phases.

N. The Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish, install, calibrate, test, start-up and place in satisfactory operation a complete Cloud based Supervisory Control and Data Acquisition (SCADA) System per the current Frederick Water SCADA specifications. The unit shall have an internal battery backup power supply.

O. Suction lift stations shall have:
   1. Pumps manufactured by Smith & Loveless
   2. The pumps shall be capable of passing a 3-inch spherical solid
   4. A 0-10 minute adjustable time delay relay on each vacuum priming pump (to act as a pump failure sensor). Should a vacuum pump not be able to prime within a pre-set time, the vacuum prime pump will be shut off and an alarm sensor will indicate pump failure
   5. Flanged ductile iron piping in the wet well. Connection between pump station discharge line and force main piping shall be by an MJ solid sleeve with joint restraints.
   6. The pump station base plate (over wet well) shall be stainless steel.
   7. Variable frequency drives are required.
   8. Mag meter and discharge pipe pressure gauge is required.

P. Submersible grinder pump stations shall have:
   1. Pumps manufactured by Vaughn
   2. Stainless steel guide rails
   3. Flanged ductile iron piping (for 4" lines) or SCH 80 PVC piping (for 2" and 3" lines) in the wet well and valve vault
   4. OS&Y plug valves with hand wheels
   5. Swing check valves with outside weighted arm. Valves shall conform to AWWA Standard C504. Valves shall be manufactured by American Darling.
   6. A floor mounted stainless steel lifting hoist socket. It shall be for a Halliday Products hoist model No. D1A24B
7. Electrical controls enclosure containing individual boxes for the items in the enclosure.

8. Mag meter and discharge pipe pressure gauge is required.

15. GENERATORS

A. Generators shall have:
   1. Sufficient fuel capacity for 24 hours of operation with a full load.
   2. Engine block heater
   3. Battery charger
   4. Diesel engine

B. Generator and transfer switch shall be Kohler.

16. METERING STATIONS

A. Metering stations shall be rectangular in shape and contain a parshall flume of appropriate size for present and future flows. The flow shall be monitored by a OCM-3 Open Channel Monitor - PL- 384 as manufactured by Milltronics equipped with a Model ST-25B or ST-25C transducer for measurement of flows using ultrasonic technology. In non-flood areas, the metering station shall have a Bilco K2 access door. The door shall have a recessed hasp covered by a hinged lid flush with the surface. In flood areas, a watertight manhole frame and cover shall be required.

17. REPAIR CLAMPS

A. Repair clamps shall be full circle all stainless steel bands. Cast couplings are not allowed.

B. Clamps for pipe thru 12 inches in diameter shall be Ford Style FS1 in 20 inch length.

C. Clamps for pipe greater than 12 inches in diameter shall be Ford Style FS3 in 24 inch length.

18. PIPE CASING

A. Casing pipe shall be sized in accordance with sewer pipe diameter. Casing pipe shall be steel and shall meet ASTM specifications A252 Grade 2 or 139 Grade B.

19. CASING SPACERS

A. Separation of carrier pipe from casing pipe shall be by stainless steel casing spacers. Spacers shall be by PSI, Inc., Recon.
20. LOCATION MARKERS

A. Sewer locator markers shall be ScotchMark Mid-Range Markers (wheel) part number 1258.
SECTION 3 - SEWER

PART 3 - CONSTRUCTION STANDARDS
Refer to Section 4 for appropriate drawings

1. GENERAL
   A. All construction shall be in strict accordance with approved plans and specifications. Any deviations or changes shall be submitted to Frederick Water for supplemental approval.
   B. Frederick Water shall have the required number of plans and cut sheets before construction begins.
   C. Frederick Water shall have access to the construction work at any time for inspection of work and construction methods.
   D. Upon substantial completion, Frederick Water will assume responsibility for locating water and sewer lines in response to Miss Utility location requests.

2. CLEARING
   A. The right-of-way shall be cleared of all trees, stumps, shrubs, and other foreign matter for the width of the easement of the mains being constructed. The debris shall be disposed of in an acceptable manner. No debris shall be buried within the right-of-way.

3. EXCAVATION
   A. Minimum clearance between the side of the trench and pipe shall be eight inches. The width of the trench above the top of the pipe may be as wide as necessary for sheeting or bracing and the proper performance of the work. All trench walls should be kept as vertical as possible and still meet OSHA requirements. The trench shall be excavated to a uniform subgrade as required for installation of pipe bedding material.
   B. For gravity sewer the trench shall be excavated to the depth required for installation of pipe bedding material.
   C. For forced sewer the trench shall be excavated to assure a minimum of 48 inches of cover on top of the pipe.
   D. Excavation at manholes and similar structures shall be sufficient to leave at least 12 inches between the structure’s outer surface and the embankment or sheeting.
   E. Excavated material suitable for backfilling shall be piled in an orderly manner and be a minimum distance of three feet from the edge of the trench. All excavated material not suitable and/or not required for backfill shall be removed and disposed of in an approved manner.
F. Such grading as necessary shall be done to prevent water from flowing into the trench or other excavations, and any water accumulating therein shall be removed by approved methods.

G. All fill material shall be in place and compacted before sewer lines are installed.

4. FOUNDATION IN POOR SOIL

A. Wherever the soil at the trench subgrade elevation is soft, unstable, or saturated with water, such unsuitable material will be removed and the trench subgrade stabilized with a granular stabilization material.

B. Maximum size of granular material shall be two inches. Depth of stabilization shall be as required to construct a firm subgrade for pipe bedding material, but must be at least 12 inches.

C. Concrete arch or cradle bedding shall be provided when necessary.

5. BEDDING

A. Refer to Section 4 for types of bedding.

B. Bedding material shall be an open-graded coarse stone aggregate meeting Virginia Department of Transportation’s requirements for size number 57, 68, or 78.

C. Standard bedding shall be used unless poor soil conditions are encountered. In this type bedding, there shall be a minimum of 12 inches of stone under the pipe. Stone shall also be backfilled around the pipe and to a height of 12 inches above the top of the pipe.

