



Utility Design Manual

Revised 2024



UTILITY DESIGN MANUAL

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ATTACHMENTS:

- A. LETTER OF AVAILABILITY REQUEST
- B. DEVELOPMENT APPLICATION
- C. METER PRICING
- D. PWS CROSS CONNECTION CONTROL PROGRAM



CHAPTER 1 – GENERAL REQUIREMENTS AND PROCEDURES

1.0 GENERAL

The procedures provided herein detail the steps involved for Pace Water System (PWS) approval of a development that requires water, sewer, or reclaimed water service from PWS. All construction work shall be subject to the approval of the Board of Directors of PWS or their designated representative. Adherence to this procedure is in the best interest of the developer, engineer, PWS, and future customers of PWS to ensure the systems are adequately sized and to minimize operation and maintenance problems in the future.

PWS works closely with the developer and his engineer to ensure all submittal information is received for a quick and satisfactory review. Construction shall not begin until required permits are obtained and the submitted construction plans are approved by PWS. A construction project or development will not be accepted by PWS until all applicable acceptance information is received.

1.1 STATEMENT OF AVAILABILITY

When requested in writing, a “Statement of Utility Availability” will be issued to the owner or developer requesting service, providing adequate capacity is currently available. The statement is not a guarantee that capacity will be available when needed. Capacity is guaranteed only upon receipt by PWS of all capacity and impact fees. For commercial site plans, the statement will be provided after approval of site plans by PWS. See **Attachment A** for requirements. For all requests that involve cost sharing of utility extensions a development agreement must be signed prior to the letter being issued.

1.2 REVIEW FEE

A review fee shall be paid to PWS by all developers in the case of new construction involving facilities to be connected to PWS. The review fee is intended to cover the cost of engineering review of construction plans and specifications by PWS. A review fee will be paid when application for service is requested and it shall be in accordance with the Development Application, **Attachment B**.



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1.3 RESPONSIBILITY

The developer shall be responsible for the cost of the permit processing as well as the installation and construction of the water, sewer or reclaimed water facilities on the user's property and from the user's property to a point in the existing system where lines are sufficient in size to supply adequate service as approved by PWS. All water, sewer, and reclaimed water facilities that are to become part of the PWS system shall be installed by a Florida licensed underground utility contractor, to be verified prior to installation. Any upgrades of the existing infrastructure due to the increased capacity required by the development will be the responsibility of the developer.

All customers must pay the water, sewer and/or reclaimed water connection (tap) fee, any impact fees, and provide the means to convey sewage to PWS at their own expense. All connection fees for water, sewer and/or reclaimed water service shall be paid to PWS. These fees are due and payable prior to the connection of any service or tap. The requirements for meters will be as described in the utility design manual Section 2, Potable Water System.

In the event PWS requires installation of larger facilities than would normally be needed by the developer to provide sewer, water, and/or reclaimed water services to the development, PWS shall bear the difference in cost of the larger facilities. A written agreement on cost sharing must be prepared in advance of construction. The developer shall provide to PWS such easements, rights-of-way, or rights-of-access to any and all parts of water, sewer, and/or reclaimed water facilities. Such rights shall be formalized prior to acceptance of the facilities by PWS. The widths shall be as prescribed by PWS. Easements shall be provided at no cost to PWS.

1.4 SUBMITTAL REQUIREMENTS/REVIEW/ACCEPTANCE

A. GENERAL

Submittal of construction plans shall include all requirements as listed in the Development Application (**Attachment B**). Prior to acceptance of improvements by PWS, all items required per the Development Application, completion of punch list items, and final inspection of the systems by PWS are necessary. Representatives of PWS shall also witness tests of the systems. All submittals to PWS shall be signed, dated and sealed by a Professional Engineer registered in Florida.

B. SALE OF TAPS

Neither water, sewer, nor reclaimed water taps will be sold within the project until all systems are accepted by PWS in accordance with paragraph A. above. If both water and sewer services are available, connection (tap) fees for both services must be purchased at the

time of purchase. When reclaim water service is available, a reclaim connection (tap) fee must be purchased at the time of purchase of water and/or sewer.

C. ACCEPTANCE OF WATER, SEWER AND RECLAIMED WATER SYSTEMS

By acceptance of water, sewer and reclaimed water systems, PWS assumes responsibility for operation and maintenance of utilities located in public rights of ways or easements. Where grinder pumps are authorized for single family (simplex units) or commercial units (duplex units), the property owner is responsible for the cost of installation of the grinder units in addition to the applicable tap and impact fees and for operation and maintenance costs.

D. PLANS AND SPECIFICATIONS

1. General

All submitted plans shall be 22"x34" with title block. Graphic scale(s) shall be provided on each sheet and all lettering shall be 1/8" or larger to permit photographic reproduction. All plans and specifications must be signed, sealed and dated by the developer's engineer.

2. Master Plan

All utilities shall be shown on a single project plan and/or master plan for the entire development (all phases of subdivision or commercial complex). This plan shall indicate the general locations and sizes of all mains, manholes, lift stations, valves, hydrants, services and service laterals with respect to the proposed development improvements and the existing utilities.

3. Plan and Profile

All gravity sanitary sewer lines, sewer force mains, watermains and reclaimed water mains must be drawn in plan and profile. Whenever possible, on-site water and wastewater systems shall be shown on the same plan sheet. As a minimum, the plan and profile drawings shall include the following information:

- a.** Construction notes regarding cover, horizontal and vertical control, special construction requirements, and references to standard and special details.



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4. Details

The plans shall include all applicable standard details as shown in this manual. Special details shall be prepared by the developer's engineer for aerial and underwater crossings of rivers, streams, canals and ditches. Other special details shall be prepared by the developer's engineer as required.

5. Scale

The master plan shall be prepared at a scale not to exceed 1" to 200'. Plan and profile sheets shall not exceed a scale of 1" to 50' horizontal and 1" to 5' vertical. Special details shall be of sufficiently large scale to show pertinent construction information.

6. General Notes

The following general notes shall be included on all plans submitted to PWS for review:

- b. Contractor shall contact PWS at least 48 hours prior to connection of proposed facilities to existing PWS facilities. PWS personnel shall be present for all taps.
- c. All on-site water and sewer facilities shall be privately owned, operated, and maintained.
- d. The contractor is responsible for adjustment of existing utilities if proposed improvements impact existing utilities.
- e. No pressure piping or fittings shall be allowed under any proposed paving including sidewalks, flumes, roadways, etc.
- f. Contractor shall have at minimum one set of plans approved by PWS on the job site.
- g. Submittals on all material located in the right-of-way (or easements) shall be submitted to PWS for approval prior to construction.
- h. Any deviations of the finished grade from approved construction plans that affects any water, sewer or reclaimed water mains and/or services must be adjusted to required depths at developer's expense.
- i. Ensure 3 ft. separation between pressure piping and sidewalk.
- j. All infrastructure must be inspected prior to backfill/cover.

E. DESIGN CALCULATIONS / PERMIT DOCUMENTATION

The design of utility improvements associated with PWS shall be in compliance with the design standards, specifications, and standard drawings contained in this manual. Design calculations will be reviewed and approved by PWS prior to action taken on permit



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documentation. It shall be the responsibility of the developer to obtain and comply with all applicable federal, state and local regulatory permits. The developer shall also be responsible for the costs associated with such permitting. The developer shall supply copies of all permit applications to PWS, and any documentation upon request by PWS.

F. POWER LAYOUT

For subdivisions, a power layout from FPL or EREC is required prior to subdivision approval.

G. CONSTRUCTION INSPECTION AND AS-BUILT DRAWINGS

A PWS designated representative(s) shall periodically inspect all construction subject to these standards and specifications. Lot corners shall be clearly marked at all times for inspection during the course of construction subject to this utility design manual.

After all required improvements have been installed, the developer's engineer shall submit certification to the system that the improvements have been constructed substantially according to approved plans and specifications. The developer's engineer shall submit copies of all testing reports, including compaction tests, prior to final acceptance. Electronic copies of photographs documenting utility conflicts and any changes in piping locations shall be submitted prior to final acceptance. Noncompliance with approved plans, specifications, or evidence of faulty materials or workmanship shall be called to the attention of the developer or developer's engineer. If not corrected in an expeditious manner, use of facilities may be withheld.

The developer's engineer shall submit two signed and sealed printed sets and electronic copies in CAD and PDF format of as-built record drawings to PWS prior to formal acceptance of improvements by PWS. The developer's engineer shall be responsible for recording information on the approved plans concurrently with construction progress. Record drawings submitted to PWS as part of the project acceptance shall comply with the following requirements:

- 1) Drawings shall be legibly marked to record actual construction.
- 2) Drawings shall show the actual location of all underground and above ground utility piping and related appurtenances. All changes to piping location including horizontal and vertical locations of utilities and appurtenances shall be clearly shown and referenced to permanent surface improvements. Drawings shall also show actual installed pipe material, class, slope, footage, etc.

- 3) Drawings shall clearly show all field changes of dimension and detail including changes made by field order or change order.
- 4) Drawings shall clearly show all details not on original contract drawings but constructed in the field. All equipment and piping relocation shall be clearly shown.
- 5) Location of all manholes, hydrants, valves, and valve boxes shall be shown. All valves shall be referenced from at least two and preferably three permanent points. One reference point shall be the center line of the roadway. Water and reclaim services shall also be referenced to the nearest lot lines. Lot lines shall be clearly delineated on the drawings.
- 6) Sanitary sewer laterals shall be measured from the nearest downstream manhole.
- 7) Dimensions between all manholes shall be field verified and shown. The inflowing and outflowing inverts, grade elevations and pipe slopes of all manholes shall be field verified and shown next to design number.

Each sheet of the plans shall be signed, sealed and dated by the developer's engineer as being "As-Built" or "Record Drawings." Construction plans simply stamped "As-Built" or "Record Drawings" and lacking in above requirements will not be accepted. The formal acceptance by the board of directors will not be issued until correct "Record Drawings" have been approved.

H. TWO YEAR PERFORMANCE BOND AND RELEASE OF LIENS

A performance bond and a release of liens shall be provided to PWS before acceptance. A letter of acceptance will be provided by PWS to the developer when accepted. The time of the performance bond shall start at the date of acceptance.

I. OPERATION AND MAINTENANCE MANUALS

At completion of construction (or before), three complete sets of operation and maintenance manuals (O&M) and one electronic set shall be submitted to PWS. O&M manuals shall include lift station startup test results. PWS will review the O&M manuals for completeness before final system acceptance by PWS.



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J. COST BREAKDOWN (CERTIFIED COST)

The developer shall submit a unit price breakdown of all utility improvements installed prior to acceptance of said improvements. The breakdown shall include water, sewer and/or reclaimed water.

K. RECORDED FINAL PLAT

Two (2) copies of the recorded final plat and one (1) electronic copy in PDF format must be submitted prior to acceptance. All easements must be shown on the plat.

L. VIDEO OF GRAVITY SEWER MAINS AND LATERALS

Video of installed gravity sewer and laterals are required prior to acceptance. The as-built video of the sewer and laterals shall be submitted on a portable hard drive (thumb drive). The video shall demonstrate installation of the gravity system acceptable to PWS, and shall reference sewer main manhole-to-manhole and sewer lateral by property address (or lot/block).

Each file on the portable hard drive shall be clearly named as to sewer main location/manholes or sewer lateral address (or lot/block). The videos will not be accepted, and thus the project will not be accepted, unless each file name clearly indicates the location and description of the video.

M. UTILITY LOCATION DATA

A spatially corrected digital record of all fittings, valves, manholes, laterals, water services, and reclaim services collected via GPS/GNSS capable equipment is required prior to acceptance. This data shall be submitted in CSV format. A different digital format may be accepted at the discretion of PWS. This digital record must include a brief description of the asset and coordinates in decimal degrees or northing/easting format where the spatial reference is clearly identified.

N. DEVELOPMENT APPLICATION (ATTACHMENT B)

All applicable required information listed on the development application shall be submitted prior to acceptance.

END OF CHAPTER 1



CHAPTER 2 – POTABLE WATER SYSTEM

2.1 GENERAL REQUIREMENTS AND DESIGN STANDARDS

A. GENERAL

The following minimum requirements are considered acceptable to PWS in the distribution of water for domestic consumption and fire protection.

Deviations from these standards may be allowed on a case-by-case basis. If the deviation is in accordance with sound engineering practice and will not create a problem for PWS, the deviation may be approved. No deviation will be allowed unless it is clearly noted on the approved construction plans.

When these standards differ from county, state and/or federal requirement, the more stringent requirement shall apply.

The distribution system of a waterworks includes the mains, valves, hydrants, customer service pipes to the meter, meters, and other appurtenances. The system should be designed to provide an adequate supply of water to the customers and for fire protection at all times.

B. STANDARDS

1. NSF Standards

Materials and methods of construction shall comply with the latest published editions of the National Sanitation Foundation (NSF) Standard 61.

2. ASME/ANSI Standards

Materials and methods of construction shall comply with the latest published editions of the American Society of Mechanical Engineers (ASME) and the American National Standards Institute (ANSI) Standards.

| | |
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| B16.20 | Metallic Gaskets for Pipe Flanges: Ring-Joint, Spiral-Wound, and Jacketed |
| B16.1 | Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250 |



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| B 1.1 | Unified Inch Screw Threads, UN, UNR and UNJ Thread Form |
| B 1.20.1 | Pipe Threads, General Purpose (Inch) |
| B 1.20.3 | Dryseal Pipe Threads (Inch) |

3. ASTM Standards

Materials and methods of construction shall comply with the latest published editions of the American Society for Testing and Materials (ASTM) Standards.

| | |
|--------------|---|
| A126 | Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings |
| A307 | Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength |
| A48 | Standard Specification for Gray Iron Castings |
| A746 | Standard Specification for Ductile Iron Gravity Sewer Pipe |
| B584 | Standard Specification for Copper Alloy Sand Castings for General Applications |
| B62 | Standard Specification for Composition Bronze or Ounce Metal Castings |
| B88 | Standard Specification for Seamless Copper Water Tube |
| D1248 | Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable |
| D1330 | Standard Specification for Rubber Sheet Gaskets |
| D1598 | Standard Test Method for Time-to Failure of Plastic Pipe Under Constant Internal Pressure |
| D1599 | Standard Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings |
| D1693 | Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics |
| D1785 | Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Schedules 40, 80, and 120 |
| D2241 | Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series) |
| D2513 | Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings |
| D2737 | Standard Specification for Polyethylene (PE) Plastic Tubing |
| D2837 | Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products |
| D3035 | Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter |
| D3261 | Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for |



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| | Polyethylene (PE) Plastic Pipe and Tubing |
| D3350 | Standard Specification for Polyethylene Plastics Pipe and Fittings Materials |
| D429 | Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates |
| F477 | Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe |
| F714 | Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter |
| F1055 | Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked Polyethylene (PEX) Pipe and Tubing |

4. Environmental Protection Agency and U.S. Public Health Service

The governing standards of these agencies will be followed when applicable.

5. Florida Department of Environmental Protection

The water distribution system shall conform to the applicable Florida Department of Environmental Protection (FDEP) laws, policies, standards, rules and regulations for public water systems. The State of Florida has adopted in its entirety the Recommended Standards for Water Facilities (10 State Standards). All work shall therefore comply with 10 State Standards.

6. Plumbing Codes

The provisions of the Florida Building Code as it pertains to water supply and distribution, service line locations and materials, and backflow prevention devices, except as provided for elsewhere in these criteria, shall apply.

7. AWWA Standards

Materials and methods of construction shall comply with the latest published editions of the American Water Works Association (AWWA) Standards.

| | |
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| C104 | Cement-Mortar Lining for Ductile-Iron Pipe and Fittings |
| C105 | Polyethylene Encasement for Ductile-Iron Pipe Systems |
| C110 | Ductile-Iron and Gray-Iron Fittings |
| C111 | Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings |
| C115 | Flanged Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Fittings |
| C116 | Protective Fusion-Bond Coatings for the Interior and Exterior Surfaces of Ductile |



UTILITY DESIGN MANUAL

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| | Iron and Gray Iron Fittings |
| C150 | Thickness Design of Ductile Iron Pipe |
| C151 | Ductile Iron Pipe, Centrifugally Cast |
| C153 | Ductile Iron Compact Fittings for Water Service |
| C213 | Fusion-Bonded Epoxy Coating for Steel Water Pipe and Fittings |
| C301 | Prestressed Concrete Pressure Pipe, Steel-Cylinder Type |
| C500 | Metal-Seated Gate Valves for Water Supply Service |
| C502 | Dry Barrel Fire Hydrants |
| C504 | Rubber Seated Butterfly Valves 3-in. (75 mm) Through 72-in. (1,800 mm) |
| C509 | Resilient Seated Gate Valves for Water Supply Service |
| C510 | Double Check Valve Backflow Prevention Assembly |
| C511 | Reduced-Pressure Principle Backflow Prevention Assembly |
| C512 | Air Release, Air/Vacuum, and Combination Air Valves for Water and Wastewater Service |
| C515 | Reduced-Wall, Resilient Seated Gate Valves for Water Supply Service |
| C550 | Protective Interior Coatings for Valves and Hydrants |
| C600 | Installation of Ductile Iron Water Mains and Their Appurtenances |
| C605 | Underground Installation of Polyvinyl Chloride (PVC) And Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings |
| C651 | Disinfecting Water Mains |
| C800 | Underground Service Line Valves and Fittings |
| C900 | PVC Pipe and Fabricated Fittings, 4-in. Through 60-in. (100 mm through 1500 mm), For Water Transmission and Distribution |
| C901 | Polyethylene (PE) Pressure Pipe and Tubing 3/4-in. (19 mm) through 3-in. (76 mm), For Water Service |
| C906 | Polyethylene (PE) Pressure Pipe & Fittings, 4-in. (100 mm) through 65-in. (1650 mm) for Water Distribution and Transmission |

8. Pace Water System, Inc.

All water distribution systems that are to become a part of PWS shall be designed and constructed in accordance with this utility design manual. Materials, installation, and construction methods and procedures shall be in accordance with this manual and attachments thereof.

C. LOCATION/FUTURE CONNECTION

Water mains shall be located in dedicated rights-of-way or dedicated PWS utility easements. When installed in rights-of-way, water mains shall, in general, maintain a consistent alignment with respect to the centerline of the road. All water mains located outside of dedicated rights-of-way shall require a minimum 20-foot easement. If a water main is located adjacent to a road right-of-way, a minimum 10-foot easement shall be provided. Additional easement width shall be provided if the pipe size or depth of cover so dictate. Water mains shall not be placed under any structures. In general, water mains shall not be located alongside of rear lot lines. Placement of a water main along side or rear lot line may be allowed on a case-by-case basis if such a water main configuration results in efficient placement and utilization of the water main network.

Provisions for future connecting mains shall be made by extending construction of all water mains to the exterior boundaries of the subdivision wherever future connections to adjacent subdivisions or lots are anticipated or are required to form an interconnected grid system or reduce the number of dead ends.

D. DESIGN BASIS

1. Pressures

The system shall be designed to maintain a minimum pressure of 20 psi at all points in the distribution system under all conditions of flow. The normal working pressure in the distribution system should be approximately 60 psi but not less than 35 psi on the downstream side of a meter. Higher pressures may be required at commercial, industrial and high-density residential areas.

2. Diameter of Mains

Only water mains of six (6) inches in diameter and larger shall be permitted. At a minimum, six (6)-inch looped systems shall be required in low density residential projects. In commercial, industrial, and high-density residential areas, eight (8)-inch looped mains (minimum) may be required. Larger size mains may be required if necessary to allow the withdrawal of the required fire flow while maintaining the minimum residual pressure. When extending water mains in areas where smaller diameters exist, the diameter of the extension may match that of the existing main as approved by PWS.

3. Fire Flow Requirements

Fire flow requirements shall be determined in accordance with the State Insurance Services Office and/or Santa Rosa County Regulations. Fire flow is not guaranteed by PWS. Fire flow testing shall be determined by a third party in coordination with PWS, at no expense to PWS.

