# STANDARDS FOR WATER AND SEWER SYSTEMS AND RELATED WORK

KING WILLIAM COUNTY UTILITIES DEPARTMENT

180 HORSE LANDING ROAD #4
KING WILLIAM, VIRGINIA 23086

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COMMONWEALTH OF VIRGINIA
ROBERT J. KRALLINGER
Lic. No. 022915
3/3/23
PROFESSIONAL ENGINEER

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[1] Rev1: Section 02665-3.1-H added January 2025.

# FOREWORD

These Standards have been developed for use by engineers and developers working on water and sewer utility projects within King William County, Virginia and for King William County personnel who review those projects. It is important to note that the ownership, operation, and maintenance of the sanitary sewer infrastructure in King William County is by the Hampton Roads Sanitation District (HRSD). All proposed sanitary sewer infrastructure (gravity mains, force mains, pump stations, etc.) shall be designed to meet the most current standards of HRSD and shall be reviewed and approved by HRSD. Within King William County, the County will review and approve the following:

- All site plans for proposed development and infrastructure projects
- Stormwater management and erosion and sedimentation plans for proposed development and infrastructure projects
- All proposed extensions and connections to the public water system infrastructure

These standards, as well as HRSD standards, are not intended as a regulation but should be used as a guide which will establish a degree of uniformity for drawings and specifications for all water and sewer utility projects.

The Standards consist of three volumes as follows:

Volume I - contains the Design Standards for waterlines, pump stations, and related work.

Volume II - contains Standard Specifications for construction and materials for waterlines and related work.

Volume III - contains Standard Details for water projects. HRSD standard details shall be used for sewer related work.

Engineers and Developers working on water and sewer utility projects should recognize the fact that State and Federal regulations must be satisfied on all projects. In the event that the King William County Standards or HRSD Standards differ from State or Federal Requirements, the more restrictive standard shall be utilized.

It is very difficult to generalize when addressing matters of engineering design without jeopardizing the final product; therefore, engineers and developers should strive for designs which show consideration of details presented herein and within HRSD Standards. However, these details are secondary to good engineering judgment. The design of water mains, pump stations, force mains, and gravity sewers is a matter which requires special consideration for each specific project and cannot be generalized for all jobs. Therefore, the design engineer is responsible for checking the specific requirements of each project against these standards and HRSD standards and making any additions, deletions or changes necessary for the project being designed.

The work described herein is under the jurisdiction of King William County hereinafter referred to as the County. The County will review all plans and specifications, however, all such documents

for new construction must be submitted to the appropriate office of the Virginia Department of Health (VDH) for water projects and to HRSD and the Virginia Department of Environmental Quality (DEQ), as required by regulations, for all wastewater projects to review. A Construction Waterworks Permit is required for water projects and a Certificate to Construct is required for sewer projects. These documents must be issued before construction can begin.

# PROCEDURAL SECTION

1. These specifications are available on King William County's website at the following link: ***https://www.kingwilliamcounty.us/505/King-William-Standards***

2. Design notes and calculations related to the water system must be submitted by the design professional to VDH, along with the drawings for the project. The approval by King William County does not relieve the design professional to obtain approval by the VDH.

3. Design notes and calculations related to the sanitary sewer system must be submitted by the design professional to HRSD and DEQ (if required by Virginia Sewage Collection and Treatment Regulations), along with the drawings for the project.

4. These specifications herein, as well as HRSD specifications, may be used for projects to be built within King William County. Project drawings will be required for each project and will be prepared and submitted in accordance with the requirements of the VDH or DEQ.

5. Any deviations to these specifications and standards or HRSD specifications and standards must have prior approval from the relevant entity – the County and VDH for the water system and HRSD and DEQ for the wastewater system - before installation.

6. All requests for deviation from these standard specifications will be set forth in writing and directed to King William County. Permission for same will be issued by King William County in the form of a letter. A copy of the letter of permission will also be sent to the VDH or DEQ.

7. The purpose of this document is to standardize the construction of water lines and sewer lines in King William County.

8. All water system materials, products and manufacturers shall be listed in the approved products list. King William County has adopted the *APPROVED MATERIALS AND MATERIALS SPECIFICATIONS* from Chesterfield County, VA which is listed in Section 3 of the *CHESTERFIELD COUNTY WATER AND SEWER SPECIFICATIONS AND PROCEDURES*. All products to be utilized in the water system within King William County shall be listed in the latest edition of that document. A link to the document provided below:

   ***https://www.chesterfield.gov/DocumentCenter/View/17485/Chesterfield-Water-and-Sewer-Specifications-Fourth-Edition-July-2020-PDF?bidId=***

9. The design professional who is responsible for the project must prepare project drawings and has the responsibility of determining that all standard details and standard specifications are appropriate for the intended use. The design professional also has the responsibility of stating upon completion of project construction that all specified tests were performed with results within specified limits and that the project was built in accordance with the drawings and specifications.

10. County Submission and Review Requirements

Prior to making any submissions of engineering plans, coordinate with King William County Planning and Zoning Staff and ensure that all applications are properly completed, and any fees are established. Submission of documents for review will consist of electronically submitting Adobe PDF documents. On the cover sheet of the plans, provide a water system materials quantity take-off table to identify the total length of each pipe by diameter and the total number of fittings, valves, and hydrants. Each valve and fitting shall be totaled by size and type.

a. Engineering Report: Where large and/or complex, or phased projects are anticipated, providing an engineering report for review and approval by the County prior to submitting plans and specifications is highly encouraged. The report by the applicant shall contain an overall plan which shall incorporate all of the proposed construction together with a sufficient amount of the surrounding area in order to clearly outline the interrelationship of the two. Existing and proposed development shall be shown as well as existing and proposed utilities. Where phased development is contemplated, the extent of each phase shall be clearly delineated. Additional requirements shall be imposed as detailed in other divisions of these standards and as required by the County.

b. The County will provide comments electronically on a PDF comment form or letter response format. Subsequent submissions made by the applicant shall include a comment and response table or letter to restate each of the County's review comments and provide the applicant's response. The comment response document shall indicate which sheet(s) have been updated as part of addressing the comment.

c. When engineering plans, specifications and reports have been updated in response to comments, the documents shall be updated with new dates on the cover sheet, the title block, or a clouded revision block edit made so that each submittal update can be clearly identifiable from the previous submission.

d. For all projects that include the installation of new fire hydrants, provide a hydraulic model report to identify the fire flow capacity at all hydrants and system pressures at normal demand conditions and fire flow conditions. The hydraulic analysis shall also be submitted to VDH for approval in accordance with State criteria.

11. Final Approval Process

a. Once the County has indicated that the project review is complete and the project is approved, the applicant shall do the following:
    i. Provide an updated water system materials take-off table on the cover sheet.
    ii. Update the dates on the cover sheet and subsequent sheets as needed to distinguish the approved set from the prior submittals.
    iii. Submit two full sized hard copy paper bound sets of the final plans to the County. The County will affix an official approval stamp onto the cover of the approved sets. The approved stamped sets shall be utilized during construction by the Engineer, Contractor, and County inspection staff.

**KING WILLIAM COUNTY**
**REVIEW CHECKLIST FOR WATER AND SEWER PLANS**

_____
Project Title

_____
Project Owner

_____
Project Engineering Firm

_____
Date

Title Page

_____1. Project Name.

_____2. Virginia registered engineer's stamp & signature.

_____3. Project vicinity map.

_____4. Table of Estimated Quantities.

_____5. Title Block

_____6. Magisterial District.

_____7. Owner/Developer name, address, and phone number.

_____8. Index of Sheets.

_____10. Legend.

General

_____1. Overall Utility Sheet with overall plan of the water and sewer layout, including any phasing of development, and a drawing index indicating extent of coverage on each drawing.

_____2. Plans have been submitted to HRSD and State agencies for review and approval where applicable. A copy of transmittal letter(s) is attached to checklist.

**KING WILLIAM COUNTY**
**REVIEW CHECKLIST FOR WATER AND SEWER PLANS**

Standards

_____1. Standard Utility Notes are shown.

_____2. All water designs conform to the latest County, State and Federal regulations or standards.

_____3. Sheets are on 24" x 36" or 22" x 34" paper.

_____4. Survey datum is NAD83 (2011) for horizontal and NAVD88 for vertical.

Utility Plans

_____1. A benchmark is shown every 500 feet.

_____2. Horizontal and vertical scale shown on each sheet (horizontal scale should be same on plan and profile).

_____3. All existing easements and proposed utility easements are shown on the plans. The existing easements reflect accurate recordation information.

_____4. All existing and proposed storm sewer lines, gas, telephone, power, and other utility lines, which cross or run parallel to the water or sewer lines are shown with horizontal and vertical separations given, where applicable. Subsurface exploration has been performed where potential conflicts exist, where applicable.

_____5. Road names, state route numbers, and right-of-way widths are shown.

_____6. Consideration has been given to areas where roads and drainage structures may be lowered in the future.

_____7. All property lines and property markers (stones, rods, pins, pipes, monuments, etc.) are shown.

_____8. Location of existing houses, buildings, fences, wells, and other structures are shown on plans. In lawn or kept areas, trees and shrubs in the easements are shown (size and type).

_____9. Proper labeling of subdivision (lot, block, street names, boundaries, etc.) are shown.

_____10. Adjacent property owner names are shown.

_____11. All erosion and sediment control measures conform to the latest County and State erosion control and sedimentation rules, regulations, and ordinances.

_____12. Locations of special features (conc. encasement, rip-rap stabilization at creek crossings, clay dams, etc.) are shown.

_____13. Location and dimensions of all water and sewer service connections are shown.

_____14. Existing and proposed contours/elevations are shown.

_____15. North arrow is reflected on all plan sheets.

_____16. Engineer understands that any changes made to the road, drainage, water and/or sewer design will require a resubmittal to the Utilities Division for review and approval of the revised water and sewer plans reflecting those changes

_____17. If horizontal bore is required, bore location, length of bore, pit location (average 10'x40') are shown and shown in relation to all existing and/or proposed utilities on plan and profile.

_____18. Relevant standard details are shown.

_____19. Alignment of utility in existing VDOT right-of-ways is consistent with County guidelines. A copy of a transmittal letter to Virginia Department of Transportation for their review is attached. Engineer understands that a letter of approval from VDOT is required prior to final utility plan approval.

_____20. Clay dams or other acceptable designs are shown at the appropriate locations to avoid water from creek and/or lake being diverted along pipe bedding.

Water Plans

_____1. Plans show all fittings, fire hydrants, and valves including sizes. Each appurtenance is properly labeled.

_____2. All conflicts with sewers and other utility lines are shown with appropriate design changes shown.

_____3. A minimum of eighteen (18) inches of vertical clearance has been designed and obtained at all crossings of other utilities, or as specified by other utility agencies, or otherwise approved by the County Utilities Division.

_____4. All water lines have a minimum of 3.5' of cover.

_____5. Fire hydrants and air relief valves are shown on plans and profile.

_____6. Hydrants are designed at major low places in the line where possible and air release valves are designed at the high points.

_____7. Hydrants are designed at the end of all lines in cul-de-sacs. Locations of hydrants comply with guidelines outlined in design standards.

_____8. All water services are shown in accordance with the design standards.

_____9. Plans show all connections to the existing subdivision mains, etc.

_____10. Engineer has designed water system in accordance with available pressures and has provided fire flow and pressure calculations to the County Utilities Division.

_____11. Pipe sizes noted on plans.

_____12. Ditch lines are shown on the plan and depth of ditch(s) are shown on the profile at the fire hydrant locations and service lines, where necessary.

_____13. Water line stubs for future extensions are designed to be installed beyond the edge of pavement.

_____14. Location of water meter boxes are shown outside of non-vehicular traveled areas. Where it is not possible to locate the boxes out of the driveways, and/or vehicular traveled area, a cast iron box is specified.

_____15. All water meter boxes are located at the property line and are a minimum of 3-feet clear of any proposed driveways, sidewalks or other physical obstructions.

_____16. For water line tie-ins, the engineer has shown the valve to be used for cut off during the tie-in. Where tapping the main line vs. cuttings in a tee is applicable, the engineer has evaluated which method will be used as outlined in the County's Design Standards.

_____17. Knockdown meter box shall not be located within any travel areas.

_____18. Water line profiles are shown.

_____19. Residential water service lines 60 feet in length or greater are a minimum of 1” diameter.

Sewer Plans

_____1. HRSD Standards (Specifications and Details) are utilized.

_____2. Plans with proposed sewer infrastructure have been submitted to HRSD for approval.

**KING WILLIAM COUNTY**
**REVIEW CHECKLIST FOR WATER AND SEWER PLANS**

I hereby attest that I have complied with the above and do herewith submit these plans for approval.

_____P.E. _____

Signature Certificate Number

_____ _____

Name Typed or Printed Date

# KING WILLIAM COUNTY
# DOMESTIC METER SIZING FORM

Project Name: _____

Address: _____

Parcel No.: _____

Subdivision: _____

Type of Occupancy: _____

| FIXTURE | | FIXTURE VALUE (35 PSI) | | NO. OF FIXTURES | | FIXTURE VALUE |
|---|---|---|---|---|---|---|
| Bathtub | | 8 | x | _____ | = | |
| Bedpan Washers | | 10 | x | _____ | = | |
| Combination Sink and Tray | | 3 | x | _____ | = | |
| Dental Unit | | 1 | x | _____ | = | |
| Dental Lavatory | | 2 | x | _____ | = | |
| Drinking Fountain | - Cooler | 1 | x | _____ | = | |
| | - Public | 2 | x | _____ | = | |
| Kitchen Sink | - 1/2” Connection | 3 | x | _____ | = | |
| | - 3/4” Connection | 7 | x | _____ | = | |
| Lavatory | - 3/8” Connection | 2 | x | _____ | = | |
| | - 1/2” Connection | 4 | x | _____ | = | |
| Laundry Tray | - 1/2” Connection | 3 | x | _____ | = | |
| | - 3/4” Connection | 7 | x | _____ | = | |
| Shower Head (Shower Only) | | 4 | x | _____ | = | |
| Service Sink | - 1/2” Connection | 3 | x | _____ | = | |
| | - 3/4” Connection | 7 | x | _____ | = | |
| Urinal | - Pedestal Flush Valve | 35 | x | _____ | = | |
| | - Wall Flush Valve | 12 | x | _____ | = | |
| | - Trough (2 Ft. Unit) | 2 | x | _____ | = | |
| Wash Sink (Each Set of Faucets) | | 4 | x | _____ | = | |
| Water Closet | - Flush Valve | 35 | x | _____ | = | |
| | - Tank Type | 3 | x | _____ | = | |
| Dishwasher | - 1/2" Connection | 4 | x | _____ | = | |
| | - 3/4" Connection | 10 | x | _____ | = | |
| Washing Machine | - 1/2" Connection | 5 | x | _____ | = | |
| | - 3/4" Connection | 12 | x | _____ | = | |
| | - 1” Connection | 25 | x | _____ | = | |
| Hose Connection (Wash Down) | - 1/2" | 6 | x | _____ | = | |
| | - 3/4" | 10 | x | _____ | = | |

**Combined Fixture Value Total**

**Maximum Demand (GPM)**

**Meter Size**

I certify that the above information is true and correct.

Signature: _____

**KING WILLIAM COUNTY**
**STANDARD UTILITY NOTES**

1. All water construction materials and installation shall conform to the latest edition of King *William County's Standards for Water and Sewer Systems and Related Work.*
2. All water system materials, products and manufacturers shall be listed in the approved products list. King William County has adopted the *APPROVED MATERIALS AND MATERIALS SPECIFICATIONS* from Chesterfield County, VA which is listed in Section 3 of the *CHESTERFIELD COUNTY WATER AND SEWER SPECIFICATIONS AND PROCEDURES.*
3. Contractor shall be responsible for notifying the County Utilities Division and scheduling a pre-construction meeting at least 48 hours prior to starting any work on this project. All work shall be subject to inspection by King William County. The Contractor shall obtain all necessary permits.
4. The Contractor shall include in applicable bid price, the cost of locating and uncovering all manholes and all valve boxes after completion of all paving and adjust them to the final road grades.
5. The location of existing utilities across or along the line of the proposed work is not necessarily shown on the plans and where shown is only approximately correct. The Contractor shall, on his own initiative and at no extra cost, locate all underground lines and structures as necessary. The Contractor shall be responsible for any damage to underground structures.
6. Minimum cover over top of water pipe shall be 3.5 feet.
7. Datum for all elevations shown is National Geodetic Survey.
8. The contractor shall maintain a field copy of the plans and identify all as-constructed conditions during the construction of the project. The contractor shall utilize the services of a licensed surveyor for field stake-out and preparation of installation records to ensure accurate vertical and horizontal installation records are maintained during the installation of utilities.
9. Engineer shall certify that unpaved streets are to subgrade prior to Contractor installing water system. Curb and gutter, if required, shall be installed prior to acceptance of water system by King William County.
10. Contractor shall call "Miss Utility" toll free at VA811.com prior to construction.
11. No structures or planting of trees shall be permitted in utility easements.
12. Lighting may not be placed on easements which contain Water or Sewer lines. If it is necessary to install lighting within the water or sewer easement, this work must be approved by King William County or HRSD, respectively.
13. Service saddles must be used on water connections to PVC mains less than 12 inches in diameter.
14. Fire hydrants shall be installed in accordance with King William County Standard Drawing.
15. All meter and cleanout boxes must be installed to final grade. No water meters will be installed for any lot where the meter box or cleanout box are not to final grade.

16. Contractor shall submit shop drawings to the County Utilities Division for approval of all materials prior to construction.

17. The Contractor shall ensure that all permits to construct the project are in place and the cover sheet of the utility plans have been stamped as approved by the County.

18. Final Acceptance by King William County shall not be made until all work shown on approved utility plans is completed including paving, grading, and all required adjustments. “As Built” drawings shall be provided to the County prior to acceptance of this work.

# VOLUME I


KING WILLIAM COUNTY, VIRGINIA

DESIGN STANDARDS
FOR WATER AND SEWER SYSTEMS
AND RELATED WORK

**VOLUME I - DESIGN STANDARDS**

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# SECTION 1 - GENERAL DESIGN STANDARDS

## 1.1 General Requirements

### 1.1.1 General

A. The design of all utility systems and extensions or modifications thereto shall be performed under the direction of a registered professional engineer with a current registration in the Commonwealth of Virginia.

B. All water design shall conform to the latest edition of the Commonwealth of Virginia Waterworks Regulations, and all sewer design shall conform to the Commonwealth of Virginia Sewage Collection and Treatment (SCAT) Regulations. Design shall also conform the requirements of other State and Federal Agencies having jurisdiction.

C. Additionally, all water designs shall conform to the requirements of King William County Utilities Division (hereinafter referred to as "County“), and all sewer designs shall conform to the requirements of Hampton Roads Sanitation District (HRSD). Where the requirements of the State and County are in conflict, the more restrictive requirements shall govern.

D. As-built drawings shall be submitted in a compatible AutoCAD format and approved by the County prior to release of bonds and prior to connection to the system.

E. The datum used for all survey work shall be the NAD83 (2011) for horizontal datum and NAVD88 for vertical datum.

### 1.1.2 System Layout

A. A layout map shall be prepared which delineates pressure zone boundaries for water projects and sewer shed area boundaries for sewer projects. The map shall clearly define the areas pertinent to interim and ultimate development of the area proposed to be served. The layout map shall show present and future development, proposed interim and future utilities, as well as those existing utilities that will be affected by or have an effect on the proposed utilities.

### 1.1.3 System Design

A. An analysis shall be prepared that will tabulate the numbers of people served or

proposed to be served as determined from the County Land Use Map and/or existing Zoning. The tabulation shall be incremental areas for evaluation purposes.

B. Minimum, average, and maximum flows shall be developed for areas and subareas and tabulated in the report as deemed necessary or appropriate.

C. The design shall address overall present and future flows and system capacities of existing and proposed utilities as they may be affected by or may affect the facilities involved and shall develop proposed water main and sewer line sizes as well as proposed sewer pump station capacities, well capacities and tank volumes as needed.

D. The design shall be based on ultimate development and shall present such factors as deemed necessary for a sound evaluation of the basis of design used in development of a report.

E. Where an alternate design is proposed that would incorporate interim or staged construction, the report shall develop the alternate design and shall present a thorough investigation and justification for consideration of the alternate.

1.1.4 Erosion Control

A. All erosion and sediment control measures shall comply with the local erosion control ordinance and with the "Virginia Erosion and Sediment Control Handbook", latest edition.

B. King William County is located in a Chesapeake Bay Preservation Area.

## 1.2 Drawing Organization and Format

1.2.1 Drawing Organization

A. Drawings shall consist of the following types of sheets arranged in the order listed:

(1) Cover Sheet
(2) General Notes, County Notes, HRSD Notes (as applicable),
(3) Overall Utility Sheet (Not less than 1" = 500' scale, showing existing and proposed water and sewer utilities)
(4) Plan Sheets
(5) Plan and Profile Sheets
(6) Erosion and Sediment Control Plan

(7) Erosion and Sediment Control Notes and Details

(8) Standard Sheets and Special Details (as applicable)

B. Projects consisting of only structures may not require plan and profile sheets. All projects which include pipelines such as gravity sewers, force mains or water lines shall include plan and profile sheets for the pipelines.

1.2.2 Sheet Format

A. All construction drawings shall be on a standard sheet size of either 24-inch x 36-inch or 22-inch X 34-inch.

B. The cover sheet shall contain the Owner's name and project description in large, distinctive letters, a vicinity map with a minimum area of 36 square inch drawn where possible on a scale of 1-inch equals 2,000 feet to indicate the general vicinity of the proposed construction, an index to the plan sheets, a legend, and the signed stamp of the Professional Engineer.

C. The Overall Utility Sheet with a drawing sheet index shall be to a scale of not less than 1-inch equals 500 feet and shall show all proposed utility construction with ties to existing utilities. The lines of proposed construction together with proposed utility structures shall be indexed to the drawings to indicate the extent of coverage on each drawing, or, in the case of structures, to the group of drawings involved.

D. Plan sheets as well as Plan and Profile Sheets shall show horizontal, vertical and topographic data.

E. Drafting Conventions

(1) Follow the suggested symbols shown on the Standard Symbols for Utility Drawings in the Standard Details. A legend shall be included on the cover sheet showing line types and symbols specific to each project.

Line weight for existing facilities shall be no heavier than 0.021 inch.

(2) Standard Symbols - Proposed Facilities

Symbols shall be as shown above except line weight shall be no lighter than 0.026 inches and no heavier than 0.035 inches. A legend shall be included on the cover sheet showing line types and symbols specific to each project.

(3) Drafting Standards for Good Reproduction

Letters will be no smaller than 0.10 inch and care will be exercised to keep the lettering open so that it will be legible in the event drawings are reduced to half size. All drawings must be capable of producing legible second generation prints after being reduced to half size.

F. Additional Information

(1) Drawings for minor utility extensions shall include estimated materials quantities and current County standard notes.

(2) Horizontal scale in Plan and Profile Sheets shall be no smaller than 1 inch equals 50 feet and shall be in State Plane Coordinates.

(3) Vertical profile scale shall be no smaller than 1 inch equals 10 feet.

(4) All existing and proposed underground utilities shall be shown in plan and profile.

(5) Bench Marks shall be set no more than 500 feet apart along the lines of construction outside the limits of construction. Datum for elevation shown shall be in State Plane Coordinates referenced to Mean Sea Level.

## 1.3 Easement Requirements

1.3.1 All water and sewer lines to be under the jurisdiction of King William County and HRSD shall be located either in public right of way or easements.

A. Private owners developing water and sewer facilities which will be under the control of King William County shall prepare plats and convey easements to King William County.

B. Water and sewer facilities prepared for King William County shall be prepared for all construction outside of public right of way.

1.3.2 Permanent easements shall be a minimum of 20 feet in width with consideration for wider easements where more than one facility may occupy an easement, or where, because of line size, line depth, or access requirements, wider easements are desirable. The County reserves the right to required wider easements on a case-by-case basis. Easements shall generally be centered on the utility line unless the Engineer can demonstrate that this impractical.

1.3.3 Installation of trees, structures, buildings, stormwater BMP's, wetlands, berms, or other obstruction which prevents the proper installation, maintenance, rehabilitation, operation, inspection, or removal of water or sewer facilities shall not be allowed within any permanent water or sewer easement unless approved by the County.

1.3.4 Construction easements shall be acquired for all County contracts. Developers

constructing facilities are not required to have construction easements where work is on the developer's property. Construction easements shall provide a minimum working width of 50 feet, including the 20 foot permanent easement. Generally it is desirable to provide more temporary construction easement on one side than the other. This allows room for construction traffic and material storage. Wherever possible, the piping should be placed within the center of the permanent easement.

1.3.5 Easement plats shall be on sheets 8-1/2 inch x 14 inch, 11 inch x 17 inch, 17 inch x 28 inch, or 24 inch x 36 inch. Where longer easements are required, multiple sheets shall be utilized.

A center line for the easement shall be shown together with the limits of both the proposed permanent and construction easement widths referenced to the center line of the easement. Bearings and distances shall be shown on the center line of the easement and on the right-of-way or property lines where they intersect the center line. Distances shall be shown from fixed points on both the center line and the property lines to the intersection of the two. Bearings, distances and closures shall be to the degree of accuracy of 1 in 8,000 except that approximations will be permitted where it is considered impractical to delineate existing property lines. The body of the plat shall show the name of the property owner and the Deed or Will Book reference for the source of title. The names of all adjacent property owners and a north arrow shall also be shown. Street names or highway route numbers shall also be shown where applicable.

1.3.6 No other utility lines, storm sewers, or other appurtenances shall be laid parallel or nearly so, within any permanent water/sewer easement. Such facilities may cross permanent water/sewer easements as nearly perpendicular as possible.

## 1.4 Review Procedure General

1.4.1 General

A. The engineer shall be responsible for obtaining the review and necessary approvals of all drawings and specifications by the County, HRSD, and State and Federal agencies having jurisdiction. Copies of such approvals shall be submitted to the County at the time of final review by the County.

B. The engineer shall be responsible for obtaining the Waterworks Construction Permit from VDH and the Certificate to Construct from VDEQ prior to the commencement of construction for utility system extensions.

**END OF SECTION**

# SECTION 2 - DESIGN STANDARDS FOR GRAVITY SANITARY SEWERS

## 2.1 General Requirements

2.1.1 All public sewers which may include gravity and/or vacuum collection systems, pump stations, booster stations, force main interceptors, conventional treatment works and alternative decentralized systems shall be owned, operated and maintained by HRSD. HRSD is a Political Subdivision of the Commonwealth of Virginia created and enacted by the General Assembly of Virginia under the Provisions afforded by the Enabling Act; HRSD shall be the Principle Agency and responsible for all matters related to public sewers.

2.1.2 With no exception, all public sewers within King William County shall be designed and constructed in accordance to HRSD Standards and Sanitary Sewer Guidelines as well as the Commonwealth of Virginia Sewage Collection and Treatment Regulations (SCAT Regs).

2.1.3 All development projects within King William County that include (a) new sewer infrastructure, and/or (b) land disturbance in close proximity to HRSD sewer infrastructure, must be coordinated with the Agency per the Project Development Review process outlined in its web site at www.hrsd.com.

**END OF SECTION**

# SECTION 3 - DESIGN STANDARDS FOR SEWAGE PUMPING STATIONS AND FORCE MAINS

## 3.1 General Requirements

3.1.1 All public sewers which may include gravity and/or vacuum collection systems, pump stations, booster stations, force main interceptors, conventional treatment works and alternative decentralized systems shall be owned, operated and maintained by HRSD. HRSD is a Political Subdivision of the Commonwealth of Virginia created and enacted by the General Assembly of Virginia under the Provisions afforded by the Enabling Act; HRSD shall be the Principle Agency and responsible for all matters related to public sewers.

3.1.2 With no exception, all public sewers within King William County shall be designed and constructed in accordance to HRSD Standards and Sanitary Sewer Guidelines as well as the Commonwealth of Virginia Sewage Collection and Treatment Regulations (SCAT Regs).

3.1.3 All development projects within King William County that include (a) new sewer infrastructure, and/or (b) land disturbance in close proximity to HRSD sewer infrastructure, must be coordinated with the Agency per the Project Development Review process outlined in its web site at www.hrsd.com.

**END OF SECTION**

# SECTION 4 - DESIGN STANDARDS FOR WATER DISTRIBUTION FACILITIES

## 4.1 General Requirements

4.1.1 Water distribution and fire protection facilities are to be provided solely for the purpose of supplying potable water and fire protection. Under no circumstances shall cross-connections be allowed to unapproved water facilities. The following design parameters should be used in the design of water distribution facilities.

4.1.2 Design shall conform to the County design standards herein and the Virginia Department of Health Waterworks Regulations.

4.1.3 Prior to submitting plans for new water distribution facilities or extensions to existing facilities, the designer shall coordinate with the County and determine the available flow and pressure from the existing system.

4.1.4 Use of irrigation meters for supply of irrigation water is discouraged and shall generally not be permitted in new subdivisions. Where irrigation systems are installed on systems connecting to public water lines, they shall be provided with rain sensors and other devices to prevent unnecessary usage.

4.1.5 All water mains 12-inches and larger shall be constructed of class 52 ductile iron. Water mains smaller than 12-inches shall be either class 52 ductile iron or AWWA C900 PVC.

## 4.2 Technical Design System Layout

4.2.1 System Layout

A. The overall layout and general design shall conform to the parameters set forth in the approved Engineering Report. Generally, all water mains shall be located, where practical, in:

(1) Legally established road rights-of-way.
(2) Legally established permanent easements for such purpose and immediately adjacent to legally established road rights-of-way or paved areas, either existing or as proposed by the designer in accordance with Section 1.3. - "Easement Requirements" of these Standards.

B. Water mains constructed in residential communities and where speed limits along the roadway are 35 mph or less, shall be constructed within the paved area of the roadway. The alignment shall be selected to provide a minimum of 10-feet separation from the sanitary sewer system in accordance with State regulations. Where the water main cannot be located within the paved area of the roadway, the County may allow an exception to place outside the roadway on a case-by-case basis.

C. Water mains constructed along arterial roadways shall be constructed within the right-of-way a minimum of 5 feet outside the paved area. If the roadway is planned for expansion or upgrade, the water main shall be installed within a utility easement adjacent to the roadway right-of-way to avoid future utility relocation needs.

D. The water main alignment shall generally be designed in parallel to the center line of roads or easements. The same offset shall be used throughout except when existing utilities dictate a change in offset along the proposed line.

E. Water mains shall be installed a minimum of 10 feet from any part of any structure, building, or its foundation.

F. Water services and water meter boxes for residential projects shall be located a minimum of three feet from driveways, sidewalks or other paved areas unless approved by the County. No fire hydrant, valve or valve box shall be installed within concrete curbs, gutters or sidewalk ramps.

G. In general, main line valves are required at intervals of 1,000 feet and at tees and crosses to allow adequate control of the system without major system shutdowns. At a minimum, two valves shall be provided at all tees with one on the branch side and three valves shall be provided at all crosses. All valves 16" and larger shall be butterfly valves.

H. In general, water lines shall be installed above storm sewer lines. Exceptions may be granted when the depth of the storm sewer is such that the waterline passing under the storm sewer will have no more than 6.5' of cover at any point. Waterlines crossing under storm sewers shall have a minimum of 18" of clearance between the storm sewer and water line, shall be constructed of Class 52 restrained ductile iron for a minimum of one joint each side of the crossing, and shall not have any fittings or joints placed under the storm sewer. When waterlines cross over storm sewer lines, a minimum clearance of 6" shall be and the water line shall be constructed of Class 52 ductile iron. Wherever possible, the design shall minimize the use of upper and lower vertical bends in the water main design.

4.2.2 System Design

A. The proposed facilities together with the pertinent existing facilities shall be evaluated based on the hydraulic design, demand design and fire protection design requirements contained herein.

B. The Design Engineer shall submit to the County a neat and orderly set of design calculations to illustrate normal and fire flows, pipe size selection and fire protection requirements. The County will provide pressure and flow at the proposed connection point to the existing water system to be used for hydraulic design. The Design Engineer shall complete the necessary computerized hydraulic

modeling analysis as required by the Virginia Department of Health Office of Drinking Water. A copy of the model results shall be submitted to the County as part of the design submittal package for review and approval.

C. The system shall be designed to maintain a minimum pressure of 20 psi at ground level elevation at all points in the distribution system with peak flow conditions. Peak flow is the total of domestic flow plus fire flow. Where the pressure at the service tap exceeds 80 psi, the provisions of the Uniform Statewide Building Code apply.

D. Conduits of non-ferrous material buried underground shall have a marking tape and tracing wire buried in the trench. Marking tape shall be installed approximately 18" above the conduit, but no less than 24" below grade. Tracing wire shall be taped directly on the pipe in a manner that a continuous tract results.

E. Dead end lines shall be minimized by looping mains. Where looping is required the minimum size pipe shall be 6".

F. At least two supply points shall be provided for subdivisions containing more than 50 lots. Phased developments may develop up to 50 lots without a second supply point. At the time that more than 50 lots are approved, a second supply point must be provided unless the County has approved a waiver from this requirement.