D. Holes shall be scooped out where joints occur, leaving the entire barrel of the pipe bearing on the bedding.

6. PIPE INSTALLATION

A. Forced sewer main shall be staked at 100 foot intervals and at all bends.

B. After bedding has been installed, pipe and fittings shall be laid in accordance with the manufacturer’s instructions and recommendations. Damaged or unsound material will be rejected.

C. Pipeline deflection of force sewer lines will only be allowed at joints and at fittings. The length of pipe itself shall not be bent. The maximum deflection limit shall be 12 inches of lateral displacement per 20 feet of pipe.

D. Joint restraints are required in all fill conditions to minimum of 20’ onto original ground.

E. Forced sewer fittings shall be restrained per Section 4.
F. On forced sewer, location markers (buried transponders) shall be placed at:

1. Fifty-foot intervals
2. Each fitting (bend, tee, reducer, etc.)
3. The end of each joint that is deflected
4. Any additional location Frederick Water’s engineer or inspector shall direct.

G. At the completion of the work shift, the end of the installed pipe shall be sufficiently plugged to keep out trench waters, soil, and other extraneous material.

H. See Section 4 for requirements in making a typical jack & bore road crossing.

7. BACKFILLING

A. Frederick Water’s specified stone aggregate shall be used to a height of twelve inches above the top of the pipe.

B. Above the stone aggregate (or concrete arch) shall be 24 inches of select backfill compacted in six-inch lifts. The maximum particle size of this backfill material shall be one-inch. Backfill shall be compacted to 95% of ASTM D-698 maximum density.

C. Above the select backfill, material shall be deposited in lifts not exceeding two feet.

D. Any backfill material used above the pipe bedding shall be free of all organic material, large clods, frozen soil, or other materials difficult to compact.

E. No rock shall be used in the select backfill. Any rock used above the select backfill shall be no longer than five inches in the greatest dimension.

8. MANHOLES

A. The Contractor is authorized to connect to existing manholes and to install new manholes into existing sewer lines.

B. Manholes shall be constructed as shown in Section 4.

C. Two stainless steel bands shall be used to hold the pipe to the manhole sleeve.

D. Inverts shall be formed with concrete. The invert channels shall be smooth and accurately shaped. The invert channels shall connect the pipes in such a manner as to diminish any loss of head which may occur due to a change in the direction of flow.

E. There shall be no more than 11 inches of grade rings installed in the neck of the manhole.

F. Only concrete adjustment rings shall be used to obtain the required grade. Rings shall be secured to manhole by concrete anchor bolts.
G. Steps shall be placed at uniform intervals of no less than 12 inches nor greater than 16 inches. The first step shall be no greater than eight inches from the top of the eccentric cone section.

H. Manhole frames and covers set on roadway shoulders shall be protected by a pad made of concrete or asphalt.

I. Drop manholes shall have the drop connections constructed as shown in Section 4.

J. Manholes four feet or less in depth (from invert out to rim) shall have a flat top. The frame shall be four inches in height.

K. Manholes with more than one drop connection shall be 5 feet diameter, minimum.

9. SERVICE LATERALS

A. The installation of new services on existing lines shall be done by Frederick Water at time of utility construction. Application for and installation of the service shall be early in the project to ensure the work is completed in a cost efficient and timely manner.

B. Exact location of sewer services on new lines is to be coordinated with Frederick Water’s inspector.

C. Wherever possible, sewer laterals shall be ten feet to the right of the water laterals as viewed from the road toward the lot.

D. Minimum cover shall be 36 inches.

E. The end of the lateral shall be marked with a pressure treated 2” x 4” stake extending from the cap to 18 inches above the ground. The top six inches of the 2” x 4” shall be painted green.

F. Where length of a service lateral exceeds 75 feet, a cleanout assembly shall be furnished at the property line.

G. Gravity service laterals are to be laid as shown in Section 4, with minimum grade being 2.00 percent. Only four-inch service laterals shall be tied into gravity sewer lines. (Lines six inches and greater in diameter shall be tied into manholes). Dead-end manholes may have laterals into them. Laterals that would discharge within ten feet of an in-line manhole may be connected to the manhole.

H. A location marker shall be placed five feet before the end of the lateral.

10. TAPPING EXISTING FORCED SEWERS

A. Shall only be permitted by Frederick Water engineer on a case by case basis.

11. NEW LINE INTO EXISTING MANHOLE
A. Connection to existing manhole shall be made by core drilling. The crown of the new line shall be at the crown of the largest line into the manhole.

12. NEW MANHOLE OVER EXISTING LINE

A. A cut in manhole shall be the method of installation of a new manhole on an existing line.
B. Cut in manholes shall be installed as specified in Section 4.
C. By-pass pumping, 24 hour manned during installation of the new manhole is required.

13. COMBINATION AIR RELEASE AND VACUUM VALVES

A. Valves shall be installed as shown in Section 4.

14. STREAM CROSSINGS

A. Stream crossings shall be installed as shown in Section 4. The crossing shall be made in such a manner as to minimize erosion and blocking of the stream flow. Backfill under the rip-rap shall be compacted to ninety percent density. Pipe shall be dip, encased in concrete from 10 feet on each side of stream bank.

15. PUMP STATIONS

A. The Owner shall make application for electric, telephone and data services.
B. Underground power shall be provided.
C. The top of the wet well shall be above the surrounding grade. Suction lift stations shall be 3 to 6 inches above grade and grinder stations shall be 6 to 12 inches above grade.
D. No electrical splices or boxes are to be installed in the wet well.
E. Two stainless steel clamps shall be used to hold the influent pipe to the wet well sleeve.

16. RESTORATION

A. Areas that are disturbed during construction shall be returned to conditions at least equal to that which existed prior to the start of work. The ground is to be returned to the same contour as existed before construction. Trees, shrubs, etc., in easements are not to be replaced. Disturbed earth surfaces shall be left with ground cover similar to surroundings. Restoration shall commence immediately following the completion of work on any section or division of project. Frederick Water’s Inspector may require no more than 1000 feet remain undisturbed at any time.
17. **GRAVITY SEWER LINE INSPECTION AND TESTING**

A. All PVC gravity sewer lines shall be subject to vertical deflection testing. The maximum allowable deflection following completion of backfill shall not exceed five percent of the pipe's internal diameter. Deflection testing shall be conducted using a properly sized go-no-go mandrel or by other methods as may be adopted by Frederick Water. Any sewer section failing to meet deflection requirements shall (at the Contractor's expense) be corrected so as to meet all standards governing the construction of sewer mains.