4. Fire Hydrant Location and Spacing

Fire hydrants shall be located along public rights-of-way preferably at street intersections and at property corners. Fire hydrants shall be spaced every 1000 feet along rights-of-way and located throughout the distribution system so that no more than 500 feet of hose, laid along public right-of-way, will be required to reach from a fire hydrant to any proposed structure within the area served. Hydrant spacing in commercial areas shall be at 500-foot intervals. Where dead ends occur, a fire hydrant or flush hydrant shall be placed at the dead-end point. Approved dead end lines extended from existing mains less than six (6) inches in diameter will require a flush hydrant. Fire hydrants or flush hydrants shall not be located in proximity to power transformers and shall avoid power pedestals when possible. In the event a development occurs near an existing hydrant installation, the hydrant shall be extended and/or re-set to accommodate any change in grade. Hydrant extensions shall be sized to the nearest 6-inch increment. If applicable, hydrants shall be placed at high points in the design to avoid air lock.

5. Dead Ends

To provide increased reliability of service and reduce head loss, dead ends shall be minimized by making appropriate tie-ins to loop the network whenever practical, as determined by PWS.

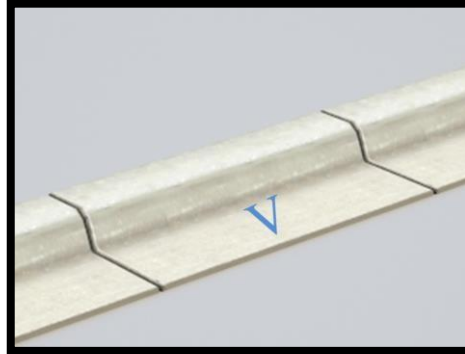
Where dead-end mains occur, they shall be provided with a fire hydrant or approved flush hydrant. Extended water mains for the sole purpose of future connection may utilize a flush hydrant, upon approval by PWS. Flushing devices shall be sized to provide flows which will give a velocity of at least 2.5 feet per second in the water main being flushed. No flushing device shall be directly connected to any sewer.

6. Valves

Sufficient valves shall be provided on water mains so that inconvenience and sanitary hazards will be minimized during repairs. Valves should be located at not more than 500-foot intervals in commercial, industrial and high-density residential areas and at not more than 1000-foot intervals in all other areas. Appropriate valving shall also be provided at all areas where water mains intersect to ensure effective isolation of water lines for repair, maintenance or future extension. In-line valves shall be located at

property corners to avoid future driveways. Valves shall not be placed in the roadway or sidewalk for proposed developments.

Valve locations shall be marked with a “V” of at least three (3) inches in size, cut into the curb and painted blue, similar to the following schematic:



7.

Crossings and Separation Distances

a. Aerial or Underwater Crossings

Aerial crossings shall be avoided whenever possible. Underwater/stream crossings shall be performed by directional drilling. PWS must be consulted before final plans are prepared.

If above-water crossings are approved by PWS, the pipe shall be adequately supported and anchored; protected from vandalism, damage and freezing; and accessible for repair or replacement.

For underwater crossings, a minimum cover of five (5) feet shall be provided over the pipe. When crossing water courses which are greater than 15 feet in width, the following shall be provided:

- The pipe shall be of special construction, having flexible, restrained or welded watertight joints.
- Valves shall be provided at both ends of water crossings so that the section can be isolated for testing or repair; the valves shall be easily accessible, and not subject to flooding.
- Permanent taps or other provisions to allow insertion of a small meter to determine leakage and obtain water samples shall be made on each side of the valve closest to the supply source.

b. Sewer Crossings

Water mains crossing sewers shall be laid to provide a minimum vertical distance of 18 inches between the outside of the water main and the outside of the force main or gravity sewer. This shall be the case where the water main is either above or below the sewer with preference to the water main located above the sewer. At crossings, one full length of water pipe shall be located so both joints will be as far from the sewer as possible. Special structural support for the water and sewer pipes may be required.

c. Parallel Installation

Water mains shall be laid at least six (6) feet horizontally from any existing or proposed gravity sewer or force main and shall be laid at least three (3) feet horizontally from any existing or proposed reclaimed water main. Separation is to be based on the outside diameter of each main.

8. Air Relief

At high points in water mains where air can accumulate, provisions shall be made to remove the air by means of hydrants or automatic air relief valves. Automatic air relief valves shall not be used in situations where flooding of the valve box may occur.

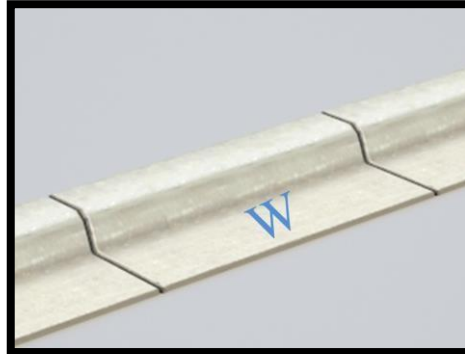
9. Water Services

a. Customer Service Lines

Customer service lines shall be provided to all lots and grassed/landscaped medians within a subdivision. Customer service connections to industrial or commercial lots may be omitted provided approval of PWS is obtained prior to approval of plans and specifications. All meters shall be adjacent to the property line and readily accessible to PWS personnel.

Customer service lines shall be limited to 55 feet in length and be perpendicular to water main. In areas where the right-of-way is wider than 60 feet, the developer shall provide a water main on each side of the right-of-way.

Water services shall not be located in proximity to power transformers and shall avoid power pedestals when possible. All new service lines must be cased under paved areas and sidewalks. Water service locations shall be marked with a "W" of at least three (3) inches in size, cut into the curb and painted blue, similar to the following schematic:



b. Master Metering

In general, individual water meters shall be installed for all users. A master meter shall be provided by the developer through PWS and installed by the Contractor after payment of applicable fees and charges. See **Attachment C** for the current pricing of meters. Under certain conditions, master metering may be allowed for shopping centers, malls and similar installations, subject to the approval of PWS.

c. Meter Installations

All residential meters will be installed by PWS after payment of applicable fees and charges. All commercial meters shall be installed by the Contractor after payment of applicable fees and charges. Commercial meters up to and including 1 ½ inches in size shall be provided by PWS. Larger sized meters shall be purchased by the developer through PWS. See **Attachment C** for the current pricing of meters. The service tap, corporation stop, tubing, curb stop and meter box shall be installed by the Contractor prior to installation of the meter for commercial sites and new subdivisions.

All meters less than two (2) inches in size will be installed underground in an approved meter box. Meters two inches and larger shall be installed below ground by the Contractor in a fiberglass or concrete vault. In commercial applications, meters larger than two (2) inches shall be installed in a meter easement located adjacent to the public right-of-way.

The size of all meters shall be determined by the developer's Engineer and approved by PWS. The developer's Engineer shall provide sufficient information on estimated peak flows and low flows so that meter size can be verified. The developer's Engineer shall include head loss through metering device when designing the water system.

d. Cross Connection Control

In accordance with the PWS Cross Connection Control Program, **Attachment D**, backflow prevention (BFP) devices shall be installed to protect public water supplies from contamination or pollution by isolating such contaminants or pollutants which could backflow into the public water system.

The selection of an appropriate BFP device will be based on the degree of hazard involved as described in **Attachment D**. However, PWS shall retain the final decision in individual cases.

The backflow prevention device shall be provided, installed, and maintained by the customer for all commercial and select residential connections. Testing shall be performed by a certified backflow tester as listed in **Attachment D** and approved by PWS.

PWS will provide and install a dual check valve (DuC) assembly for single family residential connections.

A Reduced-Pressure Principle (RP or RPZ) assembly shall be used in any high-risk installation, all commercial installations, and any installation with a secondary water source.

A Reduced-Pressure Principle Detector Assembly (RPDA or RPZDA) shall be used in all private fire water supply systems. PWS will change out the meter on the assembly.

2.2 GUIDELINES AND TECHNICAL SPECIFICATIONS

A. PIPEWORK

This section includes furnishing and installing all potable water pipework and appurtenances necessary for a fully operable water system.

1. Materials

All material shall be free from defects impairing strength and durability and be of the best commercial quality for the purpose specified. It shall have structural properties sufficient to safely sustain or withstand strains and stresses to which is normally subjected and be true to detail.

Certified records of material tests made by the manufacturer or by a reliable commercial laboratory shall be submitted to the Engineer.

All pipework will be inspected upon delivery and such as does not conform to the requirements of these specifications shall be rejected and must be immediately removed from the site by the Contractor. The Contractor shall furnish and provide all labor necessary to assist the Engineer in inspecting the material.

The basis of rejection shall be as specified in applicable AWWA and ASTM Specifications.

2. Unplasticized Polyvinyl Chloride (PVC) Pressure Pipe

PVC pipe shall meet AWWA C900 or ASTM D1785, with minimum designations per the table below. PVC pipe shall be provided with push-on joints with the bell integrally cast into the pipe. PVC pipe shall be installed with elastomeric gaskets meeting ASTM Standard F477.

| Diameter | Required Standard | DR | OD |
|----------|-------------------|--------|----|
| 2" - 3" | ASTM D1785 | Sch-40 | IP |
| 4" - 36" | AWWA C900 | 18 | DI |

PVC pipe shall be as manufactured by the JM Eagle, National Pipe and Plastics, Inc., North American Pipe Corporation, Vulcan Plastics Corporation, or approved equivalent. All potable water mains shall be blue in color.

All fittings for PVC pressure pipe shall be ductile iron mechanical joint meeting the requirements of ANSI/AWWA C153/A21.53-84. Fittings for two (2)-inch pipe may be Schedule 40.

The working pressure rating for fittings shall be 350 psi. Fittings shall be furnished with an epoxy coating in accordance with ANSI/AWWA C153/A21.53 and cement-lined and seal coated with an asphaltic material in accordance with ANSI/AWWA C104/A21.4.

Restraint lengths for PVC pipe vertical bends, horizontal bends and appurtenances shall be calculated using the Uni-Bell Handbook of PVC Pipe, Section 11.5.3.5. All valves shall be considered dead ends for thrust restraint length calculations.

Standard laying lengths shall be 20 feet and randoms shall not be less than 10 feet.

Pipe must be certified as suitable for potable water use by NSF and marked as follows: NSF-PW.

Each length of pipe shall be clearly marked with the following information at intervals of five (5) feet or less:

- Nominal pipe size and OD base.
- Material code designation.
- Dimension ratio.
- Pressure class or pressure rating.
- Manufacturer's name or trademark.
- NSF approval seal.
- Appropriate AWWA or ASTM standard number.

3. Ductile Iron Pipe (DIP)

Ductile iron pipe shall meet the requirements of ASTM A746. Pipe dimensions shall conform to ANSI/AWWA C151/A21.51, Pressure Class 250. Each pipe shall be conspicuously marked on the outside of the barrel to readily identify it from cast iron. Metal thickness shall conform to ANSI/AWWA C150/A21.50-02. Pipe must be certified as suitable for potable water use by NSF and marked as follows: NSF-PW.

a. Mechanical Joints

All mechanical joint pipe shall conform to ANSI/AWWA A21.11, Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.

b. Push-on Joints

All push-on joint pipe shall conform to ANSI/AWWA A21.11, Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings and shall be single gasket push-on type.

c. Restrained Joints

DIPRA Thrust Restraint Design for Ductile Iron Pipe shall be used to calculate required restrained joint lengths at all vertical bends, horizontal bends and appurtenances. All valves shall be considered dead ends for restrained joint length calculations.

d. Flanged Joints

All flanged joint pipe shall conform to ANSI/AWWA C115/A21.15-99 and shall have screwed on flanges, faced and drilled to ANSI Class 125-pound template. The flanged joints shall be assembled by threading plain end pipe and screwing on long hub flanges. The connection shall then be power tightened and refaced across both face of flange and end of pipe. Gaskets shall be one-sixteenth-inch ring gaskets of red sheet rubber meeting the requirements of Grade I, Table I of ASTM D1330. Connections shall be made with machine bolts and hexagonal nuts.

e. Fittings

All fittings shall be ductile iron mechanical joint meeting the requirements of ANSI/AWWA C153/A21.53. The working pressure rating for fittings shall be 350 psi. Fittings shall be furnished with an epoxy coating in accordance with ANSI/AWWA C116/A21.16 and cement lined and seal coated in accordance with ANSI/AWWA C104/A21.4.

f. Coatings for Ductile Iron Pipe

All pipe, valves, fittings and specials for water shall be cement mortar lined. The lining shall comply with ANSI/AWWA C104/A21.4. The exterior of buried pipe shall receive a zinc coating as specified in ISO 8179 at an application rate of 200 grams per square meter and coated with an outer protective coating prior to shipment. The exterior of all aboveground pipe shall receive a coat of rust inhibitor primer compatible with the finish paint schedule. Pipe and fittings to be installed underground in aggressive soils shall be encased in AWWA C105 V-Bio Polyethylene wrap, minimum four (4) mils thickness, as directed by the Engineer/PWS Representative.

4. Polyethylene (HDPE) Pipe

HDPE pipe three (3) inches and larger shall meet or exceed AWWA C906; and ASTM D2513, D3035, D3350, and D1248, latest revisions. Each manufacturer shall supply a letter of certification stating compliance with all the above standards and requirements prior to shipping any material to the project site. All HDPE piping system components shall be the products of one manufacturer. The HDPE material shall have required ultraviolet inhibitors to resist degradation by direct and prolonged sunlight.

The design of all HDPE materials shall be based on the hydrostatic design basis (HDB) of 1600 psi at 73.4°F. The cell classification shall be or exceed 345465C for all HDPE 3-

inch and larger and shall be manufactured with NSF-approved 4710 resins only. The pipe shall be SDR 11 with a ductile iron pipe OD and a pressure rating of 200 psi.

All HDPE pipe three (3) inches and larger shall have three (3) blue stripes (1/4" wide) located at the 12, 4, and 8 o'clock positions with permanent ink along the entire length of the pipe. Labeling shall include size of pipe, SDR rating and pressure rating, manufacturer's name, sewer pipe, ASTM F174, PE 4710, NSF, AWWA C906, and manufacturing date and location. This shall be at least 1/4-inch tall lettering and shall run the entire length of the pipe. Print line markings shall include a production code from which the location and date of manufacture can be identified. Upon request, the manufacturer shall provide an explanation of his production code.

HDPE pipe /tubing, two (2) inches and smaller, shall comply with or exceed AWWA C901; ASTM D3350, D2737, D1248, and D2837, latest revisions. All HDPE tubing shall be manufactured of an outer layer of 4710 resins with blue coloring and a virgin clear center of 4710 resins only. Tubing shall have NSF 14 certification. The cell classification shall be 445574E external pipe and 445574D for virgin center core. The pipe shall have UV stabilizers for direct sunlight protection, but all tubing shall be certified to resist direct sunlight such as that of Florida or Arizona for a minimum of five (5) years with no visible or physical effect to the tubing. All tubing shall be SDR 9 CTS pipe with a minimum pressure rating of 250 psi. The manufacturer shall issue a certification of compliance for purity of core and lifetime warranty for all the above-mentioned standards and cell classification.

All HDPE fittings shall comply with the same cell classification and pressure rating utilizing 4710 resins only. All fittings shall be within one DR of the pipe's specified DR to assure compatible fusion and to the pipe manufacturer's recommendations. Molded butt-type fittings shall meet the requirements of ASTM D3261. At the point of fusion, the outside diameter and minimum wall thickness of fitting butt fusion outlets shall meet the outside diameter and minimum wall thickness specifications of ASTM F714 for the same size of pipe. Electrofusion-type fittings shall meet the requirements of ASTM F1055.

Fabricated fittings are to be manufactured using Data Loggers. Reference to the Data Logger Quality Control records shall be made from an indented stamp in each fusion bead of each fitting. Temperature, fusion pressure and a graphic representation of the fusion cycle shall be part of the Quality Control records.

Transition fittings shall be used to terminate all HDPE pipe and shall be fusion welded HDPE/PVC mechanical joint adapters with stainless steel stiffeners. Fittings shall have the same pressure rating as the pipe.

B. VALVES, HYDRANTS, METERS AND MISCELLANEOUS APPURTENANCES

This section includes furnishing and installing complete all equipment and materials necessary for a complete and fully operable system.

1. Materials

All material shall be free from defects impairing strength and durability and be of the best commercial quality for the purpose specified. It shall have structural properties sufficient to safely sustain or withstand strains and stresses to which it is normally subjected and be true to detail.

All pipe work will be inspected upon delivery and such as does not conform to the requirements of these specifications shall be rejected and must be immediately removed from the site by the Contractor. The Contractor shall furnish and provide all labor necessary to assist the Engineer in inspecting the material.

The basis of rejection shall be as specified in applicable ASTM and AWWA Specifications.

2. Valves

a. Gate Valves

The Contractor shall provide gate valves meeting the following requirements:

- **Gate Valves Two Inches and Larger:** Gate valves shall be of the resilient seated wedge type, epoxy coated to AWWA C550, cast iron body design. They shall comply with AWWA C509, latest revision. Valves shall be rated for zero leakage at 200 psi water working pressure and have a 400-psi hydrostatic test for structural soundness. All testing shall be conducted in accordance with AWWA C509. Gate valves shall be mechanical joint per AWWA C111.

All cast iron shall conform to ASTM A126. Castings shall be clean and sound without defects that will impair their service. No plugging or welding of such defects will be allowed. Bolts shall be in accordance with ASTM A307.

Valves shall be M & H Model 4067, American Model 2500, Mueller A-2360 (Mueller A-2361 for valves over 12 inches), or approved equivalent.

- **Gate Valves Under Two Inches:** Gate Valves under two inches shall be bronze body, threaded ends, non-rising stem, solid wedge disc and shall be American Model G300 or approved equivalent.

3. Hydrants

All fire hydrants shall be 5¼ inches with two (2) 2½-inch connections and one (1) pumper connection designed for 250 psi working pressure (see **Detail PW-2**). Fire hydrants shall conform to the requirements of AWWA C502.

Hydrants shall have mechanical joint inlets, shall be for a three (3)-foot bury, and shall be breakaway or traffic model, dry barrel type. A six (6)-inch gate valve shall be installed with anchor coupling between the water main and each fire hydrant.

All hydrant coatings shall meet or exceed the requirements of AWWA C-550. The exterior color shall be “Fire Hydrant Red,” or equivalent, as approved by PWS.

Hydrants shall be American Flow Control, American Darling B-84-B; Mueller Co., Super Centurion 250; M & H Style No. 129; or approved equivalent.

4. Water Services

a. Meter Boxes

Meter boxes shall be furnished and installed by the developer and shall be the Carson Standard Meter Box with a pre-drilled solid lid to accept touch/radio read equipment, or approved equivalent.

b. Meters

Commercial meters up to and including 1½ inches in size shall be provided by PWS. Larger sized meters shall be purchased by the developer through PWS. All meters two (2) inches and larger shall be installed in a fiberglass or concrete vault (see **Detail PW-11**).

Any connection that serves a daycare or school shall be equipped with a sample tap consisting entirely of stainless steel and polyethylene tubing, at a location to be approved by the Engineer and PWS Representative.

c. Service Saddles

Service saddles shall meet requirements specified in AWWA C800 with an epoxy-coated stainless-steel band and shall be Ford Model FC202, or approved equivalent.

d. Corporation Stops

Corporation stops shall meet requirements specified in AWWA C800 and shall be Ford Model No. F-1000, or approved equivalent. Inlets shall have CC threads and outlets shall have compression connections.

For any commercial service 1 ½ inches or greater, corporation stops will not be approved. The Contractor shall use a gate valve of the same size as the service connection, complying with the valve section of this utility design manual.

e. Curb Stops

Curb stops shall meet requirements specified in AWWA C800 and shall be Ford Model No. B43, or approved equivalent. Inlets shall have compression connections and outlets shall have meter swivel nut. Valves shall be equipped with padlock eyes, or approved equivalent.

f. Service Tubing

Service tubing shall be polyethylene (PE) and meet the requirements of ASTM D2737, SDR 9 and shall be listed as having the approval of the NSF for water distribution. Service tubing shall have the NSF approval designation stamped on the tubing and shall be blue in color for potable water. It shall be delivered in rolls and cut to required lengths.

g. Service Tees

Service tees for double services are to be pack joint or compression tees and are to meet requirements specified in ANSI/AWWA C800. Service tees shall be Ford Model No. T444, Mueller H-15381/Mueller P-15381, or approved equivalent.