G. All dead ends shall be provided with a fire hydrant.

H. For large diameter lines (16" or larger) or for "spine" lines that extend long distances without having looped connections, air release only and/or combination valves shall be provided at all high points. Consideration may be given to extra depth of bury to avoid air release valves, but in no case shall the depth exceed 6.5' of cover. The County reserves the right to require air valves on smaller diameter lines or loop lines if, in its judgment, such valves would be needed to protect the system.

I. Design Engineer shall refer to the Virginia Department of Health Waterworks Regulations for backflow requirements. Hydrant, flushing devices, and chambers or pits containing valves, blow-offs, meters, air relief valves or other such appurtenances shall not be directly connected to any sewer or storm drain.

J. Fire protection flow requirements shall be identified in the hydraulic analysis report and submitted to the County and VDH as required.

4.2.3 Hydraulic Design

A. Hydraulic design shall be accomplished by the use of hydraulic modeling software, such as Bentley or Innovyze, or other software acceptable to the County. A Hazen-Williams coefficient of friction equal to 120 shall be used for purposes of design unless the County has data to indicate a lesser coefficient

should be used for existing lines.

4.2.4 Demand Design

A. Maximum rates of water consumption shall be calculated and used as a basis of hydraulic design. Average daily water consumption rate values for the number and type of consumers anticipated to be served shall be based on those contained in the Virginia Department of Health Waterworks Regulations. Any such rates not given or any deviations from tabulated rates shall be estimated and justified by the Design Engineer and approved by the County. The average annual daily water consumption rates shall be adjusted by a multiplier to arrive at the maximum daily water consumption rate by the application of a multiplier, expressed as follows:

Average Maximum Daily Demand = 2.5 x Average Daily Demand
Peak Hourly Demand = 4.38 x Average Daily Demand

B. Any water system shall be designed to provide effective equalization storage and fire protection storage. Equalization storage shall be calculated as 20% of the Peak Hourly Demand as defined above. Fire protection storage shall be defined by the maximum specified fire design for the users in the system. For purpose of residential development, such storage shall be provided using a volume of 120,000 gallons (based on a 1000 gpm fire flow for a 2-hour duration). No discounts for pumping capacity from wells or booster stations shall be considered for purposes of "discounting" from this requirement. Systems that contain commercial development or small systems where providing the storage as required would create water quality conditions via lack of turnover shall be evaluated on a case-by-case basis.

C. If the development is connecting to an existing County water system, it shall be the developer's responsibility to upgrade any water system storage, pumping, well, line(s) or any other system component that does not meet the design criteria at the developer's expense, unless the County requires oversizing of such components.

4.2.5 Fire Protection

A. General

Rates of how for fire protection shall be estimated based on the International Building Code (IBC) Appendix B — Fire Flow Requirements for Buildings.

B. Single Family and Duplex Residential Structures

All single family and duplex residential structures up to 3,600 $ft^2$ shall be provided a minimum hose stream flow of 1000 gpm from each hydrant. Structures in excess of 3,600 $ft^2$ shall comply with the rules for multi-family, commercial,

and residential structures. The Fire Department shall have the right to require additional flow in cases where they deem it to be appropriate. Flow reduction may be achieved by the installation of sprinklers (see E below).

C. Multi-Family Residential, Commercial, or Industrial Structures

All multi-family residential, commercial, and industrial structures shall be provided with sufficient number of hydrants and flows as appropriate relative to building construction, use, and square footage per appropriate ISO, IBC, and NFPA standards. IBC Table B105.1 shall be the general guideline used to determine required flows. All flows are to be approved by the Fire Department. Flow reduction may be achieved by the installation of sprinklers (see E below) but in no case shall the minimum fire flows for such structures shall be less than 1500 gpm.

D. Minimum System Pressures

The minimum residual pressure at all points in the distribution system during a flow event shall be 20 psi. Residual pressures are to be verified by hydraulic calculations (preferably computer flow modeling). Fire flow calculations shall be performed assuming maximum day domestic demand in addition to the fire flow and shall assume minimum normal working system pressure and tame levels. Flow calculations shall demonstrate that all hydrants can achieve the required flows without depleting the system residual pressure below 20 psi.

E. Sprinklers

Fire flow requirements under B and C above may be reduced by the installation of approved automatic sprinkler systems. Amount of flow reduction shall be as determined by the Fire Department and the IBC. Structures protected by automatic sprinkler systems require installation of a double detector check, dedicated fire hydrant, and a siamese connection. Siamese connections must be located within 50 feet of the dedicated hydrant. Double detector checks shall be located in vaults adjacent to rights of way or edges of easements per County Standard Details.

F. Minimum Line Size

The minimum size water line used for fire protection to single family or duplex residential properties shall be 8" in size. Exceptions may be granted in cases where an entire subdivision is provided with sprinkler systems and it can be demonstrated that reduced line sizes can achieve the required hose stream flow at minimum residual pressure. In no case shall lines less than 6” be installed.

The minimum size water line used for fire protection to multi-family residential, commercial, or industrial properties shall be 8" in size.

The minimum sized fire service lines shall be looped to provide feed from at least two directions. The sizing of minimum-sized fire service lines and larger than minimum fire service lines shall be determined by Sections 4.2.3 and 4.2.5 - "Hydraulic Design" and "Fire Protection." No fire hydrants shall be installed on a 6" dead end line except in cases of single family or duplex residential development where sprinklers are provided and the system can provide the required flows while maintaining minimum residual system pressure.

G. Hydrant Location & Spacing

Fire hydrants shall be located no further from edge of roadway shoulder than 10'0". Fire hydrants shall be placed on legal rights-of-way and shall generally be placed in line with street intersections. This shall be deemed to be the point of tangent (P.T.) of the returns on the rights-of-way. Where long block lengths require the use of intermediate fire hydrants, they shall be placed in line with the property boundary between adjacent lots or parcels of land. Fire hydrants on cul-de-sac dead end lines shall be located at the intersection of the cul-de-sac with the feeder road. In cases where an additional hydrant is required on the cul-de-sac due to spacing, the hydrant shall be located as near as practical to the middle of the cul-de-sac.

Fire hydrant spacing for properties zoned agricultural or with single family or duplex residential development shall not exceed 900 feet or require a hose lay of over 650 feet from the hydrant to any part of any structure to be protected.

Fire hydrant spacing for properties zoned or with multi-family residential, commercial or industrial development shall not exceed 500 feet or require a hose lay of over 350 feet from the hydrant to any part of any structure to be protected. Where multiple fire hydrants are needed to supply the required fire flow, all necessary hydrants must be located within the specified hose lay. Notwithstanding the above, hydrants shall be evenly spaced around such structures to provide adequate coverage as determine by the Fire Department.

No fire hydrant shall be placed closer than 50 feet from the face or overhang of any building to be protected.

The above criteria for spacing fire hydrants may be modified by the County Fire Chief to improve fire hydrant accessibility for fire-fighting purposes.

In areas of high water table, fire hydrants with weep holes shall not be installed or the weep hole will be hard piped to drain to daylight.

4.2.6 Structural Design

A. Structural requirements must be considered in the design of all water mains and

appurtenances.

B. The proper strengths shall be specified for the pipe material being specified. Strength shall be based on operating pressures, depth of bury, trench width and foundation conditions. This is an engineering matter and not subject to generalization.

C. Proper blocking and/or restraints must be provided and shown on the drawings. Where blocking is not detailed on the drawings, restrained joints shall be used. The restrained length shall be calculated by the design engineer and the limits of restrained joint areas shown on the profile.

D. County approval shall be required for aerial or suspended water lines. Proper support shall be designed if approved.

E. Any potable waterline crossing above surface water must be:

(1) Adequately supported.
(2) Protected from freeze damage.
(3) Accessible for repair or replacement.
(4) Above the 100-year flood plain elevation.
(5) Constructed of Class 53 flanged ductile iron.

F. Any potable waterline crossing under surface water must meet the following requirements:

(1) The pipe shall be of special construction having flexible watertight joints.
(2) Valves shall be provided at both ends of the water crossing so that the section can be isolated for test or repair; the valves shall be easily accessible and not subject to flooding.
(3) Permanent sample taps shall be available at each end of the crossing and at a reasonable distance from each side of the crossing, for the purpose of testing the section of line crossing the surface water, and for locating leaks in that section.
(4) Minimum cover over the pipe during crossing shall be 3 feet.
(5) The water line shall be constructed of Class 53 ductile iron. HDPE may be used for directional drilling with County approval.

G. Waterlines located in fill material shall be constructed of Class 52 ductile iron.

H. All waterlines, including service lines, shall conform to the specifications in Section 02665.

4.2.7 Miscellaneous Considerations

A. The minimum size water line pipe to be used for normal domestic water shall be

6".

B. Air, air/vacuum or pressure reducing valves, blow-off tees, flushing hydrants and related fittings shall be provided as required. The type, size, etc., shall be specified in Section 02665. Air release valves and combination air/vacuum valves shall typically be located at high points on waterlines. Blow-offs or flushing hydrants shall typically be located at low points and dead-ends on waterlines if a fire hydrant is not proposed at these locations.

C. The minimum depth of cover for water mains shall be 3.5 feet. Additional depth shall be provided where required for thrust restraint or to clear underground obstructions. Where water lines cross under roadside ditches, minimum cover may be reduced to no less than 3 feet but in no case shall depths less than 3.5 feet be allowed for a horizontal distance of less than 5 feet along the pipe axis.

D. Water service lines for residential connections that are 60 feet or longer shall be constructed as a 1-inch minimum size.

E. The profile of water services at ditch lines shall be shown on plans and have a minimum of 24" cover at the ditch invert.

F. All service connections shall be provided with a meter. Service lines larger than 3/4", with meters larger than 5/8", shall be sized in accordance with AWWA Manual M-22 "Sizing Water Service Lines and Meters" except as follows:

(1) Use constant pressure factor of 1.
(2) Include all outside hose bibs in combined fixture value total.
(3) Irrigation systems shall be excluded from domestic meter sizing criteria. If metered separately, the irrigation meter shall be sized based on demand criteria furnished by the Engineer.
(4) For non-residential facilities with flush-valve fixtures, the meter will be sized as follows:

| METER SIZE — INCHES* | COMBINED FIXTURE VALUE TOTAL |
|---|---|
| 1 | 41-100 |
| 1-1/2 | 101-400 |
| 2 | 401-1200 |

(5) For residential facilities and office buildings with tank type water closets, the meter will be sized as follows:

| METER SIZE - INCHES | COMBINED FIXTURE VALUE TOTAL |
|---|---|
| 5/8 | 0-40 |
| 1 | 41-400 |

| | |
|---|---|
| 1-1/2 | 401-5500 |

(6) Plumbing Fixtures Values shall be shown in AWWA No. M-22 for 35 PSI.
(7) Meter installations requiring a flow of greater than 160 gpm or greater than the total fixture values indicated above shall be reviewed and/or approved on a case by case basis in accordance with AWWA Manual M-22.
(8) Steel casing pipe shall be sized in accordance with Paragraph 3.2.1S.
(9) A 5/8" meter may be used for non-residential facilities with tank type water closets and a combined fixture value total of 0-40.

G. Where water lines are subject to extreme variations in temperature (i.e., attached to bridges or box culverts) consideration shall be given to expansion and contraction of pipe materials and the freezing of the line contents.

H. Cathodic Protection - Design Engineer shall consider ground conditions in the case of metallic conduits and provide suitable cathodic protection where necessary.

I. No flushing device shall be directly connected to a sewer.

## 4.3 Drawings

4.3.1 In addition to the requirements of Section 1.2. - "Drawings Organization and Format" of these Standards, the drawings shall incorporate the following features:

A. Drawings for water lines shall show stationing, pipe size, pipe material, bearings, deflection angles and curve data.

B. The drawings shall also show all fire hydrant and water service connections. Fire hydrants and water services over 3/4" in size shall be shown in plan and profile views which are labeled by stations.

C. Profiles shall be provided for all water lines. Grades shall be calculated and shown on the profiles. Profiles shall also show all fittings, air, air/vacuum relief valves, fire hydrants, and blow off locations.

D. Water lines shall be referenced by distances from right-of-way lines, buildings and other utilities.

E. Blocking and/or restraint details.

F. Current County Sewer and Water Notes, where applicable, see Section 6 — Standard Forms and Notes, F-3.

G. All drawings for water mains crossing sewers, force mains, storm sewers, or other utilities, shall show points where crossings occur. Crossings shall be shown in both Plan and Profile. The Profile shall clearly indicate vertical clearance between utilities.

H. Meter sizing form and backflow prevention details shall be shown on the plans.

I. All fittings to include valves, bends, tees, etc. shall be shown on the plan and profile.

J. Safety placards to include, but not limited to the following:

(1) No fuel trucks beyond this point
(2) Physical address for the particular site with County Logo
(3) Confined space area if applicable

**END OF SECTION**

# VOLUME II


KING WILLIAM COUNTY, VIRGINIA

STANDARD SPECIFICATIONS
FOR WATER AND SEWER SYSTEMS
AND RELATED WORK

## VOLUME II – STANDARD SPECIFICATIONS

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[1] Rev1: Section 02665-3.1-H added January 2025.

# SECTION 01000 - GENERAL REQUIREMENTS

## 1.0 GENERAL

1.1 Summary of Work

A. Work covered by the Contract Documents consists of providing all work indicated on Contract Drawings or required by Project Manual complete, necessary for ***(INSERT PLAN TITLE)***

B. The Contractor shall perform all work required for such construction in accordance with the Contract Documents and subject to the terms and conditions of the Contract, complete and ready for use.

C. The project consists of: ***(INSERT DESCRIPTION OF PROJECT)***

D. The foregoing description shall not be construed as a complete description of all work required. This information is provided for the convenience of the contractor.

E. Work by Others

F. Work Sequence

G. County-furnished Items

1.2 Allowances

1.3 Special Project Procedures

1.4 Coordination

A. Contractor shall schedule a pre-construction meeting with the Design Engineer before starting any work. The Design Engineer shall have all required County Departments attend the meeting.

B. Phases of the construction which involve the temporary interruption of essential services shall be scheduled in consultation with the County or his representative and shall not be of longer duration than essential to accomplish the purpose for such interruptions. Liaison with County in this matter shall be a salient feature of this Contract. The Contractor shall notify the office of _____not less than 48 hours in advance of commencing work. The Contractor shall give not less than 48 hours' notice in advance of the time and date of making any connections to the existing water or sewer system. County may disapprove the time and date of any and all connections and will advise the Contractor as to a suitable time and date.

C. The locations of existing underground and above ground utilities, including electrical, communication, gas, and similar utilities, shown on the plans are approximate. Contractor shall coordinate with each utility company for relocation of or protection of their existing facilities necessary for the proposed construction. Contractor shall comply with all methods and procedures required by each utility company for performing work in the vicinity of their existing facilities. Contractor shall pay for all costs associated with locating utilities, utilities coordination, utilities construction methods, utilities protection, and utilities relocation necessary for the work.

1.5 Field Engineering

A. Grades, Lines and Levels

(1) The Engineer has established baseline and control points. From these points the Contractor shall furnish necessary personnel and equipment to establish line and grade as required for the work. The Contractor shall furnish construction cut sheets to the County before beginning construction. The data on the cut sheets shall include centerline elevations (existing and proposed), centerline cut, centerline invert, manhole location, manhole top and invert elevations, grade between manholes, and bench mark locations and elevations. Stations shall be every 50 feet except where there are unusual conditions.

(2) The Contractor shall be responsible for the preservation of all stakes and marks established by the Engineer, and if any of the stakes and marks are carelessly or willfully disturbed, the cost of replacing them shall be charged against the Contractor.

B. Contractor shall be responsible for the preservation of all property monuments. Any monuments disturbed or destroyed due to the Contractor's operations shall be replaced by a Land Surveyor licensed in the Commonwealth of Virginia at the Contractor's expense.

1.6 Regulatory Requirements

1.7 Measurement and Payment

A. Definitions: For purposes of measurement and payment the following terms shall have the meaning assigned to each.

(1) Main Trench: A trench essentially parallel to rights-of-way or property lines and in which the proposed utility lines are to be installed.
(2) Service Trench: A trench essentially perpendicular to main trenches and in which the proposed utility service pipes are to be installed.

(3) Unclassified Excavation: The removal and disposal of all materials encountered.

(4) Classified Excavation: The removal and disposal of earth, hardpan or rock materials according to the following:

(a) Earth Excavation: The removal and disposal of all excavation materials encountered not otherwise classified below.

(b) Hardpan Excavation: The removal and disposal of material that cannot be removed from the trench without the use of an air spade or blasting. Indurated clay, shale or sand with cementitious material are typical of this material.

(c) Rock Excavation: The removal and disposal of all solid rock that cannot be excavated without continuous and systematic drilling and blasting or continuous use of rock excavation equipment. Boulders 1/2 cu. yd. or more in volume, solid rock, and rock in ledges are typical of this material. Underground concrete structures, excluding pipelines, shall be classed as rock excavation.

(d) Hand Excavation: Excavation made with hand tools when in the opinion of the Engineer such excavation is necessary.

(e) Test Hole Excavation: Excavation made at the direction of the Engineer for any purpose related to the Contract.

(f) Pavement Excavation: The removal and disposal of pavement on roadways, parking areas and the like greater than 4" thick. Pavement is defined as a concrete or bituminous wearing surface and excludes a granular base material.

B. Unauthorized Excavation consists of the removal of materials beyond indicated or specified dimensions or depths without written approval of the Engineer. Unauthorized excavation shall be replaced at the Contractor's expense.

C. Trenching and Backfilling consists of the excavation of utility line pipe trenches and the backfill and compaction of same.

D. Shoring consists of sheeting and/or braces used to prevent earth movement.

(1) The County reserves the right to require shoring to protect existing building or facilities. Where sheeting and shoring is left in place, either at the Contractor's option, or on orders by the County, such materials shall be cut-off to a depth of not less than 18" below finished grade.

(2) Sheeting and braces left in place shall be paid for in accordance with unit price contained in the Bid and shall be cut off at least 18" below finished surface. This item shall include all of the cost of furnishing, placing and cutting the sheeting as well as the braces. The entire cost of placing and removing ordinary sheeting and/or bracing installed primarily to protect workmen and to facilitate construction, and not ordered left in place shall be at the Contractor's expense.

E. Measurement and Payment of Trenching and Backfilling - Classified Excavation

(1) Earth Excavation - Volumetric Basis: Measurement and payment shall be on a cubic yard basis. Pay width shall be as defined below. Pay depth shall be as defined below based on ground surface at the center line of the trench.

(2) Earth Excavation - Depth Basis: Measurement and payment shall be on a cut increment basis. Pay depth shall be as defined below based on ground surface at the centerline of the trench. All depths in excess of the maximum depth for a cut increment shall be paid for in the next greater cut increment.

(3) Hardpan and/or Rock Excavation: Measurement and payment shall be on a cubic yard basis. Pay width shall be as defined below. Pay depth shall be as defined below based on actual profile at hardpan and/or rock.

(4) Hand, Test-Hole and/or Pavement Excavation: Measurement and payment shall be on a cubic yard basis and based on actual measured dimensions of materials excavated under any of these categories.

(5) Pay Depth: The pay width for single pipe trenching and backfilling shall be the nominal pipe diameter plus 12" increased to the nearest 1/2' with a minimum trench width of 24". When two or more pipes are laid in the same trench, the trench width shall be the sum of the nominal diameters of the pipes plus 12" plus 6" for each space between pipes.

(6) Pay Width: The pay depth for trenching and backfilling shall be the actual depth of excavation from the top of the strata at the center line of the trench to the invert of the pipe. The strata line for earth excavation shall be taken as the ground surface at the time of excavation.

(7) Where other than earth excavation is encountered, the pay depth for each category of trenching and backfilling shall be measured to the strata line between categories of excavation.

(8) For other than earth excavation, trench shall not be backfilled until Engineer has verified that such classification is appropriate and has determined strata profile.

(9) Manhole and other structure excavation shall be for the depth encountered including base slab. The horizontal dimensions shall assume a rectangle extending 1' beyond the exterior walls of the structure when forming is not required and extending 2' beyond the exterior walls of the structure when forming is required. Payment for trench excavation shall not be made within area paid for as structure excavation.

(10) Granular bedding material as shown in Standard Details will be included in measurement and payment for trenching and backfill and no additional payment will be allowed.

(11) Concrete bedding material as shown in Standard Details will be paid for separately in addition to payment for trenching and backfilling.

F. Standard Payment Items tabulated in the Bid Form shall be computed as follows:

(1) Trenching and Backfilling in Hardpan: Price per cubic yard - volume shall be measured and paid for as set forth above.

(2) Trenching and Backfilling in Rock: Price per cubic yard - volume shall be measured and paid for as set forth above.

(3) Trenching and Backfilling for Service Trenches: Price per cubic yard based on an allowable trench width of 24" and the actual depth of excavation to the invert of the service line.

(4) Removal of Unstable Soil and Replacement with Select Material: Price per cubic yard of select material provided as directed by the Engineer. Payment under this item shall include the removal of unsuitable material and replacement with select material because of unstable foundation below the pipe line as well as material provided because the excavated material is unsuitable for proper backfilling of the trench. The maximum pay width shall be equal to the trench width as set forth in Section 02225 - Trenching and Backfilling. Surplus excavation from other portions of the project will be compensated for under this item only when the haul distance exceeds 1000'.

(a) Payment for select material required when pipe is laid in rock and/or hardpan and for backfill because of the inability to use hardpan or rock removed from the trench shall be included in the price bid for "Furnish and Install (each size), (each type), (water main), (sewer pipe)."

(b) Payment for select material required when pipe is laid in earth shall be based upon the quantity of select material required for a trench with pay width as specified in the Paragraph entitled "Pay Width" for same depth and pipe diameter, and a select material depth as provided.

(5) Sheeting and Shoring Ordered Left in Place: Price per thousand board feet (MBF) for shoring ordered left in place. This item shall include all of the cost of furnishing, placing and cutting the sheeting as well as the braces. The entire cost of placing and removing ordinary sheeting and/or bracing installed primarily to protect workmen and to facilitate construction, not ordered left in place shall be at the Contractor's expense.

(6) Crusher Run Stone for Surfacing: Price per linear foot of pipe line trench, surfaced with approved crusher run stone. Stone shall be placed to the same depth as the original, with a minimum of 4".

(7) Replacement of Surface Treated Pavement: Price per linear foot of pipe line trench for replacement of base material and road surfacing on surface treated pavements. Price shall include cutting, removal and disposal of existing pavement.

(8) Replacement of Plant Mix Pavement: Price per linear foot of pipe line trench for replacement of base material and road surfacing on plant mix

surfaced pavements. Price shall include cutting, removal and disposal of existing pavement.

(9) Replacement of Concrete Pavement: Price per linear foot of pipe line trench for replacement of base material and road surfacing on concrete pavements. Price shall include cutting, removal and disposal of existing pavement.

(10) Class "A" Concrete: Price per cubic yard for concrete used for sidewalks, curbs, gutters, etc. Price shall include the cost of excavation, reinforcing, forming and finishing.

(11) Class "C" Concrete: Price per cubic yard for concrete used for trench bedding, encasement, anchors, etc. Price shall include any additional excavation required, forming and finishing.

(12) Grading and Seeding in Lawn Areas: Price per linear foot of utility trench for furnishing and installing, labor and materials to establish grass cover in areas designated by the Engineer as Lawn Areas.

(13) Mulching and Seeding in Areas other than Lawns: Price per linear foot of utility trench for furnishing and installing, labor and materials to establish grass cover in areas not designated by the Engineer as Lawn Areas.

G. Water Line Payment Items tabulated in the Bid Form shall be computed as follows:

(1) (each size) Water Main: Price per foot of water main and fittings furnished and installed including trenching, backfilling, testing and sterilization.

(2) (each size) Water Main in Casing Pipe: Price per linear foot of casing pipe to furnish and install water main carrier pipe in steel casing pipe under highways, railroads or other obstructions. Payment will be made under this item regardless of the method employed in installing the casing pipe.

(3) (each size) (each type) Valves: Price per valve shall include any additional excavation required and a valve box for each operator. Where manholes are required, the cost of the manhole and manhole accessories shall be included.

(4) Fire Hydrants: Price per fire hydrant shall include furnishing and installing of any barrel extensions required to bring outlet nozzles up to proper height, the 6" service line, valve and valve box. The mainline tee will be paid for separately under the appropriate items.

(5) Locate and Connect to (each size)(each type) Existing Water Line: Price per connection shall include locating the existing line, additional trenching and backfilling and the furnishing and installing of pipe, pipe fittings, valves and other accessories below 3" in size. Pipe, pipe fittings, valves and other accessories 3" and over in size will be paid for under the appropriate items.

(6) (each size) Water Service Connection: Price per connection shall include corporation stop, saddle, meter box or vault and meter setter.

(7) (each size) Water Service Pipe: Price per linear foot shall include the pipe

and trenching and backfilling.

(8) (each size) Water Service Pipe Pushed or Bored in Place: Price per linear foot of water service pipe furnished and pushed or bored in place including steel casing pipe.

H. Sewer Line Payment Items tabulated in the Bid Form shall be computed as follows:

(1) Trenching and Backfilling for (each size) Pipe: Price per linear foot of trench according to the actual depth classification. Payment under this item shall include the bedding specified and no additional payment will be allowed for bedding. Depth for payment shall be measured to the invert of the pipe.

(2) Trenching and Backfilling for Service Connections: Price per cubic yard of excavation for service connection trenches. Volume of excavation shall be based on an allowable pay width of 24", actual depth of cut to the invert of the pipe and the length as measured from the center line of the main sewer to the upper end of the service line.

(3) (each size) (each type) Sewer Pipe: Price per foot of sewer line including furnishing, installing and testing the pipe, exclusive of trenching and backfilling.

(4) (each size) Sewer Line in Casing Pipe: Price per linear foot of casing pipe to furnish and install sewer line carrier pipe in steel casing pipe under highways, railroads or other obstructions. Payment will be made under this item regardless of the method employed in installing the casing pipe.

(5) (each size) (each type) Carrier Pipe: Price per linear foot of carrier pipe furnished and installed inside a casing pipe.

(6) (each size) by 6" Service Tees: Price per service tee installed. Payment under this item shall be in addition to the footage payment for the main line pipe.

(7) 6" Pipe for Service Connections: Price per linear foot of service connection pipe installed, including an adequate plug and marker at the upper end of the service line. The pay length of the connection shall be the horizontal distance from the center line of the main sewer to the upper end of service line, plus the length of vertical pipe installed for stacked connections.

(8) (each size) (each type) Force Main: Price per foot of pipe measured in the horizontal (not slope) furnished and installed, including trenching, backfilling, valves, valve boxes, accessories and testing.

(9) Standard (each diameter) Manholes: Price per vertical foot of manhole furnished and installed including manhole base, frame and cover. The pay depth shall be the vertical depth from the top of the manhole cover to the lowest pipe invert plus an 8" allowance for the base slab.

(10) Drop Connections: Price per vertical foot for each drop connection constructed. The depth for payment shall be the dimension shown in Standard Details.

(11) Acid Resistant (each diameter) Manholes: Price per vertical foot of acid resistant manhole furnished and installed including manhole base, frame and cover and lining. The pay depth shall be the vertical depth from the top of the manhole cover to the lowest pipe invert plus an 8" allowance for the base slab (see Standard Detail).

(12) Special Design Manholes: Lump sum price for special design manholes in accordance with Contract Drawings and Specifications, complete in place.

1.8 Application for Payment

A. County will make Progress Payments to the Contractor as provided for in the Agreement.

B. The form of each application for payment shall be in accordance with an Application for Payment form approved by the County, supported by Continuation Sheet(s). Six copies of each application shall be submitted on forms furnished by Contractor.

1.9 Change Order Procedures

A. No amount, in part or in whole, of a Change Order shall be included in an application for payment by the Contractor until the Change Order has been executed and copies of the Change Order have been distributed to the County and Contractor.

B. Proceed Orders: A Proceed Order is a device which enables the County to promptly order changes in the work which involve changes in cost or contract time, or both pending preparation and execution of a formal Change Order.

C. Request for Change Order Proposal: The County may request the Contractor to submit a Change Order proposal for changes in Contract Work. The Contractor shall submit the proposal in accordance with contract requirements within a reasonable time. The County may issue to the Contractor a Proceed Order authorizing the required changes for an additional amount not to exceed, or a deduction of not less than the amount shown in the Proceed Order. If the Contractor is not in agreement with the amount stipulated in the Proceed Order, he shall within ten (10) days after the issue date of the Order, submit to Engineer an equitable proposal and develop with the County a mutually acceptable price for the required change in Work.

D. Change Order Proposal: Without further request and within a reasonable time from the issue date of a Proceed Order, the Contractor shall submit a written Change Order proposal covering the work authorized in the Proceed Order so that Change Order may be prepared for execution.

1.10 Project Meetings

A. Preconstruction conferences with the Contractor will be held within twenty days after the effective date of the Agreement.

B. Progress Meetings

(1) Each month the Contractor shall hold a progress meeting to review progress to date and to resolve all questions for the upcoming month. Notify Engineer and the County at least one week in advance of the meeting, to insure suitable date and time. Include meeting agenda with notification.

1.11 Submittals

A. Construction Schedules

(1) Submit a detailed construction schedule prior to the preconstruction conference. Revise the schedule before each progress meeting.

B. Progress Reports

C. Survey Data

D. Shop Drawings, Product Data, Certificate of Compliance with Standards and Samples: Submit for review by the Engineer, prior to purchase or installation of equipment, copies of shop drawings, catalog, engineering or other applicable information on all items of equipment proposed for use on the Project. After review, Engineer will retain three copies and return remaining copies to Contractor. Contractor will be responsible for making additional copies for his own use.

(1) The drawings and data shall show principal and critical dimensions, characteristics, manufacturer and other pertinent information. Modify drawings and data to delete information which is not applicable to the work. Identify each item submitted by reference to applicable section of the specifications, sheet number of the Drawings or Standard Detail reference.

(2) If samples are required, Contractor shall bear the cost of providing such samples.

(3) Checking of such submittals is only for general conformance with the design concept of the Project and general compliance with the information given in the Contract Documents. Contractor is responsible for: dimensions which shall be confirmed and correlated at the job site; fabrication processes and techniques of construction; coordination of his work with that of all other trades and the satisfactory performance of his

work.

(4) Contractor shall review all submittals prior to submission to the Engineer, determine and verify the correctness and accuracy of all information on the submittals as conforming to the Contract Documents, noting any deviations from the requirements of the Contract Documents.

(5) Affix Contractor's stamp to all submittals properly initiated or signed. Stamp shall certify to review of submittal, verification of products, field measurements and field construction criteria and coordination of the information within the submittal with requirements of the work and of Contract Documents.

(6) When Contractor is required to resubmit shop drawing or other submittal data, the resubmittal shall contain the same number of copies required as an original submittal.

E. Layout Data

F. Schedule of Values: Submit complete schedule of values at least ten days prior to first application for payment.

G. Material Schedule: Within 30 days of award of Contract, or immediately after approval by the Engineer of any "Substitutions and Product Options" under "Materials and Equipment," submit to Engineer for approval a schedule listing manufacturer of the items of equipment and materials proposed for the construction.

(1) Following approval of the schedule, no changes in material or equipment from those listed will be allowed except in unusual or extenuating circumstances.

(2) When such circumstances arise, the Contractor shall request, in writing, Engineer approval of the proposed change, stating the circumstances necessitating such a change.

(3) The intent of this schedule is to name the manufacturers of material specified by a product standard and to designate which manufacturer will be used when more than one has been named for an item in the specifications.

(4) The schedule shall not be interpreted as allowing any change from base bid items or those substitute items offered with the Bid and accepted in the Agreement.

1.12 Quality Control

A. Testing Laboratory Services: Tests called for, other than by public authorities, shall be made by approved independent laboratories with the full cooperation of the Contractor.

(1) Testing services other than those called for in these Contract Documents

may be called for by the County to check compliance with specification requirements. When tests indicate compliance with specifications, the testing service charges will be borne by the County, but when non-compliance with specifications is indicated, the testing service charges will be deducted from the contract sum.

1.13 Temporary Facilities and Controls

A. Temporary Electricity: The Contractor shall make all necessary arrangements for obtaining electric power for construction purposes. No separate payment for electric power for construction purposes or testing other than the payment included in the contract lump sum or unit prices will be allowed.

B. Temporary Heat and Ventilation: Provide approved type temporary heating as required during the progress of the project and bear all expenses related thereto. After the building is enclosed and the permanent heating system is installed, suitable for safe operation, the Contractor may, with the written permission of Engineer, use the permanent system for temporary heating. All expenses related to the Contractor's use of the permanent heating system shall be borne by the Contractor. Approved use of the permanent heating system to provide temporary heat shall not in any way be interpreted as a final acceptance of the heating system or the beginning of any guarantee periods.

(1) Temporary heat shall be supplied by the Contractor under the following conditions:

(a) To protect work and materials from damage due to cold and dampness.
(b) During application, setting and curing of plaster work, to maintain a minimum temperature of 50°F.
(c) For a period of 10 days prior to and during erection and/or application of millwork, paint, flooring, or other interior finish work. Minimum temperature shall be 70°F. Maintain this temperature until County's acceptance of building.

(2) During construction ventilate the building to provide suitable curing and drying-out conditions for various materials and types of construction work.