B. All lines and service laterals shall be flow tested to insure no ponding occurs.

C. All pipe and service laterals shall be tested for leakage by the air method. The test shall be done in the presence of a Frederick Water inspector.

1. The air test is to be conducted between two consecutive manholes. The test equipment shall consist of:
   
   a. Two plugs (one tapped and equipped for an inlet connection)
   
   b. A shut-off valve
   
   c. A pressure regulation valve
   
   d. A pressure reduction valve
   
   e. A monitoring pressure gauge having a pressure range from 0 to 5 psi, graduated in 0.10 psi increments with an accuracy of ± .40 psi. The test equipment shall be set up outside the manhole for easy access and reading.

2. Air shall be supplied to the test slowly and shall be regulated to prevent the pressure inside the pipe from exceeding 5.0 psi. The pipeline shall be filled until a constant internal pressure of 5.0 psi is maintained. The internal pressure shall be maintained at 5.0 psi or slightly above for a five-minute stabilization period, after which time the internal pressure will be adjusted to 5.0 psi, the air supply shut off and the test begun. For safety reasons, no person shall remain in the manhole while the pipe is being pressurized or throughout the test.

3. For the section of line to pass, there shall be zero leakage for a five-minute interval after the valve has been shut off.

D. Sewer line sections shall be flushed and visually inspected by means of closed-circuit television by Frederick Water at contractor’s expense. If Frederick Water is unable to perform this service, the contractor may perform this service per Frederick Water inspector’s requirements.

18. **FORCED SEWER LINE TESTING**

A. Service laterals are to be installed before testing.
B. Lines shall be tested through a special tap installed for the test.

C. A maximum of one thousand linear feet of line shall be tested at a time.

D. Tests must be conducted in the presence of a Frederick Water inspector.

E. All piping shall pass a hydrostatic pressure test.
   1. All newly laid pipe, or any valved section thereof, shall be subjected to a hydrostatic pressure of at least 1.5 times the working pressure at the point of testing.
   2. Test pressure shall:
      a. Be a minimum of 150 psi
      b. Not exceed pipe design pressure
      c. Be of at least two-hour duration
      d. Not vary by more than ± five psi
      e. Not exceed the rated pressure of the valve.
   3. Each valved section of pipe shall be slowly filled with water. The specified test pressure shall then be applied by means of a pump connected to the pipe. The manner of connecting the pump to the piping shall be satisfactory to Frederick Water.
   4. Before applying the specified test pressure, air shall be expelled completely from the pipe and valves.
   5. All exposed pipe, fittings, valves, and joints shall be examined carefully during the test. Any damaged or defective material discovered following the pressure test shall be repaired or replaced with sound material. The test shall be repeated until it is satisfactory to Frederick Water.
   6. There shall be zero leakage during the two-hour period.

19. MANHOLE AND PUMP STATION WET WELL TESTING

A. Manholes and pump stations shall be tested for leakage by either the ex-filtration method or the vacuum method. The test shall be done in the presence of a Frederick Water inspector.
   1. Pump Station Wet Well
      a. Ex-filtration method
      b. Inflatable stoppers shall be used to plug all lines into and out of the
manhole tested. The stoppers shall be positioned in the lines far enough from the manhole to assure testing of those portions of the lines not otherwise tested. Once the manhole has been filled with water to the top, a 12-hour soak shall be allowed prior to testing.

c. The manhole shall show no leakage during a continuous 24-hour test period.

d. If the manhole fails the test, necessary repairs shall be made. The ex-filtration test and repairs shall be repeated until the manhole passes the test.

2. Manholes

a. Vacuum Method (See ASTM C1244)

b. This test method is only applicable to pre-cast concrete manholes.

c. Manholes shall be tested after the frame and cover have been permanently set. Test apparatus shall be located within the manhole frame to insure proper seal between frame and precast concrete.

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

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

f. A measured vacuum of ten inches of mercury (Hg) shall be established in the manhole. The time for the vacuum to drop to nine inches of mercury shall be recorded.

g. The maximum allowable leakage rate for a four-foot diameter manhole shall be in accordance with the following:

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<th>Manhole Depth</th>
<th>Minimum Elapsed Time</th>
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<td>10 feet or less</td>
<td>60 seconds</td>
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<tr>
<td>more than 10 ft. but less than 15 feet</td>
<td>75 seconds</td>
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<tr>
<td>15 feet or more but less than 25 feet</td>
<td>90 seconds</td>
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1) For manholes five feet in diameter, add an additional 20 seconds to the time requirements for four-foot diameter manholes.

2) For manholes six feet in diameter, add an additional 30 seconds to the time requirements for four-foot diameter manholes.

3) For manholes ten feet in diameter, add an additional 60 seconds to the time requirements for four-foot diameter manholes.
seconds to the time requirements for four-foot diameter manholes.

h. If the manhole fails the test, necessary repairs shall be made. The vacuum test and repairs shall be repeated until the manhole passes the test.

B. Manholes shall show no signs of ponding water in the inverts.

20. ACCEPTANCE OF WORK

A. Should construction standards and/or tests not be met, Frederick Water shall reject all or any portion of the facilities. Any project or portion of a project rejected by the Authority shall not be permitted to discharge into any previously approved system until the rejected system or portion of system has been repaired so as to meet all standards governing the construction of sewer mains.

B. All repair methods, other than replacement of the defective areas with new materials, shall be subject to prior approval of Frederick Water.

C. Upon completion of such inspection or tests as required in these specifications, all foreign matter, (to include but not limited to rock, dirt, concrete, joint sealant, gravel) shall be removed from all sewers and manholes.
SECTION 4 CONSTRUCTION NOTES

(To be included in site plans.)
1. Frederick Water’s Water and Sewer Standards and Specifications are available at www.frederickwater.com

2. The contractor shall adhere to Frederick Water standards and specifications in effect at the time of construction.

3. The contractor shall coordinate with and arrange for inspection by Frederick Water.

4. The contractor shall connect a new sewer line to an existing manhole by core drilling the manhole.

5. A new water (or forced sewer) main shall be connected to an existing main by a wet tap. Frederick Water shall furnish all needed material and make the tap.
   a. An Application for Wet Tap shall be submitted and the initial fee paid before the tap is made.