5. Valve Boxes

Cast iron valve boxes shall be provided for all underground valve installations (see **Detail PW-4**). They shall consist of a base covering the operating nut

and head of the valve; a vertical shaft, at least 5¼ inches in diameter and with an adjustable length from 18 to 24 inches; and a top section extending to a point even with the finished ground surface. A cast iron cover marked "WATER" shall be provided and placed concentrically over the operating nut. The assembly shall be suitable for highway traffic wheel loads. Valve boxes shall be Clow, Mueller Company, Sigma, or Tyler Union screw type, or approved equivalent.

6. Backflow Preventer

Backflow preventers on residential water services shall be dual check (DuC) valve assemblies. DuC assemblies shall meet ASSE Standard 1024 and shall be Ford Meter Box Company HHS31, or approved equivalent.

A Reduced-Pressure Principle (RP or RPZ) assembly shall be used in any high-risk installation, all commercial installations, and any installation with a secondary water source (see **Detail PW-8**). RP assemblies shall meet ASSE Standard 1013 and shall be Watts, Zurn Wilkins, or approved equivalent.

A Reduced-Pressure Principle Detector Assembly (RPDA or RPZDA) shall be used on fire protection system supply mains and shall be Watts, Zurn Wilkins, or approved equivalent (see **Detail PW-8**).

7. Tapping Valves

Tapping valves shall meet the requirements of AWWA C-500, Metal Seated Gate Valves for Water Supply Service, and be designed for making taps to existing mains under pressure. Tapping sleeves shall be properly sized for the pipe being tapped. Valve, tees, and boring equipment used shall be mutually compatible. All stainless-steel bodied tapping tees may be used. All nuts and bolts shall be non-corrosive and compatible with fitting materials.

8. Submittals

The Contractor shall submit a minimum of two (2) copies of catalog data for approval by PWS for materials to be used and shall allow two (2) weeks for submittal review. Submittals shall include, but not be limited to, the following:

- Pipe and Fittings
- Tubing
- Valves, Boxes and Concrete Collars
- Hydrants

- All Service Materials
- Casing
- Backflow Preventers
- Tracer Wire and Silicone Wire Nuts

C. INSTALLATION OF PRESSURE PIPEWORK

This section covers installation of pressure pipework. Excavation and backfilling shall be in accordance with the *General Sitework* section of the utility design manual (see **Section 5.2 Earthwork**).

1. General

All pipe, fittings, and valves shall be carefully handled at all times to prevent damage to the pipe or other installation on the job site. All joints shall be wiped free of all dirt, sand and foreign material and the pipe shall be carefully examined for defects before installation. Cutting of the pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe.

At times when pipe installation is not in progress, the open ends of the pipe shall be closed with a compatible pipe plug and shall remain closed until construction on that particular section is resumed, eliminating the possibility of any flow obstructions getting into the pipe.

Deviations from the piping location, line and grade indicated on the construction plans shall not be made without the prior approval of the Engineer or PWS Representative.

No pressure piping or fittings shall be allowed under any proposed paving, including sidewalks, flumes, roadways, etc., except for approved crossings.

2. Pipe Laying Procedures for Pressure Piping

Pressure piping shall be installed in strict accordance with the manufacturer's printed instructions and as per **Detail PW-1**. Before lowering the pipe into the trench, the bottom of the trench shall be graded so that when the pipe rests on the trench bottom it will have a uniform bearing for its entire length. The pipe shall be carefully examined for defects and the inside cleaned. After placing the pipe in the trench, the ends shall be wiped free from all dirt, sand and foreign material. The joints shall be made in accordance with the recommendations of the pipe manufacturer.

Unless otherwise directed, the pipe shall be laid with bell ends facing in the direction of laying. Whenever it is necessary to deflect the pipe from a straight line, either in the vertical or horizontal plane, to avoid obstruction, to plumb stems, or where long radius curves are permitted, the degree of deflection shall be as recommended by the manufacturer of the pipe. Degree fittings are required on all long radius pipe runs as necessary.

The minimum cover for pipe will be 30 inches below top of curb and the maximum cover will be 48 inches, unless otherwise indicated on the construction plans and approved by PWS. The depth of cover shall be measured from the established street grades or the surface of the permanent improvement to the top of the barrel of the pipe. At street intersections or where the new pipelines cross existing underground lines at the approximate same depth as the new line, the cover shall be increased and the new line laid below existing lines or structures. Where the existing lines or structures are of sufficient depth that the new line when laid will have six (6) inches of separating earth between it and other pipe or structure and 30 inches cover below top of curb, the new line may be laid above the existing pipe or structure.

a. Road Crossings

In all new developments, pressure piping under road crossings shall be installed in steel casing under paving (see **Detail PW-12**). HDPE or restrained bell PVC shall be used in casing. HDPE must be one pipe diameter size larger than pressure piping utilized on either side of road crossing. Casing spacers must be used. Steel casing must meet or exceed ASTM A252 GR3. Casing pipe shall be dead 20-foot lengths, with bevel X squared ends, and have no mi welds. Pipe must be in new condition. Mill test reports shall accompany all pipe at the time of shipment. No spiral welded pipe will be acceptable for sizes 24 inches and below.

b. Sub-Surface Explorations

Whenever necessary to determine the location of existing pipes, valves, or other underground structures, the Contractor shall examine all available records and shall make all explorations and excavations for such purpose. Where the locations of existing utilities are furnished by PWS or other owners, they should be considered approximate only. The Contractor is responsible for locating and protecting all existing utilities whether shown on the drawings or not shown.

c. Protecting Underground and Surface Structures

Temporary support, adequate protection and maintenance of all underground and surface utility structures, drains, sewers, and other obstructions encountered in the progress of the work shall be furnished by the Contractor at his own expense under the direction of the Engineer or PWS.

d. Construction Equipment

Mechanical equipment may be used for trenching and excavating. However, in places where the operation of same will cause damage to trees, shrubbery, pavements or existing structures, above or below ground, hand methods shall be employed. Where a main is installed along paved streets, rubber-tired equipment is recommended; however, if track equipment is necessary for excavation due to depths, the Contractor will be permitted to use such equipment and will be responsible for any damage done to paved streets or lawns. Concrete driveways and asphalt pavement must be saw cut for final replacement.

e. Unsuitable Conditions

No pipe shall be laid in water or unsuitable soil conditions. Unsuitable soil, as determined by the Engineer or PWS, shall be removed or replaced with an approved material.

f. Trench Water

At times when pipe laying is not in progress, the open ends of pipe shall be closed with a compatible pipe plug, and no trench water shall be permitted to enter the pipe.

g. Setting Valves and Boxes

- **Valves and Fittings:** Gate valves and pipe fittings shall be set and joined to new pipe in the manner as specified in this section.
- **Valve Boxes:** Cast-iron valve boxes shall be firmly supported and maintained, centered and plumbed, over the wrench nut of the gate valve and box cover flush with the surface of the finished pavement or at such other level as may be directed. A concrete collar around valve box shall be required for protection. Tracer wire shall be looped in valve box and accessible at the top of valve box (see **Detail PW-4**).

h. Dewatering

The Contractor shall provide all necessary pumps to dewater the site properly; shall provide all labor and materials required to keep any open excavation dewatered during construction; and shall provide all necessary sheeting, bulkheads, drains, etc., so that construction operations may be performed under dry conditions. Discharge from pumps must be led to natural drainage channels, to drains, or to storm sewers. The Contractor is responsible for all permitting and testing of dewatering discharge.

i. Service Pipe

Service pipe shall have a minimum depth of 30 inches at all highway crossings and 18 inches elsewhere. The requirements for trenching and backfilling as described in the *General Sitework* section of the utility design manual (see **Section 5.2 Earthwork**) shall apply. Removal of pavement or sidewalk will not be permitted for water service lines. They may be installed by jacking, boring or pushing under sidewalks. All services shall be encased under all paving, including sidewalks, flumes, roadways, etc. (see **Details PW-9 and PW-10**).

j. Plugging Dead Ends

Standard plugs shall be inserted into the bells of all dead ends of pipes, tees, or crosses, and spigot ends shall be capped. Plugs or caps shall be joined to the pipe or fittings in the appropriate manner.

k. Concrete Encasement and Special Pipe Support

Concrete encasement or special pipe supports shall be provided as shown on the drawings or directed by the Engineer or PWS. Various pipe supports shall be as worked out in the field to suit local conditions and emergencies. Where, in the opinion of Engineer or PWS, pipe covering is inadequate, concrete encasement for protection shall be provided in accordance with **Detail PW-6** and the approved drawings. Concrete encasement shall be made using concrete with a 28-day strength of 2000 psi and shall be to the dimensions indicated on the construction plans and as required by the applicable Department of Transportation or Public Health regulations. All other concrete needed to build and protect the pipe work shall be used at the direction of the Engineer or PWS.

l. Separation of Water Mains and Sewers/Reclaimed Water

Water mains or sewer mains that are laid in the vicinity of each other shall meet the horizontal and vertical separations specified herein (see **Detail PW-7**).

m. Backfilling

Backfill material shall be free from rocks or boulders or any other objectionable material. Backfill shall be placed in the trench and compacted simultaneously on both sides of the pipe for the full width of the trench, and to an elevation level with ground on either side to densities indicated in *General Specifications* section of this utility design manual (see **Section 5.2 Earthwork**).

a. Repaving

Pavement removal where required in the construction of the project shall be done by the Contractor in a workmanlike manner. Care must be taken to make the saw cut in a straight line so the patch will be neat.

Asphalt paving shall be replaced as described in the *General Specifications* section of this utility design manual (see **Section 5.1 Sitework**) and in accordance with the approved construction plans. Concrete driveways and pavement shall be replaced using concrete with high early strength so that traffic may be resumed quickly. Concrete must be finished to conform with existing pavement.

n. Clean-Up

Before final inspection and acceptance, the Contractor shall clean ditches, shape shoulders, and restore all disturbed areas, including street crossings and grass plots, to as good a condition as existed before work started. All trenches shall be leveled, and loose material removed from pavement, gutters, and sidewalks, employing hand labor if necessary.

3. Anchorage of Bends, Tees, and Plugs

a. Thrust Block Placement

Suitable concrete reaction or thrust blocks shall be placed on all pipelines 2 inches in diameter or larger at all tees, plugs, caps and at bends deflecting 22-1/2 degrees or more, or movement shall be prevented by attaching metal rods or straps approved by the Engineer.

b. Materials for Thrust Blocking

Reaction, or thrust blocking shall be of concrete that has a 28-day compressive strength of not less than 2000 psi. Thrust blocks shall be placed in accordance with the details on the approved construction plans and PWS **Detail PW-5**. A combination of mega lugs and bell restraints may be used in lieu of thrust blocking.

Blocking shall be placed between solid ground and the fitting to be anchored. The restraint shall, unless otherwise directed, be placed so the pipe and fitting joints are accessible for repairs. No extra payment will be made for this material, but all costs shall be included in the unit price bid for the various sizes of pipe.

In some cases, the Engineer may direct the Contractor to provide restraint using cables and "deadman" anchors where the soil conditions will not support the normal concrete type as described above.

D. TAPS ON POTABLE PRESSURIZED LINES (WET TAP)

Tapping valves shall be as specified in this section of the PWS utility design manual. The Contractor shall notify the Engineer and PWS Representative 48 hours prior to the tap. The PWS Representative/Engineer must be present for the hydrostatic pressure testing and tapping of the main. The hydrostatic pressure test shall be 150 psi minimum for a duration of 15 minutes. As an alternate, air testing is permissible at 50 psi for a duration of 15 minutes. The following chart demonstrates the tapping machine shell cutter outside diameter:

| Nominal Main Size | Tapping Valve ID AWWA Standard | Tapping Machine Shell Cutter OD |
|-------------------|--------------------------------|---|
| 2" | 2-1/8" | 1-1/2" |
| 3" | 3-1/8" | 2-1/2" |
| 4" | 1-1/4" | 3-1/2" |
| 6" | 6-1/4" | 5-1/2" |
| 8" | 8-1/4" | 7-1/2" |
| 10" | 10-1/4" | 9-1/2" |
| 12" | 12-1/4" | 11-1/2" |
| 14" | 14-1/4" | Per Manufacturer's Recommendation Contractor shall submit shop drawings for valves and tapping machine for approval, prior to use. Per Manufacturer's Recommendation. |
| 16" | 16-1/4" | |
| 18" | 18-1/4" | |
| 20" | 20-1/4" | |
| 24" | 24-1/4" | |

The tap coupon shall be given to the PWS Inspector. If the coupon is lost in the main, the Contractor shall, at his expense, dismantle the main to retrieve the coupon. The main shall subsequently be reassembled, pressure tested, and bacteriological tests retaken as required at the Contractor's expense.

E. TESTING AND INSPECTION

1. General

During construction and at the completion of the work, the Contractor shall make such tests as required for potable pressure pipework. The PWS Representative/Engineer will observe the tests, but the Contractor shall furnish all apparatus required and shall pay all costs connected therewith. Defective work shall be repaired immediately at the Contractor's expense.

In general, tests shall conform to accepted testing practices for the specific type and class of test. All data, observations and results will be carefully recorded, and the PWS Representative and Engineer will be furnished two (2) signed copies of all data and reports. Project acceptance may be held contingent on receipt of satisfactory test reports.

All new construction shall be secured prior to acceptance by PWS. Valves between new systems and existing systems that are not yet accepted shall be closed while unattended (i.e., nights, weekends, and holidays).

2. Hydrostatic Tests of Potable Pressure Pipework

a. Pressure During Test

After the pipe has been laid and backfilled as specified, each valved section of newly laid pipe shall, unless otherwise specified, be subjected to a hydrostatic pressure equal to the pressure rating of the pipe being tested but not less than 150 psig. The Contractor shall record the testing by the use of a pressure recording gauge, and after all testing is complete, the recordings shall be turned over to the Engineer/PWS Representative for his files. The gauge shall be clearly visible at all times.

b. Duration of Pressure Test

The duration of each pressure test shall be at least two (2) hours.

c. Procedure

Each section of pipe shall be slowly filled with water and the specified test pressure, measured at the lowest point of elevation, shall be applied by means of a pump connected to the pipe in a satisfactory manner. The pump, pipe connection, gauges, meter and all necessary apparatus shall be furnished by the Contractor. The test shall be applied to each valved section to check the leakage through all valves.

d. Expelling Air Before Test

Before applying the specified test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made, if necessary, at points of highest elevation, and afterwards tightly plugged.

e. Definition of Leakage

Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved section of it, necessary to maintain the specified leakage test pressure.

f. Permissible Leakage

Suitable means shall be provided by the Contractor for determining the quantity of water lost by leakage under normal operating pressure. No pipe installation will be accepted until or unless this leakage (evaluation at specified pressure) is less than the specified allowance calculated using the nominal factors in the following table:

| Nominal Pipe Size | Gal/2 Hour per 1,000 FT of PVC |
|-------------------|--------------------------------|
| 2" | 0.34 |
| 3" | 0.50 |
| 4" | 0.66 |
| 6" | 1.00 |
| 8" | 1.32 |
| 10" | 1.66 |
| 12" | 1.98 |
| 14" | 2.32 |
| 16" | 2.64 |
| 18" | 2.98 |
| 20" | 3.32 |
| 24" | 3.98 |

Calculation of the specified allowance is based on the length of pipe divided by 1,000 and then multiplied by the factor supplied in the above table (according to pipe size) as demonstrated below:

$$\frac{\text{Length of Pipe (in FT)}}{1,000 \text{ FT}} \times \text{Factor}$$

g. Variation from Permissible Leakage

Should any test of combined sections of pipe laid disclose leakage greater than the specified limit, the Contractor shall, at his own expense, locate and repair the defective joints until the leakage is less than the specified allowance.

h. Water for Testing

Water for testing shall be provided by PWS at no cost to the Contractor for PWS projects only. Contractor shall make arrangements for water for testing with the developer for developer's projects.

i. Time for Making Test

Pipe may be subjected to hydrostatic pressure, inspected, and tested for leakage at any convenient time after partial completion of backfill. The Contractor may test the system with joints exposed or with backfilling complete at his option; however, not more than 300 feet of trench may be open at any time. No flushing of new lines will be permitted without 48 hours prior notification to PWS.

1. Chlorination of Water Distribution Facilities

a. Disinfection

After the water distribution system has been hydrostatically tested to the satisfaction of the Engineer and PWS, it shall be disinfected in accordance with AWWA C651 and all applicable state and federal regulations.

b. Chlorinating Valves and Flushing Hydrants

In the process of chlorinating water piping, all valves or other appurtenances shall be operated while the pipeline is filled with the chlorinating agent.

c. Final Flushing and Test

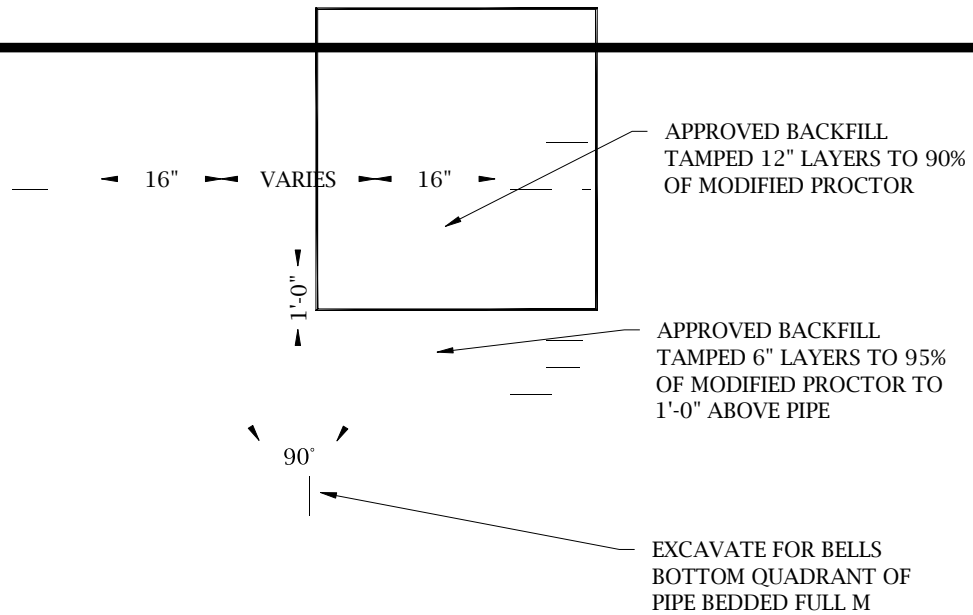
Following chlorination, all treated water shall be thoroughly flushed from the newly laid pipeline at its extremities until the replacement water throughout its length shall, upon test, both chemically and bacteriologically, be approved by the Florida Department of Environmental Protection. The Contractor shall be responsible for arranging for the Test Samples, including repeat sampling.

d. Repetition of Procedure

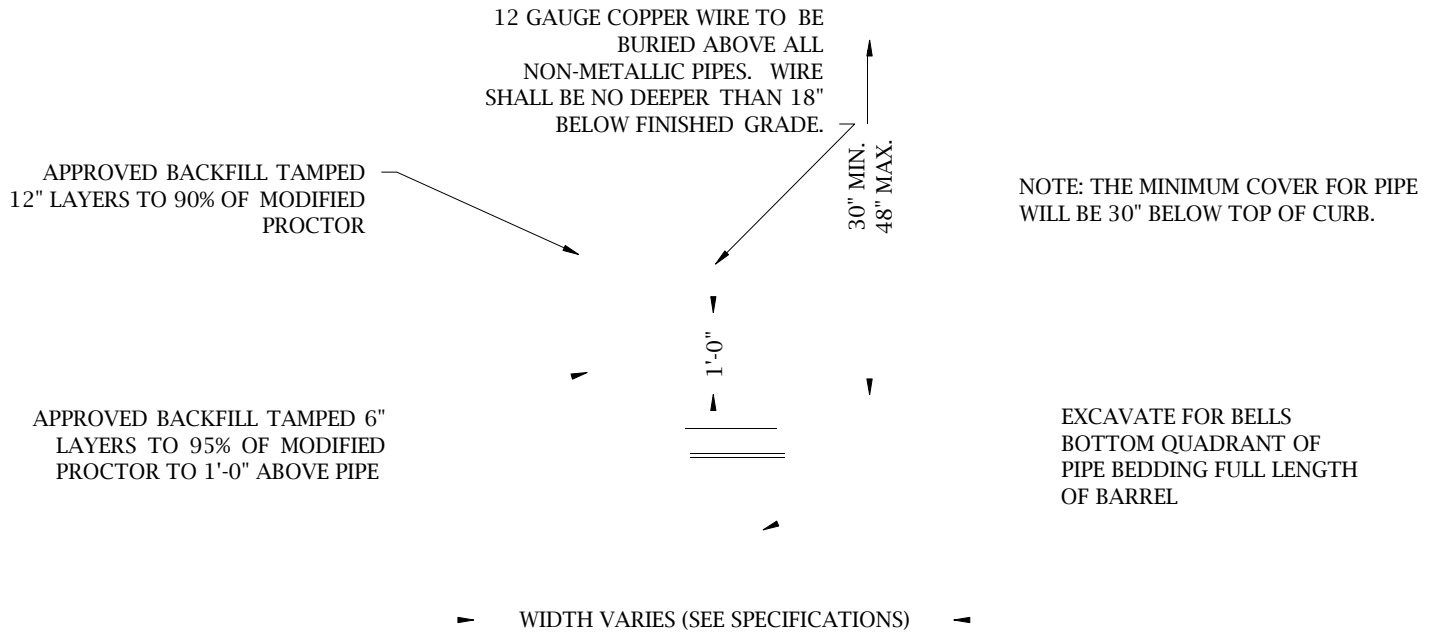
Should the initial treatment, in the opinion of the Engineer/PWS Inspector, prove ineffective, the chlorination procedure shall be repeated until confirmed tests show that the water sampled conforms to the requirements stated above.