C. Temporary Water

(1) The Contractor shall make all necessary arrangements for securing water for construction purposes at his own cost and expense. No separate payment, other than that included in the contract lump sum unit prices will be allowed for water so used.
(2) The Contractor may obtain water for any purpose through a portable meter

connected to the County's potable water distribution system. Contractor shall obtain and pay for the portable meter and water used (other than testing) in accordance with the County's requirements.

(a) Portable meters shall be used in the following manner:
1. Install the meter assembly on the fire hydrant.
2. Securely support the meter from the ground so that its weight is not on the hydrant threads.
3. Use an approved hydrant wrench to fully open the hydrant.
4. Control the flow of water with the valve on the meter assembly.

D. Temporary Sanitary Facilities: Contractor shall provide and maintain in a neat and sanitary condition such accommodations for the use of his employees as will comply with laws and regulations.

E. Tree and Plant Protection: Each tree that is to remain shall be protected by a substantial fence built at the drip line.

F. Dust Controls: Ensure that dust is held to an absolute minimum along all portions of the work through the application of moisture.

G. Pollution Controls

(1) Perform all work in accordance with Federal, State and local regulations pertaining to soil erosion, air pollution and noise pollution. Contractor shall keep himself informed of all such regulations and revisions thereto.
(2) Provide all necessary temporary structures and/or equipment to preclude any bypass of untreated or improperly treated sewage to any stream, ditch or upon the ground during any of the construction and/or connection phases of the Project.

H. Traffic Regulation: Provide traffic control on public roads during construction on or adjacent to such roads in accordance with the Contract Documents.

I. Project Identification

(1) Contractor may erect one business sign on the site for the duration of the project. Design and size of the proposed sign shall be submitted to the County for approval. Signs shall meet requirements of all local codes and ordinances.

(2) Erect one project sign consisting of 4' 0" x 8' 0" x 3/4" of exterior grade plywood APA High Density Overlay (HDO) with hardwood edging on all four edges. The sign shall be mounted on two 4" x 4" wood posts. Posts shall be set 7' 8" on centers. Top of sign shall be 9' 0" above ground, and

posts shall extend 3' 0" below ground level (or deeper if required to ensure stability). The plywood shall be painted white, front and back. Hardwood edging and posts shall be painted black. Sign shall meet requirements of all local codes and ordinances. Sample sketch shall be submitted to County for approval. Sketch shall show heights and spacing of lettering. All lettering shall be black and wording on the sign shall be as follows:

PROJECT NAME
PROJECT LOCATION

NAME OF ENGINEER
CITY AND STATE

NAME OF GENERAL CONTRACTOR
CITY AND STATE

J. Field Offices and Sheds: Provide and maintain a weathertight, heated, air conditioned and properly lighted temporary field office for the exclusive use of the Resident Project Representative. Location of the building shall be approved by the insurance agency having jurisdiction. Building shall be equipped with telephone with outside bell and message recording unit. Wood stove shall not be used for heating. Field office shall provide 120 square feet for use by the Resident Project Representative or Engineer. The office shall have a secure entrance doors and one key shall be provided for each Project Representative. The space shall be equipped with a 3 foot by 5 foot drafting table, drafting chair, a 15 inch wide 4-drawer metal filing cabinet, a plan rack and one chair furnished by the Contractor.

1.14 Materials and Equipment

A. Quality: Material and equipment incorporated into the work:

(1) Conform to applicable specifications and standards
(2) Comply with size, make, type and quality specified or as specifically approved in writing by the Engineer.
(3) Manufactured and Fabricated Products

(a) Design, fabricate and assemble in accord with the best engineering and shop practices.
(b) Manufacture like parts of duplicate units to standard size and gages, to be interchangeable.
(c) Two or more items of the same kind shall be identical, by the same manufacturer.
(d) Products shall be suitable for service conditions.
(e) Equipment capacities, sizes and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing.

(4) Do not use material or equipment for any purpose other than that for

which it is designed or is specified.

(5) Except as specifically indicated or specified, materials and equipment removed from the existing structure shall not be used in the completed work.

(6) For material and equipment specifically indicated or specified to be reused in the work:

(a) Use special care in removal, handling, storage and reinstallation, to assure proper function in the completed work.

(b) Arrange for transportation, storage and handling of products which require off-site storage, restoration or renovation. Pay all costs for such work.

(7) Manufacturer's Instructions

(a) When Contract Documents require that installation of work shall comply with manufacturer's printed instructions, obtain and distribute copies of such instructions to parties involved in the installation, including two copies to Engineer.

1. Maintain one set of complete instructions at the job site during installation and until completion.

(b) Handle, install, connect, clean, condition and adjust products in strict accord with such instructions and in conformity with specified requirements.

1. Should job conditions or specified requirements conflict with manufacturer's instructions, consult with Engineer for further instructions.

2. Do not proceed with work without clear instructions.

(c) Perform work in accord with manufacturer's instructions. Do not omit any preparatory step or installation procedure unless specifically modified or exempted by Contract Documents.

B. Transportation and Handling

(1) Arrange deliveries of products in accord with construction schedules, coordinate to avoid conflict with work and conditions at the site.

(a) Deliver products in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.

(b) Immediately on delivery, inspect shipments to assure compliance

with requirements of Contract Documents and approved submittals, and that products are properly protected and undamaged.

(2) Provide equipment and personnel to handle products by methods to prevent soiling or damage to products or packaging.

C. Storage and Protection

(1) Store products in accordance with manufacturer's instructions, with seals and labels intact and legible.

(a) Store products subject to damage by the elements in weathertight enclosures.
(b) Maintain temperature and humidity within the ranges required by manufacturer's instructions.

(2) Exterior Storage

(a) Store fabricated products above the ground, on blocking skids, prevent soiling and staining. Cover products which are subject to deterioration with impervious sheet coverings, provide adequate ventilation to avoid condensation.
(b) Store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign matter.

(3) Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to assure that products are maintained under specified conditions, and free from damage or deterioration.

(4) Protection After Installation: Provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations. Remove when no longer needed.

(5) In the event of damage, immediately make all repairs and replacements necessary to the approval of the Engineer and at no additional cost to the County.

D. Equivalent Materials and Equipment - All provisions of the General Conditions will govern the consideration of Equivalent Materials and Equipment (Substitutions).

(1) Where the Bid Form contains provisions for the offering of Substitutions on specified items of equipment as a part of the Bid, no requests for substitutions on those items will be considered after the Bids are opened.

Substitutions for other items will be considered as outlined below.

(2) For items not designated as above and/or where the Bid Form does not contain provisions for the offering of Substitutions as a part of the Bid, the following will govern their offering:

(a) For products specified by naming one product of manufacturer without the words "or equal," Contractor shall use the product or manufacturer specified without substitution.

(b) Where more than one product or more than one manufacturer is named the first named product or manufacturer has been used as the basis of design. The Contractor may use any of the named products or manufacturers without written request for substitution; however, if other than the first named product or manufacturer is used the Contractor agrees to the representations listed below under - Contractors Representation.

(c) For products specified only by reference standard, select any product meeting that standard.

(d) For a period of 30 days after Notice to Proceed, Engineer will consider written requests by Contractor for substitution of products.

(e) Submit a separate request for substitution for each product, supported with complete data, with drawings and samples as appropriate, including:

1. Comparison of the qualities of the proposed substitution with that specified.
2. Changes required in other elements of the work because of the substitution.
3. Effect of the substitution on the construction schedule.
4. Cost data for operation and maintenance comparing the proposed substitution with the product specified.
5. Any required license fees or royalties pertaining to the proposed substitution.
6. Availability of maintenance service, and source of replacement materials of the substitute item.

(3) Contractor's Representation: A request for a substitution or use of other than the first named product or manufacturer constitutes a representation that Contractor:

(a) Has investigated the proposed product and determined that it is equal to or superior in all respects to that specified.

(b) Will provide the same warranties or bonds as for the first named product specified or for the first named manufacturer specified.

(c) Will coordinate the installation of an approved substitution or other than the first named product or manufacturer into the work,

and make such other changes as may be required to make the work complete in all respects.

(d) Accepts full responsibility for any structural, electrical, mechanical, dimensional or other changes required by such substitutions and agrees to reimburse County for all such costs that County may incur due to such change, as provided in the General Conditions.

(e) Waive all claims for additional costs, under his responsibility, which may subsequently become apparent.

(4) Where substitutions are permitted after Bids have been opened, Engineer will review requests for substitutions with reasonable promptness, and notify Contractor, in writing, of the decision to accept or reject the requested substitution.

(5) Where substitutions are permitted after Bids have been opened, the Contractor shall submit to Engineer a complete list of all products proposed to be used, with the name of the manufacturer and the installing subcontractor for which shop drawings are required. Such list shall be submitted within 45 days after Notice to Proceed, exempting those requests under review by the Engineer.

1.15 Work in Inclement Weather

A. During stormy or inclement weather, no work shall be done except as can be done satisfactorily and in a workmanlike manner to secure first-class construction throughout. If in the County's opinion satisfactory work is not being performed or cannot be performed during inclement weather, the County may issue a "stop work" order.

1.16 Contract Closeout shall include the following:

A. Punch List: Correct all punch list items.

B. Cleaning: Clean all glass, replace all broken glass, remove stains, spots, marks and dirt, clean hardware, remove paint spots and smears from all surfaces, clean fixtures, wash all concrete and tile, and vacuum the building as applicable.

C. Project Record Documents: During construction, maintain one complete set of Drawings, Project Manual and shop drawings in clean, undamaged condition, with mark-up of actual installation which vary substantially from the work as originally shown. Mark-up new information which is recognized to be of importance to County, but was not shown on either Contract Drawings or shop drawings. Note related Change Order numbers where applicable. Upon completion of construction, deliver all Project Record Documents to Engineer. Changes to be recorded shall include but are not limited to the following:

(1) Size, depth, or position of foundations. Exact location and elevation of all underground utility services. Any changes in general construction or mechanical work above or below ground.
(2) Any additions, deletions or changes in electrical work from that shown in the Contract Documents.
(3) These records are a specific Contract requirement, and final payment will not be made until these Drawings and Project Manual have been submitted in an acceptable form.

D. Operations and Maintenance Data: Obtain, assemble, and submit to the County's designated representative, three Manuals containing comprehensive operating and maintenance instructions and parts list on all items of mechanical and electrical equipment furnished under this Contract. Each manual shall be self-contained and include the information for efficient servicing of equipment supplied and installed under this Contract.

(1) Operating instructions shall explain maintenance procedures, methods of checking the systems for safe and normal operation, and recommended procedure for safely stopping and starting the equipment and/or systems.
(2) These requirements shall be fulfilled before any guarantee periods become effective so as to limit the possibility of claims arising from the absence of pertinent information.

E. Guarantees, warranties and bonds: Submit all required guarantees, warranties, and bonds.

F. Spare parts and maintenance materials: Deliver all spare parts and maintenance materials required by these Contract Documents to County as directed by County.

G. List of manufacturers and suppliers: At the conclusion of the project, the Contractor shall furnish Engineer with a complete list of subcontractors, manufacturers and suppliers who participated in the construction or who furnished materials or equipment. The address of each firm shall be included, together with types of materials or work performed.

H. Affidavit of Payment of Debts and Claims

I. Affidavit of Release of Liens

J. Consent of Surety Company to Final Payment.

**END OF SECTION**

# SECTION 02110 - SITE CLEARING

## 1.0 GENERAL

1.1 Description

A. Work under this Section of the Specifications includes general site clearing operations, including tree and vegetation removal, protection of existing trees to be left standing, and clearing and grubbing.

1.2 Provide barricades, coverings, or other types of protection necessary to prevent damage to existing improvements not indicated to be removed, and improvements on adjoining properties.

A. Restore all improvements damaged by this Work to their original condition, and acceptable to the Owner or other parties or authorities having jurisdiction.

1.3 Protect existing trees and other vegetation indicated to remain in place against cutting, breaking, or skinning of roots, skinning and bruising of bank, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary fences, barricades or guards as required to protect trees and vegetation to be left standing.

1.4 Burning where allowed by local ordinances will be permitted.

## 2.0 PRODUCTS

2.1 Not Applicable

## 3.0 EXECUTION

3.1 Clearing

A. Remove from the site trees, brush, shrubs, down timber, rotten wood, rubbish, other vegetation as well as fences, and incidental structures necessary to allow for new construction.

(1) Remove all trees, stumps and roots within 10' of any structure or pipeline.

(2) Stumps of trees, other than the above, to be left in place shall be cut off and shall be left not more than 6" above original grade. Remove all stumps when such stumps will be less than 5' below finished grade.

B. Clearing work shall be restricted to area within rights-of-way or easements or within "Construction Limits" indicated on Contract Drawings.

3.2 Existing Trees and Shrubs

A. Trees and shrubs that are to remain within "Construction Limits" will be indicated on Contract Drawings or conspicuously marked on site.

B. Ownership to Trees: Unless otherwise noted, trees within the "Construction Limits" shall become the property of the Contractor and shall be removed from the site.

3.3 Grubbing

A. Grub areas within and to a point 10' outside of all structures and pipe lines, areas to receive fill where finished grade will be less than 3' above existing grade, cut areas where finished grade will be less than 2' below existing grade, transitional areas between cut and fill, and any area to receive control fill.

B. Remove from the ground to a depth of 18", all stumps, roots 1/2" and larger, organic material and debris.

C. Use only hand methods for grubbings inside the drip lines of trees which are to remain.

3.4 Clean up debris resulting from site clearing operations continuously with the progress of the work.

3.5 Remove all waste material from site.

3.6 Remove debris from site in such a manner as to prevent spillage. Keep pavement and area adjacent to site clean and free from mud, dirt and debris at all times.

**END OF SECTION**

# SECTION 02225 - TRENCHING & BACKFILLING

## 1.0 GENERAL

1.1 Work included in this section includes trenching and backfilling for underground pipelines and related structures only.

1.2 Reference Specifications are referred to by abbreviation as follows:

A. American Society for Testing and Materials. . . . . ASTM
B. American Association of State Highway & Transportation Officials . . . AASHTO
C. Virginia Department of Transportation . . . . . VDOT
D. Virginia Erosion and Sediment Control Handbook . . . . . VESCH

1.3 The Contractor shall perform all construction operations in accordance with the U.S. "Occupational Safety and Health Act of 1970", the Standards of the U.S. Department of Labor, Occupational Safety and Health Administration and the latest amendments thereto.

1.4 The Contractor shall perform all construction operations in accordance with the "Rules and Regulations Governing the Safety and Health of Employees Engaged in Construction" as adopted by the Safety and Health Codes Commission of the Commonwealth of Virginia and all latest revisions thereto and issued by the Department of Labor and Industry.

1.5 Store and use explosives in accordance with Federal, State and Local regulations. The Contractor shall be responsible for and shall satisfactorily correct all damage resulting from use of explosives.

1.6 Within roadways, the Contractor shall provide compaction testing per VDOT Standards for construction within easement, the Contractor shall provide compaction testing at County’s request at the Contractor’s expense.

1.7 Locate existing utilities, culverts and structures, above and/or below ground, before any excavation starts. Coordinate work with utility companies through MISS UTILITY. Protect, maintain in service, and prevent damage to utilities not designated to be removed. When utilities are encountered that not shown on Drawings or when locations differ from those shown on Drawings, notify the County for instructions before proceeding.

1.8 All excavation is unclassified and no additional payment will be allowed regardless of materials encountered.

## 2.0 PRODUCTS

2.1 Pipe Bedding Fill

A. Granular pipe bedding shall meet requirements for coarse aggregates, VDOT Size No. 57 stone in accordance with VDOT Road and Bridge Specifications.

B. Crushed or recycled concrete shall not be used as pipe bedding.

C. Fly ash shall not be used as pipe bedding.

2.2 Select Backfill

A. Aggregate fill shall meet requirements for subbase and aggregate base material, Size No. 21A or 21B, in accordance with VDOT Road and Bridge Specifications.

B. Clean earth fill shall be an approved material free of debris, roots, frozen materials, organic matter, rock or gravel larger than 1" in any dimension or other harmful matter.
   (1) Crushed or recycled concrete shall not be used as backfill.
   (2) Fly ash shall not be used as pipe backfill.

2.3 Rip-rap, where shown on the Drawings shall conform to Section 414 of the VDOT Road and Bridge Specifications.

## 3.0 EXECUTION

3.1 Strip existing topsoil, leaf mold, and organic materials. Deposit in storage piles separate from other excavated material.

3.2 Where the trench width exceeds the standard width, the Contractor at his own expense shall provide for increased loads on pipe as directed by the County.

3.3 Unauthorized excavation consists of the removal of material beyond indicated subgrade elevations or side dimensions without specific approval of the County. Where unauthorized excavations occur, restore these areas to the elevations and dimensions shown on the Drawings with granular fill.

3.4 Where removal of unsatisfactory material is due to fault or negligence of the Contractor, by inadequate shoring or bracing, dewatering, material storage or other failure to meet specified requirements, any work deemed necessary by the County to correct the faulty condition shall be performed at no additional cost to the County.

3.5 Excavation

A. Open trenches only so far in advance of pipe laying as permitted by County. In no case will more than 500 feet of trench be open at one time. Trenches shall be backfilled at the end of each working day except where otherwise permitted.

B. The width of the trench at and below the top of the pipe shall not exceed the outside diameter of the pipe plus 18 inches except that for pipe 12 inches or less in diameter, the trench width shall not exceed 33 inches. Where this width is exceeded, Contractor shall provide for increased pipe loading as directed by the County.

C. The trench walls above the top of the pipe may be sloped or the trench, above the top of the pipe may be widened as necessary for bracing, sheeting and shoring, or a trench box may be utilized. Construction methods shall be subject to review and approval by the County.

D. Excavate trenches for gravity lines to elevations shown on the Drawings. Excavate trenches for pressure lines to elevations shown on the Drawings or to depths specified in other sections of this Specification.

E. The bottom of the trench for gravity lines shall be as specified herein under 3.7 "Pipe Bedding".

F. The bottom of the trench for pressure lines shall be shaped to fit the bottom of the pipe as specified herein under 3.7 "Pipe Bedding".

(1) Excavate for bell holes at each joint so that the entire barrel of pipe shall be fully supported the entire length.
(2) Where rock is encountered, excavate a minimum of 6 inches below the bottom of the pipe for bedding in granular material.

G. Dewater excavation as necessary to provide proper protection. If deemed necessary, the County may require continuous dewatering 24 hours per day by adequate pumpage or well-points until backfilling is completed. The method, and equipment used for dewatering shall be subject to the approval of the County.

H. Where unsuitable soil is encountered, excavate to depth determined by the County and replace with select backfill thoroughly and uniformly compacted.

I. Where underground-streams or springs are found, provide temporary drainage and notify the County.

J. Remove from project site and dispose of material unsatisfactory for backfill, trash, and all excess material continuously with the progress of the work.

K. Remove shoring and all form materials, unless ordered to remain.

L. Where rock is encountered so that a manhole, vault, or other structure will bear entirely on rock, it shall be used to support the foundation. Where only a part of the foundation would bear on rock, excavate to an even depth of 8 inches below the entire structure and backfill with aggregate fill and thoroughly compact.

M. Provide a minimum of 8 inches between rock excavation and sides of structures.

3.6 Sheeting

A. Maintain trench walls in a safe condition at all times. Provide sheeting, shoring, and bracing as necessary to prevent cave-in of excavation or damage to existing structures on or adjoining the site.

B. Establish requirements for trench shoring and bracing to comply with local codes and authorities having jurisdiction.

C. Maintain sheeting, shoring and bracing in excavations regardless of time period excavations will be open. Carry down sheeting, shoring and bracing as excavation progresses in accordance with the proper County requirements.

D. Sheeting, shoring and bracing left in place shall be cut off to a depth of not less than 18 inches below grade.

3.7 Pipe Bedding

A. Bed all sewer pipe in accordance with bedding details as shown in the Standard Details.

B. Except where otherwise shown on the Drawings, all gravity lines using rigid pipe such as concrete, etc. shall be Class C bedding as a minimum as shown on the Standard Drawings.

C. Except where otherwise shown on the Drawings, all gravity lines using flexible pipe such as PVC, etc. shall be Class B-2 bedding as a minimum.

D. Except where otherwise shown on the Drawings, all pressure lines using rigid pipe such as ductile iron, etc. shall be Class C-1 bedding as a minimum.

E. Except where otherwise shown on the Drawings, all pressure lines using flexible pipe such as PVC, etc. shall be Class C- 1 bedding as a minimum.

F. Compact pipe bedding by tamping or rodding to prevent settlement.

3.8 Backfill

A. Backfill trench to a compacted depth of 1 foot over the pipe with select backfill in accordance with the details shown in the Standard Details. Backfill shall be placed by hand, uniformly on each side of the pipe and compacted in layers not exceeding 5". Do not backfill on muddy or frozen soil, or with muddy or frozen soil.

B. Backfill trench from 1 foot above the pipe to grade with clean earth fil1 free of stones not larger than 5" or 1/2 the layer thickness, whichever is smaller. Layers shall not exceed 12", except that under road shoulders and under existing or future paved areas, layers shall not exceed 8 inches. Backfill shall be compacted to the density specified for the areas in which it is located except that minimum compaction in any area shall be to the density of the adjacent soil.

C. Excavation depressions caused by removal of stumps or other clearing operations to firm subgrade, shall be filled with clean earth fill and compact as specified.

D. Place backfill materials evenly adjacent to structures. Take care to prevent wedging action of the backfill against structures by carrying the material uniformly around the structure to approximately the same elevation in each lift.

E. Compact soil materials using equipment suitable for materials to be compacted and work area locations. Use power-driven hand tampers for compacting materials adjacent to structures.

F. Compact aggregate fill placed around manholes or other structures to required density.

3.9 Compaction

A. Percentage of maximum density requirements.

(1) Compact each layer of fill or backfill to not less than the following percentages of the maximum density at optimum moisture content as determined by ASTM D 698 (AASHTO T-99).

100% beneath and within 10 feet of buildings and structures, including those shown for future construction.

95% beneath pavements, walks, and road shoulders, including those shown for future construction.

90% in other unpaved areas.

B. Where compaction greater than 90 percent is required, test reports shall be submitted to the County prior to Substantial Completion.

C. Test reports are not required where the trench is completely backfilled with select aggregate fill.

3.10 Grading

A. Uniformly grade all areas within the limits designated on the Drawings, including adjacent transition areas. Finish surfaces within specified tolerances with uniform levels or slopes between points where elevations are shown.

B. Finish all surfaces free from irregular changes.

C. Finish subgrade areas to receive topsoil to within 0.10 foot of required subgrade elevations.

D. Shape subgrade under walks to line, grade, and cross-section to within 0.10 foot of required subgrade elevations.

E. Shape subgrade under pavement to line, grade, and cross-section within 1/2 inch of required subgrade elevations.

F. Protect newly graded areas from traffic and erosion. Repair and reestablish grade in settled, eroded, or rutted areas to the specified tolerances. Stabilize disturbed areas in accordance with the approved erosion and sediment control plan.

G. Where compacted areas are disturbed by subsequent construction or adverse weather scarify the surface, reshape and compact to the required density. Use hand tamper for recompaction over underground utilities. Stabilize disturbed areas in accordance with the approved erosion and sediment control plan.

3.11 Utilities to be Abandoned or Removed

A. When underground utilities are to be abandoned in place, plug, cap, or seal with concrete at the "construction limits" or at points shown.

B. Remove underground utilities indicated on the Drawings to be removed and backfill resulting excavation with suitable material, compacted as specified. Plug, cap or seal utilities with concrete, at the construction limits or at points shown.

3.12 Erosion Control

A. Comply with local erosion control ordinance and with the "Virginia Erosion and Sediment Control Handbook".

B. Install all applicable erosion and siltation control measures in accordance with approved erosion and sediment control plan prior to grading.

C. Protect graded areas from the action of the elements. Settlement or other damage that occurs prior to acceptance of the work shall be repaired and grades satisfactorily reestablished.

D. Repair after cleanup: Upon completion of construction work and after spoils and debris have been removed, regrade and permanently stabilize any areas disturbed by operations.

3.13 Clean Up

A. Keep area of Work cleaned up at all times and promptly remove all materials and debris not intended for incorporation in the Work. Broom clean the surfaces of all paved areas immediately after backfilling operations.

B. Maintain backfilled trenches from the nuisance of dust, mud or settling during the entire length of the Contract and for a period of one year following Final Acceptance of the work.

C. In the event the Contractor fails to satisfy these requirements to the satisfaction of the County, or otherwise prosecute the Work in a reasonable or proper manner, and after a reasonable period of time has elapsed after notification by the County of unsatisfactory conditions, the Owner shall take such corrective action as deemed necessary by the County. The cost incurred in taking corrective actions will be deducted from any monies due the Contractor by the Owner or by such other means of collection as may be available to the Owner.

3.14 Preparation for Final Inspection

A. Locate and adjust all manholes, valve boxes, etc. to final grade and flush out all gravity pipe lines as necessary prior to final inspection by the County. The costs of this work shall be included in the applicable bid prices.

3.15 Existing Driveways, Fences, Culverts, etc.

A. The Contractor shall return all driveways, fences, culverts, lawn areas, paved areas, etc. to the original condition existing prior to construction. Any culverts damaged during construction shall be replaced with new culverts at no cost to the property owner or County.

**END OF SECTION**

# SECTION 02665 - WATER DISTRIBUTION SYSTEM

Rev1: Section 02665-3.1-H added January 2025

## 1.0 GENERAL

1.1 Work in this Section includes all exterior potable water distribution system piping and appurtenances.

1.2 References

| | | |
|---|---|---|
| A. | American National Standards Institute | ANSI |
| B. | American Society for Testing and Materials | ASTM |
| C. | American Water Works Association | AWWA |
| D. | Commercial Standard (National Bureau of Standards) | CS |
| E. | Federal Standards | FS |
| F. | Virginia Department of Transportation | VDOT |

1.3 Separation of Water Lines and Sanitary and/or Combined Sewers

A. Follow Virginia Department of Health "Waterworks Regulations" for separation of water mains and sewer lines.

B. Parallel Installation

(1) Normal Conditions - Water lines shall be constructed at least 10 feet horizontally from a sewer or sewer manhole whenever possible. The distance shall be measured edge-to-edge.

(2) Unusual Conditions - When local conditions prevent a horizontal separation of at least 10 feet, the water line may be laid closer to a sewer or sewer manhole provided that:

(a) The bottom of the water line is at least 18 inches above the top of the sewer.

(b) Where this vertical separation cannot be obtained, the sewer shall be constructed of ductile iron water pipe pressure-tested in place to 50 psi without leakage prior to backfilling. The sewer manhole shall be of watertight construction and tested in place.

C. Crossing

(1) Normal Conditions - Water lines crossing over sewers 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) Unusual Conditions - When local conditions prevent a vertical separation described in crossing, normal conditions, paragraph above the following construction shall be used.

(a) Sewers passing over or under water lines shall be constructed of the materials described in parallel installation, unusual conditions Paragraph (B) above.

(b) Water lines passing under sewers shall, in addition, be protected by providing:

(3) A vertical separation of at least 18" between the bottom of the sewer and the top of the water lines.
(4) Water lines passing under sewers shall, in addition, be constructed of ductile iron.
(5) That the length of the water line shall be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewer.

D. Sanitary or sewer manholes - No water pipes shall pass through or come in contact with any part of sewer or sewer manhole.

## 2.0 PRODUCTS

2.1 General

A. Submit shop drawings on all products as required by the County.

B. Provide test results of pipe testing.

2.2 Ductile iron pipe shall meet requirements of AWWA/ANSI C151/A21.51 for Pressure Class 350, Special Class 51, unless otherwise indicated on the Drawings. All pipe shall have a cement mortar lining on the interior and a bituminous coating on the exterior.

2.3 Flanged cast iron and ductile iron pipe shall meet the requirements of AWWA/ANSI C115/A21.15 for Pressure Class 350, Special Class 53, unless otherwise shown on Contract Drawings. Thickness class shall meet requirements of AWWA/ANSI C150/A21.50. All pipe shall have a cement mortar lining on the interior and a

bituminous seal coat on the exterior.

2.4 Polyvinylchloride (PVC) pipe and fittings in sizes 6 inches through 12 inches shall meet the requirements of AWWA C900, DR-18, CL 150, except that all connections shall be made using elastomeric gasket joints unless shown differently on the Drawings. No PVC pipe larger than 12 inches shall be used for water lines.

2.5 Polyethylene pipe for use in Directional Drilling shall be Driscopipe HDPE, Series 4000, SDR 11 meeting the requirements of AWWA C906.

2.6 Copper tubing shall meet requirements of ASTM B88 for Type "L" copper, hard drawn, for above ground and Type "K" hard drawn for below ground.

2.7 Gray iron and ductile iron fittings shall meet requirements of AWWA/ANSI C110/A2l.10. Pressure ratings shall be a minimum of 250 psi for fittings 12 inches and smaller and at least 150 psi for fittings 16 inches and larger, or pressure specified for adjacent piping, whichever is greater. All fittings shall be push-on joint, mechanical joint, or mechanical joint plain end unless otherwise approved by the County. All fittings shall have a cement mortar lining on the interior and a bituminous coating on the exterior.

2.8 Compact ductile iron fittings shall meet requirements of AWWA/ANSI C153/A21.53 in sizes 4 inches through 12 inches. 16-inch sizes shall conform to manufacturer's standard. All fittings shall be push-on joint, mechanical joint, or mechanical joint plain end unless otherwise approved by the County. All fittings shall have a cement mortar lining on the interior and a bituminous coating on the exterior.

2.9 Mechanical joints and jointing materials shall meet requirements of AWWA /ANSI C111/A21.11.

A. Mechanical joint retainer glands shall meet requirements of AWWA /ANSI C111/A21.11. Glands for ductileiron pipe shall be Megalug Series 1100 as manufactured by EBAA Iron Sales Inc. or approved equal. Glands for PVC pipe shall be Megalug Series 2000 as manufactured by EBAA Iron Sales Inc. or approved equal.

B. Locked type mechanical joints may be used where restrained joints are required.

2.10 Push-on joint and rubber gasket shall meet requirements of AWWA/ANSI C111/A21.11.

A. Push-on joint retainer glands shall meet requirements of AWWA /ANSI C111/A21.11. Glands for ductileiron pipe shall be Megalug Series 1700 as manufactured by EBAA Iron Sales Inc. or approved equal. Glands for PVC pipe shall be Megalug Series 1600 or 6500 (IPS) as manufactured by EBAA Iron Sales

Inc. or approved equal.

B. Locked type mechanical joints may be used where restrained joints are required.

2.11 Flanged joints for ductile iron pipe shall meet requirements of ANSI B16.1.

2.12 Flanged joint gaskets shall be full-face, made of rubber, and shall meet requirements of ANSI B16.21.

2.13 Cement mortar lining with bituminous seal coat for ductile iron pipe and fittings or for cast iron fittings shall meet requirements of AWWA C104.

A. Cement mortar lining shall be standard thickness.

2.14 Exterior, bituminous coating for ductile iron pipe and fittings and cast iron fittings shall meet requirements of AWWA C106 or AWWA C151 as applicable.

2.15 Metal harness shall be galvanized rods and clamps as detailed on Drawings.

2.16 Fittings for copper piping shall meet requirements of ANSI Bl6.22 for wrought copper, compression fitting or pack joint.

2.17 Screwed fittings for galvanized steel pipe shall be 150 lb. standard, malleable iron meeting the following requirements: dimensions, ANSI B16.3; threads, ANSI B2.1; material, ASTM A47; galvanizing, ASTM Al53.

A. Exterior, coal tar enamel coatings for steel pipe shall be materials and applications as specified in AWWA C203. Finish coat shall be single wrap kraft paper. Affidavit of compliance will not be required. Conditions of service shall be as indicated on Contract Drawings.

2.18 Approved Products List

A. All water system materials, products and manufacturers shall be listed in the approved products list. King William County has adopted the *APPROVED MATERIALS AND MATERIALS SPECIFICATIONS* from Chesterfield County, VA which is listed in Section 3 of the *CHESTERFIELD COUNTY WATER AND SEWER SPECIFICATIONS AND PROCEDURES*. All products to be utilized in the water system within King William County shall be listed in the latest edition of that document.

2.19 Thrust blocking and/or joint restraint units shall be as shown on drawings or as directed by Project Representatives based upon field conditions. Concrete shall have 3000 psi

strength at 28 days in accordance with Cast-in-Place Concrete Standard and shall meet requirements of ASTM C94.

2.20 Detectable Marking Tape

A. Plastic marking tape shall consist of one layer of aluminum foil laminated between two layers of inert plastic film. Tape shall be resistant to alkalis, acids and other destructive agents commonly found in the soil. The laminate shall be strong enough that the layers cannot be separated by hand.

B. Tape shall be a minimum of 4 1/2 mils thick with a minimum tensile strength of 60 lbs. in the machine direction and 58 lbs. in the transverse direction per 3 inch wide strip. Tape color shall be APWA Color Coded for marking the particular utility line and shall be imprinted with a continuous warning message to indicate the type of utility being marked, the message normally being repeated every 16 to 36 inches. Tape shall be inductively locatable and conductively traceable using a standard pipe and cable locating device. Tape shall be 3 inch wide Terra Tape "Sentry Line Detectable 620".