6. Exact locations of water and sewer services on new lines are to be coordinated with Frederick Water’s inspector.

7. Frederick Water’s maintenance division shall furnish and install all water meters through 2 inch in size. It is the contractor’s responsibility to have the meter box assembly installed correctly. Before a permanent meter is installed:
   a. The meter box, with its frame and cover, must be properly aligned with the yoke bar.
   b. The frame and cover shall be set to final grade.
   c. The distance between the top of the cover and the yoke bar shall be between 20 and 23 inches.
   d. All components of the meter box assembly shall be in proper working order.

8. For services that connect to existing lines:
   a. Frederick Water shall furnish and install:
      i. all ¾”x¾”, ¾”, 1”, 1½” and 2” water services
      ii. all sewer services.
   b. The owner/developer shall:
      i. coordinate (or have the contractor coordinate) the location of the service lateral with Frederick Water’s engineering assistant.
      ii. submit an Application for Service and pay the required fees.

9. All water service lines must have a backflow prevention assembly (double check valve or RPZ, as required). The assembly must meet ASSE standard number 1015 or 1013.

10. All fire lines must have a backflow prevention assembly (detector double check valve or RPZ, as required). The assembly shall meet ASSE standard number 1048 or 1047. Any privately owned fire line, interior or exterior, shall also have a fire service HP Protectus III meter. This assembly shall be installed immediately before the backflow prevention unit. Radio read remotes are required.

11. Frederick Water shall review the mechanical plan(s) for design and material approval of a building’s:
    a. domestic water meter and its backflow prevention device, and/or its
    b. Fire service line’s water meter and backflow prevention device.

12. DEQ must also approve sewer pump stations. Frederick Water requires a copy of DEQ’s Certificate to Operate and a copy of the station’s DEQ approved O&M manual. These documents must be received before substantial completion is issued and water meters released.
SUCTION LIFT SEWER PUMP STATION GENERAL NOTES

1. Pump station shall be installed per Frederick Water’s standard drawings.

2. Pump station materials (wet well, pumps, electrical controls, etc.) are to be reviewed and approved by the Contractor and the Engineer of Record prior to submittal to Frederick Water’s engineer. Frederick Water shall review and approve submittals.

3. The Contractor shall make application for electric and internet service. The Contractor shall coordinate the switching of account responsibility to Frederick Water after final acceptance.

4. Pump station shall be pre-engineered. It shall be a duplex unit and be capable of providing the pump rate at the total design head stated in the drawings.

5. Controls shall be provided by the pump manufacturer. Controls shall include low voltage, short circuit, and overload protection in all phases. They shall also provide the functions listed on the drawings and in the Frederick Water specifications.

6. Pump station shall be fully compliant with the current Frederick Water SCADA Standards and shall include a magnetic flow meter, pressure transducer, an ultrasonic level transducer, system monitoring of the main power supply, the auxiliary power supply, failure of each pump to discharge, high liquid level in the wet well, and have a test function.

7. Electric service shall be 120/208 volt, 3-phase, and 4 wire.

8. Pumps shall be 208 volt 3-phase.

9. Each sewage pump shall have an hour meter which shall record accumulated running time in hours.

10. Pump control shall provide for alternate pump operation.

11. Mercury float switches shall be provided for backup station control if PLC should fail.

12. There shall be no electrical splices or boxes inside the wet well.

13. Self-priming vacuum pump shall be provided as a package by the sewage pump manufacturer. Each vacuum priming pump shall be supplied with a 0 – 10 minute adjustable time delay relay to act as a pump sensor. Should the vacuum pump not be able to prime within a pre-set time (five minutes), the vacuum prime pump will shut off and an alarm sensor will indicate pump failure.

14. Flanged ductile iron piping shall be used in the wet well. Connection between pump station discharge line and force main piping shall be by solid sleeve with joint restraints.

15. Two spare impellers, pump seals, and vacuum pumps shall be provided in cartons suitable for long term storage.

16. Two hard copies of the O&M manual shall be delivered to Frederick Water’s engineer. An electronic version in PDF format shall also be provided.

17. A sign indicating notification procedures (responsible persons, telephone numbers, etc.) to be followed in case of alarm actuation must be conspicuously displayed at the pump station.
1. Pump station shall be installed per Frederick Water’s standard drawings.

2. Pump station materials (wet well, pumps, electrical controls, etc.) are to be reviewed and approved by the Contractor and the Engineer of Record prior to submittal to Frederick Water’s engineer. Frederick Water shall review and approve submittals.

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6. Pump station shall be fully compliant with the current Frederick Water SCADA Standards and shall include a magnetic flow meter, pressure transducer, an ultrasonic level transducer, system monitoring of the main power supply, the auxiliary power supply, failure of each pump to discharge, high liquid level in the wet well, and have a test function.

7. Pump rail system shall be by pump manufacturer and be fitted to the specified pump. The system shall include all the necessary components for proper operation. It shall include, but not be limited to, the stainless steel rails, breakaway fittings, and moveable fittings for connection of the pump.

8. Electric service shall be 120/208 volt, 3-phase, and 4 wire. Pumps shall be 208 volt, 3-phase.

9. Pump control shall provide for alternate pump operation. Each sewage pump shall have an hour meter which shall record accumulated running time in hours.

10. Mercury float switches shall be provided for backup station control if PLC should fail.

11. There shall be no electrical splices or boxes inside the wet well.

12. Flanged ductile piping (for 4” lines) or SCH 80 PVC piping (for 2” and 3” lines) shall be used in the wet well and valve vault.

13. A third (spare) pump shall be provided in a box, suitable for long term storage.

14. Two hard copies of the O&M manual shall be delivered to Frederick Water’s engineer. An electronic version in PDF format shall also be provided.