2.3 DETAILS

END OF CHAPTER 2



PIPE BEDDING



TYPICAL PRESSURE PIPE INSTALLATION

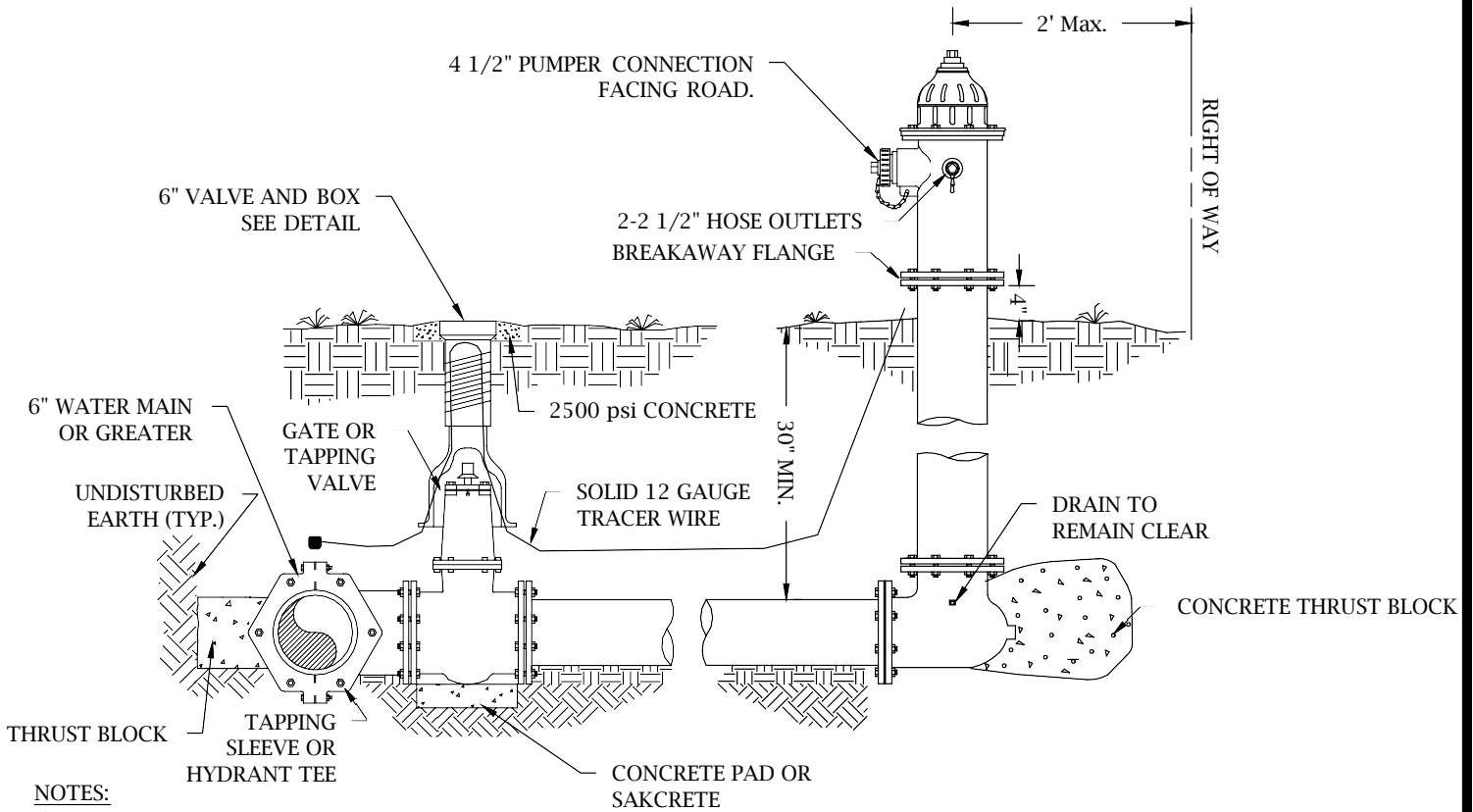
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PIPE BEDDING & TYPICAL PRESSURE PIPE INSTALLATION DETAIL

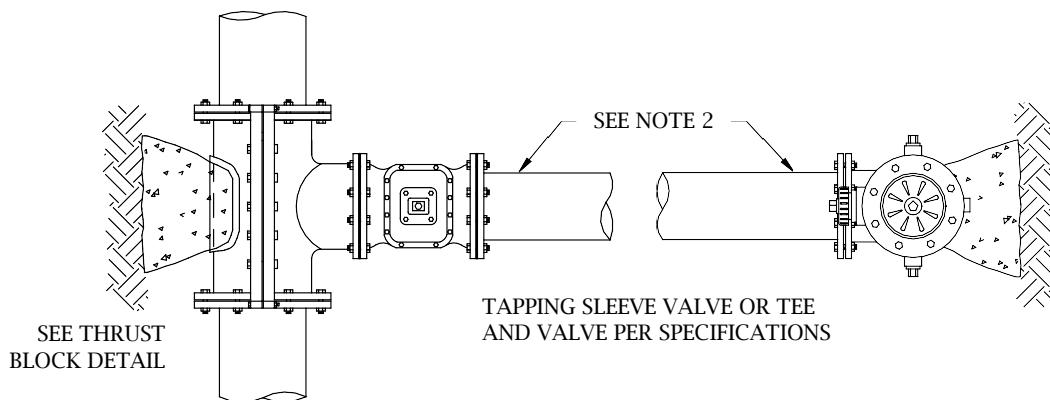
Revision Date:
2024

Detail #:
PW-1

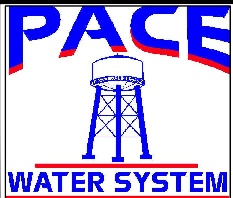


NOTES:

- 1) ALL JOINTS FROM THE HYDRANT THRU THE TEE AT THE MAIN ARE TO BE RESTRAINED D.I. M.J. WITH RETAINER RINGS.
- 2) HYDRANT CONNECTORS OR DIP HYDRANT SPOOLS OR C900 PVC WITH MEGALUG JOINT RESTRAINTS OR APPROVED EQUAL.
- 3) CONTRACTOR TO ADJUST FIRE HYDRANT TO FINISHED GRADE.
- 4) HYDRANT SHALL BE "FIRE HYDRANT RED" IN COLOR.



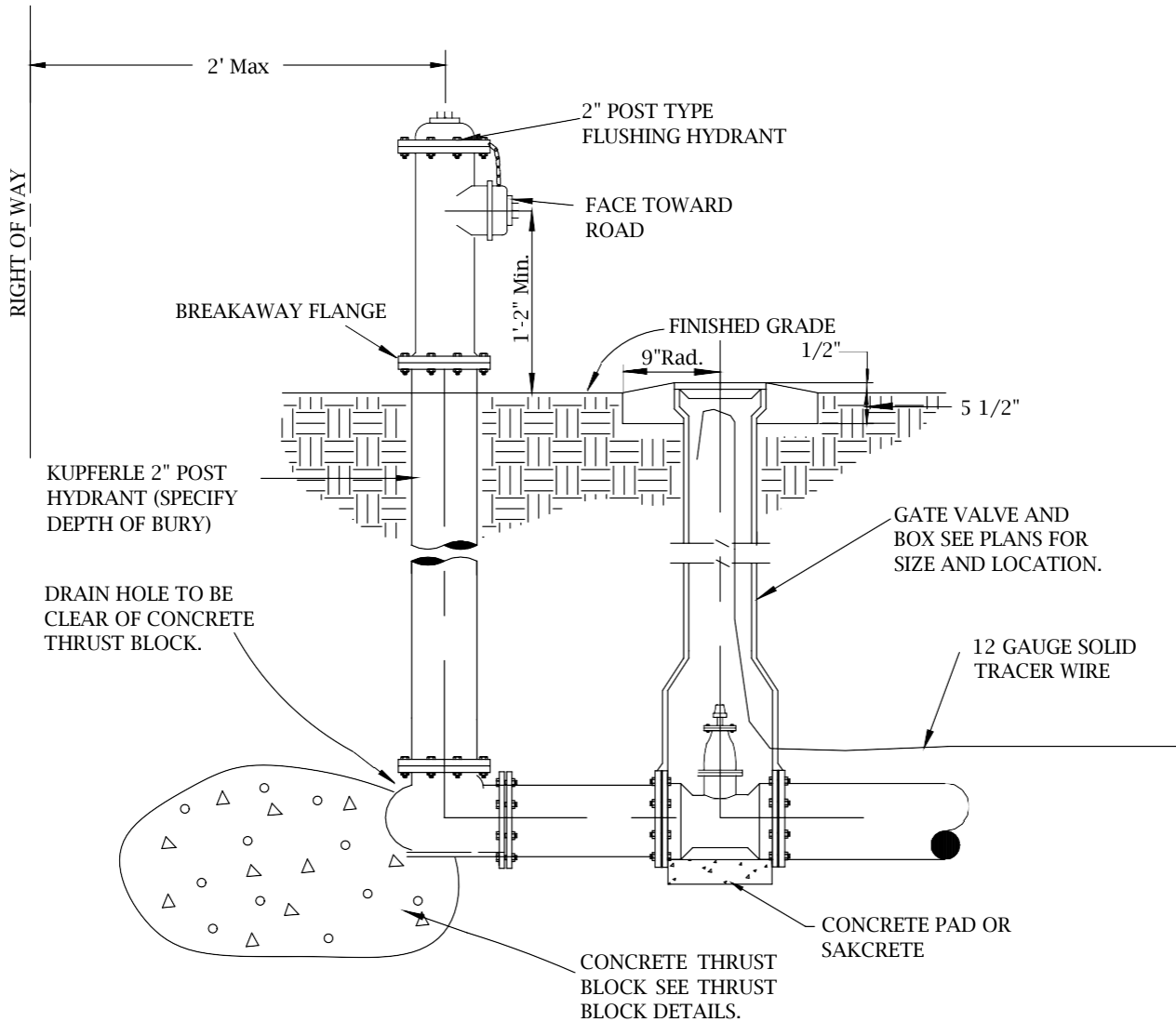
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TYPICAL FIRE HYDRANT ASSEMBLY

**Revision Date:
2024**

**Detail #:
PW-2**



NOTES:

- 1) HYDRANTS SHALL BE SELF-DRAINING, NON-FREEZING, COMPRESSION TYPE WITH 2-3/16" MAIN VALVE OPENING. INLET CONNECTION SHALL BE (2" MJ OR 3" MJ). OUTLET SHALL BE (2-1/2" NST).
- 2) HYDRANTS SHALL HAVE A 3" DUCTILE IRON PIPE RISER WITH A CAST IRON TOP STOCK AND BOLTED FLANGE. EPOXY COATED CAST IRON BOTTOM SHOE, AND NON-TURNING OPERATING ROD. PRINCIPAL INTERIOR PARTS SHALL BE BRASS AND REMOVABLE FROM AND BE REMOVABLE FROM WITHOUT EXCAVATING THE HYDRANT.
- 3) HYDRANT SHALL BE "FIRE HYDRANT RED" IN COLOR.

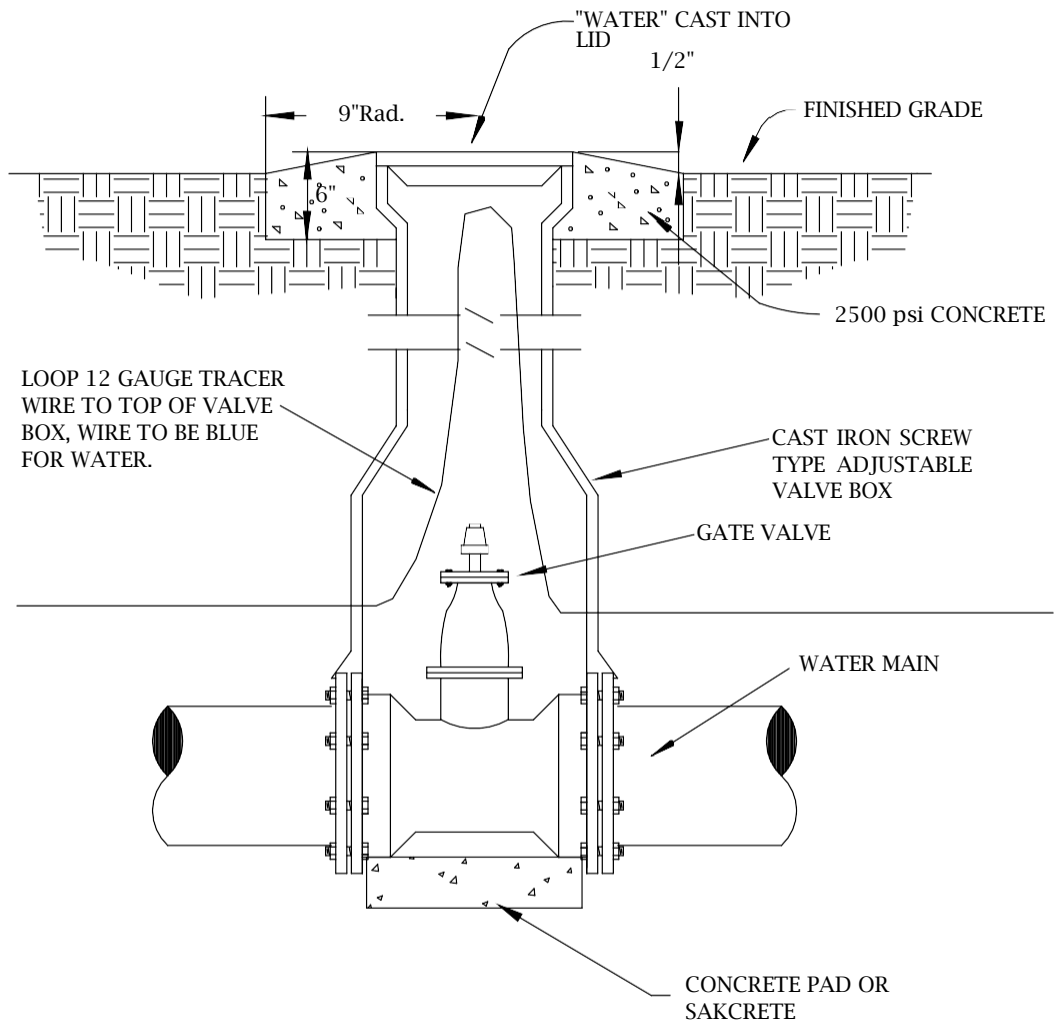
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TYPICAL FLUSH HYDRANT ASSEMBLY

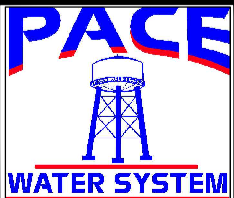
**Revision Date:
2024**

**Detail #:
PW-3**



Note: Valve box alignment device (VBAD) shall be utilized per specifications.

NOT TO SCALE

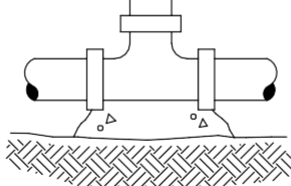
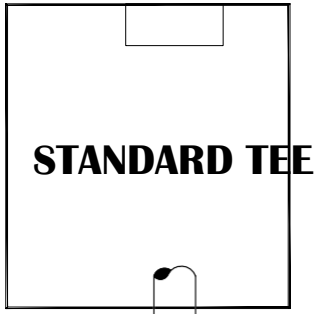
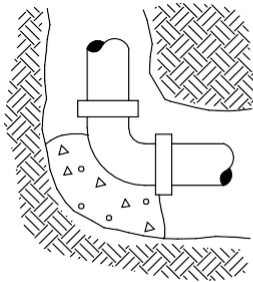


VALVE BOX SETTING DETAIL

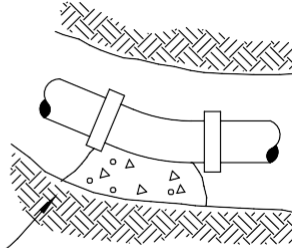
Revision Date:
2024

Detail #:
PW-4

90° BEND

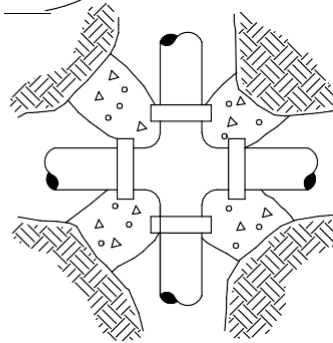
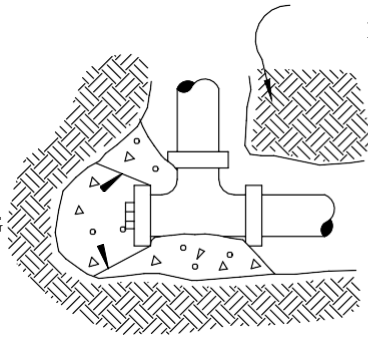


22.5° BEND



UNDISTURBED
EARTH (TYP.)

WRAP
PLASTIC
SHEETING
AROUND
FITTING



PLUG

CROSS

BEARING AREAS

| | Tee or Cap | 90° Bend | 45° Bend | 22.5° Bend |
|-----|---------------|-------------|-------------|---------------|
| 2" | 1.0 S.F. | 1.0 S.F. | 1.0 S.F. | 1.0 S.F. |
| 3" | 1.3 S.F. | 1.8 S.F. | 1.0 S.F. | 1.0 S.F. |
| 4" | 2.7 S.F. | 3.7 S.F. | 1.9 S.F. | 1.0 S.F. |
| 6" | 4.9 S.F. | 6.9 S.F. | 3.7 S.F. | 1.9 S.F. |
| 8" | 8.1 S.F. | 11.3 S.F. | 6.2 S.F. | 3.2 S.F. |
| 10" | 11.7 S.F. | 16.4 S.F. | 8.9 S.F. | 4.6 S.F. |
| 12" | 17.6 S.F. | 24.6 S.F. | 13.4 S.F. | 6.9 S.F. |

NOTE:
MINIMUM THICKNESS OF THRUST BLOCKS TO BE 12" WITH AREA AS ABOVE.