C. In addition to the marking tap, a tracing wire of 12 gauge copper shall be installed and taped directly on the pipe in a manner that a continuous trace results. Turn up into meter boxes every 500 LF if no other appurtenances (valves, hydrants, etc.) are available within that distance.

2.21 Double Detector Check Valves

A. Double detector check (DDC’s) valves shall be of ductile iron body, epoxy coated, UL and FM approved. The check valves shall be accessible for maintenance without removing the device from the line. DDC's shall be Zurn Wilkins Model 350 DA for 2" and 350 ADA for 2-1/2" or greater or approved equal.

## 3.0 EXECUTION

3.1 Pipe Laying - General

A. Take all precautions necessary to ensure that pipe, valves, fittings, and other accessories are not damaged in unloading, handling, and placing in trench. Examine each piece of material just prior to installation to determine that no damage has occurred. Remove any damaged material from the site and replace with undamaged material.

B. Exercise care to keep foreign material and dirt from entering pipe during storage, handling, and placing in trench. Close ends of in-place pipe at the end of any work period to preclude the entry of animals and foreign material.

C. Bedding of pipe shall be as specified in Trenching & Backfilling Standard.

D. Do not lay pipe when trench bottom is muddy or frozen, or has standing water.

E. Use only those tools specifically intended for cutting the size and material and type pipe involved. Make cut to prevent damage to pipe or lining and to leave a smooth end at right angles to the axis of the pipe.

F. Lay pipe with bell ends facing the direction of laying. Where grade is 10% or greater, lay pipe uphill with bell ends upgrade.

G. Generally, water lines in local and residential streets shall be located under the roadway pavement. If the roadway is an arterial roadway, the water main shall be a minimum of 5 feet off the back of curb, and 1 foot off the edge of pavement if a ditch is present.

H. The Contractor is reminded that prior to the installation of water mains, the design engineer must certify in writing that:

(1) All pavement and shoulder areas within the right-of-way are graded to within 6" of subgrade.

(2) All ditches and slopes to 1 foot outside the right-of-way have been graded to final grade.

(3) Markers for the sewer laterals are visible.

(4) All necessary property pins have been installed. [1]

3.2 Install pressure line with a minimum depth of cover of 42 inches over the top of the pipe, where no grades are shown on the Drawings.

A. Where grades on the pressure line conflict with existing pipes or structures, lay pressure line to additional depth with a uniform vertical curve to provide proper clearance without the use of fittings. No additional payment will be allowed for additional excavation.

B. Lay pressure line pipe with bell ends facing the direction of laying. Where grade is 10% or greater, pipe shall be laid uphill with bell ends upgrade.

3.3 Joining Mechanical Joint Pipe

A. Thoroughly clean inside of the bell and 8 inches of the outside of the spigot end of

[1] Section 02665-3.1-H added January 2025

the joining pipe to remove oil, grit, excess coating and other foreign matter. Paint the bell and the spigot with soap solution (half cup granulated soap dissolved in 1 gallon water). Slip cast iron gland on spigot end with lip extension of gland toward end of pipe. Paint rubber gasket with or dip into the soap solution and place on the spigot end with thick edge toward the gland. Apply a thin film of gasket lubricant supplied by pipe manufacturer that meets the requirements of AWWA C111/C600, to either the gasket or the spigot end of the joining pipe.

B. Push the spigot end forward to seat in the bell. Then, press the gasket into the bell so that it is located evenly around the joint. Move the gland into position, insert bolts and screw nuts up finger tight. Then tighten all nuts to torque listed below:

| Bolt Size (Inches) | Torque (Ft. – Lbs.) |
|---|---|
| 5/8 | 40 - 60 |
| 3/4 | 60 - 90 |
| 1 | 70 - 100 |
| 1 1/4 | 90 - 120 |

Tighten nuts on alternate side of the gland until pressure on the gland is equally distributed.

C. Join lock-type mechanical joint pipe according to manufacturer's recommendations.

D. Permissible deflection in mechanical joint pipe shall not be greater than 2/3 of that listed in AWWA C600.

E. Permissible deflection in lock-type mechanical joint pipe shall be as recommended by manufacturer.

3.4 Joining Push-On Joint Pipe

A. Thoroughly clean inside of the bell and 8 inches of the outside of spigot end of the joining pipe to remove oil, grit, excess coating, and other foreign matter. Flex rubber gasket and insert in the gasket recess of the bell socket. Apply a thin film of gasket lubricant supplied by pipe manufacturer, to either the gasket or the spigot end of the joining pipe. Start the spigot end of the pipe into the socket with care. Then complete the joint by forcing the plain end of the bottom of the socket with a forked tool or jack-type device. File the end of field cut pipe to match the manufactured spigot end.

B. Join restrained push-on joints according to manufacturer's recommendations.

C. Permissible deflection in push-on joint pipe shall not be greater than 2/3 of that listed in AWWA C600.

D. Permissible deflection in restrained push-on joint pipe shall be as recommended by manufacturer.

3.5 Join PVC pipe and fittings in accordance with manufacturer's instructions and install in accordance with ASTM D2321.

3.6 Setting Valves and Valve Boxes

A. Install valves with operator stems in the vertical plane through the pipe axis and perpendicular to the pipe axis. Locate valves where shown on Drawings. Thoroughly clean before installation. Check valves for satisfactory operation.

B. Equip all underground valves with valve boxes where shown on the Drawings. Set valve boxes in accordance with Standard Details. Set box in alignment with valve stem centered on valve nut. Set the valve box to prevent transmitting shock or stress to the valve. Set the box cover flush with the finished ground surface or pavement. PVC extensions shall not be permitted.

C. Construct manholes for all underground valves where shown on the Drawings. Construct manholes so as to prevent transmitting any load or shock to the valve or pipe. Locate manholes and valve relative to each other in order that packing, operator and other parts of the valve are readily accessible for minor repairs.

D. Valves shall be marked in non-residential easements by markers approved by the County.

3.7 Locate fire hydrants as shown on Drawings and in accordance with Standard Detail.

3.8 Provide air and vacuum valve at locations shown on Drawings. Install gate valve between water main and relief valves. Construct manholes for air and vacuum valves as shown on the Drawings.

3.9 Provide reaction anchors of concrete blocking, metal harness, retainer gland type or restrained joint type pipe at all changes in direction of pressure pipelines and as shown on Drawings.

A. Concrete reaction anchors shall bear against undisturbed earth and shall be of the size and shape shown on the Drawings.

B. Use metal harness restraints as shown on Drawings.

C. Where retainer glands are used, extreme care shall be taken so that each set screw is tightened as recommended by the manufacturer before the pipe is backfilled and tested.

3.10 Installation of Tapping Sleeves and Tapping Valves

A. All tapping sleeves must be crated for shipment with a signed manufacturer's tag certifying that the sleeve meets King William County specifications. The County inspector shall turn this tag in to the contract file with the location of installation note on the tag.

B. Rigorous testing and conditions relating to tapping sleeves, applied to all manufacturers, is standard operating procedure. These conditions are as follows:

(1) The tapping sleeve shall be tested in place to a minimum of 200 psi. It is the contractor's responsibility to order the correct pressure rated tapping sleeve.

(2) If the sleeve fails the 200 psi pressure test, the original failed sleeve shall be replaced with an entirely new sleeve.

(3) The concrete thrust block shall be poured to also support the tapping sleeve from beneath. The tapping sleeve, valve and tapping machine assembly is to be adequately supported during the tapping operation to prevent movement or rotation of the tapping sleeve.

(4) Installation instructions must be followed in strict accordance with the latest County's procedures.

C. The actual tap shall be made in presence of a representative of the County. The County shall be notified 48 hours in advance of making the tap.

3.11 Detectable Tape

A. Install marking tape in all trenches containing buried, non-metallic, pressure pipe lines. Tape shall be installed in all trenches with a minimum of 18" over the pipe. Place tape on edge of trench toward the center of the pavement in roadways. In other locations, place tape to the north or east of the utility line. Wrap tape around all valves, corporation stops and meter setters. Wrap tape three tums around base of fire hydrants and extend tape up above ground against fire hydrants. Tape shall be made electrically conductive throughout the entire system through the use of splices of a type recommended by the manufacturer.

In addition to the marking tape, a tracing wire of 12 gauge copper shall be installed and taped directly on the pipe in a manner that a continuous tract results. Turn up into meter boxes every 500 LF if no other appurtenances (valves, hydrants, etc.) are available within that distance.

3.12 Disinfection of Water Lines

A. Disinfect and test water mains and accessories in accordance AWWA Standard C651 and the following:

B. All water lines shall be disinfected prior to being placed in operation.

C. Prior to disinfection all water lines shall be flushed. All valves and hydrants shall be operated during this operation. Flushing velocities should not be less than 3.0 ft./sec. Adequate provisions shall be made for drainage of flushing water to prevent causing erosion damage, nuisance, or interruption of traffic.

D. Methods of Chlorine Application

(1) Continuous feed method - Potable water shall be introduced into the pipe line at a constant flow rate. Chlorine shall be added to 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 line at least 24 hours, after which, the chlorine concentration in the water shall be at least 10 mg/L. All valves and appurtenances shall be operated while the chlorinated water remains in the pipe line.

(2) Slug Method - Potable water shall be introduced into the pipe line at a constant flow rate. This water shall receive a chlorine dosage which will result in a chlorine concentration of 100 mg/L in a "slug" of the water. The chlorine shall be added long enough to insure that all portions of the pipe are exposed to the 100 mg/L chlorine solution for at least 3 hours. The chlorine residual shall be checked at regular intervals not to exceed 2000' to insure that adequate disinfection is occurring. As the chlorinated water passes valves and appurtenances, they shall be operated to insure disinfection of these appurtenances.

(3) The filling velocity of the potable water in the pipe line shall be less than 1 ft/sec. The water chlorine solution shall remain in contact with the pipe for 24 hours. All valves and appurtenances shall be operated while the chlorinated water is in the pipe line.

E. Final Flushing - After the required retention period, the heavily chlorinated water shall be flushed from the main until the chlorine concentration in the water leaving the main is no higher than that generally prevailing in the system, or less than 1 mg/l. The chlorine in heavily chlorinated water needs to be neutralized before discharge. Contractors must provide equipment for neutralizing heavily chlorinated water prior to discharging the water.

F. Testing - After the lines have been flushed, the water lines shall be tested. Samples shall be collected at regular intervals, not exceeding 1200' throughout the

length of pipe line.

(1) All chlorine residual determinations shall be made using only those methods approved by the Virginia Department of Health.

(2) Two water samples for bacteriological analysis must be collected at least 16 hours apart and analyzed by a certified laboratory. The results of these samples must indicate no coliform contamination before the pipe, tanks, or equipment can be utilized as part of the waterworks. If contamination is indicated, then the disinfection and sampling procedures must be repeated.

G. Maintain a copy of AWWA Standard C651 on Project site during all disinfecting operations.

3.13 Acceptance Tests

A. The Contractor shall supply the pumps, calibrated gauges and meters, and all the necessary apparatus. Contractor shall notify King William County at least 48 hours in advance of the test date and perform tests in presence of King William County representative.

B. The County will supply water at no cost for one test of potable water lines only; all other water will be supplied by the Contractor at his own cost.

C. When existing water mains are used to supply test water, they should be protected from backflow contamination by temporarily installing a double check-valve assembly between the test and supply main or by other means approved by the County. Prior to pressure and leakage testing, the temporary backflow protection should be removed and the main under test isolated from the supply main.

D. After the line has been backfilled and at least seven days after the last concrete reaction anchor has been poured, subject the line or any valved section of the line to a hydrostatic pressure test in accordance with AWWA C600, except as modified herein. Fill the system with water at a velocity of approximately 1 ft per second while necessary measures are taken to eliminate all air. After the system has been filled, raise the pressure by pump to 1.5 x the working pressure. Test pressures shall: (1) Not be less than 1.25 x the working pressure at the highest point along the test section, (2) not exceed thrust restraint pressure, (3) not vary by more than + or – 5 psi, (4) not exceed twice the rated pressure of the valves or hydrants when test includes closed gate valves, (5) not exceed rated pressure of valves if resilient-seated butterfly valves are used, (6) shall be at least 150 psi. Measure pressure at the low point on the system compensating for gage elevation. Maintain this pressure for two (2) hours. If pressure cannot be maintained, determine cause, repair, and repeat test until successful

E. A leakage test shall be conducted concurrently with the pressure test. Leakage is defined as the quantity of water that must be supplied to the test section to

maintain a pressure within 5 psi of the specified test pressure, after air has been expelled and the pipe filled with water. No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{S\ x\ D\sqrt{P}}{148{,}000}$$

Where:
L is the allowable leakage in gallons per hour,
S is the length of pipe in feet,
D is the nominal pipe diameter in inches, and
P is the average test pressure in psig.

If leakage exceeds that specified, then find and repair the leaks, and repeat the test until successful.

F. All visible leaks shall be repaired regardless of the amount of leakage.

G. Tie-ins shall be made within 7 working days of the acceptance of the water line.

**END OF SECTION**

# SECTION 02835 - CHAIN LINK FENCING

## 1.0 GENERAL

1.1 Furnish and install chain link fencing complete in place with gates and accessories as specified herein and as shown on the Contract Drawings.

1.2 Reference Specifications are referred to by abbreviation as follows.

A. American Society for Testing and Materials..... ASTM

B. Chain Link Fence Manufacturer's Institute..... CLFMI

1.3 Submittals

A. Shop Drawings: Submit complete layout and details of fence and gate construction, fence height, post spacing, dimensions and unit weights of framework and concrete footing details.

## 2.0 PRODUCTS

2.1 Materials

A. End, Corner and Gate Posts:

(1) Type I tubular members shall be Schedule 40 welded or seamless steel pipe with 1.8 oz. zinc coating per sq. ft. of surface area conforming to ASTM F1083.

(2) Type II tubular members shall be pipe manufactured from steel conforming to ASTM A568, cold-rolled, high frequency or induction welded and having a minimum yield strength of 50,000 psi. External surface triple coated per ASTM F1043, Type B & Type D with a minimum of 0.9 oz of zinc per sq. ft., a minimum of 15 micrograms of chromate per sq. in. and high performance polymer top coating with a zinc-rich exterior thickness of not less than 0.3 mil. Posts shall demonstrate the ability to resist 1,000 hours of exposure to salt spray with a maximum of 5% red rust in a test conducted in accordance with ASTM B117. Internal surface coat, after welding, with a zinc-rich based organic coating having a 91% zinc powder loading capable of providing the ability to withstand 650 hours of exposure to salt fog with a maximum of 5% red rust, when conducted in accordance with ASTM B117.

(3) All coatings shall be applied inside and out after welding.

(4) Pipe shall be straight, true to section and conform to the following weights:

| Pipe Size Outside Diameter | Type I Weight lbs./ft. | Type II Weight lbs./ft. |
|---|---|---|
| 1 5/8" | 2.27 | 1.84 |
| 2" | 2.72 | 2.28 |
| 2 1/2" | 3.65 | 3.12 |
| 3” | 5.79 | 4.64 |
| 3 1/2" | 7.58 | 5.71 |
| 4" | 9.11 | 6.56 |
| 6 5/8" | 18.97 | -- |

B. Fabric: Zinc-coated fabric shall be hot-dipped galvanized after weaving with a minimum of 1.2 oz. of zinc per sq. ft. of surface area and shall conform to ASTM A392, Class I. Fabric shall be 9 gauge wire woven in a 2” diamond mesh. Top sewage shall be twisted and barbed, bottom sewage shall be knuckled.

2.2 Concrete Mix: Mix shall consist of Portland cement concrete ASTM C94 with a maximum 3/4" aggregate and having a minimum compressive strength of 3,000 psi at 28 days.

2.3 Components

A. Fence Posts

| Fabric Height | Line Post O.D. | Terminal Post O.D. |
|---|---|---|
| Under 6’ | 2” | 2 1/2" |
| 6’ to 9’ | 2 1/2" | 3” |
| 9’ to 12’ | 3” | 4” |

B. Gate Posts

| Single Gate Width | Double Gate Width | Post O.D. Type I/II |
|---|---|---|
| Up to 6’ | Up to 12’ | 3” |
| 7’ to 12’ | 13’ to 25’ | 4” |

C. Top Rails and Braces: 1 5/8" O.D.

D. Gates: Frame assembly of 2" O.D. pipe Type I or II with welded joints. Weld areas repaired with zinc-rich coating applied per manufacturer's directions. Fabric to match fence. Gate accessories, hinges, latches, center stops, keepers and necessary hardware of quality required for industrial and commercial application.

Latches shall permit padlocking.

E. Fittings

(1) Post Caps: Pressed steel, malleable iron or cast iron designed to fit snugly over posts to exclude moisture. Supply cone type caps for terminal posts and loop type for line posts. All fittings to conform to ASTM F626.

(2) Rail and Brace Ends: Pressed steel, malleable iron or cast iron, cup-shaped to receive rail and brace ends.

(3) Top Rail Sleeves: Tubular steel, 0.051" thickness x 7" long, expansion type.

(4) Tension Bars: Steel strip, 5/8" wide x 3/16" thick.

(5) Tension Bands: Pressed steel, 14 gauge thickness x 3/4" wide.

(6) Brace Bands: Pressed steel, 12 gauge thickness x 3/4" wide.

(7) Truss Rods: Steel rod, 3/8" diameter merchant quality with turnbuckle.

(8) Barbed Wire Arms: Pressed steel, malleable iron or cast iron fitted with clips or slots for attaching three strands of barbed wire. Arms shall be set outward on a 45° angle and be capable of supporting a 250 pound load at outer barbed wire connecting point without causing permanent deflection.

F. Tension Wire: Marcelled 7 gauge steel wire with minimum coating of 0.80 oz. of zinc per square foot of wire surface and conforming to ASTM A824.

G. Hog Rings: Steel wire, 11 gauge, alloy 1100-H4 or equal.

H. Barb Wire: Commercial quality steel, 12-1/2 gauge, two strand twisted line wire with 4 point barbs at 5" spacing. Coating shall consist of a minimum of 0.80 oz. of zinc per sq. ft. of wire surface conforming to ASTM A121.

I. Cantilever slide gates shall meet requirements of CLFMI specifications.

J. Locks: Each gate shall be furnished with a Master Lock Company, Model No. 2, brass case padlock with two keys per lock and all locks master keyed to Owner's system.

K. Grounding clamps shall be 3/8 in. cadium-plated plus gold chromated steel U-bolt and nuts with cast bronze, plain-finish clamp. Ground wire shall be #4 AWG copper wire. Ground rod shall be 5/8" x 8 feet with a 6" projection and shall have a resistance to ground of 25 ohms or less.

## 3.0 EXECUTION

3.1 Installation

A. General: Installation shall conform to ASTM F567.

B. Height: Fence shall be six (6) feet in height unless otherwise indicated on Contract Drawings.

C. Post Spacing: Space line posts at intervals not exceeding ten (10) feet.

D. Post Setting: Set terminal, gate and line posts plumb in concrete footings. Top of footing shall be 2" above grade and sloped to direct water away from posts. Bottom of footing shall be 3'-4" below grade and shall have the following diameters:

line posts - 10"
end and corner posts - 12"
gate posts - 14"

Post shall be set to a depth of 3' below grade.

E. Bracing: Brace gate and terminal posts back to adjacent line posts with horizontal brace rails and diagonal truss rods.

F. Top Rail: Install through line post loop caps connecting sections with sleeves to form a continuous rail between terminal posts.

G. Bottom Tension Wire: Stretch between terminal posts 6" above grade and fasten to outside of line posts with tie wires.

H. Fabric: Pull fabric taut with bottom selvage 2" above grade. Fasten to terminal posts with tension bars threaded through mesh and secured with tension bands at maximum 15" intervals. Tie to line posts and top rails with tie wires spaced at maximum 12" on posts and 24" on rails. Attach to bottom tension wire with top rings at maximum 24" intervals.

I. Barbed Wire: Anchor to terminal extension arms, pull taut and firmly install in slots of line post extension arms.

J. Gates: Install gates plumb, level and secure for full opening without interference. Mushroom center cap and duckbill latches. Anchor center stops and keepers in concrete. Drawing to depict what is needed.

K. Fasteners: Install nuts for fittings, bands and hardware bolts on inside of fence.

L. Fence shading shall be required at water, wastewater facilities or as deemed necessary by the County.

3.2 Grounding

A. Ground fence enclosures at diagonally opposite corners and at intervals not exceeding 500 feet.

B. Where an electric utility line rated 65 KV or greater passes over the fence, fence shall be grounded at points 50 feet, measured horizontally, beyond where the outside conductors pass over the fence.

C. Where an electric utility line rated 65 KV or greater runs parallel to and within 40 feet of the fence, measured horizontally, fence shall be grounded at 50 ft. maximum intervals along the parallel section of fence.

D. Fence post grounding shall consist of three grounding clamps, installed at the top, middle and bottom of the post, connected to the ground wire.

E. Fence grounding shall consist of conductors secured to the fence with compression connectors.

F. Provide ground rod at each grounding point located on post side of fence as close as possible to post and fence.

G. Provide flexible copper bonding jumper between fixed fencing and moveable elements such as gates.

3.3 Completion: Leave area of installation free of debris caused by installation of the fence.

**END OF SECTION**

# SECTION 16620 – EMERGENCY STANDBY POWER SYSTEM

## 1.0 GENERAL

1.1 Standards - NEMA MG1

1.2 A complete emergency standby power system shall be provided including a diesel engine driven generator set and all auxiliary systems required for automatic operation.

1.3 Fuel storage tank for generator shall be placed a minimum of fifty (50) feet from a well with a steel casing, and a minimum of one hundred (100) feet from a well with a PVC casing.

1.4 Two hard copy sets and one PDF copy of operating and maintenance instruction manuals shall be furnished. They shall cover the entire emergency standby power system including the transfer scheme. Framed operating instructions shall be mounted on or near the unit.

1.5 Instruction of Owner personnel in performance of routine maintenance and operation shall be provided.

1.6 Renewal parts and major maintenance shall be readily available through authorized manufacturers dealers located within 100 miles of job site.

1.7 A single manufacturer's dealer shall supply and warrant all equipment for the emergency standby power system. Warranty period shall be at least two years or 1000 hours of operation, whichever occurs first, and shall include all parts, labor, travel time and mileage.

1.8 Manufacturer of the engine generator set shall be Caterpillar, Cummins, MTU Onsite Energy, or approved equal. Equipment selections are based on Caterpillar. Equipment selections for the transfer switch are ASCO 4000 series switches.

1.9 The generator set provided under these specifications shall be completely factory assembled and shall be listed and labeled per UL2200.

The engine generator set shall fully comply with all current Environmental Protection Agency (EPA) emission regulations including, but not limited to, the New Source Performance Standards (NSPS) for stationary and non-road generator sets. The engine generator set must meet the EPA new source performance requirements required at the time the engine generator set submittal is approved by the engineer. Engines

manufactured previous to the submittal approval date that do not meet the current regulated emissions levels are not acceptable.

It shall be the responsibility of the engine generator supplier to comply with all applicable requirements of the Commonwealth of Virginia and or the municipality of county where the generator set will be installed.

## 2.0 PRODUCTS

2.1 The generator set shall have a minimum standby rating sufficient to start and run all equipment in the facility not designated as “Standby” or “Spare”. The engine shall have a maximum governed speed of 1800 rpm.

A. Generator set shall be capable of producing rated output in an outside ambient temperature of 110°F at an altitude of 1000'.

B. Certified copy of generator set standard factory tests shall be provided for the engineers and owners records.

C. Voltage regulation shall be +/- 1.0 percent of rated voltage for any constant load between no load and rated load.

D. The generator set shall be capable of starting the equipment in the facility in either one full step or in multiple steps (not to exceed four) as determined by the equipment supplier. Voltage dip shall not be greater than 20% at any point in the operating cycle. Factory approved voltage dip calculations shall be submitted for review and approval.

(1) Supplier shall define starting step 1. Facility lighting, receptacle, electric heat and air conditioning loads shall always be included in Step 1.
(2) Supplier shall define starting step 2 (15 second delay) if applicable.
(3) Supplier shall define starting step 3 (30 second delay) if applicable
(4) Supplier shall define starting step 4 (45 second delay) if applicable.

E. All motors will have across the line starting unless otherwise noted.

F. Readily accessible voltage droop, voltage level and voltage gain controls shall be provided. Voltage level adjustment shall be a minimum of plus or minus 5 percent.

G. Generator insulation shall be Class H. Temperature rise shall not exceed 105°C over 40°C ambient for continuous operation at the standby rating.

H. Frequency regulation from no load to full load shall be in accordance with governor specification. For any addition of load up to 90 percent of rated load, the frequency shall recover to steady state frequency band within five seconds.

I. Voltage regulator shall be digital microprocessor based with fully programmable operating and protection characteristics. The regulator shall maintain generator output voltage within +/- 0.5% for any constant load between no load and full load. The regulator shall be capable of sensing true RMS in three phases of alternator output voltage, or operating in single phase sensing mode. The voltage regulator shall include a VAR/Pf control feature as standard. The regulator shall provide an adjustable dual slope regulation characteristic in order to optimize voltage and frequency response for site conditions. The voltage regulator shall include standard the capability to provide generator paralleling with reactive droop compensation and reactive differential compensation.

J. Generator field for sets less than 40 KW shall be self-excited.

K. Generator field excitation, for sets 40 KW, and larger shall be permanent magnet.

L. Equipment supplier shall furnish printed copy of equipment starting steps to Instrumentation/Controls equipment supplier to insure that the starting steps are included in the control systems.

2.2 Diesel Engine shall be Four Cycle

A. All engine ratings shall be shown in manufacturer's literature published at least six months prior to bid opening and engine shall be of a design that has been successfully used for at least three years.

B. Generator shall be driven by a single engine without the use of gearing.

C. Provide an engine instrument panel which contains water temperature gauge, lubricating oil pressure gauge and fuel pressure gauge.

2.3 Engine lubrication shall include a forced feed lubricating oil system with wet sump.

A. Provide water cooled lube oil cooler.

B. Provide full flow replaceable oil filters with spring loaded bypass valve to insure oil flow if filter clogs.

2.4 Engine combustion air cleaner shall be dry replaceable element type cleaner.

2.5 Engine fuel system shall be fuel injection type capable of performance on commercial Grade No. 2 fuel oil. Provide primary and secondary fuel filters of replaceable cartridge type. A positive displacement engine mounted fuel pump capable of 12' minimum suction shall be provided. All fuel lines shall have flexible connections and a check valve shall be provided ahead of the fuel pump.

2.6 Engine exhaust system shall include a minimum 18" long flexible steel exhaust connection for each exhaust outlet to muffler. For outdoor units with mufflers bolted to engine or engine housing, flex connection may be omitted.

A. Provide a muffler which shall reduce noise to not more than 75 db at 23’ from the end of the exhaust pipe.

B. For indoor units, mufflers and rigid exhaust pipe shall be insulated with calcium silicate suitable for temperatures up to 1000°F. Flexible connection shall have screen guard for protection of operating personnel. For outdoor units, mufflers mounted on top of the weatherproof enclosure shall be shielded with formed expanded metal guards for protection of operating personnel.

C. Provide a threaded drain hole for generator sets larger than 200 KW.

D. Diesel exhaust system piping shall be extra heavy black steel (schedule 80). Fitting shall be standard weight forged steel with beveled ends.

2.7 Engine governor shall be Electronic Isochronous type which shall control the frequency within 4 pct of rated frequency from no load to full load. The frequency at any constant load shall remain within a steady state band width of plus or minus .25 pct of rated frequency.

2.8 Provide a thermostatically controlled jacket water heater to maintain jacket water at 40°F with ambient of -20°F. Heater voltage shall be suitable for circuit voltage shown on Contract Drawings.

2.9 Radiator shall be engine mounted and cooled by blower fan. Fan belts if used shall be "V" type and have tension adjustment. The radiator shall be capable of cooling the engine at its standby load ratings and 110°F ambient air temperature. The radiator shall be filled with ethylene glycol and water solution to protect to -20°F and shall include a cooling system rust inhibitor. All cooling system gaskets shall be suitable for use with ethylene glycol.

2.10 Provide engine driven centrifugal type water circulating pump and thermostatic valve to maintain engine at recommended temperature level.

2.11 For generator sets, 200 KW and larger, provide a thermostatically controlled alternator heater in the generator to prevent condensation. Heater shall be suitable for circuit voltage shown on Contract Drawings.

2.12 Generator controls and main output circuit breaker shall be mounted on the generator.

A. The controls shall include the following meters and relays:

(1) A.C. voltmeter
(2) A.C. ammeter
(3) Frequency meter
(4) Running time meter
(5) S.P.D.T. contacts that operate on failure of engine to run when "called for."

B. The controls shall include the following alarms which shall light an individual indicating lamp for each alarm condition and shall stop and lockout the unit. Lockout shall require manual reset.

(1) Over-crank
(2) Low oil pressure
(3) High water temperature
(4) Low Coolant Water Level
(5) Over-speed
(6) "Not In Automatic" alarm light
(7) Low fuel oil level
(8) Auxiliary S.P.D.T. contact to indicate alarm condition (for use with plant annunciator system).
(9) Indicator/Display lamp test switch to permit checking indicator and display lamps.

C. Starting and stopping controls shall be activated by switch on generator control panel.

D. Controls shall include means to cause fuel tank anti-siphon valve to open during engine starting and running periods. Valve shall be closed when engine is not running. Valve coil voltage shall be same as engine battery voltage.

E. Output circuit breaker shall be installed inside of the weatherproof housing. The breaker shall be rated for generator full load amps.

2.13 Engine-generator set shall be provided with spring type vibration isolator secured to a common steel channel or H-beam type engine generator base and bolted to the foundation.

2.14 Engine starting shall be electrically powered from lead-acid storage batteries, having voltage rating and ampere hour minimum capacity ratings recommended by the manufacturer to provide 120 seconds of cranking at an ambient temperature of 40°F. Provide batteries, battery rack, cables and a U/L listed automatic battery charger with automatic two rate charging that will provide recharge from 0 volts to full charge in 8

hours. Charger shall have 120 volt single phase input, ammeter, voltmeter and suitable enclosure.

A. In addition to battery charger, an engine driven battery charging alternator shall be factory installed with required guards. Alternator shall be rated minimum of 24 volts and 35 amperes.

2.15 Provide 75W, 120V battery heater under the battery as recommended by the equipment supplier.

2.16 Finish paint coat of engine generator set, accessories and auxiliary equipment shall be standard factory color.

2.17 Fuel system shall include fuel storage and piping equipment for a complete system as follows:

A. Day tank with accessory equipment shall be equipped with and have threaded pipe connections for inlet, suction, return, overflow, vent, drain, float switch and fuel gauge. Provide a ¼ full low level alarm light at generator control unit. Tank shall be mounted on housekeeping pad. Auxiliary fuel transfer pump shall be provided. Provide day tank when required by generator set supplier.

B. Provide above ground, stand-alone type fuel tank with double wall construction consisting of a UL listed rectangular steel tank with secondary containment. Tank shall:

(1) Comply with the requirements of UL 2085, including fire resistive, vehicle impact and ballistics protection listings, and shall be so labeled.
(2) Be of a type that has been in production for at least five years and shall carry a minimum 30-year warranty.
(3) Be constructed in accordance with UL-142 Standard for Steel Above Ground Tanks for Flammable and Combustible Liquids.
(4) Shall have the space between the inner (primary) and outer (secondary) tank walls filled with a lightweight thermal insulation to provide a minimum two-hour fire wall rating as tested by UL 2085.
(5) Have capacity to run the generator for a period of 72 hours at ¾ load plus an additional 15% capacity to allow for 10% overfill and 5% below the suction pipe.
(6) Have threaded openings for fill, supply, return, atmospheric vent, emergency vents and gauge lines. Supply and return openings shall be as recommended by generator-set supplier. Coordinate location of openings with tank facilities shown on Contract Drawings.
(7) Provide sight glass fuel level indicator showing fuel level in ¼ increments.
(8) Have dip stick type monitoring.
(9) Have lockable fill cap, atmospheric vent, and emergency vent.

(10) Have a high level fuel alarm contact, a low level fuel alarm contact and leak detection alarm contact.
(11) Have grounding lug.
(12) Have UL listed seven gallon spill/overflow container with drain valve that drains back into tank.
(13) Have overfill prevention valve rated for pressurized delivery. Valve shall close automatically at 90% full level.
(14) Have alarm panel in NEMA 4 enclosure attached to the tank. Alarm shall consist of horn and light to signal when tank has dropped to 20% of its capacity or has developed a leak. Panel shall be complete with alarm reset switch and with test switch to permit testing alarm devices.
(15) Have one coat epoxy paint and one coat polyurethane finish coat. Color shall be selected by generator set supplier and approved by owner.
(16) If tank height exceeds 36″, have galvanized steps and handrails of sufficient height to allow fuel supplier to fill tank without supplementary ladders or lifts. Steps and handrails shall be of a design allowable under all pertinent OSHA platform regulations.
(17) Have fuel tank piping as indicated.
(18) Be installed where indicated and shall be as manufactured by General Industries Inc., Tramont or Superior Systems and Technologies.
(19) Contractor shall assist the Owner in obtaining necessary permits and certificates of use.