15. A sign indicating notification procedures (responsible persons, telephone numbers, etc.) to be followed in case of alarm actuation must be conspicuously displayed at the pump station.
SECTION 5 DRAWINGS

1. Trench & Bedding
2. Restrained Joints for Tee, Cross, Wye and Horizontal Bend
3. Restrained Joints for Reducer, Gate Valve and Dead End
4. Restrained Joints for Vertical Offset
5. Gate Valve
6. Fire Hydrant Assembly
7. Water Main Flushing Assembly
8. ¾” x ¾”, ¾” and 1” Meter Installation
9. 1 ½” and 2” Meter Installation
10. 3” and Larger Meter Installation
11. Combination Air Release and Vacuum Valve Vault
12. Pressure Reducing Valve Vault
13. Jack and Bore Road Crossing
14. Stream Crossing
15. Standard Manhole
16. Drop Manhole
17. New Manhole on Existing Line
18. Manhole Vent
19. Forced Sewer Manhole Connection
20. Service Lateral Manhole Connection
21. Manhole Connection for Steep Pipe Slope (17% or Greater)
22. Gravity Sewer Lateral for Main with Cover 15ft. or less
23. Gravity Sewer Lateral for Main with Cover Greater than 15ft.
24. Gravity Sewer Cleanout
25. High Pressure Forced Sewer Service Lateral
26. Low Pressure Forced Sewer Service Lateral
27. Low Pressure Forced Sewer In-Line Ball Valve
28. Low Pressure Forced Sewer In-Line Flushing Connection
29. Low Pressure Forced Sewer Terminal Flushing Connection
30. Sewer Pump Station Typical Wiring Diagrams
31. Sewer Pump Station Pump Design Calculations
32. Sewer Pump Station Installation Data
33. Suction Lift Sewer Pump Station Section View
34. Suction Lift Sewer Pump Station Plan View
35. Suction Lift Sewer Pump Station Wet Well Cover
36. Grinder Sewer Pump Station – Plan View
37. Grinder Sewer Pump Station – Section View
38. Grinder Sewer Pump Station Electrical Controls Enclosure
39. Sewer Pump Station Emergency Pump Connection
40. Pump Station Access Road
41. Concrete Anchor
42. Chain Link Fence
43. Double Swing Gate
All backfill to be compacted to 95% of ASTM D698 maximum density.

STANDARD

CONCRETE CRADLE

CONCRETE ARCH

CONCRETE ENCASEMENT

TRENCH & BEDDING
In addition to restraining each joint of the fitting, any joint that falls within the specified length of each branch of the fitting shall be restrained.

$L =$ restrained length of pipe (PVC or DIP)

$D =$ pipe diameter

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**TEE, CROSS, WYE**

$L =$ restrained length of pipe (PVC or DIP)

$D =$ pipe diameter

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**HORIZONTAL BEND**

**RESTRAINED JOINTS FOR TEE, CROSS, WYE AND HORIZONTAL BEND**
Both joints of the fitting shall be restrained. In addition, all joints within the specified length on the large side of the reducer shall be restrained.

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L = restrained length of pipe (PVC or DIP)
D = pipe diameter

REDUCER

In addition to restraining the connection, any joint that falls within the specified length shall be restrained.

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L = restrained length of pipe (PVC or DIP)
D = pipe diameter

VALVE, DEAD END

RESTRAINED JOINTS FOR REDUCER, GATE VALVE AND DEAD END
Each side of any vertical offset bend shall be restrained. In addition, any joint that falls within the specified length on each side of the fitting shall be restrained.

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RESTRAINED JOINTS FOR VERTICAL OFFSET
6", 8" and 12"

16", 18", 20" and 24"

GATE VALVE
BOLLARD DETAIL

NOTE:
Weep holes shall not be subject to being submerged. If installation is in an area having a high groundwater table, the Authority's engineer shall be contacted for hydrant relocation.

FIRE HYDRANT ASSEMBLY

-6-

JAN 19
Valvco, Inc valve box assembly:
lid: Figure No. 7 marked 'WATER'
top section: Figure No. 7S26TO
bottom section: Figure No. IBOB24

concrete pad
1'-6" dia. x 6' deep

varies to property line

finished grade

6" stone
roadway box
screw type

8"-10"

2" brass FIP cap
2" brass nipple, 2" long
2" brass FIP

brick base
stone

6" stone

2" CTS polyethylene tubing (PET) 200 psi
w/ SS inserts at all connections

2" ball valve curb
stop w/ 2" gate
valve operating nut

2" brass MIP

2" brass 90° bend
with 1/8" weep hole

2" brass

WATER MAIN FLUSHING ASSEMBLY

-7-

MAR 18
INSTALLATION NOTES:

1. Exact location of meter box assembly to be approved prior to installation.

2. Water service crossing street:
   a. Encase in 3" diameter SCH40 PVC or SDR21 pipe. The piping shall run from one foot beyond sidewalk, across the street, to one foot beyond sidewalk.
   b. Install 12 gauge solid insulated copper wire (for line tracing) from corporation stop to into the meter box; wrap wire around corporation stop; wire to be taped to top of PET at 10 foot intervals; come up into meter box; wrap around bottom of angle ball valve; terminate with 12" tail piece.

THIS WATER SERVICE CONFORMS TO THE UNIFORM STATEWIDE BUILDING CODE

METER INSTALLATION

\[ \frac{5}{6} " \times \frac{3}{4} " \, \frac{3}{4} " \text{ AND } 1 " \]

-8-
CUTOUT DETAIL
(typical)

NOTES:

1. Water service crossing street shall be encased in SCH 40 PVC or SDR 21 pipe. The piping shall run from one foot beyond sidewalk, across street, to one foot beyond sidewalk.

2. Install 12 gauge solid insulated copper wire (for line tracing) from corp. stop to into the meter box [wrap wire around corp. stop; wire to be taped to top of PET at 10 foot intervals; come up into meter box; wrap around bottom of angle ball valve; terminate with 12" tail piece].

THIS WATER SERVICE CONFORMS TO THE UNIFORM STATEWIDE BUILDING CODE

1 1/2" AND 2"
METER INSTALLATION
access ladder

meter interface unit; bracket furnished by FCSA and installed by contractor

main

bypass

meter

building

backflow prevention assembly

precast concrete vault - minimum 6" walls, top slab and floor

finished grade of pavement or earth

access lid

3/4" concrete wedge anchor bolt - 4 ea.