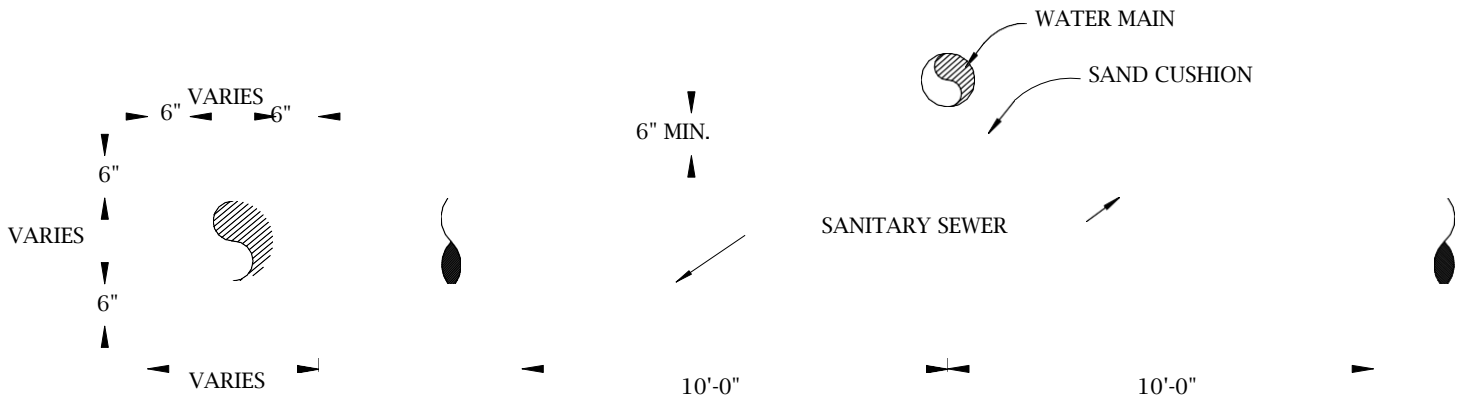
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THRUST BLOCK DETAILS

**Revision Date:
2024**

**Detail #:
PW-5**



NOTES:

PIPE CROSSING

USE CONCRETE ENCASEMENT WHERE A SEWER MAIN CROSSES OVER A WATER MAIN OR WHERE A WATER MAIN CROSSES OVER A SEWER MAIN WITH LESS THAN 18" OF VERTICAL CLEARANCE BETWEEN THE BOTTOM OF THE WATER MAIN AND THE TOP OF THE SEWER MAIN.

PARALLEL MAINS

CONTACT ENGINEER IN LOCATIONS WHERE WATER AND SEWER MAINS ARE PLACED WITH LESS THAN 6' HORIZONTAL SEPARATION AND LESS THAN 18" VERTICAL SEPARATION FOR INSTRUCTION ON REQUIRED ENCASEMENT.

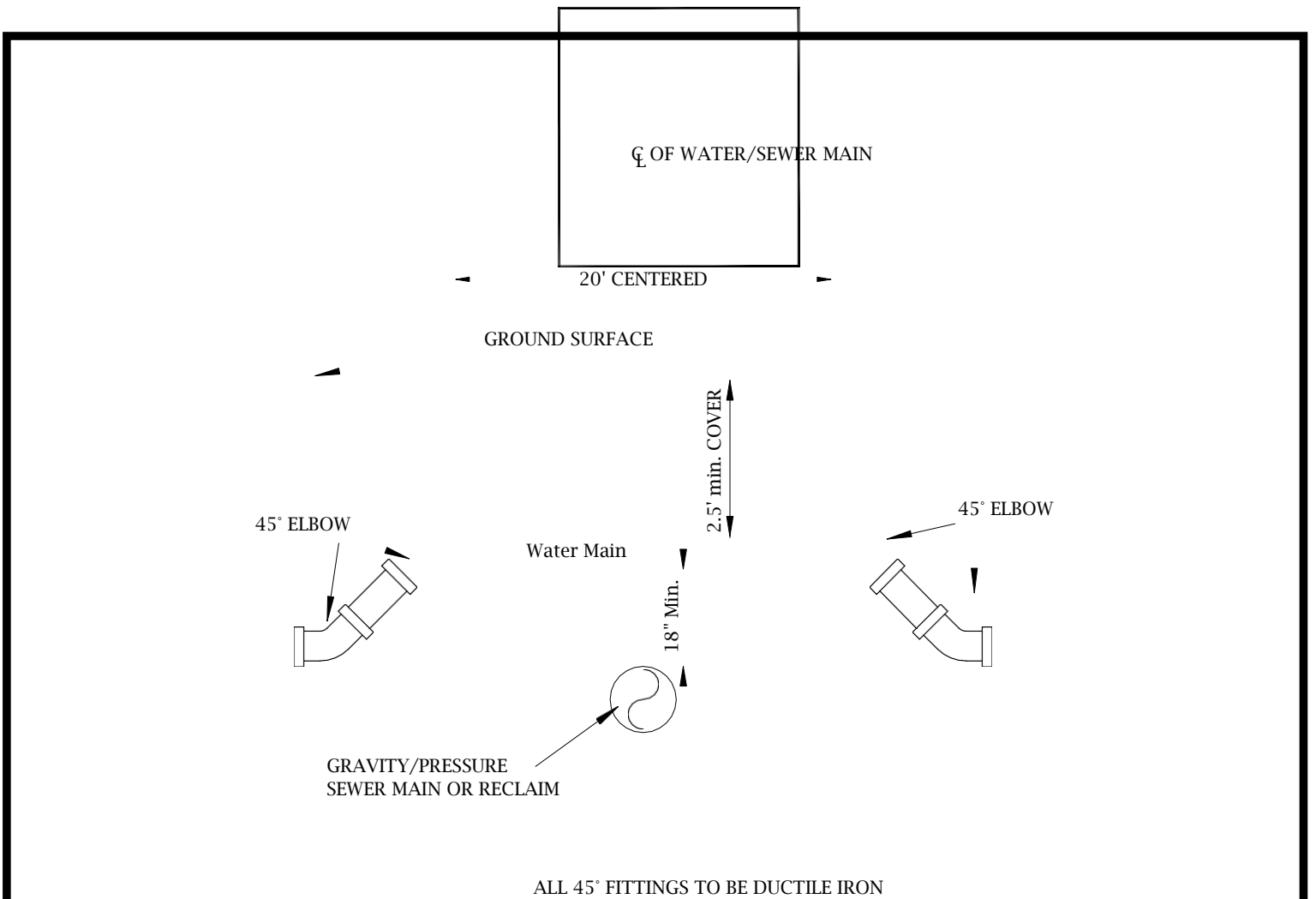
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CONCRETE ENCASEMENT

**Revision Date:
2024**

**Detail #:
PW-6**



ALL 45° FITTINGS TO BE DUCTILE IRON

NOTES:
 CENTERING A 20' SECTION OF SANITARY SEWER/ WATER MAIN PIPE AT CROSSING MAY BE USED IN LIEU OF ENCASEMENT.

POTABLE WATER IS TO BE ROUTED ABOVE SANITARY SEWER COLLECTION MAIN IF MINIMUM COVERAGE SPECIFIED CAN BE OBTAINED. IF SAID MINIMUM COVERAGE IS NOT POSSIBLE, POTABLE WATER IS TO BE ROUTED BELOW SANITARY SEWER LINE.

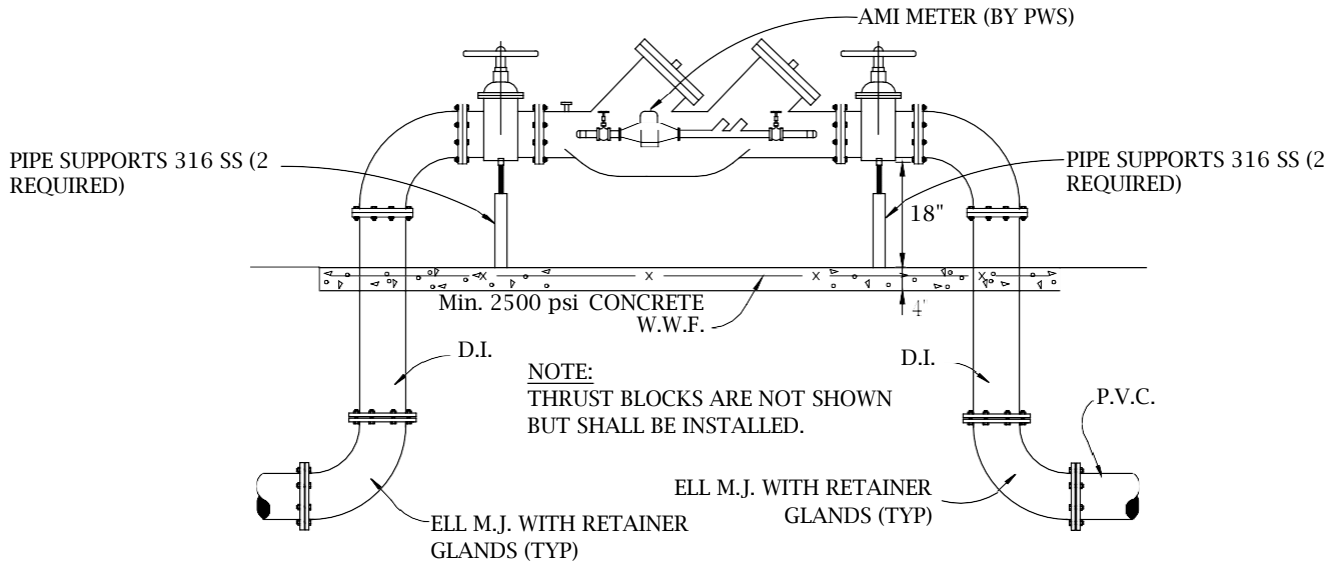
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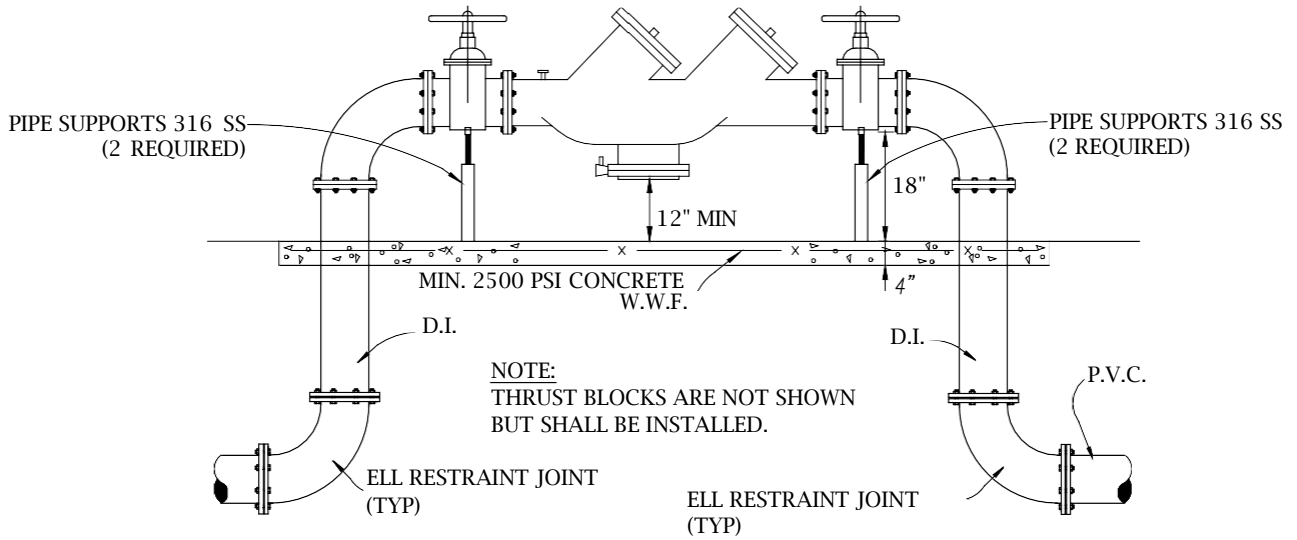
CONFLICT DETAIL

**Revision Date:
2024**

**Detail #:
PW-7**



DCDA BACKFLOW PREVENTER (BFP)

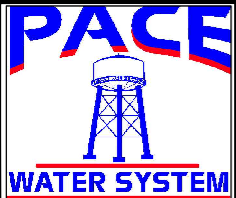


RPZ BFP

NOTES:

- 1) ABOVE GROUND PIPING, VALVES, AND BACKFLOW PREVENTER TO BE INSULATED.
- 2) LOCATE THE BFP ON THE DEVELOPER SIDE OF THE METER BOX.
- 3) BFP TO BE TESTED AFTER INSTALLATION AND PRIOR TO SERVICE BEING TURNED ON.
- 4) SEE SPECIFICATIONS FOR APPROVED MANUFACTURER'S.

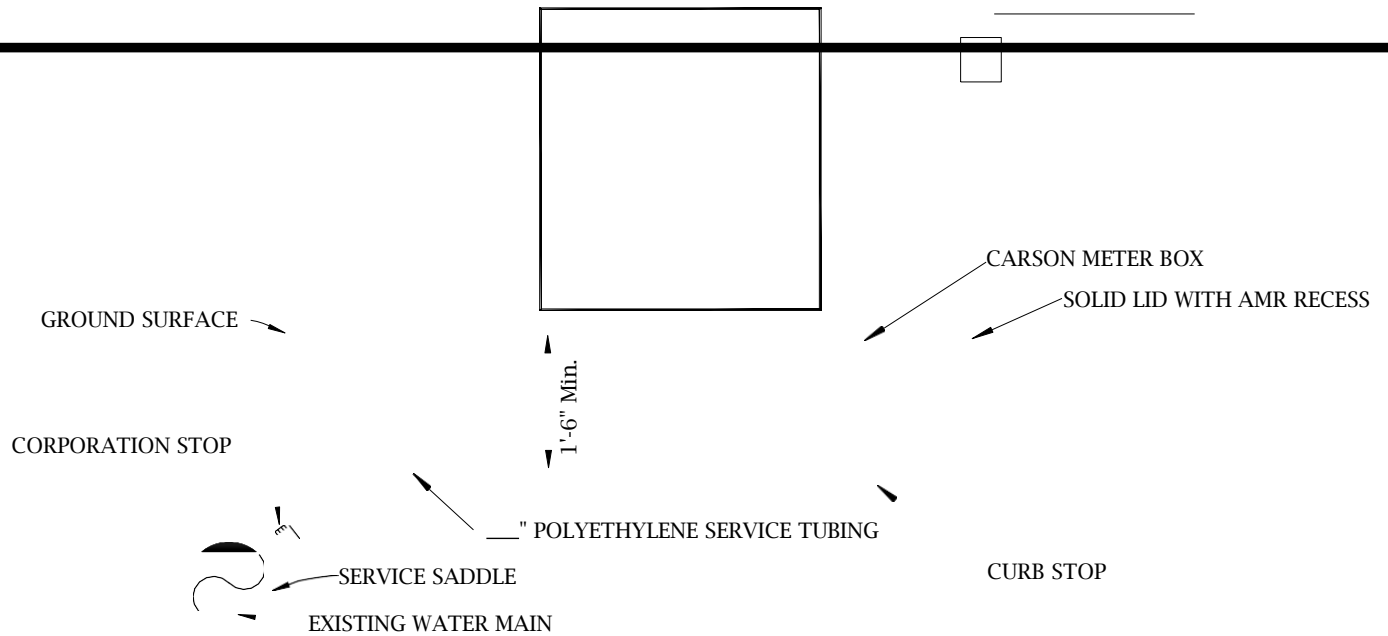
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BACKFLOW PREVENTER DETAIL

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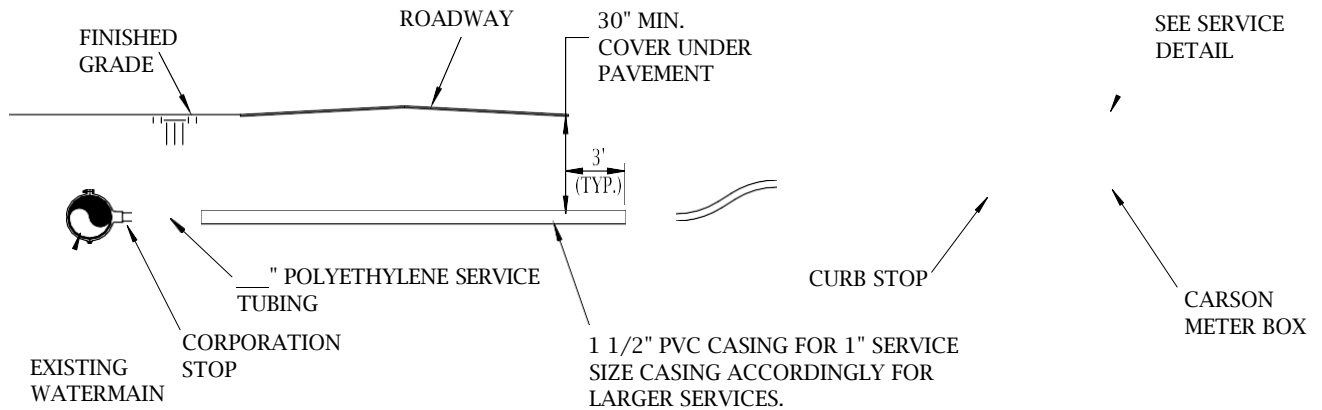
Detail #:
PW-8



NOTES

- 1) ACCEPTABLE ABOVE GROUND BACKFLOW PREVENTION DEVICE SHALL BE INSTALLED ON THE PROPERTY OWNER SIDE OF ALL COMMERCIAL CONNECTIONS AND ALL RESIDENTIAL CONNECTIONS WITH SECONDARY WATER SOURCE.
- 2) ALL COMMERCIAL TAPS WILL BE MADE BY CONTRACTOR WITH PWS INSPECTOR PRESENT. CONTRACTOR TO FURNISH ALL MATERIALS EXCEPT METER (5/8" TO 1-1/2" BY PWS). METERS 2" AND GREATER SHALL BE PURCHASED BY CONTRACTOR THRU PWS.
- 3) CONTRACTOR TO MARK LOCATION OF SERVICES WITH A TREATED 2"x4" STAKE 6' ABOVE THE GROUND AND PAINTED BLUE.
- 4) SERVICE LINE CONNECTIONS ACROSS ROADWAY SHALL BE BORED UNDER ROADWAY. SERVICE LINE SHALL BE ENCASED IN 1 1/2" PVC. CASING TO EXTEND 3' BEYOND EDGE OF PAVEMENT.
- 5) CONTRACTOR SHALL INCLUDE ALL SERVICES IN THE PRESSURE TEST OF THE PROPOSED WATER MAIN.

COMMERCIAL/RESIDENTIAL WATER SERVICE CONNECTION



NOTE

- 1) IF SERVICE IS UNDER SIDEWALK EXTEND CASING PAST SIDEWALK.