2.18 Fuel System Piping

A. Engine return fuel oil line shall be returned to main supply tank.

B. Above ground piping shall be:

(1) Schedule 40 A53, Grade B black steel pipe.
(2) ASTM Black Malleable Iron, 150 class threaded fittings and 300 lb. Malleable Iron Unions.
(3) Verify pipe sizes with generator manufacturer to provide required fuel flow. Design line size is 1″.
(4) Above ground pipe shall be threaded.

2.19 Generator set shall be installed in a sound attenuated weatherproof housing with muffler installed inside of the enclosure. The enclosure shall reduce the noise level of the generator operating at 100% load to no more than 75 dBA at 23 feet. The enclosure shall be equipped with two access doors on each side that permits full access to the engine generator set inside. One door shall have a plexiglass window installed in it that allows full view of the generator control panel with the door shut. Housing shall be finished with manufacturer's standard finish.

2.20 A remote “Emergency Off/Lockout” station shall be installed on the exterior of the housing. Station shall be red, 2.25 inch mushroom head push for “Off” and pull for

"On" type with D.P.D.T. contact block and NEMA 4X stainless steel enclosure.

2.21 The Automatic By-Pass Isolation Transfer Switch shall be of the pause in neutral, double throw type with integral By-Pass Isolation switch in a common NEMA 1 or NEMA 3R enclosure as required. The switch shall have a contact to contact transfer time greater than 0.5 seconds. Operation of the By-Pass Isolation switch shall not interrupt power to the load. Switch shall be three pole with ampere rating as indicated.

A. The transfer switch operation shall be accomplished as follows:

(1) The transfer shall be initiated by a drop of any phase of normal supply voltage below 75% of rated voltage.
(2) Provide adjustable time delay for transfer operation, in order to over-ride momentary power outages or fluctuations. Time delay shall be adjustable from 0.5 to 300 seconds and shall be set at 20 seconds.
(3) Load transfer to the alternate source shall occur only if the alternate source has at least 90% of rated voltage and 95% of rated frequency.
(4) The load shall be transferred back to the normal supply when the voltage of each phase of the normal supply has continuously remained above 90% of rated voltage for 300 seconds, and the phase rotation of the two sources is identical. Time delay shall be adjustable from 0 to 60 minutes, and set at 5 minutes.

B. Following re-transfer of the load to the normal voltage supply, the engine shall continue to run for a cool down period to be specified by the engine manufacturer. Time delay shall be adjustable from 0 to 60 minutes.

C. The ATS shall be equipped with the following isolated, dry, auxiliary contacts:

(1) A1TD - SPDT timed open, timed close contacts to indicate Normal Power Available. Timing range shall be 3 to 300 seconds and shall be set at 30 seconds.
(2) A1E - SPDT instantaneous contacts to indicate Emergency Power Available
(3) A4DT - SPDT instantaneous contacts to indicate ATS in Normal Position
(4) A3DT - SPDT instantaneous contacts to indicate ATS in Emergency Position
(5) A1LTD - SPDT timed open, timed close contacts to indicate Load Energized. Timing range shall be adjustable 1 to 300 seconds set at 5 seconds.

D. The ATS shall be equipped with a time clock to exercise power system. The exerciser shall be switchable for Load/No Load operation, and shall permit exercising the generator on a weekly basis for periods adjustable from 1 minute to 24 hours. Exerciser shall be programmed as requested by site personnel at start-up.

E. The ampere rating of the complete By-Pass Isolation ATS shall be a continuous rating with the switch installed in a non-ventilated enclosure. The thermal capacity of the main contacts shall not be less than 20 times the continuous rating.

F. ATS/BPS combined shall be equipped with the following indicator lights:

(1) L2 - Normal Position
(2) L1 - Emergency Position
(3) L4 - Normal Power Available
(4) L3 - Emergency Power Available
(5) ATS in Test Position
(6) ATS Isolated
(7) ATS Inhibited
(8) ATS Operator Disconnect Switch in "Off"
(9) By-Pass Switch in Normal Position
(10) By-Pass Switch in Emergency Position

G. When coordinated with molded case circuit breakers, the minimum withstand and closing rating (WCR) shall be as follows, for a minimum of 3 electrical cycles. WCR rating of the By-Pass Isolation switch shall be equal to the ATS.

| Amperage | 3 Cycle Rating (UL1008) |
|---|---|
| 0-100A | 22,000 Symmetrical |
| 101-399A | 30,000 |
| 400-599A | 35,000 |
| 600-1599A | 50,000 |
| 1600-3000A | 100,000 |

ATS/BPS shall also be rated for 200,000 WCR when coordinated with current limiting fuses, regardless of ampere rating.

H. Transfer switch and all accessories and terminations may require front and side access. Provide adapter bay, where required, to permit cables to enter at bottom of switch.

I. The ATS shall be equipped with Pause-in-Neutral feature. Pause time shall be adjustable 0 to 10 minutes and shall be set at five (5) seconds.

J. The ATS shall be equipped with a maintained contact test switch.

K. The ATS shall be equipped with one set of meters to monitor the load. The set of meters shall consist of an ammeter with selector switch to permit monitoring current in each phase and a voltmeter with a seven position selector switch to permit monitoring phase to phase and phase to neutral voltages for each phase.

L. The ATS/BPS combination shall be rated as indicated on the drawings and shall include the following accessories:

| | | |
|---|---|---|
| (1) | CDP | Load / No Load Exerciser |
| (2) | DS | Selector switch to permit automatic (auto) operation or non automatic (inhibit) operation of the transfer switch. |
| (3) | S5P | Auto/Semi Manual selector switch. In semi manual mode, retransfer to source 1 shall be automatic if source 2 fails. |
| (4) | E | Engine Start Contacts |
| (5) | P2 | Time Delay, Engine Start – Extended |
| (6) | T | Time Delay, Re-Transfer to Normal |
| (7) | U | Time Delay, Engine Cool Down |
| (8) | W | Time Delay, Transfer to Emergency |
| (9) | M2 | Ammeter with 3 position selector switch |
| (10) | M4-7 pos. | Voltmeter with 7 position selector switch |
| (11) | A-62 | Programmed/Sequenced motor control contacts to be closed with ATS in normal position and timed to close when switch moves to emergency position. Contacts shall be provided when motors are to be started in steps that are not provided by system motor control schemes. Contact timing shall be:<br><br>15 seconds – Starting step #2 (if applicable)<br>30 seconds – Starting step #3 (if applicable)<br>45 seconds – Starting step #4 (if applicable)<br><br>Contacts shall be rated 10 amps at 480 volts. |
| (12) | | UMD SPST contact to open prior to transfer in either direction. Time of operation shall be adjustable from 0 to 60 seconds prior to transfer and shall be set at 15 seconds to permit orderly shutdown of the system prior to transfer. |

2.22 An ATS installed outdoors shall be equipped with a keyed locking device to prevent unauthorized access to, or operation of, the microprocessor based keypad or the meter selector switches. The cover shall have a clear Plexiglas window to permit viewing the keypad and selector switches without opening the cover. Enclosure and cover shall be rated NEMA 3R.

2.23 Generator set shall be tested at the factory or on site, at full rated KVA load for a minimum period of 2½ hours with the use of resistive and reactive load banks furnished by the generator set supplier.

A. Data shall be tabulated at 30 minute intervals for the following:

(1) Voltage - each phase
(2) Amperage - each phase

(3) Frequency
(4) Power factor
(5) Cooling water temperature
(6) Exhaust gas temperature
(7) Oil pressure
(8) Ambient temperature

B. Results of this test shall be submitted to the Engineer for approval prior to final acceptance of the equipment and installation.

C. All fuel and other consumables required for this test when performed on site shall be provided by the Contractor. Fuel tank shall be filled to capacity prior to acceptance of installation by Owner.

## 3.0 EXECUTION

3.1 Oil tanks shall be installed and tested according to current installation instructions provided with the tank.

**END OF SECTION**

# VOLUME III


KING WILLIAM COUNTY, VIRGINIA

STANDARD DETAILS
FOR WATER AND SEWER SYSTEMS
AND RELATED WORK

## VOLUME III – STANDARD DETAILS

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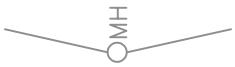
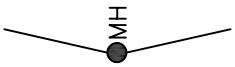
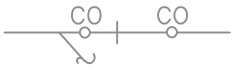
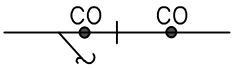
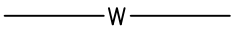
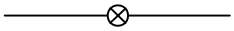
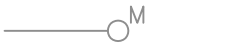
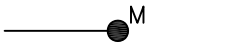
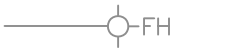
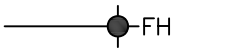
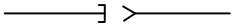
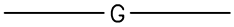
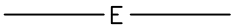
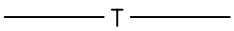
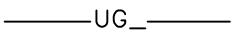
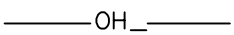
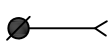
| **Sewer:** | |
| Utilize Hampton Roads Sanitation District (HRSD) Standard Details | |

| DESCRIPTION OF UTILITY | SYMBOL FOR EXISTING | SYMBOL FOR PROPOSED |
|---|---|---|
| SANITARY SEWER |   |   |
| MANHOLE |   |   |
| CLEANOUT |   |   |
| SEWAGE FORCE MAIN |   |   |
| WATER MAIN OR SERVICE LINE |   |   |
| VALVE |  |  |
| VALVE |  |  |
| METER |   |   |
| FIRE HYDRANT |   |   |
| REDUCER |  |  |
| PIPE FITTINGS & REACTION BLOCKING |  |  |
| PIPE END CAP OR PLUG |  |  |
| GAS MAIN OR SERVICE LINE |   |   |
| STORM SEWER WITH ENDWALLS |  |  |
| ELECTRIC LINE |   |   |
| TELEPHONE LINE |   |   |
| CABLE TV LINE |   |   |
| UNDERGROUND LINE (FILL IN UTILITY) |   |   |
| OVERHEAD LINE (FILL IN UTILITY) |   |   |
| UTILITY POLE WITH GUY & ANCHOR |  |  |

| REVISED SEPTEMBER 2018 | STANDARD SYMBOLS FOR UTILITY DRAWINGS | DRAWING NO. G–1.0 |
|---|---|---|

| CARRIER PIPE DIAMETER | CASING PIPE | | | | | |
|---|---|---|---|---|---|---|
| | DIAMETER | MINIMUM WALL THICKNESS | | | | |
| | | CRITERIA WITHIN RAILROAD RIGHT OF WAY | | CRITERIA WITHIN VDOT RIGHT OF WAY | | |
| | | R.C.P. WITH PROTECTIVE DIAMETER | STEEL WITH PROTECTIVE DIAMETER | R.C.P. | STEEL | |
| 6" | 16" | 3.0" | 0.281" | 3.0" | 0.500" | |
| 8" | 20" | 3.0" | 0.375" | 3.0" | 0.500" | |
| 10" | 20" | 3.0" | 0.375" | 3.0" | 0.500" | |
| 12" | 24" | 3.5" | 0.375" | 3.5" | 0.500" | |
| 15" | 24" | 3.5" | 0.375" | 3.5" | 0.500" | |
| 16" | 24" | 3.5" | 0.375" | 3.5" | 0.500" | |
| 18" | 30" | 4.0" | 0.500" | 4.0" | 0.500" | |
| 20" | 30" | 4.0" | 0.500" | 4.0" | 0.500" | |
| 21" | 30" | 4.0" | 0.500" | 4.0" | 0.500" | |
| 24" | 36" | 4.5" | 0.563" | 4.5" | 0.500" | |
| 30" | 42" | 5.0" | 0.625" | 5.0" | 0.500" | |
| 33" | 42" | 5.0" | 0.625" | 5.0" | 0.500" | |
| 36" | 48" | 5.5" | 0.688" | 5.5" | 0.500" | |
| 42" | 54" | 6.0" | 0.781" | 6.0" | 0.500" | |

REINFORCED CONCRETE CASING PIPE SHALL BE ASTM C–76, CLASS III.

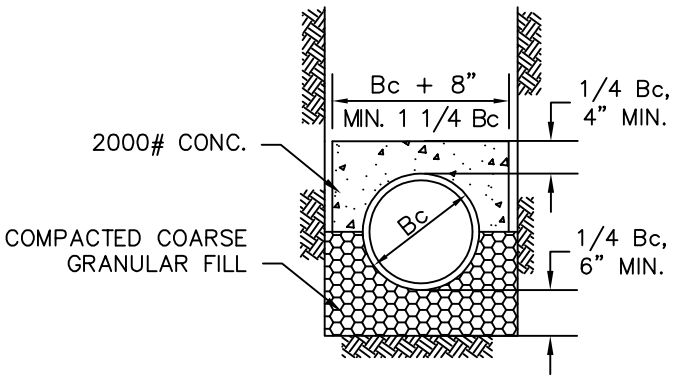
STEEL CASING PIPE SHALL BE ASTM 1–139, GRADE B.

NOTES:

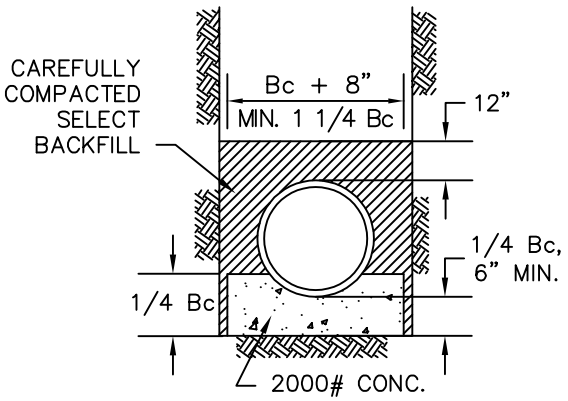
A. SLOPES THROUGH BORES SHALL NOT BE BASED ON MINIMUM GRADE UNLESS IT IS THE ONLY SLOPE AVAILABLE.
B. INCREASING THICKNESS OF CASING MUST BE CONSIDERED WHERE BORE LENGTHS EXCEED 125'.
C. USE USING STEEL CASING, A MINIMUM OF 0.3125" THICKNESS IS REQUIRED WHERE GROUND COVER OVER PIPE EXCEEDS 15'.
D. CONTRACTOR SHALL MAKE AN EFFORT TO BORE IN THE APPROPRIATE DIRECTION BASED ON EXISTING SOIL CONDITIONS. ENGINEER MUST SHOW LOCATION AND SIZE OF BORE PIT AND LOCATION AND SIZE OF PERMANENT AND CONSTRUCTION EASEMENT WHERE APPLICABLE.
E. WHERE RESTRAINING DEVICES ARE REQUIRED FOR CARRIER PIPE, THE CASING PIPE DIAMETER SHALL BE INCREASED AS NECESSARY.
F. FOR CROSSING UNDER RAILROADS THE MINIMUM REQUIREMENTS OF THE RAILROAD COMPANY APPLY.

| REVISED SEPTEMBER 2018 | CASING PIPE REQUIREMENTS | DRAWING NO. G–2.0 |
|---|---|---|

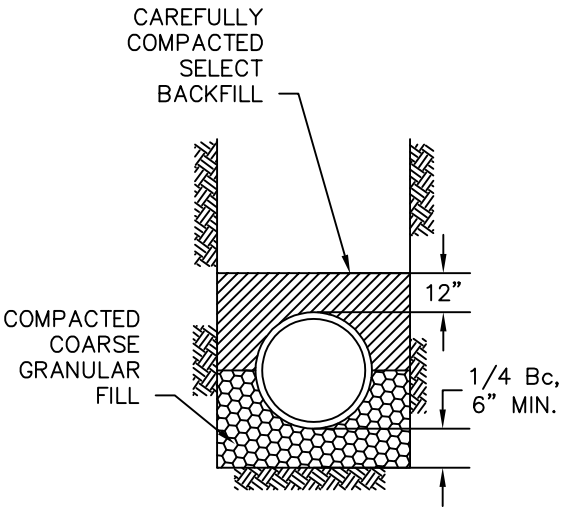
Bc = O.D. OF PIPE



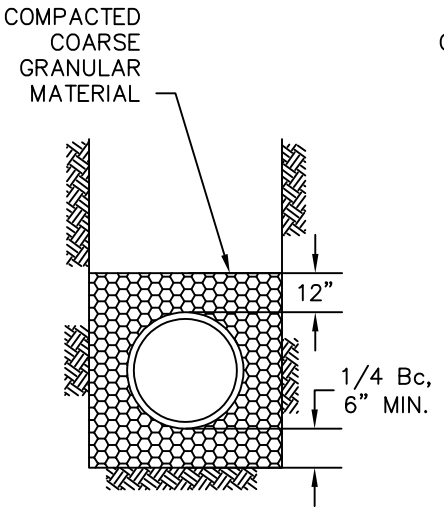

CLASS "A" BEDDING
LOAD FACTOR = 2.8



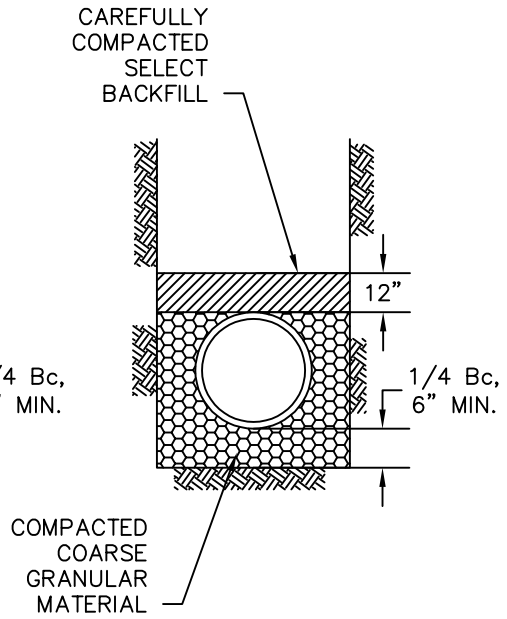

CLASS "A-1" BEDDING
LOAD FACTOR = 2.8




CLASS "B" BEDDING
LOAD FACTOR = 1.9




CLASS "B-1" BEDDING
LOAD FACTOR = 1.9



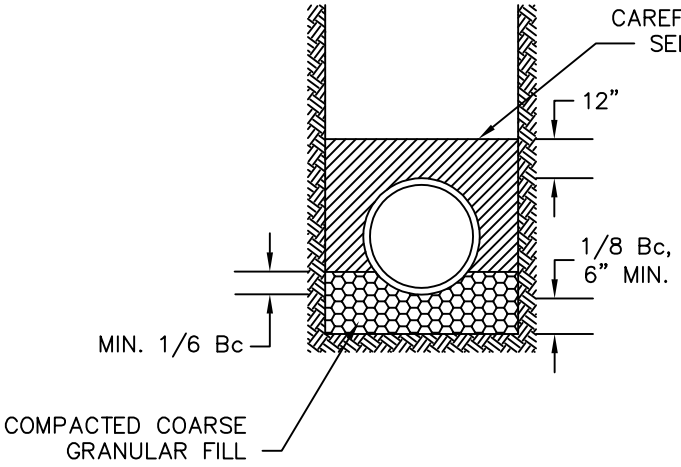

CLASS "B-2" BEDDING
LOAD FACTOR = 1.9

NOTE: IN ROCK TRENCH, EXCAVATE AT LEAST
6" BELOW THE BOTTOM OF THE PIPE.

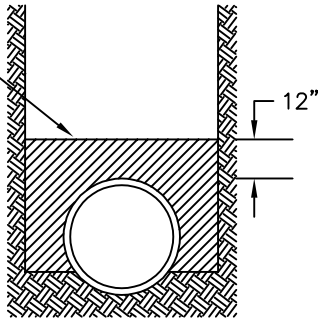
FOR RIGID PIPING (DUCTILE IRON OR CONCRETE)

| REVISED SEPTEMBER 2018 | TRENCH BEDDING – 1 | DRAWING NO. G–3.0 |
|---|---|---|

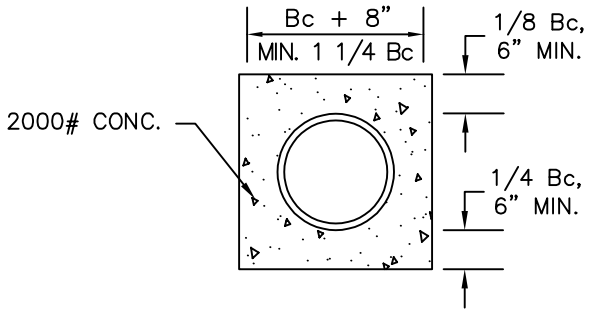
Bc = O.D. OF PIPE




CLASS "C" BEDDING
LOAD FACTOR = 1.5



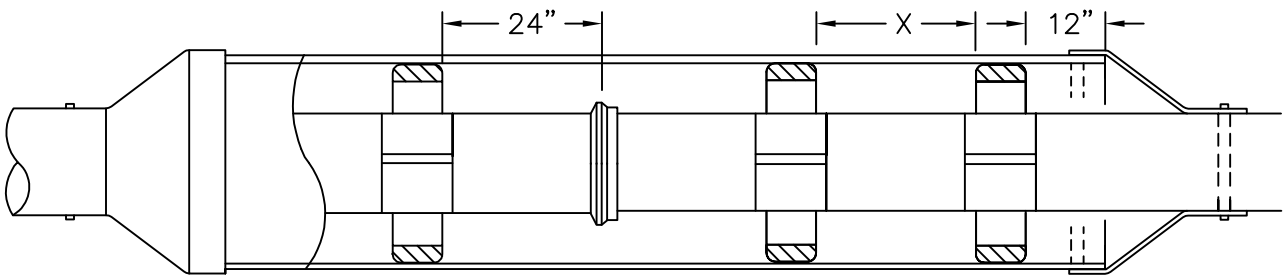

CLASS "C–1" BEDDING
LOAD FACTOR = 1.5




CONCRETE ENCASEMENT
LOAD FACTOR = 4.5

NOTE: IN ROCK TRENCH, EXCAVATE AT LEAST
6" BELOW THE BOTTOM OF THE PIPE.

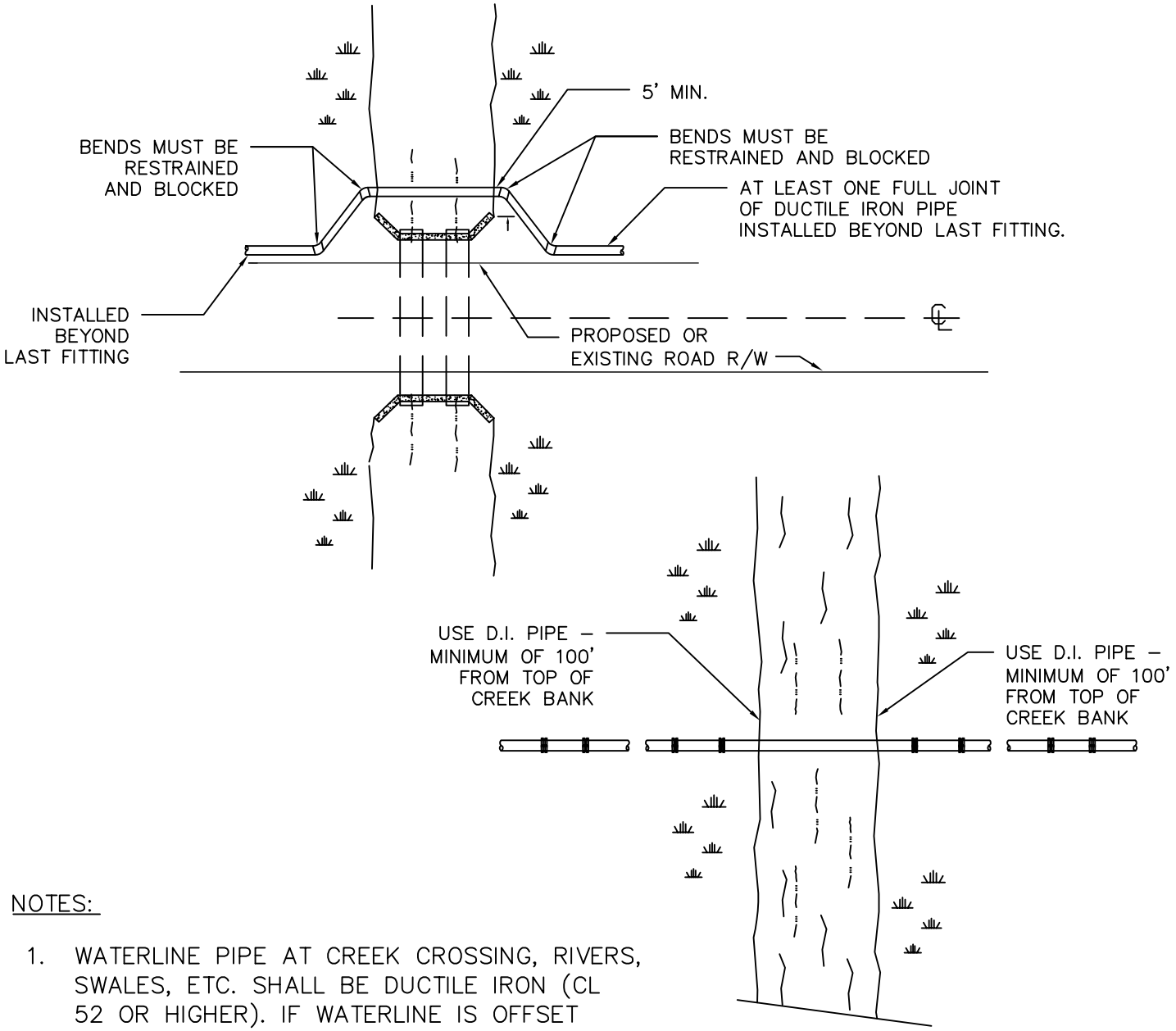
| REVISED | TRENCH BEDDING – II | DRAWING NO. |
|---|---|---|
| SEPTEMBER 2018 | | G–4.0 |




## CASING DETAIL NOTES:

1. CARRIER PIPE SHALL BE CENTERED WITHIN CASING BY AN APPROVED STAINLESS STEEL CASING SPACER.
2. CASING PIPE SHALL BE SEALED BY USE OF WRAPAROUND END SEALS OR WRAP ENDS OF CARRIER PIPE WITH TAR PAPER AND INSTALL 4" THICK BRICK AND MORTAR PLUG IN THE ANNULAR SPACE A 1" WEEP HOLE.
3. THREE CASING SPACERS SHALL BE ATTACHED TO EACH JOINT OF CARRIER PIPE WITH ONE AT THE CENTER AND ONE NOT MORE THAN 24" FROM EACH END.
4. ONE CASING SPACER SHALL BE LOCATED NOT MORE THAN 12" FROM EACH END OF CASING PIPE.
5. VALVES OR OTHER CONTROL/MAINTENANCE EQUIPMENT ATTACHED TO WATERLINE MAINS SHALL BE LOCATED A MINIMUM FOUR PIPE LENGTHS FROM THE END OF THE CASING, OR AS APPROVED BY THE COUNTY.
6. STEEL CASING SHALL HAVE A MINIMUM YIELD STRENGTH OF 35,000 PSI AND SUFFICIENT CORROSION PROTECTION.
7. LINES TO BE ENCASED UNDER STATE ROADS/RAILROADS WILL COMPLY WITH COUNTY AND ANY APPLICABLE VDOT/AMERICAN RAILROAD ENGINEERING SPECIFICATIONS WHICHEVER IS MORE STRINGENT.
8. WHEN INSTALLING CARRIER PIPE, CONTRACTOR SHALL PUSH SO THAT PIPE JOINTS ARE ALWAYS BEING COMPRESSED.
9. REINFORCED CONCRETE CASING PIPE SHALL BE ASTM C–76; CLASS III STEEL CASING PIPE SHALL BE ASTM–139, GRADE B.
10. ALL WATERLINES IN CASING SHALL BE A MINIMUM OF THICKNESS CLASS 52 DIP WITH MJ BELLS AND AN APPROVED JOINT RESTRAIN DEVICE AT EACH MJ CONNECTION. MINIMUM 3 JOINTS OUTSIDE EACH END OF CASING SHALL BE MJ DUCTILE IRON WITH RESTRAINED JOINTS.

| REVISED SEPTEMBER 2018 | CASING DETAIL – WATER | DRAWING NO. W–1.0 |
|---|---|---|



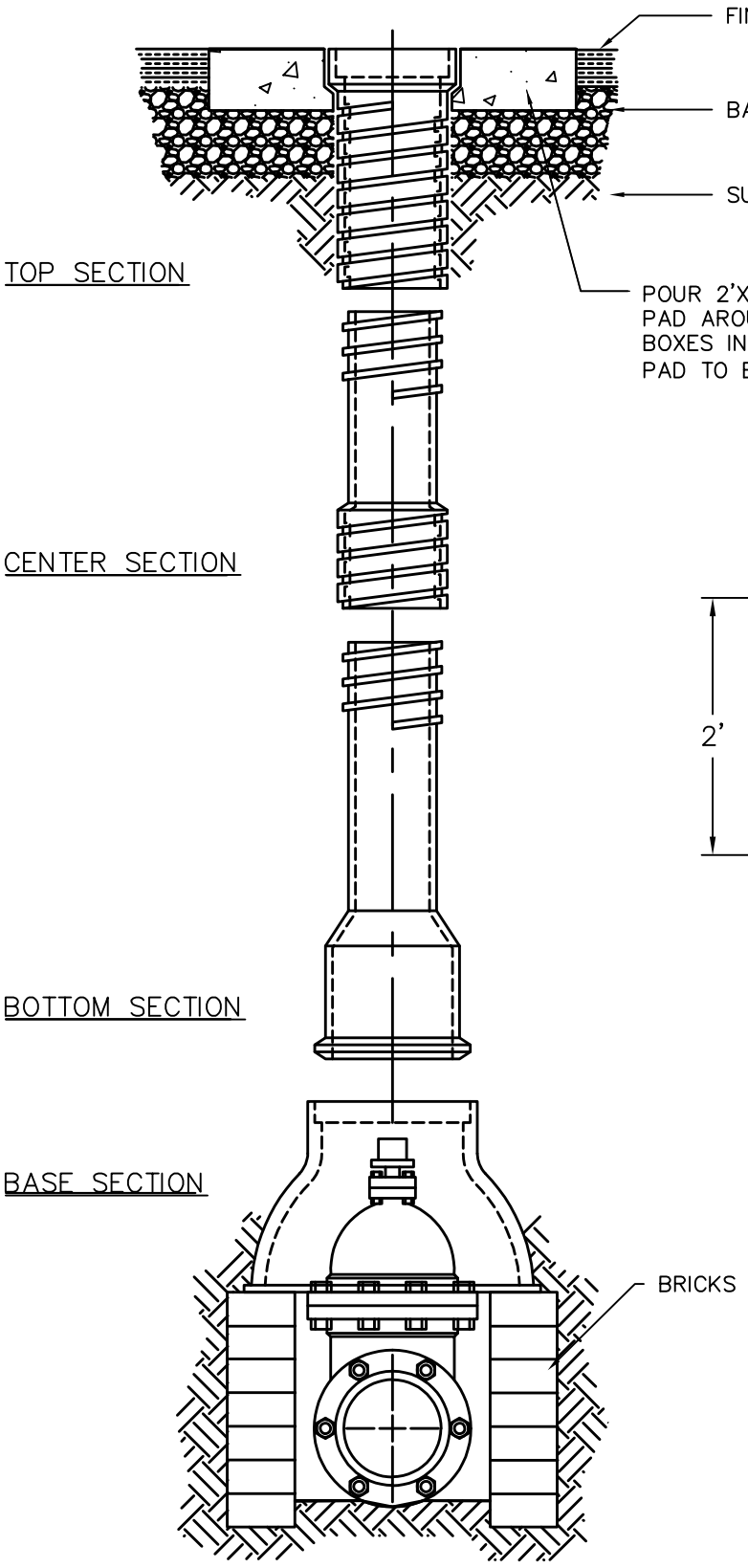

NOTES:

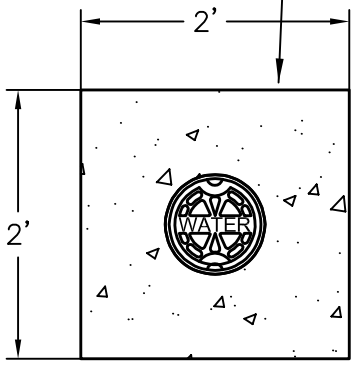
1. WATERLINE PIPE AT CREEK CROSSING, RIVERS, SWALES, ETC. SHALL BE DUCTILE IRON (CL 52 OR HIGHER). IF WATERLINE IS OFFSET AROUND CREEK CULVERTS, ENTIRE RUN OF OFFSET SHALL BE DUCTILE IRON. ALL FITTINGS SHALL BE INSTALLED WITH AN APPROVED JOINT RESTRAINT SYSTEM.