2" adjustment ring with butyl joint sealant on top and bottom

5' minimum

valve

6' stone

tee

block support

3' minimum DIP

NOTES:
1. Vault inside dimensions shall be: L = 8 ft., W = 6 ft., H = variable
2. All fittings and pipe in vault to be flanged D.I. Class 52
3. Access lid shall be CertainTeed Rexus 24" manhole cover no. CDRU60EH or FCSA approved equal
4. Water meter and backflow prevention assemblies to be per FCSA specifications

THIS WATER SERVICE CONFORMS TO THE UNIFORM STATEWIDE BUILDING CODE

3" AND LARGER
METER INSTALLATION

-10-

FEB 09
NOTES:
1. All piping shall be 2" diameter
2. For forced sewer 4" or less in diameter install tee in main (no saddle)
3. Quick disconnect (cam and groove) coupling
   a. coupling to be polypropylene
   b. FIP X male adapter mates with,
   c. female coupler X MIP
4. Valve shall be H-Tech, Inc.
   a. water - Model 993 w/2" NPT connection
   b. sewer - Model 986 steel body w/2" NPT connection
5. Brace shall be 1-1/2" X 1-1/2" X 3/16" aluminum angle w/u-bolt around elbow of valve

COMBINATION AIR RELEASE
AND VACUUM VALVE VAULT
NOTES:
1. All fittings and pipe in vault to be flanged D.I. Class 52
2. Access door shall be by Halliday Products or our approved equal
   a. in non-traffic area - model no. S1R3636
   b. in traffic area - model no. H1R3636
3. Pressure reducing valves to be per FCSA specifications
4. Vaults in traffic areas shall be H2O load rated

PRESSURE REDUCING VALVE VAULT
SIZES REQUIRED

<table>
<thead>
<tr>
<th>CARRIER PIPE</th>
<th>CASING PIPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dia. (inches)</td>
<td>Dia. (inches)</td>
</tr>
<tr>
<td>4 or less</td>
<td>12</td>
</tr>
<tr>
<td>6</td>
<td>16</td>
</tr>
<tr>
<td>8</td>
<td>18</td>
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<tr>
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<td>36</td>
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<td>21</td>
<td>36</td>
</tr>
<tr>
<td>24</td>
<td>36</td>
</tr>
</tbody>
</table>

(for larger pipe use tunnel liner)

NOTES:
1. Separation of carrier pipe from casing pipe shall be by manufactured steel and/or plastic casing spacers.
2. Spacers shall be placed on spigot end within 10 inches of connection to bell; then 2 spacers evenly placed on length of pipe.
3. Carrier pipe within the casing shall be restrained
4. Water service laterals
   a. Casing pipe shall be SCH 40 PVC or SDR 21
      1) 3" diameter pipe for 1" service lines
      2) 6" diameter pipe for 2" service lines
   b. No spacers or sand fill to be installed

SECTION

JACK AND BORE ROAD CROSSING
NOTES: 1. Manhole sections shall have an external coating of approved polymer film water proofing prior to installation.
2. If adjustment elevation exceeds two inches use concrete adjustment rings with an exterior coating of water proofing.
3. Final slope adjustment of manhole frame shall be by shims and non-shrink grout.
4. Skid pad to be placed around manholes located in shoulders of roads.
5. Flat top shall be used if height from invert out to rim is four feet or less. Frame to be 4" in height.
6. There shall be a 0.20 foot drop in elevation through the manhole.

STANDARD MANHOLE
Inside drop system to be Reliner Drop Bowl, manufactured by Duran, Inc.
NEW MANHOLE ON EXISTING LINE

-17-
Wager 1700 Series Sewer Vent Check Valve; manufactured by the Robert H. Wager Co. Inc.
1.800.562.7024 or www.wagerusa.com

4" DI flanged 90 degree bends

4" F X PE CL 52 DIP

2" wide X 3/8" thick stainless steel strap, mounted with 3/4" concrete anchor bolts

4" X 4" pressure treated block, 6" long

4" DI mj 90 degree bend with joint restraints

Raven® coating required on all watertight MH's

watertight frame and cover

finished grade

MANHOLE VENT

-18-
Raven® coating required on all forced sewer connection MH's plus the following 3 downstream MH's.
NOTES:
Gravity sewer:
1. All pipe and fittings inside manhole shall be solvent weld SCH 40 PVC.
Forced sewer:
1. Piping to Wye shall be SDR 21.
2. Piping for drop shall be same size as incoming sewer.
3. All pipe and fittings inside manhole shall be solvent weld SCH 40.

SERVICE LATERAL
MANHOLE CONNECTION
-20-
<table>
<thead>
<tr>
<th>% Slope</th>
<th>Bend</th>
</tr>
</thead>
<tbody>
<tr>
<td>17.0 - 29.0</td>
<td>11 1/4&quot;</td>
</tr>
<tr>
<td>29.1 - 53.0</td>
<td>22 1/2&quot;</td>
</tr>
<tr>
<td>53.1 - 81.0</td>
<td>22 1/2&quot; &amp; 11 1/4&quot;</td>
</tr>
<tr>
<td>81.1 - 119.0</td>
<td>45&quot;</td>
</tr>
<tr>
<td>119.0 - 236.0</td>
<td>45&quot; &amp; 11 1/4&quot;</td>
</tr>
<tr>
<td>236.1 - 308.0</td>
<td>45&quot; &amp; 22 1/2&quot;</td>
</tr>
</tbody>
</table>

NOTES:
1. All joints (pipe & fittings) shall be restrained.
2. Multiple bends shall be connected by a foster adapter.

MANHOLE CONNECTION FOR STEEP PIPE SLOPE
(17% OR GREATER)
All pipe and fittings shall be SDR 35/26.
GRAVITY SEWER LATERAL
FOR MAIN WITH COVER GREATER THAN 15 FT
Panella Model PA4SV-CSK (4") cast iron cleanout cap with standard gasket and brass plug having a countersunk square head

Capitol Foundry of VA, Inc. traffic bearing cleanout/lamphole frame and cover, Item No. VB-9*S

Concrete skid pad 24" dia. x 6' deep

6' stone

45° bend

6' stone

Sanitary sewer main

Wye

12"

Finished grade

All pipe and fittings shall be SDR 35/26.