TYPICAL SERVICE LINE ROADWAY CROSSING

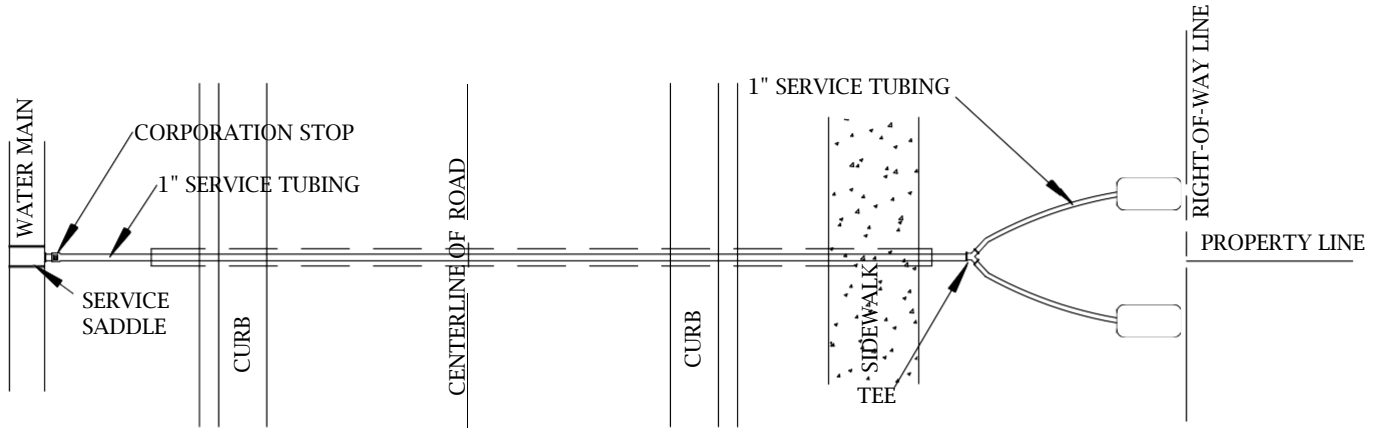
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WATER SERVICE DETAILS

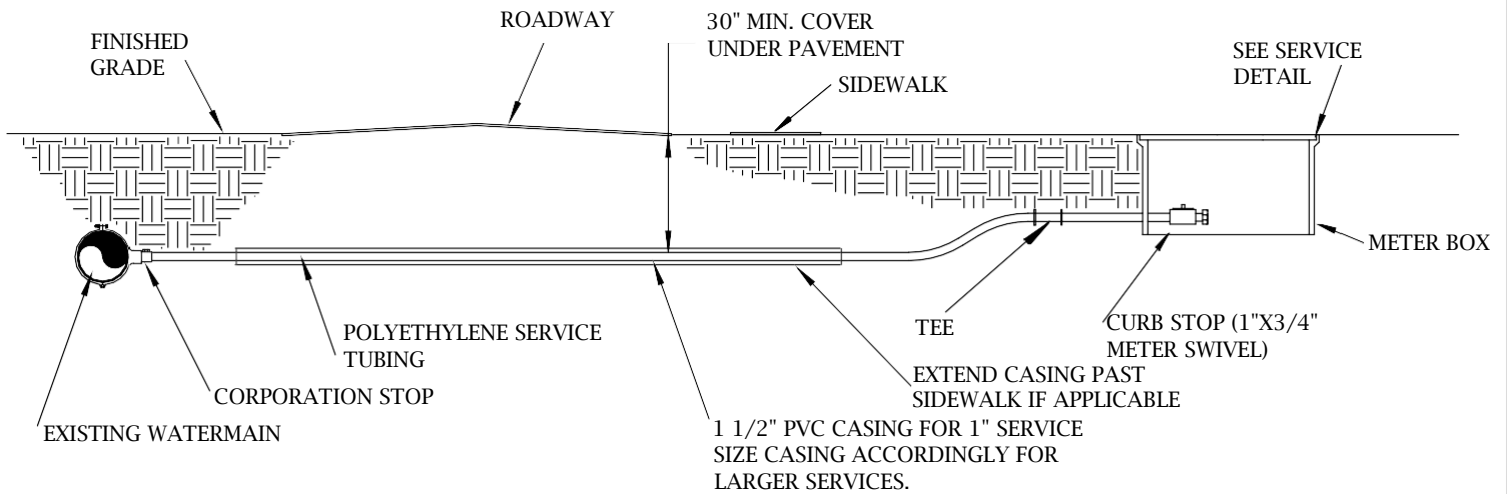
**Revision Date:
2024**

**Detail #:
PW-9**



NOTE: IF SERVICE IS UNDER SIDEWALK EXTEND CASING PAST SIDEWALK.

DOUBLE WATER SERVICE CONNECTION DETAIL



DOUBLE WATER SERVICE ROADWAY CROSSING

NOT TO SCALE

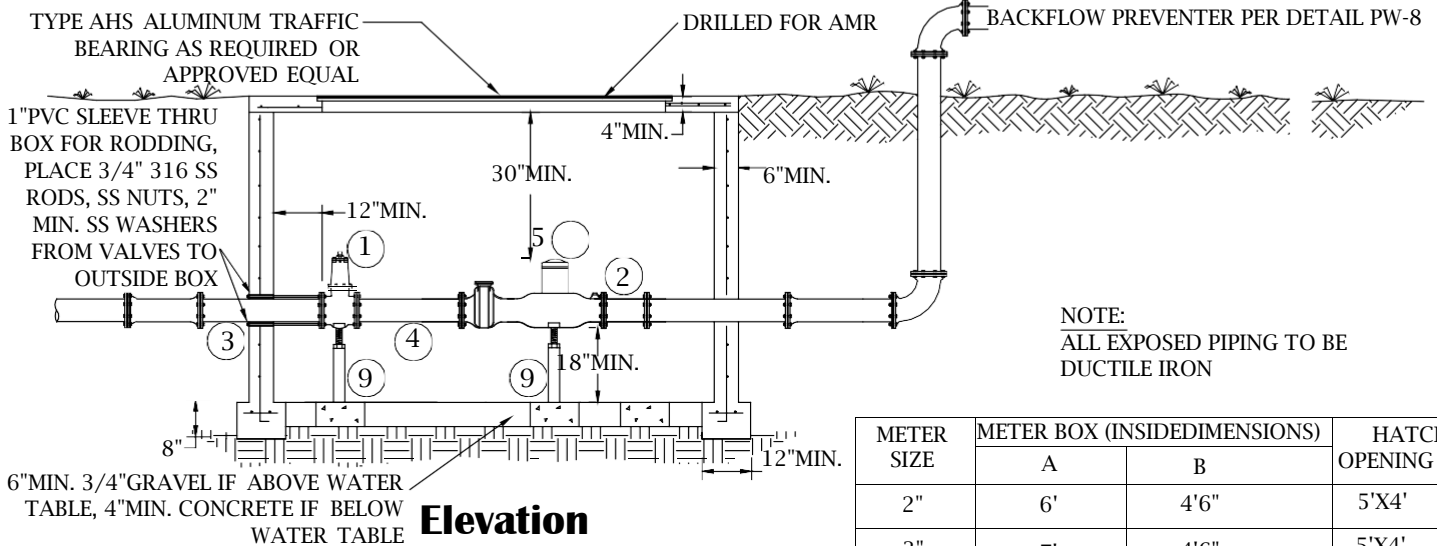
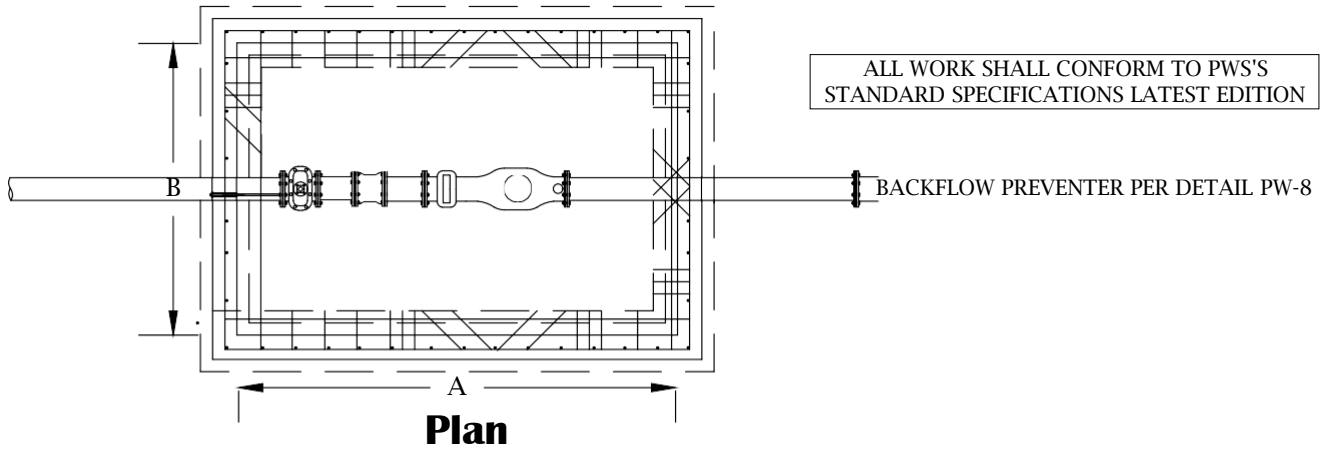


DOUBLE WATER SERVICE CONNECTION

Revision Date:
2024

Detail #:
PW-10

ALL WORK SHALL CONFORM TO PWS'S
STANDARD SPECIFICATIONS LATEST EDITION



NOTE:
ALL EXPOSED PIPING TO BE
DUCTILE IRON

| METER SIZE | METER BOX (INSIDEDIMENSIONS) | | HATCH OPENING SIZE |
|------------|------------------------------|------|--------------------|
| | A | B | |
| 2" | 6' | 4'6" | 5'X4' |
| 3" | 7' | 4'6" | 5'X4' |
| 4" | 7' | 5' | 5'X4' |
| 6" | 7' | 5' | 5'X4' |

*SIZE TO BE APPROVED BY PWS

- ① M.J. GATE VALVE (3" OR LARGER) OR WHEEL VALVE (2" ONLY)
- ② DISMANTLING JOINT
- ③ FLANGED BY PLAIN END DUCTILE IRON CEMENT LINED PIPE
- ④ FLANGED BY FLANGED DUCTILE IRON CEMENT LINED PIPE
- ⑤ METER (BY PWS)
- ⑥ HATCH OPENING CENTERED IN VAULT
- ⑦ VAULT TO BE CONCRETE OR FIBERGLASS
- ⑧ ALL SERVICES 3" OR GREATER MUST BE HARD PIPED (INSTALL TEE BY SERVICE SIZE EXCEPT FOR EXISTING MAINS, THEY MAY BE WET TAPPED)
- ⑨ 316 SS ADJUSTABLE JACK STAND

NOT TO SCALE

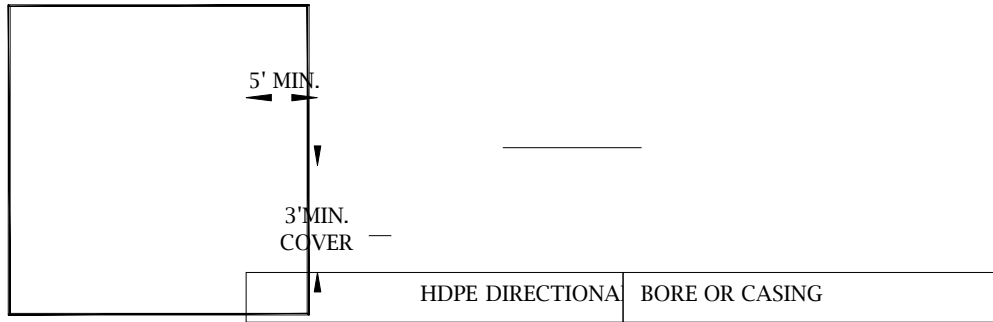


COMMERCIAL METER DETAIL 2" AND LARGER

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2024

Detail #:
PW-11

RIGHT OF WAY VARIES



WATER/REUSE MAIN

| Carrier Pipe I.D. | | Steel Casing | Minimum Wall Thickness | |
|-------------------|-----------|--------------|------------------------|----------|
| Gravity | Pressure* | Diameter | Highway | Railroad |
| N/A | 4" | 10" | 0.188" | 0.188" |
| 4" | 6" | 12" | 0.188" | 0.188" |
| 6" | 8" | 14" | 0.250" | 0.250" |
| 8" | 10" | 16" | 0.250" | 0.250" |
| 10" | 10" | 18" | 0.250" | 0.250" |
| 12" | 12" | 20" | 0.250" | 0.250" |
| 14" | 14" | 24" | 0.250" | 0.281" |
| 16" | 16" | 24" | 0.250" | 0.281" |
| 18" | 18" | 30" | 0.312" | 0.312" |
| 20" | 20" | 30" | 0.312" | 0.344" |
| 24" | 24" | 36" | 0.312" | 0.406" |
| 30" | 30" | 42" | 0.375" | 0.469" |
| 36" | 36" | 48" | 0.500" | 0.532" |
| 42" | 42" | 60" | 0.500" | 0.563" |
| 48" | 48" | 72" | 0.625" | 0.625" |

CASING PIPE SIZE CHART

NOTES:

1. ALL ROAD CROSSINGS UNDER NEW/PROPOSED ROADWAY SHALL BE CASED ACCORDING TO CURRENT COUNTY STANDARDS.
2. ROAD CROSSING UNDER EXISTING ROADWAY SHALL BE HDPE VIA DIRECTIONAL BORE OR CASED PER COUNTY STANDARDS. REFER TO TABLE FOR SIZING OF CASING. IF CASED, CASING SPACERS REQUIRED.
3. NO HDPE JOINTS ALLOWED UNDER PAVEMENT.
4. HDPE MUST BE ONE PIPE DIAMETER SIZE LARGER THAN WATER/SEWER MAIN WHEN DIRECTIONAL BORE IS UTILIZED.
5. DETAILS MAY VARY BETWEEN COUNTY AND STATE ROADS, CHECK FOR CURRENT COUNTY AND STATE STANDARDS.

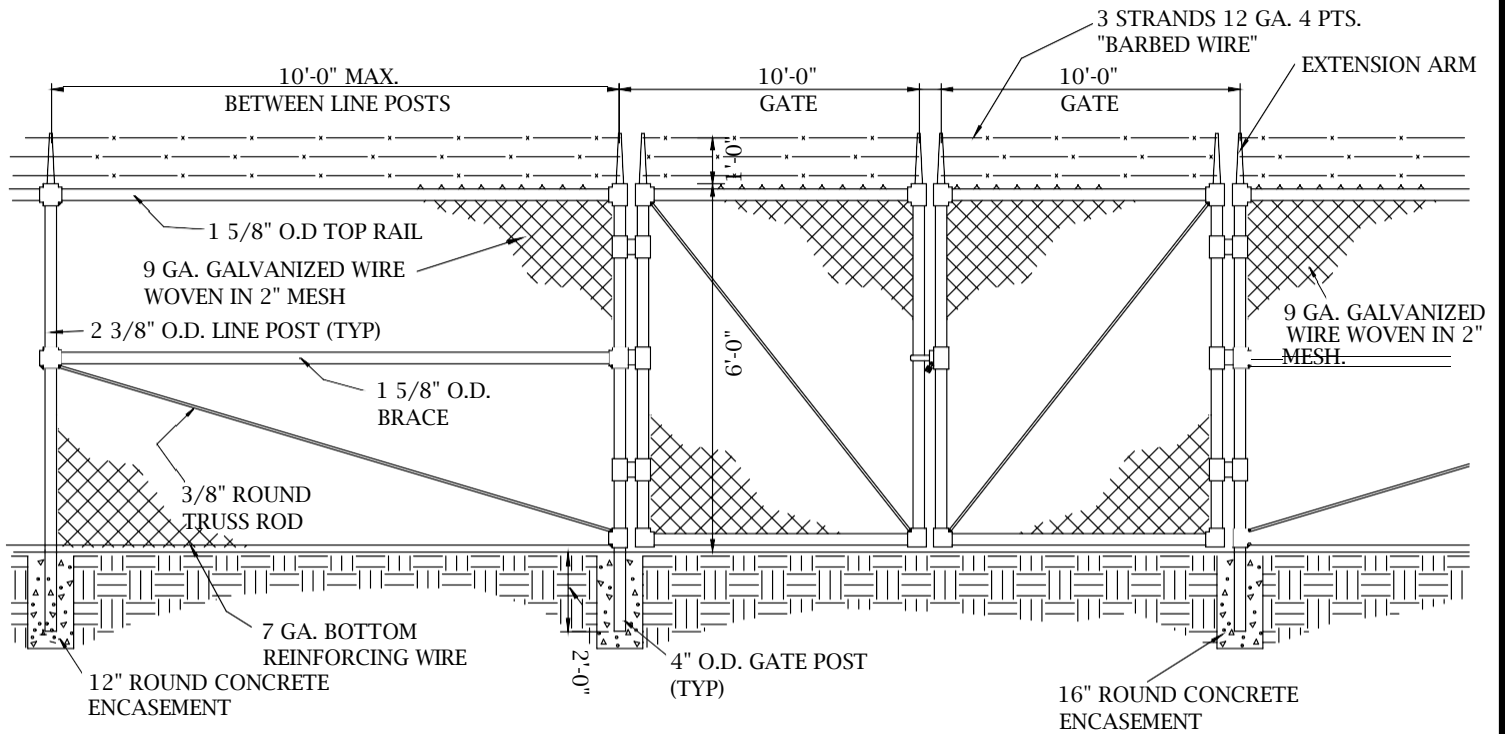
NOT TO SCALE



ROAD CROSSING DETAIL

**Revision Date:
2024**

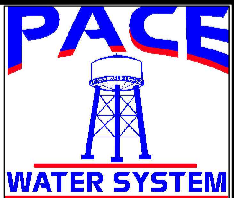
**Detail #:
PW-12**



NOTE:

ENTIRE FENCE AND GATE TO BE GREEN OR BLACK VINYL COATED AS APPROVED BY PWS.

NOT TO SCALE



TYPICAL CHAIN LINK FENCE (GREEN OR BLACK VINYL COATED)

**Revision Date:
2024**

**Detail #:
PW-13**



CHAPTER 3 – WASTEWATER COLLECTION SYSTEM

3.1 GENERAL REQUIREMENTS AND DESIGN STANDARDS

A. GENERAL

The following minimum requirements are considered acceptable to PWS in the collection of wastewater from domestic and commercial customers.

Deviations from these standards may be allowed on a case-by-case basis. If the deviation is in accordance with sound engineering practice and will not create a problem for the system (PWS), the deviation may be approved. No deviation will be allowed unless it is clearly noted on the approved construction plans.

When these standards differ from state and/or federal requirements, the more stringent requirement shall apply.

The collection system for wastewater includes the gravity mains, manholes, service laterals located within the right of way or easement, lift stations, force mains, and other appurtenances. The system should be designed to provide the collection of wastewater safely and economically from the customer to the PWS Wastewater Reclamation Facility.

B. STANDARDS

1. ASME/ANSI Standards

Materials and methods of construction shall comply with the latest published editions of the American Society of Mechanical Engineers (ASME) and the American National Standards Institute (ANSI) Standards.

| | |
|-----------------|---|
| B16.20 | Metallic Gaskets for Pipe Flanges: Ring-Joint, Spiral-Wound, and Jacketed |
| B16.1 | Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250 |
| B 1.1 | Unified Inch Screw Threads, UN, UNR and UNJ Thread Form |
| B 1.20.1 | Pipe Threads, General Purpose (Inch) |
| B 1.20.3 | Dryseal Pipe Threads (Inch) |

2. ASTM Standards

Materials and methods of construction shall comply with the latest published editions of the American Society for Testing and Materials (ASTM) Standards.

| | |
|--------------|--|
| A126 | Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings |
| A307 | Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength |
| A536 | Standard Specification for Ductile Iron Castings |
| A746 | Standard Specification for Ductile Iron Gravity Sewer Pipe |
| C1244 | Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill |
| C990 | Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants |
| D1238 | Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer |
| D1248 | Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable |
| D1330 | Standard Specification for Rubber Sheet Gaskets |
| D1784 | Standard Classification System and Basis for Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds |
| D1785 | Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 |
| D2412 | Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading |
| D2513 | Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings |
| D2737 | Standard Specification for Polyethylene (PE) Plastic Tubing |
| D2837 | Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products |
| D3034 | Standard Specification for Type PSM – Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings |
| D3035 | Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter |
| D3212 | Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals |

| | |
|--------------|---|
| D3299 | Standard Specification for Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks |
| D3350 | Standard Specification for Polyethylene Plastics Pipe and Fittings Materials |
| D3753 | Standard Specification for Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Manholes and Wetwells |
| D638 | Standard Test Method for Tensile Properties of Plastics |
| D695 | Standard Test Method for Compressive Properties of Rigid Plastics |
| D790 | Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials |
| D792 | Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement |
| F1143 | Standard Specification for Manhole Cover Assembly, Bolted, Semi-Flush, Oiltight and Watertight |
| F1144 | Standard Specification for Manhole Cover Assembly, Bolted, Semi-Flush, Oiltight and Watertight, Hinged |
| F1336 | Standard Specification for Poly(Vinyl Chloride) (PVC) Gasketed Sewer Fittings |
| F174 | Standard Practice for Installation of Machine Spiral Wound Poly(Vinyl Chloride) (PVC) Liner Pipe for Rehabilitation of Existing Sewers and Conduits |
| F477 | Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe |
| F679 | Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings |
| F913 | Standard Specification for Thermoplastic Elastomeric Seals (Gaskets) for Joining Plastic Pipe |

3. AWWA Standards

Materials and methods of construction shall comply with the latest published editions of the American Water Works Association (AWWA) Standards.

| | |
|-------------|---|
| C111 | Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings |
| C115 | Flanged Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Fittings |
| C116 | Protective Fusion-Bond Coatings for the Interior and Exterior Surfaces of Ductile Iron and Gray Iron Fittings |
| C150 | Thickness Design of Ductile Iron Pipe |
| C153 | Ductile Iron Compact Fittings, for Water Service |
| C500 | Metal-Seated Gate Valves for Water Supply Service |



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| | |
|-------------|---|
| C509 | Resilient Seated Gate Valves for Water Supply Service |
| C550 | Protective Interior Coatings for Valves and Hydrants |
| C900 | PVC Pipe and Fabricated Fittings, 4-in. Through 60-in. (100 mm through 1500 mm), For Water Transmission and Distribution |
| C901 | Polyethylene (PE) Pressure Pipe and Tubing 3/4-in. (19 mm) through 3-in. (76 mm), For Water Service |
| C906 | Polyethylene (PE) Pressure Pipe & Fittings, 4-in. (100 mm) through 65-in. (1650 mm) for Water Distribution and Transmission |

4. Environmental Protection Agency and US Public Health Service

The governing standards of these agencies will be followed when applicable.