2. NO JOINTS ARE TO BE INSTALLED UNDER THE CREEK, WHERE POSSIBLE.

3. ISOLATION VALVES SHALL BE PLACED ON EITHER SIDE OF THE CREEK IN A LOCATION NOT NORMALLY SUBJECT TO FLOODING.

| REVISED SEPTEMBER 2018 | TYPICAL WATERLINE CREEK CROSSING | DRAWING NO. W–2.0 |
|---|---|---|



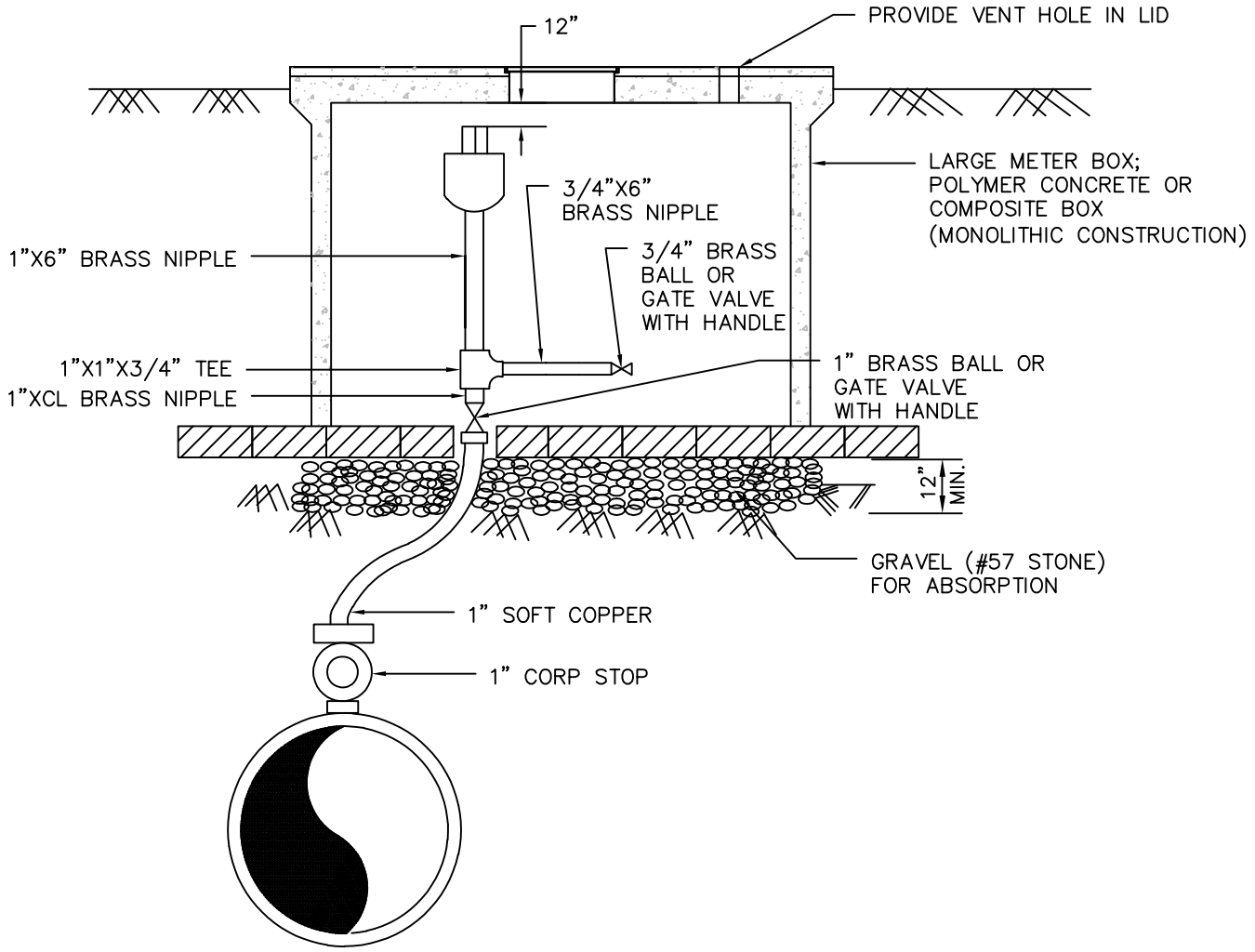




VALVE IN GRASS/OPEN AREA TYPICAL

NOTES:

1. SCREW-TYPE ADJUSTABLE VALVE BOX SHALL BE CAST IRON.
2. VERTICAL ADJUSTMENT MADE BY SCREWING TOP SECTION AND/OR REPLACEMENT OF CENTER SECTION. VALVE BOX LID SHALL NOT BE CUT OR MODIFIED.

| REVISED SEPTEMBER 2018 | VALVE BOX SCREW TYPE ADJUSTABLE | DRAWING NO. W-3.0 |
|---|---|---|




NOTES:

1. IT IS THE RESPONSIBILITY OF THE DESIGN ENGINEER TO DESIGN THE PUBLIC WATER SYSTEM TO MINIMIZE THE NUMBER OF AIR RELEASE VALVES BY ELIMINATING HIGH POINTS WHERE REASONABLY FEASIBLE AND TO PROPERLY SIZE THE AIR RELEASE VALVE TAKING INTO CONSIDERATION ALL THE DESIGN FACTORS. ORIFICE SIZE SHALL BE NOTED ON PLANS.

2. ALL COPPER FITTINGS WILL BE COMPRESSION TYPE.

3. SADDLE MUST BE USED FOR TAP.

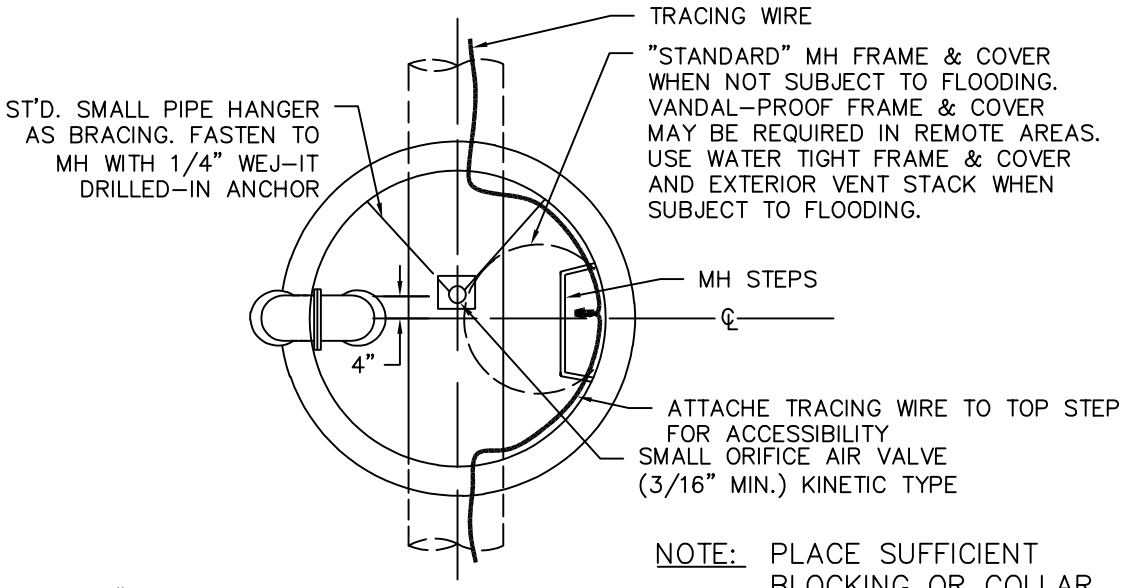
4. WHERE THE AIR RELEASE VALVE IS REMOTE FROM THE WATER LINE THERE MUST BE CONTINUOUS RISE IN THE COPPER SUPPLY LINE TO THE AIR RELEASE VALVE AND NO TRAP SHALL BE PERMITTED.

5. AIR RELEASE VALVE TO BE PLACED WHERE NOT SUBJECT TO FLOODING.

6. 1" AIR RELEASE VALVES ARE GENERALLY USED ON WATERLINES 12" OR LESS IN DIAMETER.

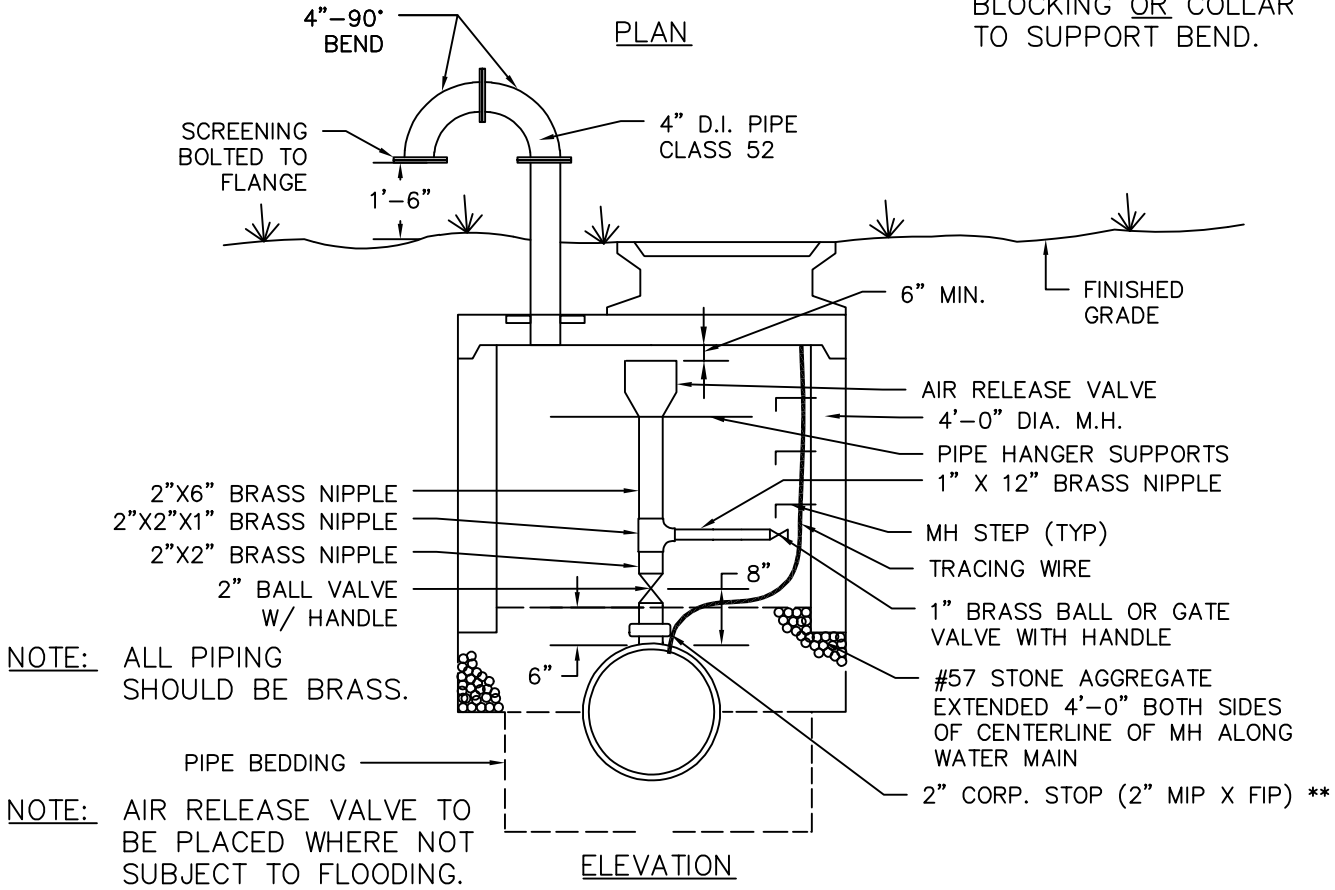
7. LARGER, STRAIGHT RUN LINES MAY REQUIRE EVEN LARGER AIR RELEASES UNDER CERTAIN CIRCUMSTANCES. THESE ARE TO BE EVALUATED ON A CASE–BY–CASE BASIS.

| REVISED SEPTEMBER 2018 | 1" AIR RELEASE VALVE | DRAWING NO. W–4.0 |
|---|---|---|




PLAN

NOTE: PLACE SUFFICIENT BLOCKING OR COLLAR TO SUPPORT BEND.




NOTE: ALL PIPING SHOULD BE BRASS.

NOTE: AIR RELEASE VALVE TO BE PLACED WHERE NOT SUBJECT TO FLOODING.

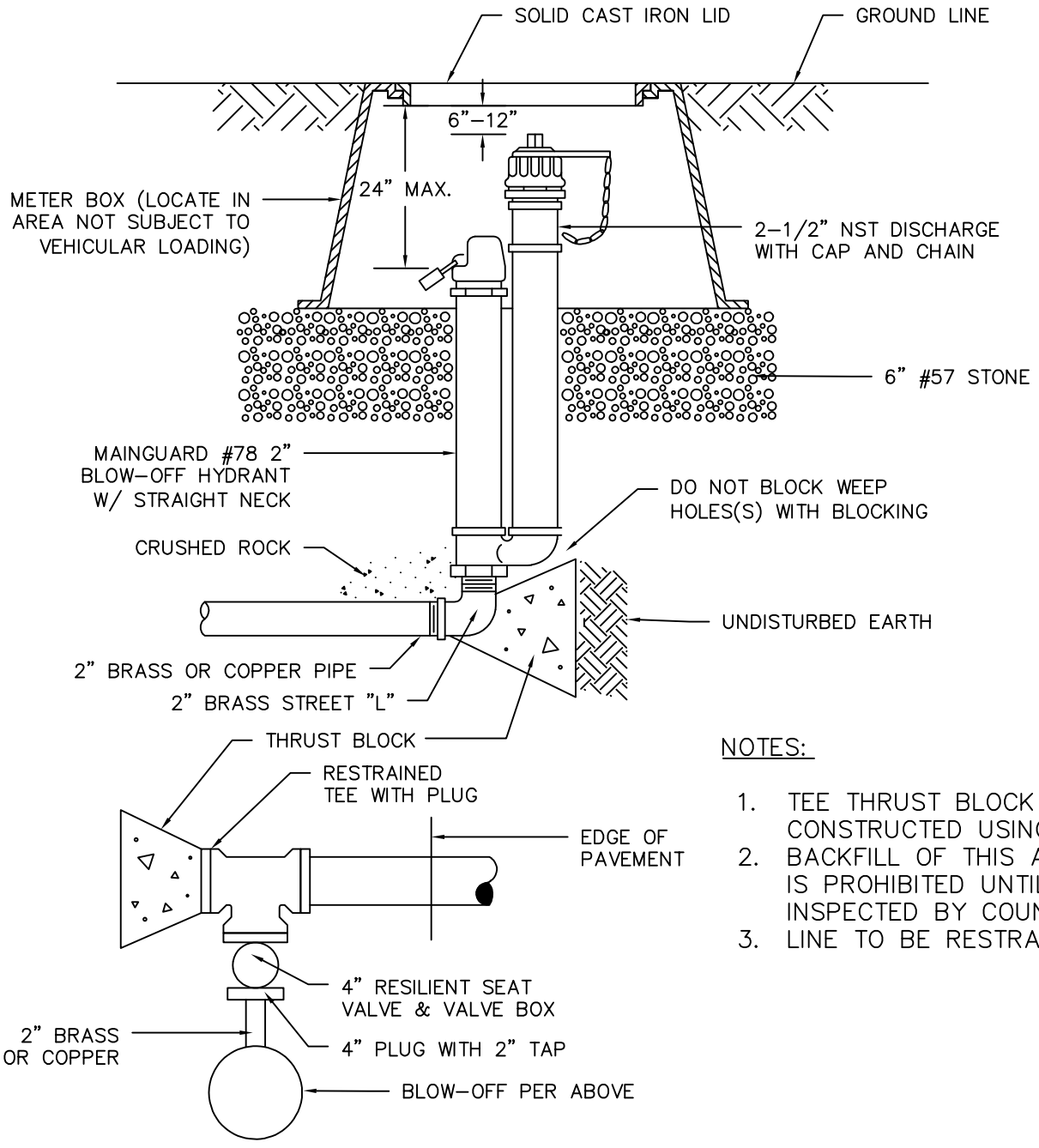
ELEVATION

** SADDLES MUST BE USED FOR TAP

NOTES:

1. 2" AIR RELEASE VALVES ARE GENERALLY USED ON WATERLINES 16" OR LARGER IN DIAMETER.
2. LARGER, STRAIGHT RUN LINES MAY REQUIRE EVEN LARGER AIR RELEASES UNDER CERTAIN CIRCUMSTANCES. THESE ARE TO BE EVALUATED ON A CASE-BY-CASE BASIS.

| REVISED SEPTEMBER 2018 | 2" AIR RELEASE VALVE | DRAWING NO. W-5.0 |
|---|---|---|

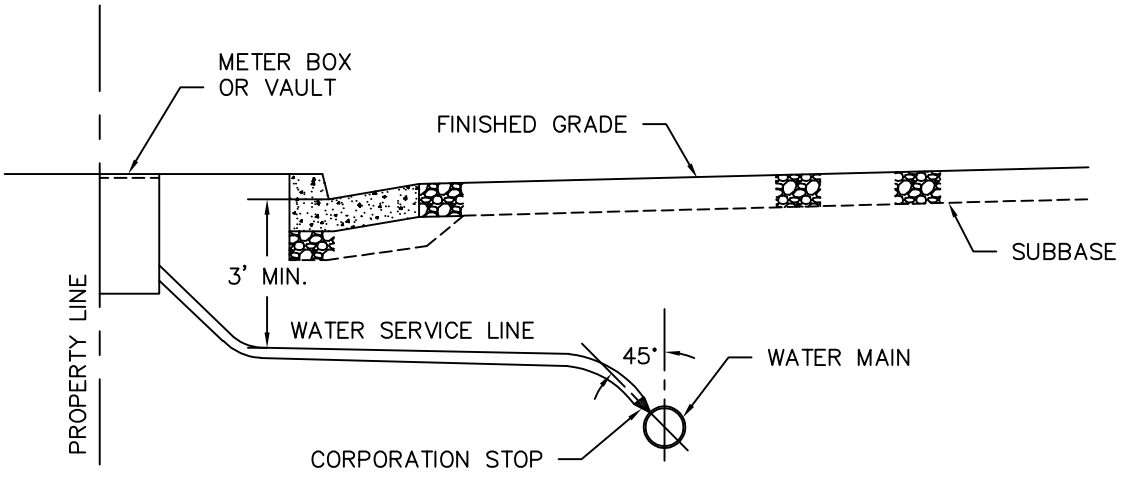



TYPICAL PLAN VIEW OF INSTALLATION

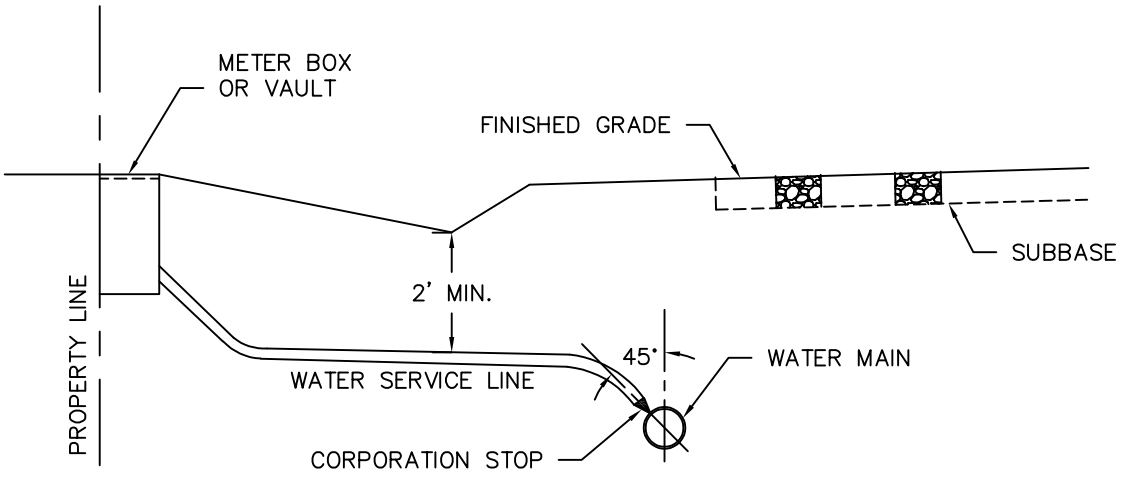
NOTES:

1. TEE THRUST BLOCK TO BE CONSTRUCTED USING FORMS.
2. BACKFILL OF THIS ASSEMBLY IS PROHIBITED UNTIL INSPECTED BY COUNTY.
3. LINE TO BE RESTRAINED.

| REVISED SEPTEMBER 2018 | 2" FLUSHING HYDRANT (BLOW–OFF) | DRAWING NO. W–6.0 |
|---|---|---|

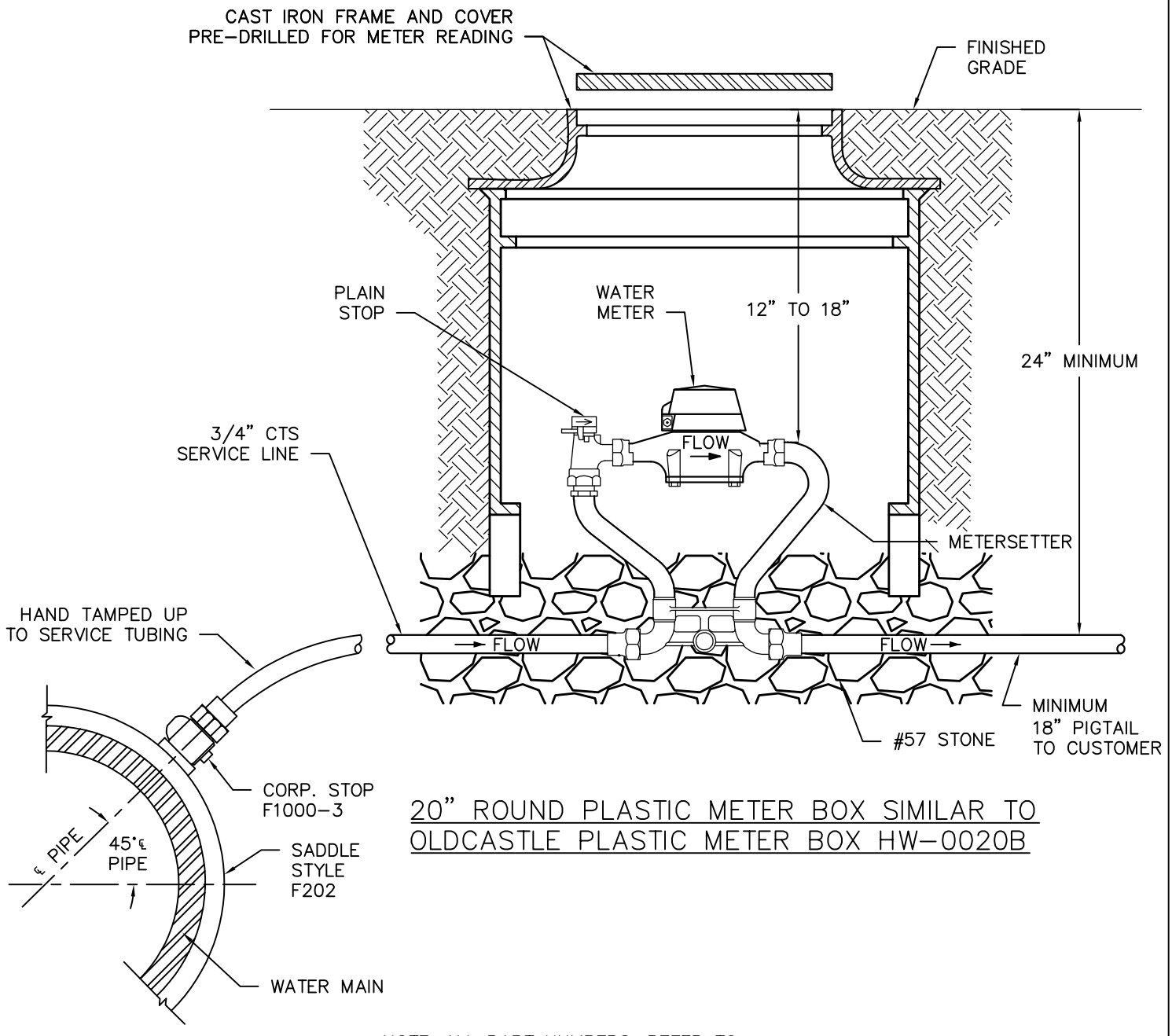



CURB & GUTTER




DITCH

| REVISED SEPTEMBER 2018 | METER INSTALLATION DETAIL | DRAWING NO. W–7.0 |
|---|---|---|

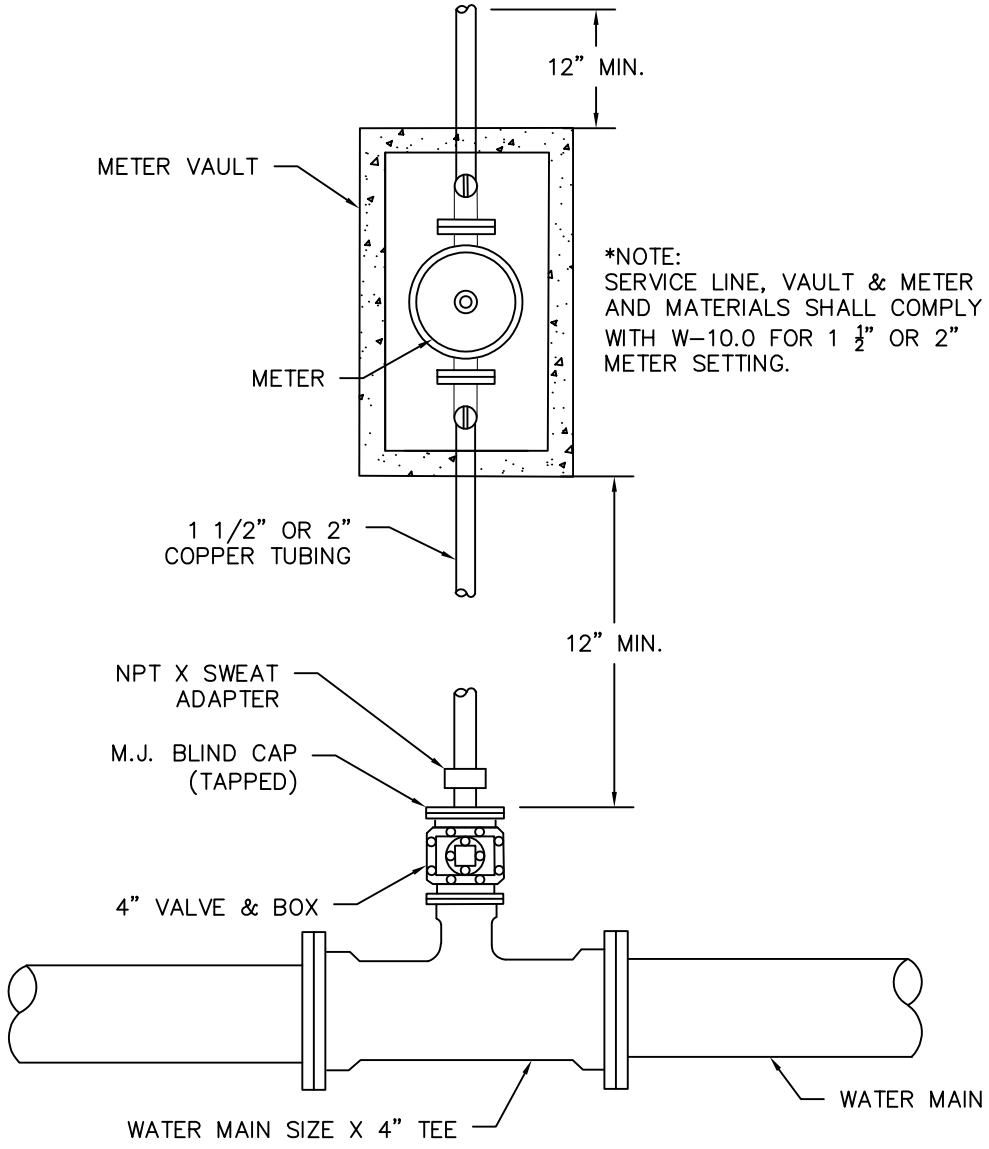



20" ROUND PLASTIC METER BOX SIMILAR TO OLDCASTLE PLASTIC METER BOX HW-0020B

ENLARGED VIEW

NOTE: ALL PART NUMBERS, REFER TO FORD METER BOX CO., INC.

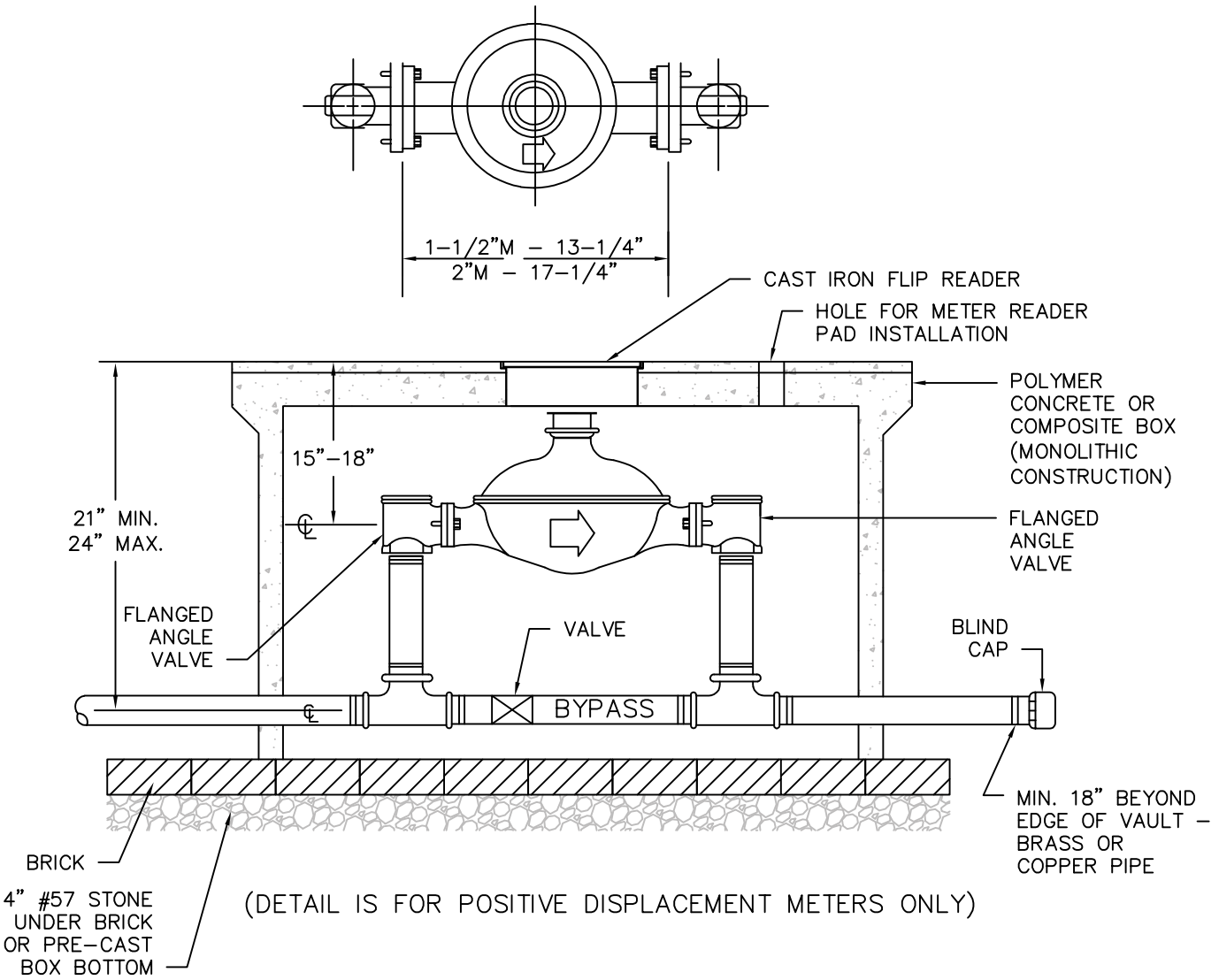
| REVISED SEPTEMBER 2018 | TYPICAL WATER METER CONNECTION FOR 3/4" SERVICES | DRAWING NO. W-8.0 |
|---|---|---|




| REVISED SEPTEMBER 2018 | STANDARD WATER SERVICE CONNECTION FOR COMMERCIAL AND MULTI–FAMILY PROPERTIES WITH 1 1/2" OR 2" METERS | DRAWING NO. W–9.0 |
|---|---|---|

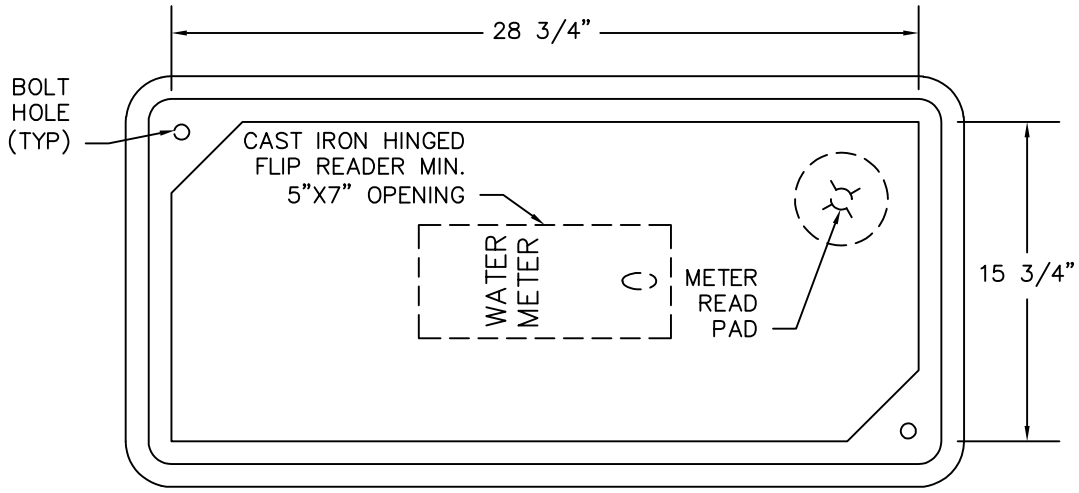
NOTES:

1. ALL 1–1/2" AND 2" METERS SHALL BE TIED TO THE MAIN PER W–9.0.
2. WATER SERVICE LATERALS FOR 1–1/2" AND 2" SERVICES WILL BE TYPE K HARD COPPER. CONNECTIONS FOR 1–1/2" AND 2" SERVICES WILL BE APPROVED COMPRESSION FITTINGS.
3. METER BOX TO BE AS NEAR TO THE WATER MAIN AS POSSIBLE WITHOUT PLACING BOX IN AREAS SUBJECT TO VEHICULAR TRAFFIC.
4. METER BOX TO HAVE MOUSE HOLES FOR SERVICE LINE ENTRY AND EXIT. SEAL RESIDUAL OPENING AS DIRECTED BY COUNTY.
5. BYPASS SHALL BE LOCATED ABOVE OR AT FLOOR LEVEL OF METER VAULT.
6. IF BOTTOM PROVIDED IS PRECAST BOX, DRAINAGE HOLES TO BE INSTALLED AS DIRECTED BY COUNTY.