GRAVITY SEWER CLEANOUT

-24-

FEB 09
INSTALLATION NOTES:
1. Exact location of roadway box to be approved prior to installation.
2. Sewer service crossing street:
   a) Encase in 4" diameter SCH40 PVC or SDR21 pipe. The piping shall run from one foot beyond sidewalk, across the street, to one foot beyond sidewalk.
   b) Install 12 gauge insulated solid copper wire (for line tracing) from corp. stop to into the roadway box [wrap wire around corp. stop; wire to be taped to top of PET at 10 foot intervals; come up into roadway box and terminate at top of box just under lid.

HIGH PRESSURE FORCED SEWER
SERVICE LATERAL

-25-
LOW PRESSURE FORCED SEWER
SERVICE LATERAL
LOW PRESSURE FORCED SEWER
IN-LINE BALL VALVE
if line is 1\(\frac{1}{2}\)" to 2\(\frac{1}{2}\)" dia. use FORD valve w/ 2" operating nut
if line is 3" or greater use gate valve

SDR-21 PVC
gasketed main by MIP adapter

gasketed main by 2" gasketed branch tee

Valvco, Inc valve box assembly:
lid: Figure No. 7 marked 'SEWER'
top section: Figure No. 7S261TO
bottom section: Figure No. IB0024

PVC MIP X gasketed adapter
2" SDR-21 PVC

concrete skid pad
1'-6" dia. x 6' deep

finished grade

6" stone

screw-type roadway box with lid marked "SEWER"

6" stone

36'

8'-10'

48"

24"

2" SCH 80 PVC
FIP cap

2' brass nipple, 2' long

2" SCH 80 PVC FIP x female solvent weld coupling

2" SCH 80 PVC

SCH 80 PVC
threaded nipple

2" ball valve w/ 2" operating nut

2" SCH PVC solvent weld 90° bend with 1/8" weep hole

6" stone

bricks

brick base

stone

LOW PRESSURE FORCED SEWER
IN-LINE FLUSHING CONNECTION
Valvco, Inc valve box assembly:
lid: Figure No. 7 marked 'SEWER'
top section: Figure No. 7S26TO
bottom section: Figure No. IBOB24

concrete skid pad
1'-6" dia. x 6" deep

finished grade

finished grade

6" stone

6" stone

8'-10"

2' SCH 80 PVC
FIP cap

2" brass
nipple, 2" long

2" SCH 80 PVC FIP x
female solvent weld
coupling

brick base

stone

2" SCH 80 PVC

2" SCH PVC solvent
weld 90° bend with
1/8" weep hole

2" ball valve w/ 2"
operating nut

2" SDR-21
PVC

PVC MIP X
gasketed
adapter

36°

48°

24"

SCH 80 PVC threaded nipple

6" stone

bricks

SDR-21
PVC gasketed
reducer

LOW PRESSURE FORCED SEWER
TERMINAL FLUSHING CONNECTION

-29-
OVERALL WIRING

NOTE:
Pump station controls shall provide low voltage, short circuit and overload protection on all phases.
1. Determination of flows
   Show - type and number of units
   flow per unit per day (use table 3 of DEQ’s SCAT regulation 9 VAC 25-790 for flow rates)
   total flow per day
   total flow ___________ gpd

   pump design flow = peak flow = total flow X 2.5 = ___________gpd = ___________gpm

2. Pipe size selection
   Pipe diameter that will provide a velocity of between 2 and 8 ft/sec at the pump design flow

   pipe diameter __________ inch

3. Total dynamic head
   Static head
   wet well pump off elevation ________ ft
   sewer line high point elevation ________ ft
   sewer discharge elevation ________ ft
   static head ________ ft

   Friction loss head
   pump station pipe length ________ ft
   pump station fitting equivalent pipe length ________ ft
   pump station equivalent (line + fitting loss) length ________ ft
   forced sewer pipe length ________ ft
   forced sewer fitting equivalent pipe length ________ ft
   forced sewer equivalent (line + fitting loss) length ________ ft
   length from pump station to highest point ________ ft
   length from highest point to discharge point ________ ft
   total line length ________ ft
   friction loss C factor (per 100 linear feet) ________
   friction loss head ________ ft
   total dynamic head (TDH) ________ ft

4. Pump selection
   supply pump performance curve drawing
   pump design flow ___________ gpm
   discharge pipe diameter ___________ inches
   TDH ___________ ft
   pump:
   manufacturer ___________
   model ___________
   impeller diameter ___________ inches
   speed ___________ rpm
   horse power ___________ hp
   voltage 208 volts
   phase 3 phase

SEWER PUMP STATION
PUMP DESIGN CALCULATIONS
-31-
Piping:
- pump suction pipe diameter: _____ inches
- discharge pipe diameter: _____ inches
- influent pipe diameter: _____ inches

Wet Well:
- diameter (6 ft or 8 ft): _____ feet
- volume per vertical foot: _____ gallons

Pump Cycle Time:
- cycle time: ________ minutes
- time between pump starts: ________ minutes

- anti-flotation collar: ________ inches (width) X inches ________ (height)

Elevations:
- top of wet well: ________ feet
- grade at wet well: ________ feet
- influent invert: ________ feet
- discharge invert: ________ feet
- high water alarm: ________ feet
- lag pump on: ________ feet
- lead pump on: ________ feet
- pump off: ________ feet
- invert of wet well: ________ feet

Electrical
- voltage: 208 volts
- phase: 3 phase
- service/fuse rating: ________ amps
- control service: 110 volts; 20 amps

Generator (diesel)
- make: ______________________
- model: ______________________
- standby rating: ________ kW @ 60 Hz
- voltage: 120/208 volts
- phase: 3 phase
- amps: ________ amps

unit shall have:
- battery charger
- engine block heater
- vibration insulators (for pad mounting)
- weather housing (with roof-mounted critical silencer)
- sub-base fuel tank with sufficient capacity to operate for 24 hours at 75% load