5. Florida Department of Environmental Protection

The wastewater collection system shall conform to the applicable Florida Department of Environmental Protection laws, standards, and rules and regulations for public wastewater collection systems. The State of Florida has adopted in its entirety the Recommended Standards for Wastewater Facilities (10 States Standards). All work shall therefore comply with 10 States Standards.

6. Plumbing Codes

The provisions of the Florida Building Code as it pertains to sanitary wastewater collection, service line locations and materials, and backflow prevention devices, except as provided for elsewhere in these criteria, shall apply.

7. Pace Water System, Inc.

All wastewater collection systems that are to become a part of PWS or that connect to PWS shall be designed and constructed in accordance with these standards. Materials, installation, and construction methods and procedures shall be in accordance with this manual.

3.2 GRAVITY SEWER

3.2.1 DESIGN STANDARDS

A. LOCATION/FUTURE CONNECTION

Gravity sewer shall be located in dedicated rights-of-way or utility easements. Whenever possible, sewer shall be located under pavement in dedicated rights-of-way. All sewer located outside of dedicated rights-of-way shall require a minimum 20-foot easement. Additional easement widths shall be provided when the pipe size or depth of cover so dictate. If a gravity sewer main is located adjacent to a road right-of-way, a minimum 10-foot easement shall be provided. Additional easement widths shall be provided if the pipe size or depth of cover so dictate. No gravity sewer shall be placed under retention ponds or other structures. In general, gravity sewer shall not be located along side of rear lot lines. Placement of a gravity sewer along side of a rear lot line may be allowed on a case-by-case basis if such a configuration results in efficient placement and utilization of the sewer system.

Provisions for future connecting mains shall be made by providing appropriate easement and/or extending construction of all wastewater mains to the exterior boundaries of the subdivision where future connections to adjacent subdivisions or lots are anticipated.

B. DESIGN BASIS

1. Average Daily Flow

Required average daily flow for sanitary use in residential areas shall be based on 350 gallons per day per unit (100 gpcpd x 3.5 persons) or as approved by PWS.

The required flow for commercial, industrial or other nonresidential areas shall be as determined by the Engineer and approved by PWS for each specific instance. Justification for such flows shall be documented within the design calculations.

2. Peak Design Flow

Gravity sewer shall be designed based on ultimate development maximum rates of flow, which shall be the product of selected peak factors times the accumulative average daily flow. In general, the following minimum peak factors shown in the table below shall be applicable for the range of average daily flow rates:

| Flow Range | Minimum Peak Factor |
|----------------------------------|---------------------|
| Flows to 100,000 GPD | 4.0 |
| 100,000 GPD to 250,000 GPD | 3.5 |
| 250,000 GPD to 1,000,000 GPD | 3.0 |
| Flows greater than 1,000,000 GPD | 2.5 |

For design average daily flows above 2,000,000 GPD, peaking factors less than 2.5 may be considered if substantiated by extensive data. Under no circumstances shall peaking factors less than 2.0 be allowed.

3. Minimum and Standard Main Size

The minimum gravity main diameter shall be eight (8) inches in all areas. Standard sizes of gravity mains used shall have nominal diameters of eight (8) inches, 10 inches, 12 inches, 15 inches, 18 inches, 21 inches, 24 inches, 30 inches, 36 inches, and 42 inches.

4. Cover

A minimum cover of 48 inches must be provided. Less than 48 inches of cover may be considered with special provisions for protection of the pipe and must be approved by PWS on a case-by-case basis.

At buried stream crossings, a minimum cover of 36 inches is required.

5. Slope

Slopes shall be designed with a hydraulic gradient sufficient to prevent deposition of solids, by developing a minimum velocity of 2.0 feet per second as computed using Manning's formula and an "n" value of not less than 0.013 while flowing full. The following table establishes the minimum allowable slopes for various size pipe and indicates their approximate carrying capacity when flowing full at the minimum slope.

| Pipe Size (Inches) | Minimum Slope (%) | Capacity Full MGD |
|--------------------|-------------------|-------------------|
| 8 | .4 | .5 |
| 10 | .28 | .7 |
| 12 | .22 | 1.0 |
| 15 | .15 | 1.6 |
| 18 | .12 | 2.4 |
| 21 | .10 | 3.7 |
| 24 | .08 | 4.2 |
| 30 | .06 | 6.6 |
| 36 | .05 | 10.0 |

Under special conditions, if full and justifiable reasons are given, slopes slightly less than those required for the two (2) feet per second velocity when full may be permitted. Such decreased slopes will only be considered where the depth of flow will be 0.3 times the diameter or greater for design average flow. Whenever such decreased slopes are selected, the engineer must furnish with his report his computations of the depths of flow in such pipes at minimum, average, and peak rates of flow. The selection of the size of pipe shall be determined based on the most desirable flow characteristics obtainable.

In the case of sewer where the slope and volume are such that velocities exceeding 10 feet per second at design flow, special provision shall be made to protect against erosion. Where velocities greater than 15 feet per second are attained, special provision shall be made to protect against displacement by erosion and impact.

Sewers on 20 percent slopes or greater shall be anchored securely with concrete, or equal, and anchors spaced as follows: not over 36 feet center to center on grades 20 percent and up to 35 percent; not over 24 feet center to center on grades 35 percent and up to 50 percent; and not over 16 feet center to center on grades 50 percent and over.

The sewer design shall take full advantage of suitable topography, and paralleling of ground slopes shall be utilized wherever possible. Minimum slopes should be maintained, particularly with eight (8)-inch pipe. When depth exceeds 10 feet, pipe class shall be checked for strength, and/or stricter bedding requirements shall be required.

Sewer shall be designed and laid with a uniform slope between manholes.

6. Size Transition and Alignments

Change in pipe shall not occur between manholes.

When a smaller sewer joins a larger one, the invert of the larger sewer shall be lowered sufficiently to maintain the same hydraulic gradient. The crowns of pipes shall be at the same elevation within the manhole.

Sewers shall be laid with straight alignment between manholes.

7. Separations

Vertical separation when crossing other utilities shall be 18 inches at a minimum. If 18-inch separation is not possible, then concrete encasement or casing pipe must be utilized.

In general, horizontal separation between gravity sewer and other utilities shall be as shown in the table below.

| | Required Horizontal Separation |
|----------------------|--------------------------------|
| Water Main | 6 feet |
| Reclaimed Water Main | 3 feet |

8. Crossings

When crossing under existing paved streets or roads, developer's Engineer must determine if open cut will be permitted. If a boring will be required, complete details must be included in the plans. Every effort shall be made to locate any possible conflict with existing utilities. Extra slope through the bore shall be allowed, and minimum and maximum allowable deviations shall be specified.

Buried stream crossings shall be encased in steel casing or made with ductile iron pipe. This protection shall extend 10 feet beyond the bank and the pipe or casing shall be anchored to prevent shifting.

Aerial stream crossings shall be encased in steel casing or made with ductile iron pipe. This protection shall extend until 30 inches of cover is provided.

When crossing under pipes, conduits or other structures greater than 24 inches in diameter, and a six (6)-inch separation distance cannot be maintained, the pipe shall be encased in steel casing or made with ductile iron pipe for a minimum of 10 feet on either side of the crossed pipe.

9. Additional Requirements for Gravity Main

In general, all sewer extensions for future connections shall terminate at a manhole. PWS may allow such extensions without a terminal manhole on a case-by-case basis subject to the following conditions: total sewer extension length shall be limited to 50 feet and sewer extension location at the initiating manhole shall be plugged to the satisfaction of PWS.

The depth of the collection system shall be sufficient to receive flows by gravity from all buildings and lots to be served. Sewer lines shall be installed in accordance with all applicable plumbing code specifications and slopes.

A privately maintained lift station for an individual building will be considered on a case-by-case basis when gravity service is not feasible, with PWS consent.

Main drain and backwash systems for pools/spas and storm drain systems shall not connect to the gravity sewer system.

10. Manholes

a. Location

Manholes shall be installed at the end of each gravity sewer; at all changes in grade, size or alignment; at all sewer intersections; and at distances not greater than 400 feet for sewer 15 inches or less, and 500 feet for sewer 18 inches to 30 inches. Lamp holes shall not be used.

b. Drop Pipe

An outside drop pipe shall be provided for a sewer entering a manhole where its invert elevation is 24 inches or more above the manhole invert (i.e., a drop manhole). Inverts that enter a manhole less than 24 inches above the manhole invert (outgoing invert) shall be brought in at 0.10 feet higher than the manhole invert. Outside drop connections shall be encased in concrete.

c. Diameter

For sewer smaller than 15 inches in diameter, the minimum inside diameter of manholes shall be 48 inches. For sewer 18 inches to 42 inches, the minimum inside diameter shall be 60 inches.

The minimum depth of a manhole shall be five (5) feet, and any proposed deviation shall be approved by PWS. When the manhole depth equals or exceeds five (5) feet, it shall have a concentric cone section that narrows to two (2) feet in diameter at the top.

d. Cover

A minimum access cover diameter of 24 inches shall be provided for 48-inch diameter manholes. A minimum access cover diameter of 30 inches shall be provided for 60-inch diameter manholes.

e. Flow Channel

The flow channel through manholes shall be made to conform in shape and slope to that of the sewer. The channel walls should be formed or shaped to the full height of the crown of the outlet sewer in such a manner to not obstruct maintenance, inspection or flow in the sewer. No Moor base inverts will be allowed. Flow direction changes in excess of 90 degrees shall not be included in sewer alignments. All manholes shall have a minimum flow line elevation drop of 0.10 foot across the manhole.

f. Bench

A bench shall be provided on each side of any manhole channel when the pipe diameter(s) are less than the manhole diameter. The bench should be sloped no less than ½ inch per foot. No lateral sewer, service connection, or drop manhole pipe shall discharge onto the surface of the bench. Internal drop shall discharge to the flow channel.

11. Service Connections

Each service connection shall be through a lateral and miscellaneous appurtenances, all as shown on the approved plans and standard details, to connect the gravity sewer to the house or establishment being served. Service laterals shall be provided to all lots within a subdivision in accordance with PWS requirements.

Service laterals and fittings shall be a minimum of four (4) inches in diameter for residential and six (6) inches in diameter for commercial. All service laterals shall be less than 60 feet in length. Longer laterals may be accepted by PWS on a case-by-case basis. In areas where the right-of-way is wider than 60 feet, the developer shall provide a sewer main on each side of the right-of-way.

Service laterals shall be located approximately in the center of the lot.

Service laterals shall have a minimum slope of 1/8 inch per foot (1.04%).

In general, service laterals shall not be allowed to discharge into sanitary manholes unless the manhole is a terminal manhole. A case-by-case exception to this requirement may be allowed by PWS.

12. Grease Traps

All Food Preparation/Service Establishments shall have properly sized outside grease traps. All wastewater flow from the kitchen areas of these establishments must flow through approved grease traps prior to entering the PWS sewer system.

Sizing and maintenance of a grease trap shall be in accordance with the requirements of Santa Rosa County and the Florida Department of Health.

3.2.2 GUIDELINES AND TECHNICAL SPECIFICATIONS

A. GRAVITY SANITARY SEWER PIPEWORK

This section includes furnishing and installing all gravity sanitary sewer lines, manholes, fittings and appurtenances required for a complete system as shown on the drawings and specified herein.

1. Materials

All material shall be free from defects impairing strength and durability and be of the best commercial quality for the purpose specified. It shall have structural properties sufficient to safely sustain or withstand strains and stresses to which it is normally subjected and be true to detail.

All pipework will be inspected upon delivery, and such as does not conform to the requirements of this utility design manual, shall be rejected and must be immediately

removed from the site by the Contractor. The Contractor shall furnish and provide all labor necessary to assist the Engineer/PWS Inspector in inspecting the material.

The basis of rejection shall be as specified in applicable ASTM Specifications.

2. Polyvinyl Chloride (PVC) Pipe

PVC gravity sewer pipe and fittings shall meet or exceed ASTM Specification D3034. PVC sewer pipe shall be green in color.

Pipe lengths shall not exceed 20 feet and provisions shall be made at each joint to accommodate expansion and contraction providing a maximum SDR of 26 and a minimum “pipe stiffness” $(F/\Delta Y) = 46$ psi at 5 percent deflection when tested in accordance with ASTM D2412, external loading properties of plastic pipe by paneled plate loads. For all pipe depths, SDR 26 shall be required. The minimum wall thickness of SDR 26 pipe shall be as demonstrated in the table below.

Minimum Wall Thickness Chart

| Diameter | 4" | 6" | 8" | 10" | 12" | 15" |
|--------------------------|--------|--------|--------|--------|--------|--------|
| Wall Thickness for SDR26 | 0.162" | 0.241" | 0.323" | 0.404" | 0.481" | 0.588" |

All pipe and fittings shall be jointed by means of an integral wall bell and spigot joint and sealed with a rubber ring. The pipe and fittings shall be shipped to the job with a solid cross-section rubber sealing ring securely locked in place in the bell. The bell shall consist of an integral wall section of pipe formed into shape and stiffened with two PVC retainer rings, which also serve to securely lock the rubber ring in place. The joint shall be capable of withstanding an internal hydrostatic pressure of 25 psi for one hour with no leakage.

Each length of pipe shall be clearly marked with the following information at intervals of five feet or less:

- Manufacturer’s name
- Nominal pipe size
- ASTM specification
- NSF approval

a. PVC Fittings

PVC sewer fittings shall conform to the requirements of ASTM D3034 with minimum wall thickness of SDR 26, as defined in section 7.4.1. Fittings eight (8)-inch and smaller shall be molded in one piece with gasket joints that encapsulate a continuous stainless-steel ring/bar to assure a locked-in design to prevent loss during

transport or fish mouthing during pipe insertion. The gasket shall be designed with a butterfly lip design for easy insertion of PVC pipe. All SDR 26 PVC molded fittings shall be supplied in green color for ease of identification. White fittings may be used as long as they have two green strips painted on both sides of the fitting with each strip being at least one (1)-inch wide. The minimum socket depths shall comply with ASTM D3034 as specified in sections 6.2 and 7.3.2. Fittings 10-inch and larger shall be molded or fabricated in accordance with section 7.11 with manufacturer's standard pipe bells and gaskets. Gaskets shall have a minimum cross-sectional area of 0.20 square inch and conform to ASTM F0477 standard and shall be manufactured and supplied by the fitting manufacturer. PVC material shall have a cell classification of 12454 as defined in ASTM D1784. All fittings shall be supplied by one manufacturer and shall comply with the following additional standards: ASTM F1336, ASTM D3212, and ASTM F913. All PVC fittings must be certified by CSA to the CSA B182.1 and CSA B182.2 standards as third-party certification.

All PVC fittings shall be manufactured and assembled in the USA. Submittals for SDR 26 fittings shall show the cross section of the gaskets and the shade of green coloring of the fitting.

3. Ductile Iron Pipe

Ductile iron pipe shall meet the requirements of ASTM A746. Pipe dimensions shall conform to Federal Specification WW-P-421, Class 250. Each pipe shall be conspicuously marked on the outside of the barrel to readily identify it from cast iron pipe. Metal thickness shall conform to ANSI/AWWA C150/A21.50-02.

a. Mechanical Joints

All mechanical joint pipe shall conform to ANSI/AWWA A21.11, Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.

b. Push-on Joints

All push-on joint pipe shall conform to ANSI/AWWA A21.11, Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings and shall be single gasket push-on type.

c. Flanged Joints

All flanged joint pipe shall conform to ANSI/AWWA C115/A21.15-99 and shall have screwed on flanges, faced and drilled to ANSI Class 125-pound template. The flanged joints shall be assembled by threading plain end pipe and screwing on long hub flanges. The connection shall then be power tightened and refaced

across both face of flange and end of pipe. Gaskets shall be one-sixteenth-inch ring gaskets of red sheet rubber meeting the requirements of Grade I, Table I of ASTM D1330. Connections shall be made with machine bolts and hexagonal nuts.

d. Fittings

Fittings shall meet ANSI/AWWA C153/A21.53-00, latest revision, and minimum pressure rating shall be 250 psi. Stainless steel or ductile iron fittings are to be per ANSI in dimension and size.

e. Coatings for Ductile Iron Pipe

All ductile iron pipe and fittings to be installed underground shall be coated on the exterior with a zinc coating and conform to all appropriate requirements for seal coat in ANSI/AWWA C116/A21.16. The exterior of all above ground pipe shall receive a coat of rust inhibitor primer compatible with the finish paint schedule. All bolts, nuts, studs and other uncoated parts of joints for underground installation shall be 316 stainless steel.

The interior lining for all ductile iron pipe and fittings shall be factory applied with a minimum dry film thickness of 10 mils. The epoxy coating shall be Permax, Tnemec, or P401. The coating shall incorporate a polyamide cured epoxy resin which shall consist of a primer coat and two (2) coats of epoxy.

All ductile iron installed south of Sterling Way in the PWS service area shall be coated exteriorly with Permax PCS-9043 Type II glass flake epoxy pipe coating, or approved equivalent.

B. MANHOLES

Manholes shall be fiberglass, Armorock, or approved equivalent.

1. Watertight Fiberglass Manhole

Fiberglass reinforced polyester manholes shall be manufactured from commercial grade polyester resin or other suitable polyester or vinyl ester resins with fiberglass reinforcements. Each manhole shall be a one-piece unit manufactured to meet or exceed all specifications of ASTM D-3753, latest revision, as manufactured by L.F. Manufacturing, Inc., Containment Solutions, or approved equivalent.

a. Stubouts and Connections

Kor-N-Seal boots may be installed by the manhole manufacturer using fiberglass reinforced pipe stubouts for the Kor-N-Seal boot sealing surface. Inserta-Tee or Qwik Seal fittings may be requested and installed per manufacturer's instructions when adding new services to existing fiberglass manhole structures.

b. Manhole Bottom

Fiberglass manholes shall have resin fiber-reinforced bottoms. Deeper manholes may require a minimum of two fiberglass channel stiffening supports as per the manufacturer's recommendations. All fiberglass manholes manufactured with a fiberglass bottom shall have a minimum 3-inch-wide anti-flotation ring. The manhole bottom shall be a minimum of ½ inch thick.

c. Fiberglass Enclosed Invert and Bench Area

A fiberglass enclosed invert and bench area shall be installed in the manhole by the manufacturer. The invert shall be formed using a non-corrosive material and completely enclosed in a minimum 1/4-inch layer of fiberglass chop.

d. Height Adjustment/Chimney

Fiberglass manholes shall have the ability to be height adjustable with the use of a height adjustment ring. Height adjustment will be made as a field operation without the use of uncured resins or fiberglass lay-ups. Fiberglass manholes shall maintain all load and soundness characteristics required by ASTM D3753 after height adjustment has occurred. HDPE adjustment grade rings shall be used for height adjustment (up to 15 inches).

Adjustment rings shall be manufactured from polyethylene as identified in ASTM D1248 and shall be tested and qualified for usage under this standard. Recycled material meeting this standard may be used. Any defective rings shall not be used and shall be sent back to the manufacturer for recycling. Concrete rings and brick with mortar cement will not be acceptable.

All HDPE rings shall be manufactured utilizing the injection molding process as defined by the Society of Plastic Engineers and shall be tested to assure compliance with impact and loading requirements of AASHTO's Standard Specifications for Highway Bridges, latest edition. All riser rings shall be recognized by the Florida Department of Transportation (DOT) for use in DOT rights-of-way, with history of use in those rights-of-way. All rings must comply with ASTM D1238 (Melt Flow Index), ASTM D792 (Density), and ASTM D638

(Tensile Strength) standards and property values. The supplier must certify proof of load factor and manufacturing quality control prior to installation of riser rings.