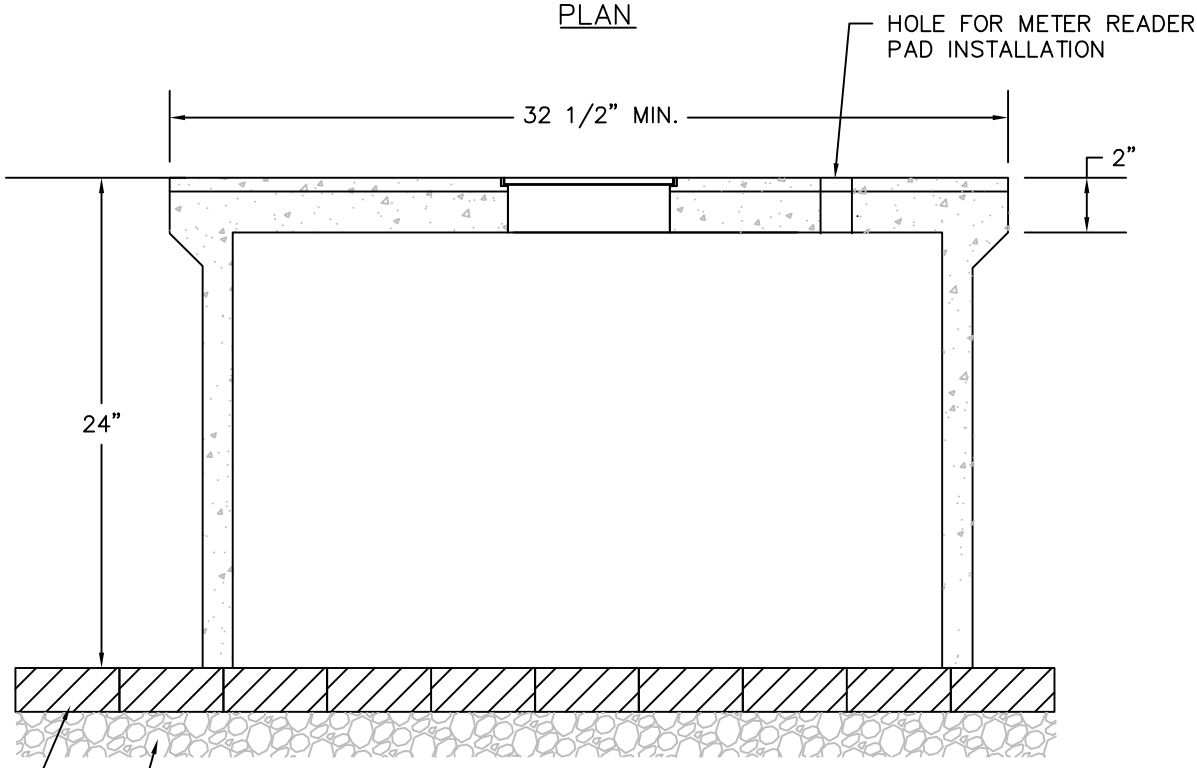



(DETAIL IS FOR POSITIVE DISPLACEMENT METERS ONLY)

| REVISED SEPTEMBER 2018 | 1–1/2" OR 2" METER SETTING | DRAWING NO. W–10.0 |
|---|---|---|



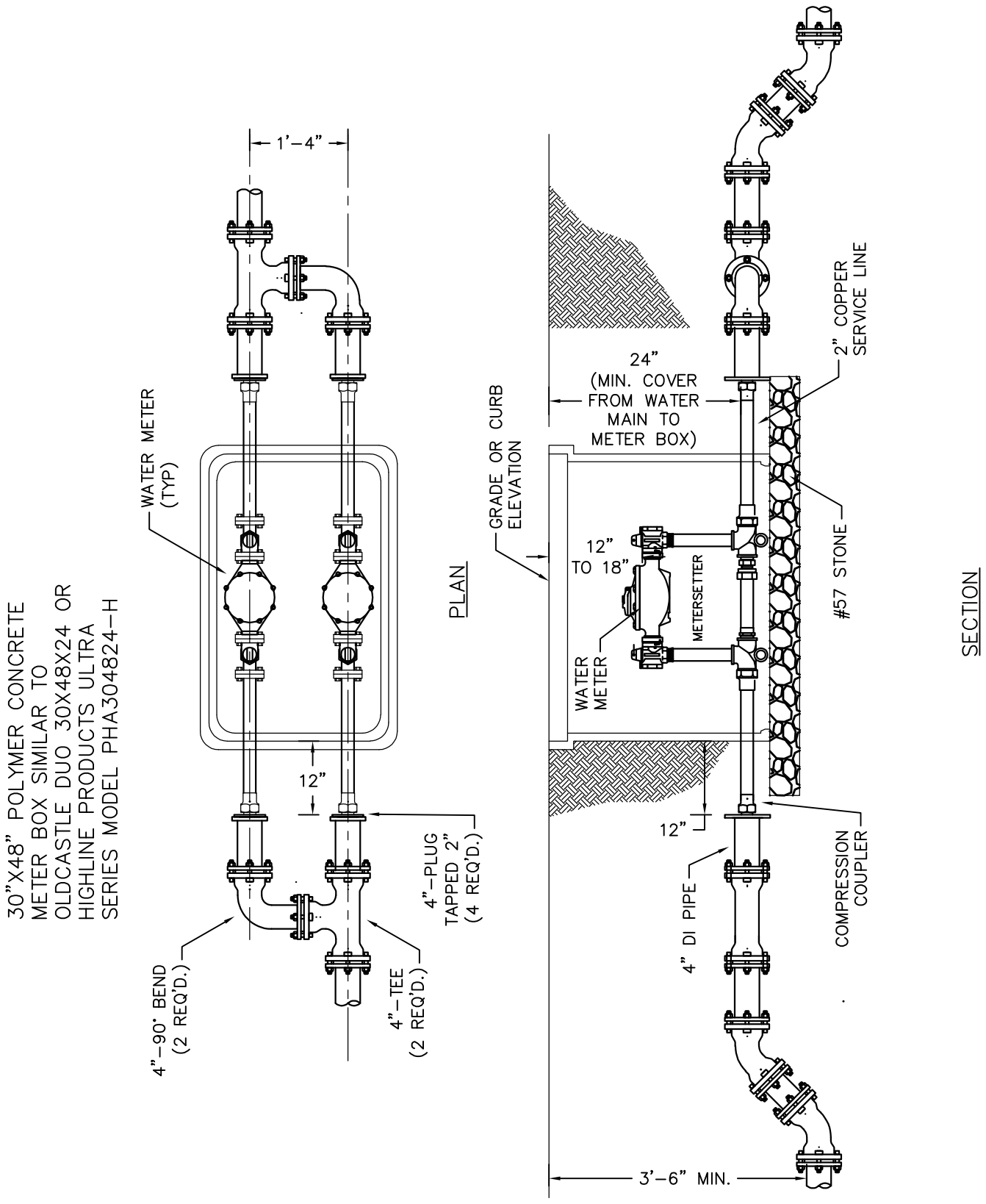

PLAN



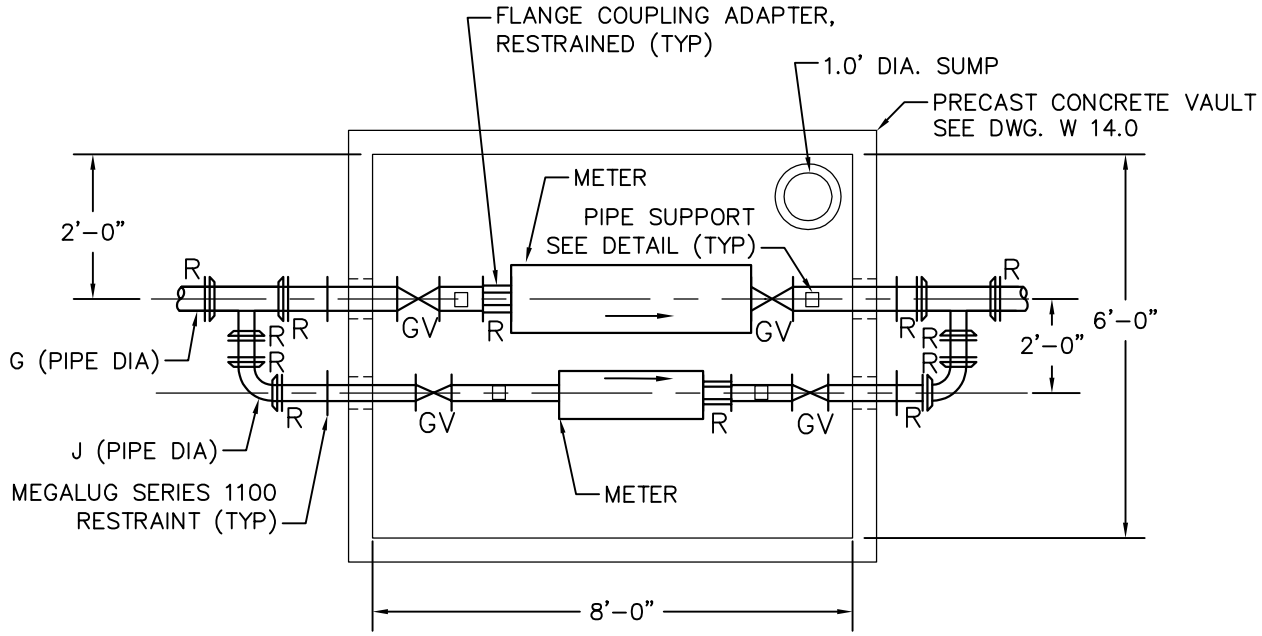

ELEVATION

NOTE:
MONOLITHIC CONSTRUCTION POLYMER CONCRETE OR COMPOSITE BOX WITH SEPARATE LID. BOX MAY HAVE BOTTOM AS PART OF CAST STRUCTURE. BOX WITHOUT BOTTOM AND BRICK BASE SHOWN ABOVE.

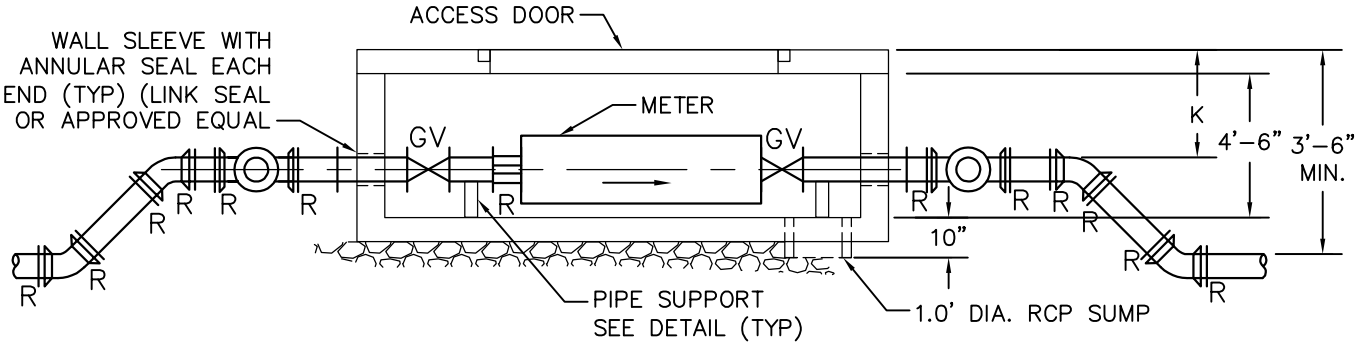
| REVISED SEPTEMBER 2018 | 1-1/2" & 2" METER BOX | DRAWING NO. W-11.0 |
|---|---|---|




| REVISED SEPTEMBER 2018 | DUAL 1-1/2" & 2" METER SETTING | DRAWING NO. W-12.0 |
|---|---|---|




PLAN

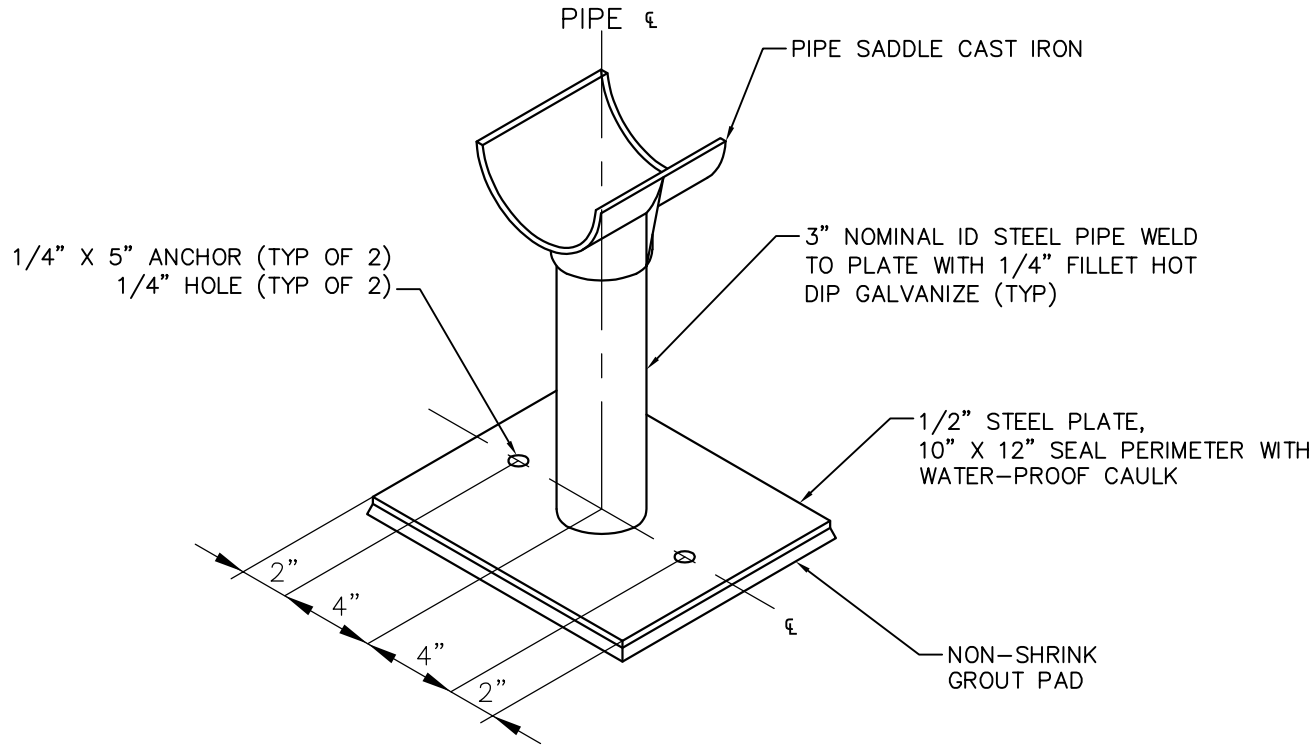



SECTION

| DIMENSIONS | | | |
|---|---|---|---|
| | 4" METER | 6" METER | 8" METER |
| G | 4" | 6" | 8" |
| J | 2" | 4" | 6" |
| K | 3'-4" | 3'-3" | 3'-2" |



| REVISED SEPTEMBER 2018 | 4", 6", & 8" METER SETTING | DRAWING NO. W-13.0 |
|---|---|---|



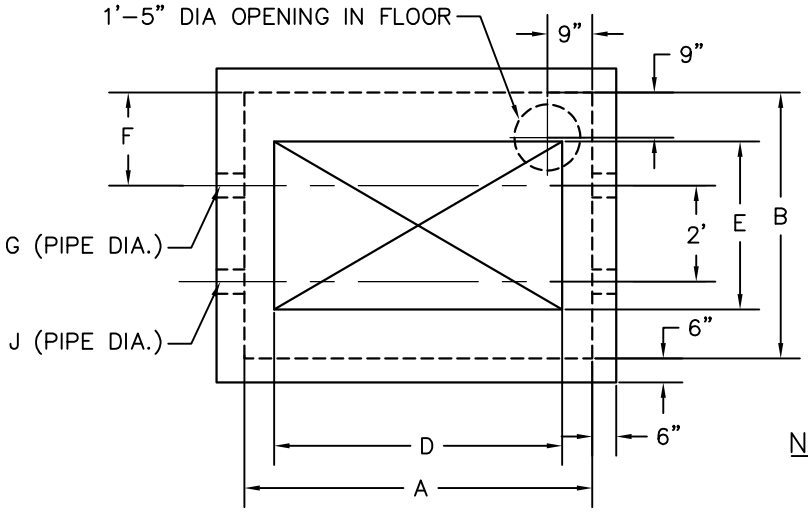

# PIPE SUPPORT DETAIL

## MATERIALS LIST

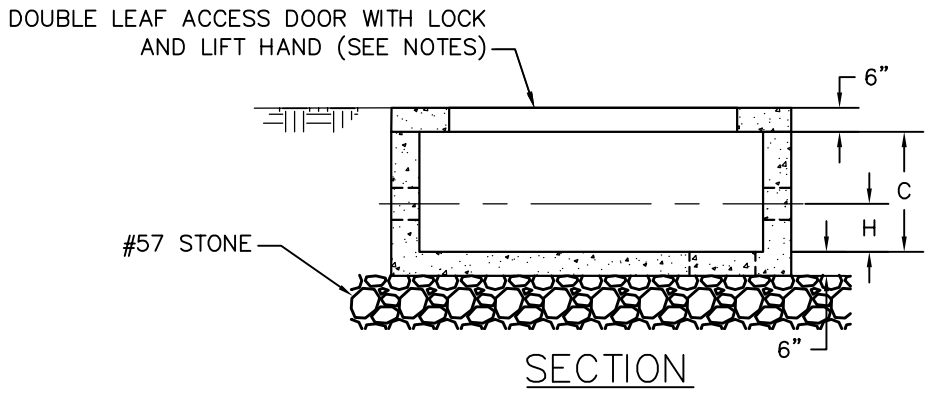
| QTY. | ITEM |
|---|---|
| 1 | 4", 6", OR 8" METER |
| 1 | 2", 4", OR 6" METER |
| 2 | 4", 6", OR 8" FLANGED GATE VALVES |
| 2 | 2", 4", OR 6" FLANGED GATE VALVES |
| 1 | 4", 6", OR 8" COUPLING |
| 1 | 2", 4", OR 6" COUPLING |
| 2 | 4", 6", OR 8" MEGALUG RESTRAINTS |
| 2 | 2", 4", OR 6" MEGALUG RESTRAINTS |
| 2 | 4", 6", OR 8" FLANGED BY PLAIN NIPPLES |
| 2 | 4", 6", OR 8" GASKETS |
| 4 | 4", 6", OR 8" 45° MJR BENDS |
| 2 | TEES |
| 1 | PRECAST CONCRETE VAULT |
| 1 | ACCESS DOOR |
| 2 | PIPE SUPPORTS |
| 10" | 1.0' DIA RCP |



| REVISED SEPTEMBER 2018 | MATERIALS FOR 4", 6", & 8" METER SETTING | DRAWING NO. W-13.1 |
|---|---|---|




PLAN



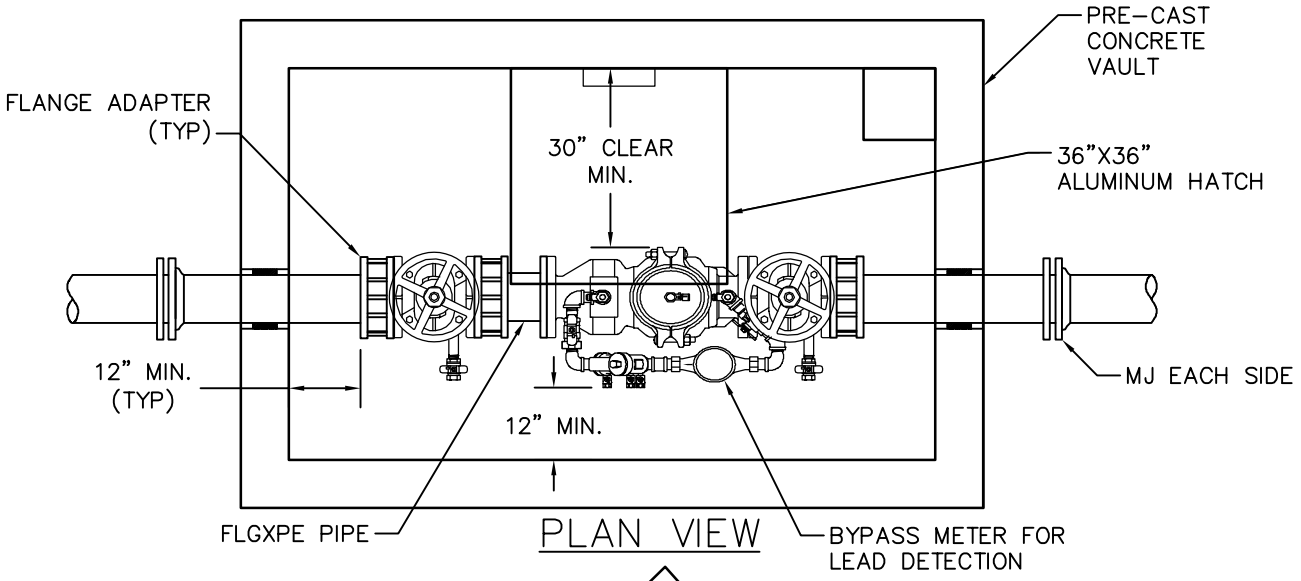

SECTION

NOTES:

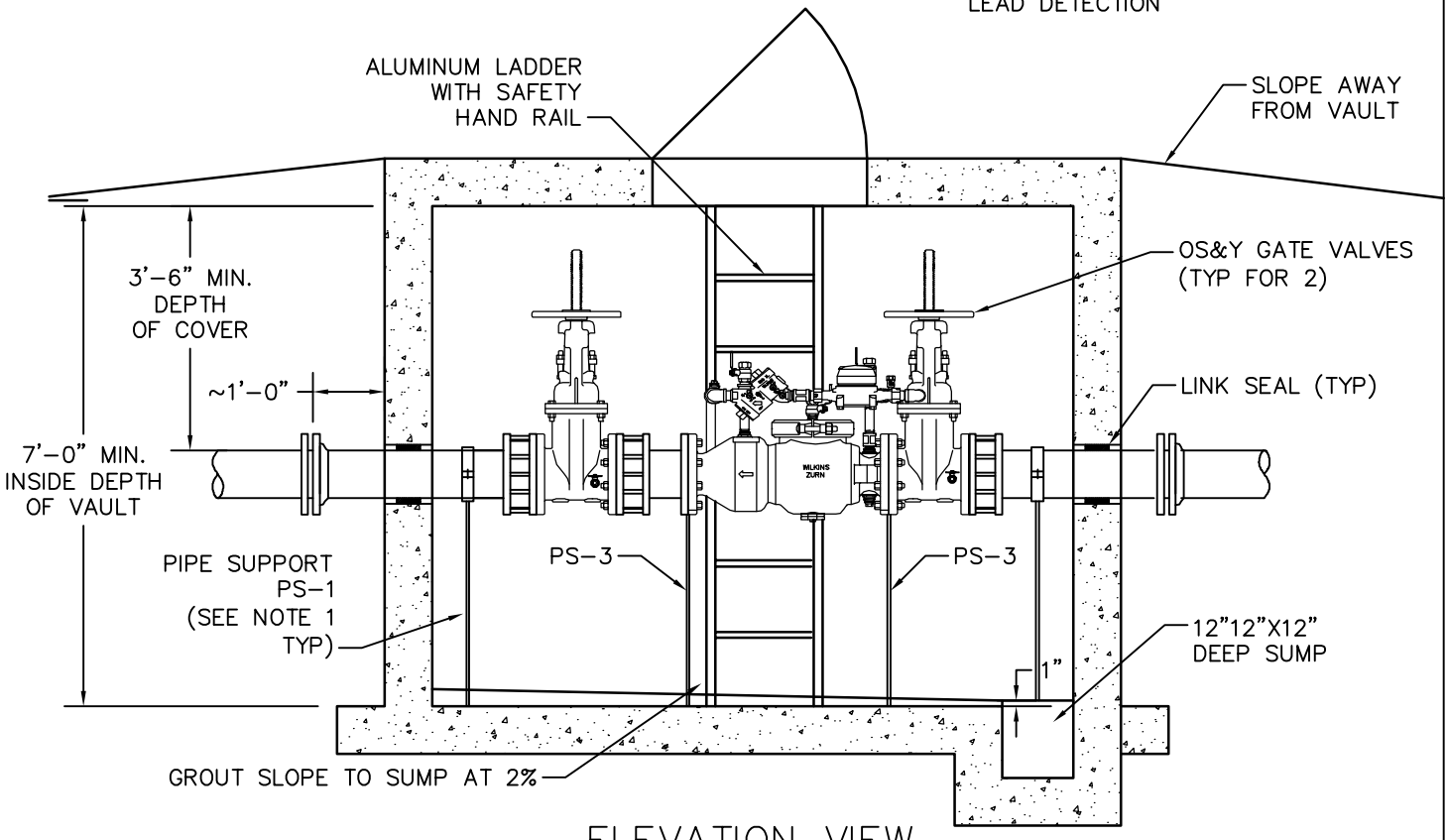
1. LOAD BEARING DOOR SHALL BE BILCO MODEL J H20 OR JD H20 ACCORDING TO SIZE OR APPROVED EQUAL.
2. CONCRETE 2000 PSI MINIMUM.
3. ALL REBAR MEETS ASTM A–615 GRADE 60.

| DIMENSIONS | |
|---|---|
| | 4", 6", OR 8" METER |
| A | 8'–0" |
| B | 6'–0" |
| C | 4'–6" |
| D | 6'–0" |
| E | 4'–0" |
| F | 2'–0" |
| G | 4", 6", OR 8" |
| H | 1'–6" |
| J | 2", 4", OR 6" |

| REVISED SEPTEMBER 2018 | METER VAULT FOR 4", 6", & 8" METERS | DRAWING NO. W–14.0 |
|---|---|---|




PLAN VIEW

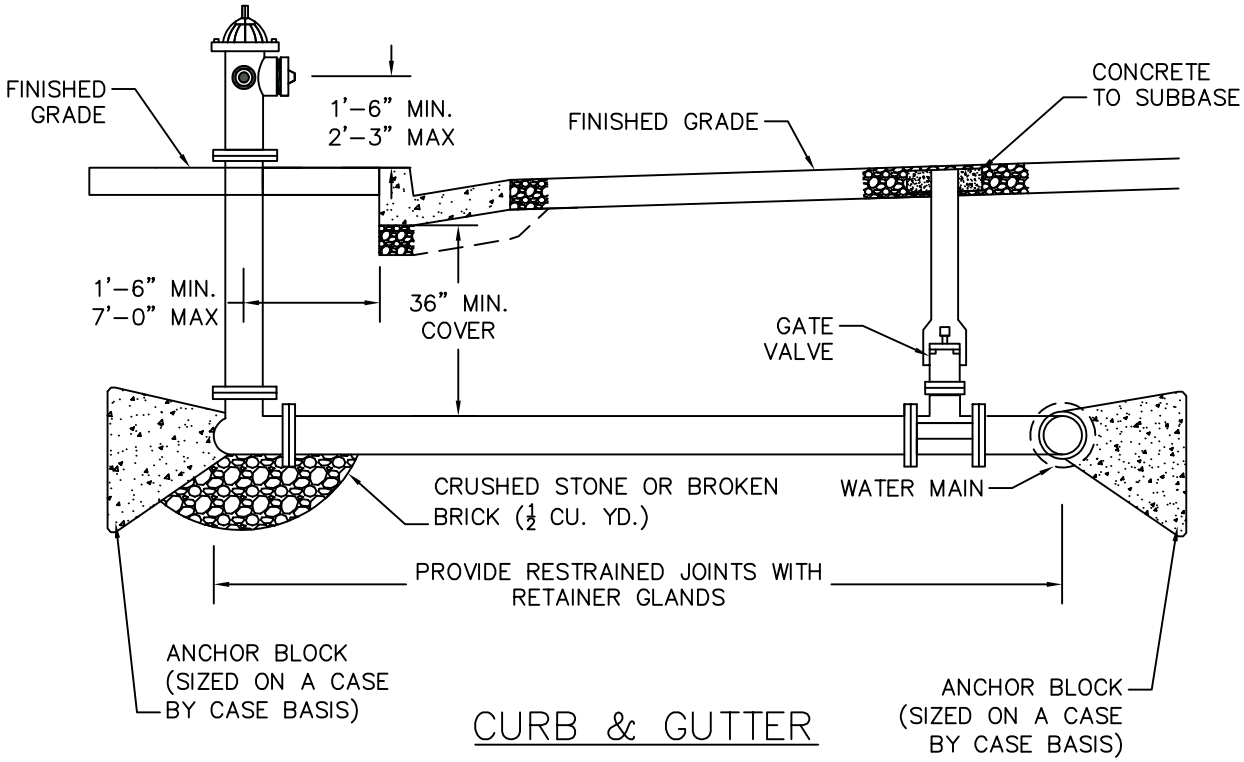



ELEVATION VIEW

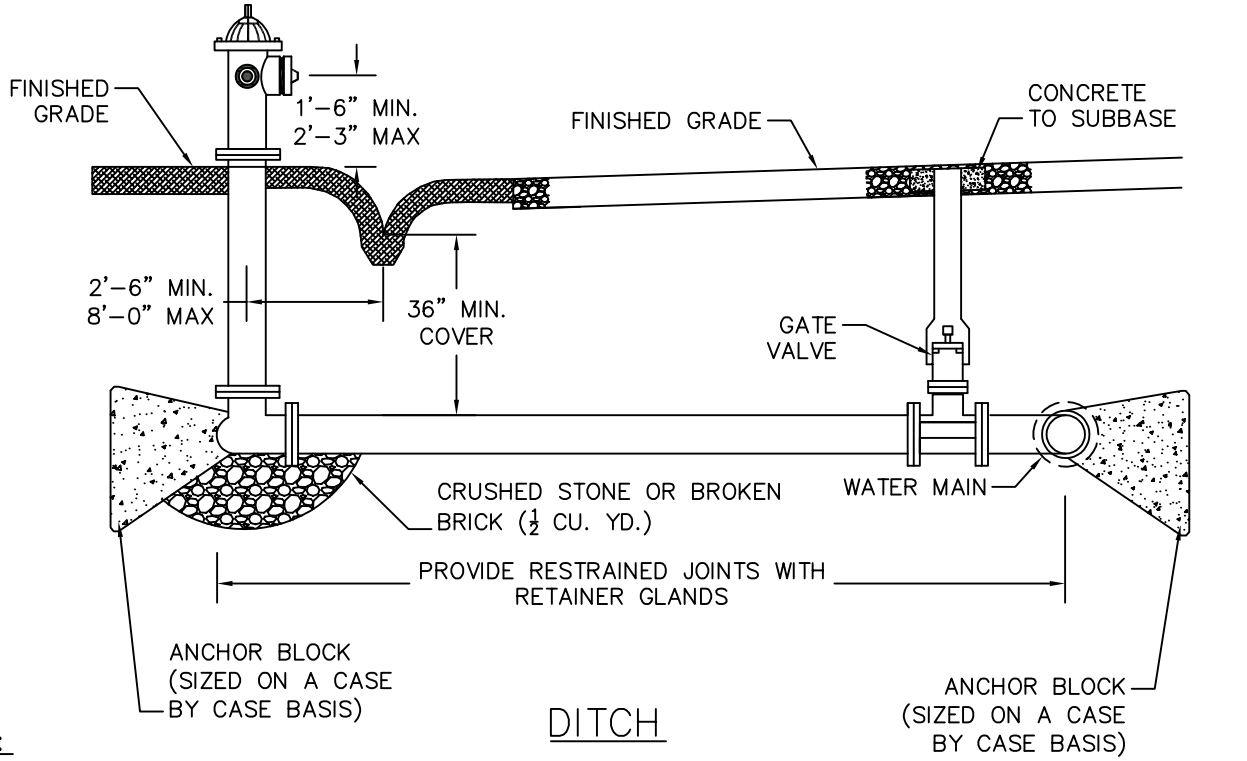
NOTES:

1. PIPE SUPPORTS TO BE ANCHORED TO VAULT FLOOR NOT GROUT WITH STAINLESS STEEL ADHESIVE ANCHORS
2. PIPE SUPPORTS TO BE IN ACCORDANCE WITH STANDARD DETAILS

| REVISED SEPTEMBER 2018 | DOUBLE CHECK VALVE ASSEMBLY FOR FIRE SERVICE | DRAWING NO. W-15.0 |
|---|---|---|




CURB & GUTTER



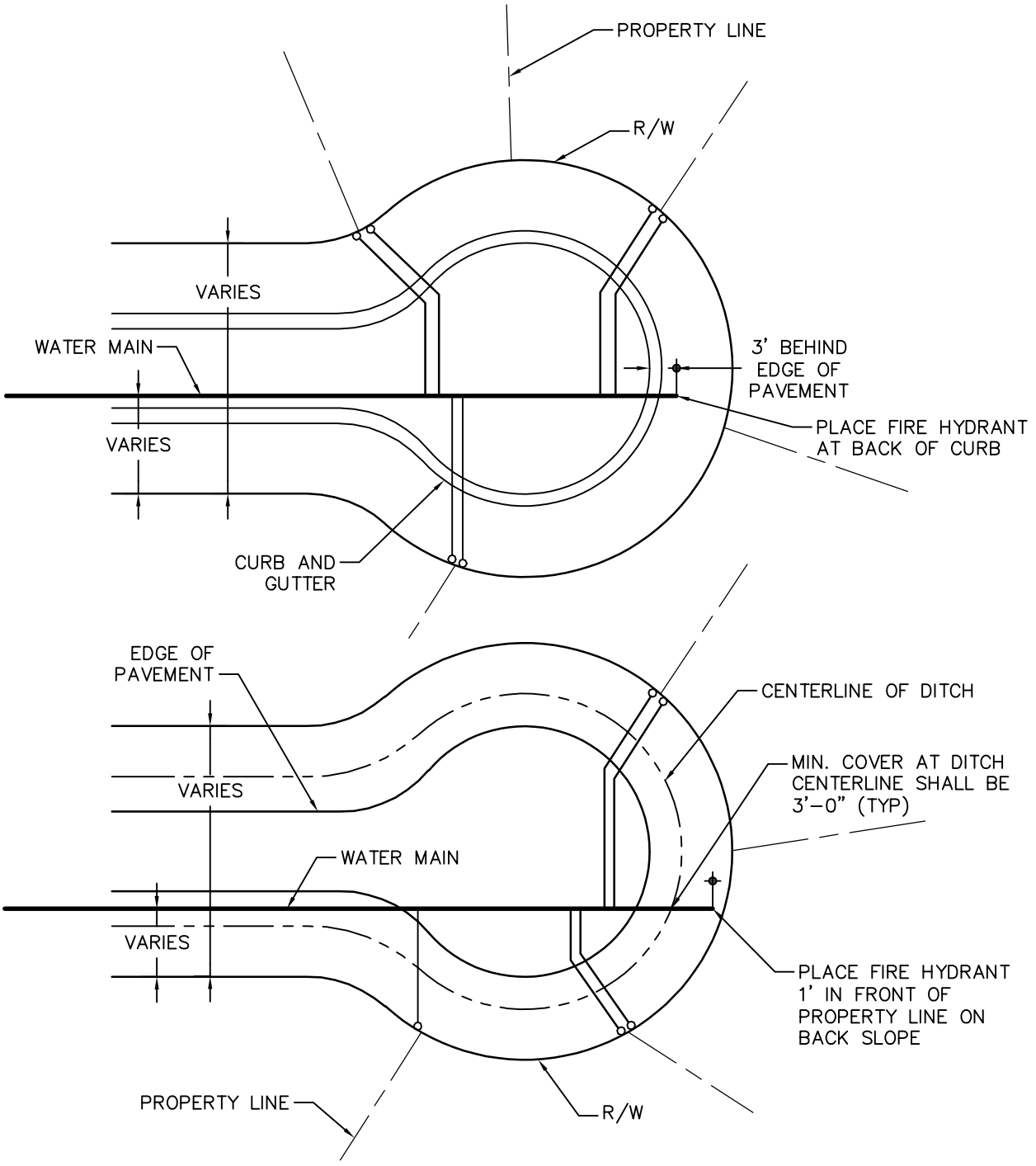

DITCH

NOTES:

1. ALL FIRE HYDRANTS SHALL HAVE THRUST BLOCKS AND JOINT RESTRAINTS FROM HYDRANT TO WATER MAIN.

2. APPURTENANCES WITH WEEPHOLES ARE SUBJECT TO CONTAMINATION WHEN INSTALLED IN AREAS SUBJECT TO HIGH GROUNDWATER, TO FLOODING, TO CONTAMINANT OR POLLUTANT SPILLS, OR IN AREAS WHERE SURFACE WATER PONDS. WEEPHOLES SHOULD BE PLUGGED OR HARD PIPED TO DRAIN TO DAYLIGHT WHEN HYDRANTS ARE INSTALLED UNDER THESE CONDITIONS.

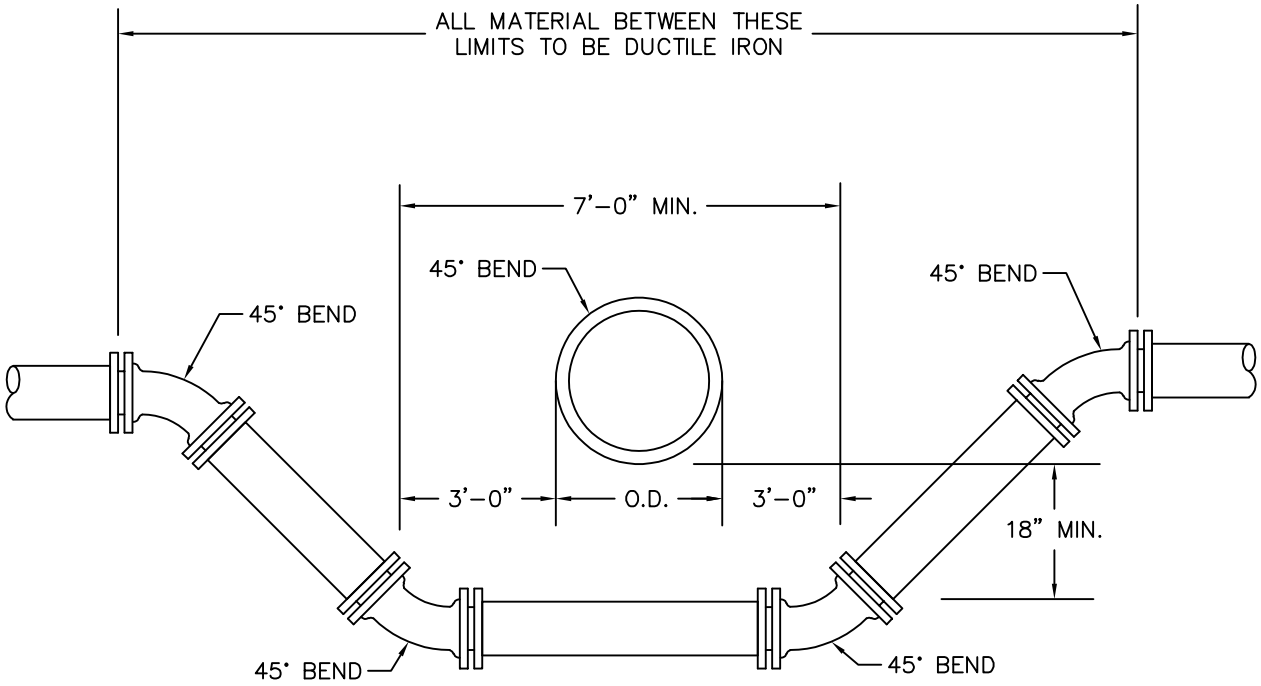
| REVISED SEPTEMBER 2018 | TYPICAL FIRE HYDRANT DETAIL | DRAWING NO. W–16.0 |
|---|---|---|




NOTES:

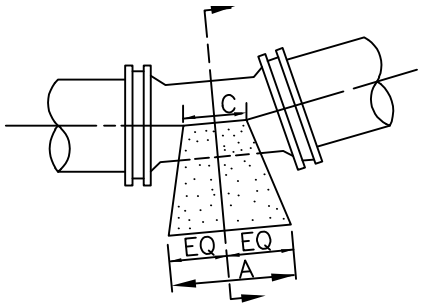
1. MINIMUM 3' COVER UNDER DITCH.
2. IN THE EVENT THAT THE WATER SERVICES AND BOXES CANNOT BE ARRANGED AS REFLECTED IN THIS DETAIL, AT LEAST 10 FEET HORIZONTAL SEPARATION IS REQUIRED BETWEEN THE WATER METER BOX/SERVICE LINE AND FIRE HYDRANT.

| REVISED SEPTEMBER 2018 | TYPICAL LOCATION OF WATER MAIN AND SERVICES IN CUL-DE-SAC | DRAWING NO. W-17.0 |
|---|---|---|

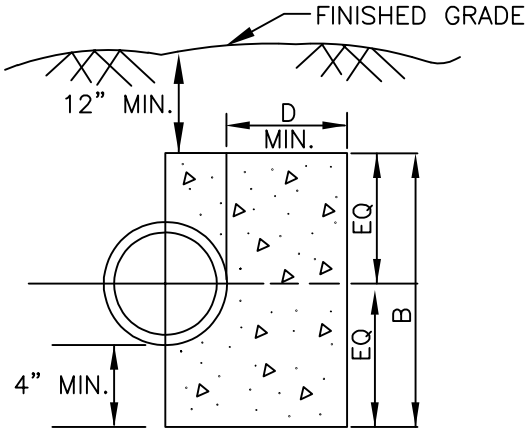



NOTE: USE RETAINER GLANDS ON 45° BENDS

| REVISED SEPTEMBER 2018 | TYPICAL METHOD OF ADJUSTING WATER LINES | DRAWING NO. W-18.0 |
|---|---|---|




PLAN




CARRY CONCRETE TO UNDISTURBED EARTH OR FIRM SUBGRADE

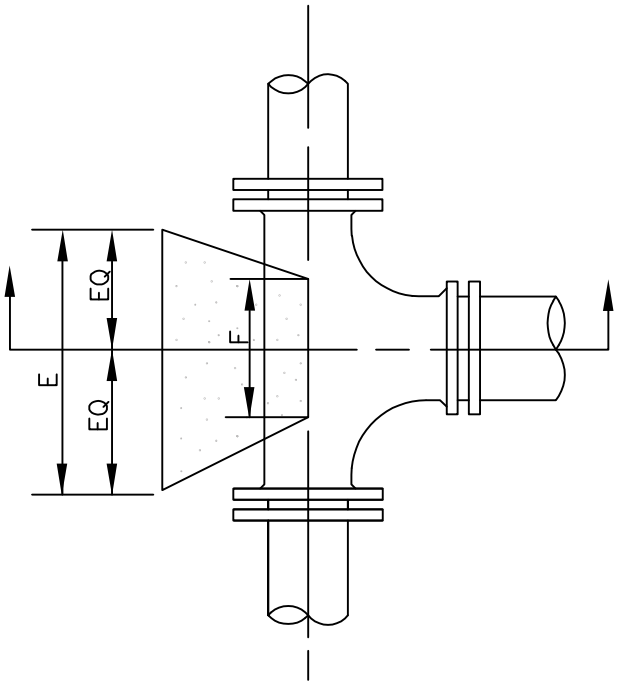
SECTION

| PIPE SIZE | 11-1/4° BEND | | | | 22-1/2° BEND | | | | 45° BEND | | | | 90° BEND | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | A | B | C | D | A | B | C | D | A | B | C | D |
| 4" | 6" | 1'-0" | 4" | 6" | 8" | 1'-0" | 6" | 7" | 1'-1" | 1'-0" | 6" | 6" | 1'-10" | 1'-0" | 6" | 1'-0" |
| 6" | 8" | 1'-2" | 6" | 7" | 10" | 1'-2" | 6" | 8" | 1'-4" | 1'-2" | 6" | 8" | 2'-3" | 1'-2" | 6" | 1'-6" |
| 8" | 8" | 1'-4" | 8" | 7" | 1'-4" | 1'-4" | 8" | 8" | 2'-0" | 1'-4" | 8" | 9" | 3'-3" | 1'-4" | 8" | 1'-6" |
| 10" | 1'-1" | 1'-6" | 8" | 8" | 1'-7" | 1'-6" | 8" | 10" | 2"-6" | 1'-6" | 8" | 10" | 3'-9" | 2'-0" | 10" | 1'-6" |
| 12" | 1'-4" | 1'-8" | 1'-0" | 9" | 2'-0" | 1'-8" | 1'-0" | 1'-0" | 3'-3" | 1'-8" | 1'-0" | 1'-0" | 5'-0" | 2'-0" | 10" | 1'-6" |
| 16" | 1'-9" | 2'-0" | 1'-0" | 9" | 2'-6" | 2'-0" | 1'-0" | 1'-3" | 4'-3" | 2'-6" | 1'-0" | 1'-3" | 6'-0" | 2'-6" | 1'-4" | 1'-9" |
| 18" | 1'-9" | 2'-6" | 1'-0" | 10" | 3'-3" | 2'-6" | 1'-0" | 1'-6" | 6'-0" | 2'-6" | 1'-0" | 1'-4" | 8'-0" | 3'-4" | 1'-8" | 1'-9" |
| 20" | 1'-9" | 2'-6" | 1'-0" | 10" | 3'-3" | 2'-6" | 1'-0" | 1'-6" | 6'-0" | 2'-6" | 1'-0" | 1'-4" | 8'-0" | 3'-4" | 1'-8" | 1'-9" |
| 24" | 2'-0" | 3'-0" | 1'-0" | 1'-0" | 3'-9" | 3'-0" | 1'-0" | 1'-6" | 7'-0" | 3'-0" | 1'-0" | 1'-9" | 9'-9" | 4'-0" | 2'-0" | 2'-0" |
| 30" | 2'-6" | 3'-6" | 1'-4" | 1'-2" | 4'-0" | 3'-6" | 1'-4" | 1'-9" | 7'-6" | 4'-0" | 1'-4" | 2'-3" | 9'-9" | 5'-0" | 2'-6" | 2'-6" |

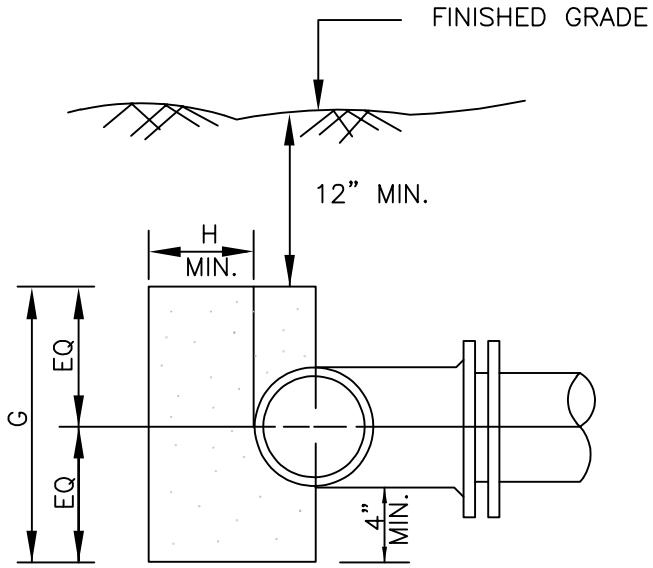
NOTES:

1. BLOCKING DIMENSIONS ARE SHOWN AT A MINIMUM.
2. BLOCKING DIMENSIONS ARE BASED ON A STATIC PRESSURE OF 150 PSI AND AN ALLOWABLE SOIL BEARING CAPACITY OF 2,000 PSF.
3. WHERE SOIL BEARING CAPACITY IS LESS THAN OR GREATER THAN 2,000 PSF, BLOCKING DESIGN CALCULATIONS ARE TO BE SHOWN ON THE PLANS.
4. FITTINGS TO BE WRAPPED IN 4 MIL. POLYETHYLENE TO PROTECT NUTS AND BOLTS.
5. CONCRETE TO BE 3,000 PSI.

| REVISED SEPTEMBER 2018 | BLOCKING DETAIL – HORIZONTAL BENDS | DRAWING NO. W-19.0 |
|---|---|---|




PLAN




CARRY CONCRETE TO
UNDISTURBED EARTH
OR FIRM SUBGRADE

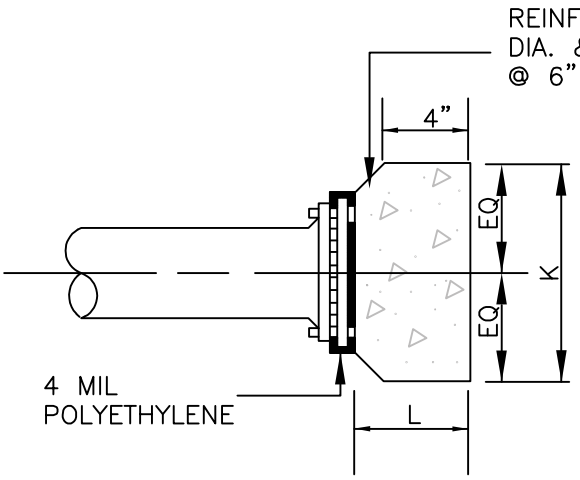
SECTION

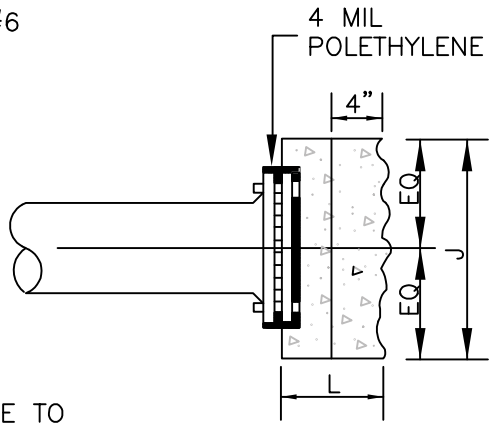
| BRANCH SIZE | E | F | G | H |
|---|---|---|---|---|
| 4" | 1'–0" | 8" | 1'–4" | 6" |
| 6" | 1'–4" | 1'–0" | 1'–8" | 8" |
| 8" | 1'–6" | 1'–0" | 2'–6" | 9" |
| 10" | 2'–2" | 1'–0" | 2'–8" | 10" |
| 12" | 2'–6" | 1'–0" | 3'–6" | 1'–0" |
| 16" | 3'–4" | 1'–4" | 4'–8" | 1'–2" |
| 18" | 4'–0" | 2'–0" | 6'–0" | 1'–6" |
| 20" | 4'–0" | 2'–0" | 6'–0" | 1'–6" |
| 24" | 5'–0" | 2'–0" | 6'–8" | 1'–8" |
| 30" | 5'–6" | 2'–6" | 7'–0" | 1'–10" |

NOTE:

SEE APPLICABLE
NOTES AS SHOWN
ON W 19.0

| REVISED SEPTEMBER 2018 | BLOCKING DETAIL – TEES | DRAWING NO. W–20.0 |
|---|---|---|




CARRY CONCRETE TO UNDISTURBED EARTH OR FIRM SUBGRADE

PLAN

ELEVATION

| SIZE | J | K | L |
|---|---|---|---|
| 4" | 1'–0" | 1'–0" | 8" |
| 6" | 1'–6" | 1'–6" | 8" |
| 8" | 2'–6" | 1'–6" | 10" |
| 10" | 2'–8" | 2'–2" | 1'–0" |
| 12" | 3'–6" | 2'–6" | 1'–2" |
| 16" | 4'–8" | 3'–4" | 1'–4" |
| 18" | 6'–0" | 4'–0" | 1'–6" |
| 20" | 6'–0" | 4'–0" | 1'–6" |
| 24" | 6'–8" | 5'–0" | 1'–8" |
| 30" | 8'–0" | 6'–8" | 2'–0" |

NOTE:

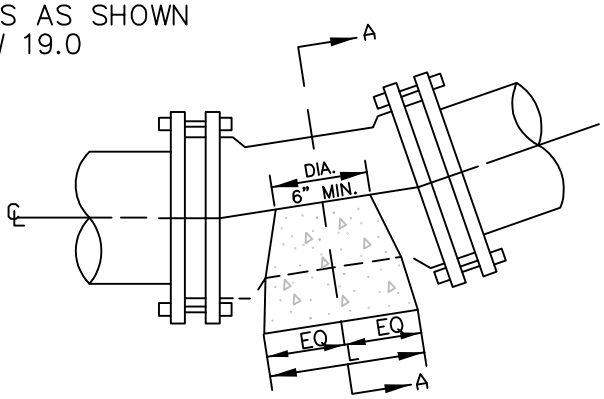
SEE APPLICABLE NOTES AS SHOWN ON W 19.0

NOTE:
BLOCKING BASED ON PRESSURE OF 150 PSI AND ALLOWABLE SOIL BEARING CAPACITY OF 2000 PSF CONCRETE TO BE 3000 PSI

| REVISED SEPTEMBER 2018 | BLOCKING DETAIL – PLUGS, CAPS, & HYDRANTS | DRAWING NO. W–21.0 |
|---|---|---|

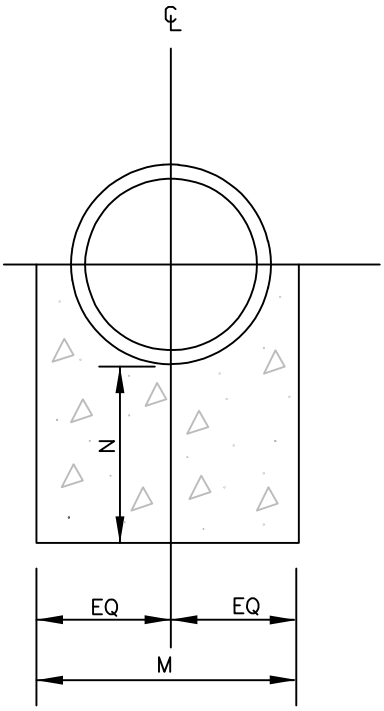
NOTE:

SEE APPLICABLE
NOTES AS SHOWN
ON W 19.0




CARRY CONCRETE TO
UNDISTURBED EARTH
OR FIRM SUBGRADE

ELEVATION




SECTION A–A

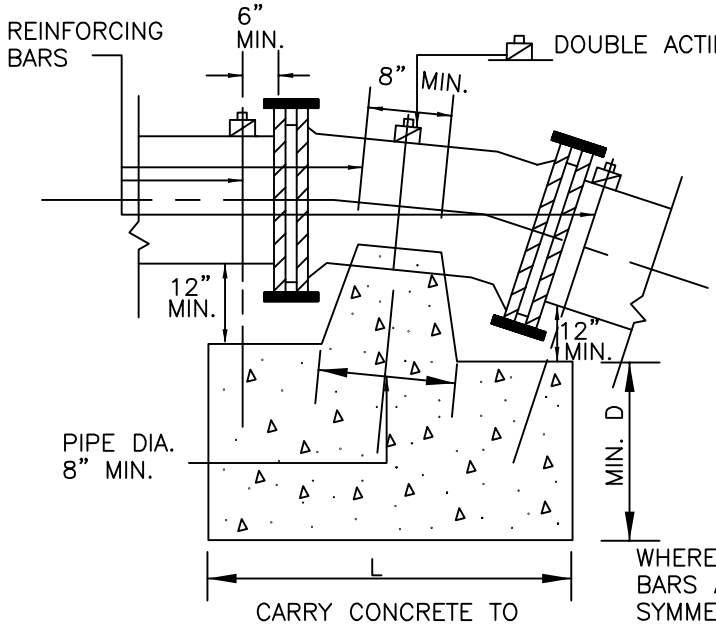
| PIPE | 11–1/4° BEND | | | 22–1/2° BEND | | | 45° BEND | | |
|---|---|---|---|---|---|---|---|---|---|
| SIZE | L | M | N | L | M | N | L | M | N |
| 6" | 6" | 1'–2" | 8" | 10" | 1'–2" | 8" | 1'–2" | 1'–2" | 8" |
| 8" | 8" | 1'–4" | 8" | 11" | 1'–4" | 8" | 1'–9" | 1'–4" | 8" |
| 10" | 8" | 1'–6" | 8" | 1'–3" | 1'–6" | 9" | 2'–5" | 1'–6" | 1'–0" |
| 12" | 8" | 2'–0" | 8" | 1'–4" | 2'–0" | 9" | 2'–8" | 2'–0" | 1'–2" |
| 16" | 1'–1" | 2'–4" | 9" | 2'–1" | 2'–4" | 1'–0" | 4'–0" | 2'–4" | 1'–6" |
| 18" | 1'–5" | 2'–8" | 10" | 2'–9" | 2'–8" | 1'–2" | 5'–6" | 2'–8" | 2'–0" |
| 20" | 1'–5" | 2'–8" | 10" | 2'–9" | 2'–8" | 1'–2" | 5'–6" | 2'–8" | 2'–0" |
| 24" | 1'–10" | 3'–0" | 1'–0" | 3'–7" | 3'–0" | 1'–4" | 6'–0" | 3'–6" | 2'–6" |
| 30" | 2'–0" | 3'–6" | 1'–2" | 3'–11" | 3'–6" | 1'–6" | 6'–6" | 3'–10" | 2'–9" |

NOTE:
BLOCKING BASED ON PRESSURE OF 150 PSI AND
ALLOWABLE SOIL BEARING CAPACITY OF 2000 PSF
CONCRETE TO BE 3000 PSI

| REVISED SEPTEMBER 2018 | BLOCKING DETAIL – LOWER VERTICAL BENDS | DRAWING NO. W–22.0 |
|---|---|---|

NOTE:

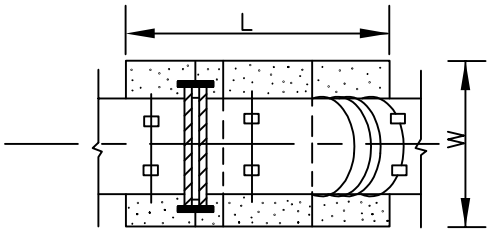
SEE APPLICABLE NOTES AS SHOWN ON W 19.0




CARRY CONCRETE TO UNDISTURBED EARTH OR FIRM SUBGRADE

ELEVATION

EMBED REINFORCING BARS MIN. 36 DIAMETERS INCLUDING HOOK PAINT EXPOSED REINF. BARS WITH 2 COATS OF BITUMINOUS PAINT.




WHERE 4 REINFORCING BARS ARE USED, PLACE 2 SYMMETRICALLY PLACED REINFORCING BARS AT BENDS AND OTHER 2 BARS AS SHOWN IN DETAIL.

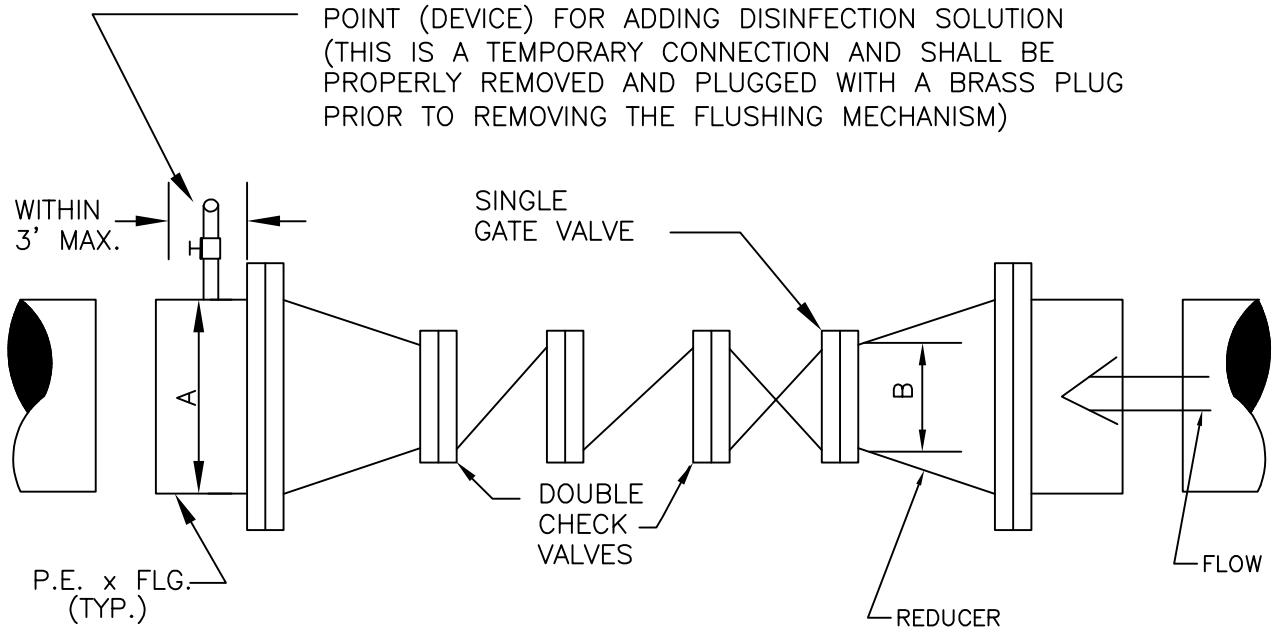
PLAN

| PIPE SIZE | 11–1/4° BEND | | | | 22–1/2° BEND | | | | 45° BEND | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | L | W | D | REINF.BAR # & SIZE | L | W | D | REINF.BAR # & SIZE | L | W | D | REINF.BAR # & SIZE |
| 6" | 2'–0" | 2'–0" | 1'–6" | 3 # 7 | 2'–6" | 2'–6" | 2'–0" | 3 # 7 | 3'–0" | 3'–0" | 2'–0" | 3 # 7 |
| 8" | 2'–0" | 2'–0" | 2'–0" | 3 # 8 | 2'–9" | 2'–9" | 2'–3" | 3 # 8 | 3'–6" | 3'–6" | 2'–6" | 3 # 8 |
| 10" | 2'–3" | 2'–3" | 2'–0" | 3 # 8 | 3'–6" | 3'–6" | 2'–3" | 3 # 8 | 4'–0" | 4'–0" | 2'–9" | 4 # 8 |
| 12" | 2'–6" | 2'–6" | 2'–3" | 3 # 8 | 4'–0" | 4'–0" | 2'–6" | 4 # 8 | 4'–6" | 4'–6" | 3'–0" | 4 # 8 |
| 16" | 3'–3" | 3'–3" | 2'–6" | 3 # 8 | 4'–6" | 4'–6" | 3'–0" | 4 # 8 | 6'–0" | 6'–0" | 3'–6" | 4 # 10 |
| 18" | 4'–0" | 4'–0" | 2'–6" | 3 # 10 | 5'–6" | 5'–6" | 3'–6" | 3 # 10 | 7'–6" | 7'–6" | 4'–0" | 4 # 10 |
| 20" | 4'–0" | 4'–0" | 2'–6" | 3 # 10 | 5'–6" | 5'–6" | 3'–6" | 3 # 10 | 7'–6" | 7'–6" | 4'–0" | 4 # 10 |
| 24" | 4'–6" | 4'–6" | 3'–0" | 3 # 10 | 6'–0" | 6'–0" | 4'–0" | 4 # 10 | 8'–6" | 8'–6" | 4'–6" | 4 # 10 |

NOTES:

1. BLOCKING BASED ON PRESSURE OF 150 PSI AND ALLOWABLE SOIL BEARING CAPACITY OF 2000 PSF. CONCRETE TO BE 3000 PSI.
2. PIPES GREATER THAN 24", THE DESIGN ENGINEER TO SPECIFY RESTRAINT SYSTEM NECESSARY.

| REVISED SEPTEMBER 2018 | BLOCKING DETAIL – UPPER VERTICAL BENDS | DRAWING NO. W–23.0 |
|---|---|---|




| A | B |
|---|---|
| 6" | 4" |
| 8" | 4" |
| 12" | 6" |
| 16" | 6" |
| 20" | 8" |
| 24" | 12" |
| 30" | 12" |
| 36" | * |

A = MAIN SIZE

B = CHECK VALVE AND GATE VALVE SIZE

* = TO BE DESIGNED BY CONSULTANT

NOTE: CONTRACTOR SHALL USE IN ACCORDANCE WITH FLUSHING SCHEDULE

| REVISED SEPTEMBER 2018 | ISOLATION DEVICE FOR NEW MAIN DOUBLE CHECK VALVE ASSEMBLY | DRAWING NO. W-24.0 |
|---|---|---|