**Submittals (two copies minimum) are required for the wet well, pumps and generator.**
1. Precast building shall be 10'x12'x7-6", with faux brick finish (desert sand), without floor, manufactured by The Clear Flow Co. or FW approved equal.
2. Interior walls and ceiling to be primed and painted:
   a. primer - alkali resistant Pittsburg 6-603 or FW approved equal
   b. finish coat - white, 100% acrylic industrial enamel Pittsburg 90-374 or FW approved equal
3. Light and horn shall be Edwards model no. 50-R (light) and model no. 876-N5 (horn) or FW approved equal. The light and horn shall have a manual off switch.
4. A gas tight seal must be provided between pumping station base plate and wet well flat top.
5. Wet well excavation shall be backfilled with VDOT #57 stone and compacted.
6. All bolts, nuts, fasteners etc. shall be stainless steel within wet well.
NOTES:

1. Unit Fan Heater shall be Marley-QMark model MUH35, 208/240 volts, 30 amp, w/ integral thermostat, ceiling mounted.

2. Louver shall be Ruskin model L745 (12" x 12") or FW approved equal. Electric operator for louver shall be interlocked with exhaust fan.

3. Exhaust fan shall be Airmaster shutter fan catalog No. EPRSM12 w/ WR12E (exhaust shutter), or FW approved equal, controlled by remote wall mounted switch. Provide fan with motorized damper in conjunction w/ fan operation.

4. Exterior lights shall be LED RAB model SLUM 12/PC, or FW approved equal, photocell operated and switched at door.

5. Interior Lighting to be Phillips Daybright Vaporlum LED #V2-W-P-B-43L-845-4 universal voltage or FW approved equal.

6. Main disconnect, double throw switch, circuit breaker panel.

7. Switches to operate interior lights, exterior lights, & fan separately.

8. Alarm system shall be SCADA per FW SCADA Standards w/ surge suppressor.

9. Pump run time monitor shall be High Tide Technologies model HTT-1000.

10. Lockset to be Kwik Set 980S W26D finish single cylinder w/ thumb latch deadbolt.

11. Floor drain required.

12. Telephone and internet conduits shall turn up inside building.
NOTES:
1. Access door shall be Halliday Products S1R2424 or FCSA approved equal.
2. Access door to open away from vent and when opened be perpendicular to wall.
3. Manufacturer will need to specify which dimension is parallel to wall and which one is perpendicular to wall.

Suction Lift Sewer Pump Station
Wet Well Cover

-35-
1. lifting hoist socket shall be floor mounted stainless steel for a Halliday Products hoist model no. D1A24B
2. pumps shall be Vaughan Chopper pumps
3. access doors (2 ea.) shall be 30" x 48" aluminum Halliday Products model no. S1R0304 or FCSA approved equal
4. guide rails shall be stainless steel
5. lifting chain shall be 1/4" diameter electro zinc plated, grade 30 proof coil

Note: Excess float cord shall be bound with nylon cable ties with nylon lock. Minimum length shall be 15".

FLOAT SETTING BRACKET

anti-Flotation collar; minimum size 12" X 12"; precaster to provide calculations to verify correct size and configuration of steel reinforcing and concrete needed per installation.
NOTES:
1. Enclosure construction:
   a. to meet NEMA 3R standards
   b. sized to house all required equipment with space for future additions
   c. 12 gauge galvanized steel
   d. double doors with:
      1) heavy duty hinges
      2) heavy duty 3 point latching mechanism
      3) heavy duty hasp (for padlock)
   e. drip shield
   f. back panel (of 12 gauge steel) to provide a minimum of 5/8" clearance
2. The following items are to be mounted in enclosure:
   a. main disconnect
   b. automatic transfer switch
   c. circuit breaker panel
   d. 110 V outlet
   e. SCADA per FW SCADA Standards, High Tide monitor, both with surge suppressor
   f. phone jack
   g. pump control panel
3. Controls to be in their own enclosures and mounted inside panel enclosure.
4. The pump control panel shall be accessible without cutting off power.
5. Inside 110 V outlet to be on separate circuit
6. Light and horn shall be Edwards model no. 50-R (light) and model no. 876-N5 (horn) or FW approved equal.
7. Alarm light and horn to have manual on/off switch inside control enclosure.
8. Overhead light to be on separate circuit and have on/off switch inside enclosure.
9. Overhead light to be min. 175 watt equivalent LED security light.
30" clear opening manhole frame and cover. Neenah R 1743 or FCSA approved equal

finished grade

grade rings for manhole frame

flange cap

6" - 8"

8" - 12"

48" minimum

flange X plain end DIP nipple

6" stone

two full joints minimum

CL 52 DIP

45° bend

NOTE: All mechanical joints shall be restrained.

SEWER PUMP STATION
EMERGENCY PUMP CONNECTION
NOTE: Slope road in direction of drainage.

2" type SM 12.5A bituminous concrete

8" aggregate base, type 21B

compacted subgrade; subgrade shall be compacted to 95% maximum density in accordance with ASTM D698; standard proctor.

PAVEMENT SECTION
Gravity sewer lines having a 17% or greater slope shall have concrete anchors spaced as follows:

- 17% - 34% - 36 ft. center to center
- 35% - 50% - 24 ft. center to center
- 51% + - 16 ft. center to center
No. 11 gauge & 1”
beveled galvanized
steel band with
bolt and nut

height of brace shall be
in accordance with
manufacturer's specifications

3 strands class III
barbed wire

2-1/2”OD
SS-40
terminal
post

1-5/8’ SS-15 top rail
2” OD SS-40 line post
2-1/2’ mesh, 9 gauge galvanized wire fabric
tension wire no. 7 gauge galvanized
coil spring wire stretched out

3’-0”

6’-0”

3’-6”

6’-0”

concrete footing

end corner or
gate post

12”

10’ (max)

12’

10’ (max)

3/8” min. round rod
with turnbuckle

typical spacing between all line posts
ground clearance 3” max. 1” min.

Line brace - shall be used when vertical alignment changes 15’ (max. spacing 500’)
- shall be used at fence end (as shown above) and gate locations

Corner brace - shall be used when horizontal alignment changes 15° or more
- shall be used as detailed above with bracing in both directions