All riser rings shall be manufactured in accordance with industry standards for dimension, sizing, and ratio to ensure tight fit in the installation of the rings and uniformity in multiple units. Riser rings shall have the structure and sealing properties for vacuum test to 11 inches of mercury for set time. Only butyl rubber adhesive rope will be allowed as the sealant between rings as recommended in ASTM C990. All HDPE riser rings shall be manufactured by Ladtech Inc., or approved equivalent.

e. Ring and Cover

The manhole shall provide an area from which an HDPE grade ring can be installed to accept a ring and cover and have the strength to support a traffic load without damage to the manhole or the grade rings. The manufacturer of manhole rings and covers shall be experienced in their design and construction, regularly engaged in their manufacture and have produced manhole rings and covers that have performed successfully in service for at least 10 years. The rings and covers shall meet or exceed the following standards: ASTM A536, F1144, F1143, and ISO 1083 for ductile iron rings and covers; ASTM G154, C1028, D256, and D790 for composite rings and covers; as well as AASHTO M306.

Manhole rings and covers shall be watertight and locking and shall be U.S. Foundry (#170-E), Composite Access Products CAP ONE® (#A-1BK24S4-P13P16SS-H1 or A-1BK30S4-P13P16SS-H1), or approved equivalent.

All manhole rings and covers shall be water-tight when closed and secure. The covers shall have cast in the cover "PACE WATER SYSTEM" and "SANITARY SEWER."

Manholes located in roadways shall have a concrete ring constructed around the ring and cover. Concrete rings shall be 5,000 psi with fiberglass mesh.

f. Fillers and Additives

Fillers, when used, shall be inert to the environment and manhole construction. Sand shall not be accepted as approved filler. Additives, such as thixotropic agents, catalysts, promoters, etc., may be added as required by the specific manufacturing process to be used to meet the requirements of this utility design manual. The resulting reinforced plastic material must meet all requirements of this utility design manual.

g. Reinforcing Materials

The reinforcing materials shall be commercial Grade “E” type glass in the form of continuous roving and chop roving, having a coupling agent that will provide a suitable bond between the glass reinforcement and the resin.

h. Exterior Surface/ Material

The exterior surface shall be relatively smooth with no sharp projections. Handwork finish is acceptable if enough resin is present to eliminate fiber show. The exterior surface shall be free of blisters larger than 0.5 inch in diameter, de-lamination or fiber show.

For a UV inhibitor, the resin on the exterior surface of the manhole shall have pigment added for a minimum thickness 0.125 inches.

i. Interior Surface/Material

The interior surface shall be resin rich with no exposed fibers. The surface shall be free of crazing, de-lamination, blisters larger than 0.5 inch in diameter, and wrinkles of 0.125 inch or greater in depth. Surface pits shall be permitted if they are less than 0.75 inch in diameter and less than 0.0625 inch deep. Voids that cannot be broken with finger pressure and are entirely below the resin surface shall be permitted if they are less than 0.5 inch in diameter and less than 0.0625 inch thick.

The inner surface exposed to the chemical environment shall be a resin-rich layer of 0.010 to 0.020 inch thick. The inner surface layer exposed to the corrosive environment shall be with the minimum of two passes of chopped roving of minimum length 0.5 inch (10mm) to maximum length of 2.0 inch (50.8 mm) and shall be applied uniformly to an equivalent weight of 3 ounces per foot. Each pass of chopped roving shall be well-rolled prior to the application of additional reinforcement. The combined thickness of the inner surface and interior layer shall not be less than 0.10 inch (2.5mm).

j. Wall Construction/Thickness

After the inner layer has been applied to the manhole, the wall shall be constructed with a chop and continuous strand filament wound manufacturing process which ensures continuous reinforcement and uniform strength and composition. The cone section, if produced separately, shall be affixed to the barrel section at the factory with a resin-glass reinforced joint, resulting in a one-piece unit. Seams shall be fiberglassed on the inside and the outside using the

same glass-resin jointing procedure. Field joints shall not be accepted by anyone except the manufacturer.

Fiberglass manholes 48 inches in diameter and up to 20 feet in depth will have a minimum wall thickness of 0.3125 inches. Fiberglass manholes 48 inches in diameter and 20 feet to 30 feet in depth will have a minimum wall thickness of 0.5 inches.

k. Repairs

Manhole repairs are subject to all requirements of this utility design manual and are to be performed by the manufacturer’s representative.

l. Load Rating

The complete manhole shall have a minimum dynamic-load rating of 16,000 pounds when tested in accordance with ASTM D3753 8.4 (note 1). To establish this rating the complete manhole shall not leak, crack, or suffer other damage when load tested to 40,000 pounds and shall not deflect vertically downward more than 0.25 inch at the point of load application when loaded to 24,000 pounds.

m. Stiffness

The manhole cylinder shall have the minimum pipe stiffness values shown in the table below when tested in accordance with ASTM D3753 8.5 (note 1).

| Length - FT | F/ΔY - PSI |
|--------------------|-------------------|
| 3 - 6.5 | 0.75 |
| 7 - 12.5 | 1.26 |
| 13 - 20.5 | 2.01 |
| 21 - 25.5 | 3.02 |
| 26 - 35 | 5.24 |

n. Soundness

To determine soundness, the manufacturer shall apply an air or water pressure test to the manhole test sample. Test pressure shall not be less than 3 psig or greater than 5 psig. While holding at the established pressure, the entire manhole shall be inspected for leaks. Any leakage through the laminate is cause for failure of the test (see ASTM D3753 8.6).

o. Chemical Resistance

The fiberglass manhole and all related components shall be fabricated from corrosion-proof material suitable for atmospheres containing hydrogen sulfide and dilute sulfuric acid, as well as other gases associated with the wastewater collection system.

p. Physical Properties

Physical properties shall be in accordance with ASTM D3753.

| | Hoop Direction | Axial Direction |
|-------------------------|-------------------|-------------------|
| Tensile Strength (psi) | 18,000 | 5,000 |
| Tensile Modules (psi) | 0.6×10^6 | 0.7×10^6 |
| Flexural Strength (psi) | 26,000 | 4,500 |
| Flexural Modules (psi) | 1.4×10^6 | 0.7×10^6 |
| Compressive (psi) | 18,000 | 10,000 |

q. Test Methods

All tests shall be performed as specified in ASTM D3753, latest revision, section 8. Test methods utilized shall include ASTM D790 (see note 5) and D695.

r. Quality Control

Each completed manhole shall be examined by the manufacturer for dimensional requirements, hardness, and workmanship, and all required ASTM D3753 testing shall be completed. Records of all testing shall be kept, and copies of test records shall be presented to PWS upon formal written request within a reasonable time period.

s. Certifications

As a basis of acceptance, the manufacturer shall provide certification. Certification shall consist of a copy of the manufacturer's test report accompanied by a copy of the test results stating the manhole has been sampled, tested, and inspected in accordance with the provisions of this utility design manual and meets all requirements.

t. Shipping and Handling

The fiberglass manhole shall not be dropped or impacted. The manhole may be lifted by inserting a 4"x4"x30" timber into the top of the manhole with a cable attached, or by a sling or "choker" connection around the center of manhole, to lift as required. The use of chains or cables in contact with the manhole surface is prohibited.

u. Installation

The fiberglass manhole shall be installed per the manufacturer's recommendations. Anti-flotation calculations shall be required from the manufacturer or engineer for all structures.

v. Backfill

Unless shown otherwise on drawings and approved by the engineer, sand, crushed stone, or pea gravel shall be used for backfill around the manhole for a minimum distance of one foot from the outside surface and extending from the bottom of the excavation to the top of the reducer section. Suitable material chosen from the excavation may be used for the remainder of the backfill. The material chosen shall be free of large lumps or clods, which will not readily break down under compaction. This material will be subject to approval by the engineer.

Backfill shall be placed in layers of not more than 12 loose measure inches and mechanically tamped to 95% Standard Proctor Density, unless otherwise approved by the engineer. Flooding will not be permitted. Backfill shall be placed in such a manner as to prevent any wedging action against the fiberglass manhole structure. A certified copy of the backfill testing report shall be provided to PWS prior to acceptance.

The chimney shall be constructed on the flat shoulder of the manhole and brought to grade using height adjustment rings, as specified herein.

w. Marking and Identification

Each manhole shall be marked on the inside and outside with the following information.

- Manufacturer's name or trademark
- Manufacturer's serial number
- Total manhole depth
- ASTM Designation

2. Fiberglass Doghouse Manhole

Fiberglass doghouse manholes shall be constructed in accordance with ASTM D3753 and as described in the Fiberglass Manhole section of this utility design manual.

The manhole shall be lowered into wet concrete until it rests at the proper elevation, with a minimum of four (4) inches of fiberglass manhole inserted into the wet concrete below the flow line, then moved to plumb. The concrete shall extend a minimum of one foot from the outside wall of the manhole and a minimum of six (6) inches above incoming lines. On the inside, concrete shall form the bench and invert area and rise a minimum of 4 inches above incoming lines. The Contractor must ensure that 6" of concrete is below the invert of the manhole. If required by the Engineer, concrete may be used around the reducer section for buoyancy. Marine grade epoxy adhesive shall be used to seal around the pipe and structure.

Manhole Rehabilitation

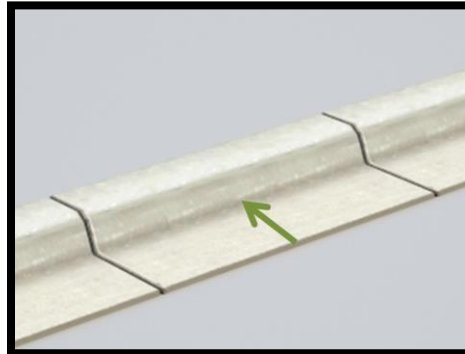
When tying into an existing manhole, the existing manhole must be rehabilitated. Manhole rehabilitation consists of installing a fiberglass liner, or approved equivalent, on a case-by-case basis (*Detail WW-4*).

3. Lamp Holes

Lamp holes will not be allowed.

4. Gravity Sewer Service Lateral

The requirements for construction of gravity sewers shall apply for service laterals. Installation shall be in accordance with *Typical Sewer Lateral Connection (Detail WW-7)*. Service laterals and fittings shall be a minimum of four (4) inches in diameter for residential connections and six (6) inches for commercial connections with a minimum slope of 1/8 inch per foot. Customer service laterals shall be provided to all lots within a subdivision. All sewer laterals shall be marked with an arrow "↑" of at least three (3) inches in size, cut into the curb and painted green, as per the diagram below.



C. INSTALLATION

This section covers installation of gravity pipework. Excavation and backfilling shall be in accordance with Section 5 of this utility design manual.

1. General

- All pipe and fittings shall be carefully handled at all times to prevent damage to the pipe or other installation on the job site.
- At times when pipe installation is not in progress, the open ends of the pipe shall be closed by approved means and shall remain closed until construction on that particular section is resumed, eliminating the possibility of any flow obstructions getting into the pipe.
- All joints shall be wiped free of all dirt, sand and foreign material and the pipe shall be carefully examined for defects before installation.
- Cutting of pipe for inserting fittings or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe.
- Deviations from the piping location, line and grade indicated on the construction plans shall not be made without the prior approval of the Engineer or PWS Representative.

2. Pipe Laying Procedures

a. Gravity Flow Piping

Gravity flow piping shall be installed to the line and grade indicated on the construction drawings. Before lowering the pipe into the ditch, the bottom of the ditch shall be graded so that when the pipe rests on the ditch bottom it will have a uniform bearing for its entire length. Bell holes shall be dug for bell placement. The pipe shall be carefully examined for defects and the inside cleaned. After placing the pipe in the ditch, the ends shall be wiped free from all dirt, sand and foreign material. The joints shall then be made in accordance with the recommendations of the pipe manufacturer.

Installation of pipe shall proceed in an upstream direction with bells facing in the direction of laying. All pipe reaches will be inspected for straightness. No bows or dips, either horizontally or vertically, will be accepted. A full circle of light must be readily seen when looking from one end of a pipe through to the other end, between manholes.

b. Sub-Surface Explorations

Whenever necessary to determine the location of existing pipes, valves, or other underground structures, the Contractor shall examine all available records and shall make all explorations and excavations for such purpose. Where the locations of existing utilities are furnished by the Owner, they should be considered approximate only. The Contractor is responsible for locating and protecting all existing utilities whether shown on the drawings or not shown.

c. Protecting Underground and Surface Structures

Temporary support, adequate protection, and maintenance of all underground and surface utility structures, drains, sewers, and other obstructions encountered in the progress of the work shall be furnished by the Contractor at his own expense under the direction of the Engineer or PWS Representative.

d. Construction Equipment

Mechanical equipment may be used for trenching and excavating. However, in places where the operation of same will cause damage to trees, shrubbery, pavement, or existing structures, whether above or below ground, hand methods shall be employed. Where a main is installed along paved streets, rubber-tired equipment is recommended; however, if track equipment is

necessary for excavation due to depths, the Contractor will be permitted to use such equipment and will be responsible for any damage done to paved streets or lawns. Concrete driveways and asphalt pavement must be saw-cut for final replacement.

e. Unsuitable Conditions

No pipe shall be laid, or manholes placed in water or unsuitable soils conditions. Unsuitable soil, as determined by the Engineer or PWS Representative, shall be removed or replaced with an approved material. Approved material may depend on site conditions.

f. Trench Water

At times when pipe laying is not in progress, the open ends of pipe shall be closed by approved means, and no trench water shall be permitted to enter the pipe.

g. Dewatering

The Contractor shall provide all necessary pumps to dewater the site properly; shall provide all labor and materials required to keep any open excavation dewatered during construction; and shall provide all necessary sheeting, bulkheads, drains, etc., so that construction operations may be performed under dry conditions. Discharge from pumps must be led to natural drainage channels, to drains, or to storm sewers. The Contractor is responsible for all permitting and testing of dewatering discharge.

h. Laterals

Gravity service pipe shall be installed to each residential lot or individual business lot or property, or as directed by the Engineer or PWS Representative. Refer to **Detail WW-7** for lateral installation requirements. Street crossings shall have a minimum of two (2) feet cover to subgrade unless approved by the Engineer or PWS Representative. For stub outs, a cap shall be glued on the end of stub out and a ½-inch metal rebar driven adjacent to each service connection with the top of post one (1) foot below ground surface. Each service lateral shall be marked with a painted and pressure treated wood stake, 2"x4"x4' long.

Plugging Dead Ends

Plain end pipe with glued cap shall be inserted into the bells of all future stub out ends to accommodate ease of removal. Plugs or caps shall be jointed to the pipe in the appropriate manner.

i. Concrete Encasement and Special Pipe Support

Concrete pipe encasements or special pipe supports shall be provided as shown on the drawings or directed by the Engineer. Various pipe supports shall be as worked out in the field to suit local conditions and emergencies. Where, in the opinion of Engineer or PWS, pipe covering is inadequate, concrete encasement for protection shall be provided in accordance with the details on the approved drawings. Concrete encasement shall be made using concrete with a 28-day strength of 2000 psi and shall be to the dimensions indicated on the approved construction plans and as required by the applicable Department of Transportation or Department of Health regulations. All other concrete needed to build and protect the pipe work shall be used at the direction of the Engineer or PWS Representative.

j. Separation of Water Mains and Sewers/Reclaimed Water

Water mains or sewer mains that are laid in the vicinity of each other shall meet the horizontal and vertical separations specified herein (see **Detail WW-12**).

k. Backfilling

Backfill material shall be free from rocks or boulders or any other objectionable material and shall be placed in the trench and compacted simultaneously on both sides of the pipe for the full width of the trench, and to an elevation level with ground on either side to densities indicated in **General Specifications** section of this utility design manual (see **Section 5.2 Earthwork**).

l. Repaving

Pavement removal where required in the construction of project shall be done by the Contractor in a workmanlike manner. Care must be taken to make the saw cut in a straight line so the patch will be neat.

Asphalt paving shall be replaced as described in the *General Specifications* section of this utility design manual (see **Section 5.1 Sitework**) and in accordance with the standard detail drawings. Concrete driveways and pavement shall be replaced using concrete with high early strength so that traffic may be resumed quickly. Concrete must be finished to conform with existing pavement.

m. Clean-Up

Before final inspection and acceptance, the Contractor shall clean ditches, shape shoulders, and restore all disturbed areas, including street crossings and grass plots, to as good a condition as existed before work started. All trenches shall be leveled, and loose material removed from pavement, gutters, and sidewalks, employing hand labor, if necessary.

D. TESTING AND INSPECTION

1. General

During construction and at the completion of the work, the Contractor shall make such tests as required for gravity sewer pipework. The PWS Representative or Engineer will observe the tests, but the Contractor shall furnish all apparatus required and shall pay all costs connected therewith. Defective work shall be repaired immediately at the Contractor's expense. All testing is to be performed after final grading (pre-testing is encouraged).

In general, tests shall conform to usually accepted testing practices for the specific type and class of test. All data, observations and results will be carefully recorded, and the PWS Representative and Engineer will be furnished two (2) signed copies of all data and reports. Project acceptance may be held contingent on receipt of satisfactory test reports.

All new construction shall be secured prior to acceptance by PWS. New gravity systems shall be plugged between new systems and existing systems to prevent infiltration while under construction.

2. Tests of Gravity Pipework

a. Inspection

It is imperative that all sewers and manholes be built water-tight, and that the Contractor adheres rigidly to the specifications for material and workmanship.

After completion, the sewer system, or sections thereof, will be tested and gauged, and if infiltration is above allowable limits specified, the sewer will be rejected.

On completion of each section of sewer, or such other time as the Engineer or PWS Representative may direct, the section of sewer is to be cleaned, tested and inspected. All repairs shown necessary by the tests are to be made; broken or cracked pipe replaced; all deposits removed; and the sewers left true to line and grade as herein specified, or shown on the plans, entirely clean and ready for use. Each manhole or other appurtenance to the system shall be of the specified size and form, be watertight, neatly and substantially constructed, with the top set permanently to exact position and grade.

b. Air Testing

Air testing shall be an acceptable method of leakage testing. The requirements and procedures for air testing shall conform to the following specifications:

- **Scope:** Work under this section shall consist of furnishing all labor and materials and performing air tests for leakage on all sewer lines installed. Defective work as indicated by tests specified herein shall be corrected immediately and the defective sections shall be retested. The cost of air testing shall be included in the unit price bid for pipe and manholes. The Contractor shall furnish all equipment required for all tests.
- **Responsibility:** The Contractor shall furnish all the necessary equipment and be responsible for conducting all air tests. In addition, the Contractor is responsible for any necessary repair work on sections that do not pass the test. The Engineer and/or PWS Representative shall witness all air tests and verify the accuracy and acceptability of the equipment utilized.
- **Safety:** All temporary pneumatic plugs shall be installed and braced in such a manner that blowouts are prevented. No internal pressure of more than nine (9) psig will be permitted on the sewer mains. All pressurizing equipment used for air testing shall include a regulator or relief valve set no higher than nine (9) psig to avoid over-pressurizing and displacing temporary plugs.
- **Equipment:** Either mechanical or pneumatic plugs may be used. All plugs shall be designed to resist internal testing pressures without the aid of external bracing or blocking. However, the Contractor should internally restrain or externally brace the plugs to the manhole wall as an added safety precaution throughout the test.

To facilitate test verification by the inspecting Engineer, all air used shall pass through a single, aboveground control panel. The aboveground air control equipment shall include a shut-off valve, pressure regulating valve, pressure relief valve, input pressure gauges and a continuous monitoring pressure gauge having a pressure range from 1 to at least 10 psi. The continuous monitoring gauge shall be no less than 4 inches in diameter with minimum divisions of 0.10 psi and an accuracy of ± 0.04 psi.

Two (2) separate hoses shall be used to: (1) Connect the control panel to the sealed line for introducing low-pressure air, and (2) Constantly monitor air pressure build-up in the line (separate hose connection). If pneumatic plugs are utilized, a separate hose shall also be required to inflate the pneumatic plugs from the aboveground control panel.

Testing equipment shall be manufactured to include the test certification.

- **Line Preparation:** During sewer construction, all service laterals, stubs, and fittings shall be properly capped or plugged so as not to allow for air loss during testing. All caps, plugs, and short pipe lengths shall be restrained with bracing stakes or clamps.
- **Test Procedure:** Low pressure air shall be slowly introduced into the sealed line until the internal air pressure reaches 5.0 psig greater than the average back pressure of any groundwater above the pipe. After a constant pressure of 5.0 psig is reached, the air supply shall be throttled to maintain that internal pressure for at least two (2) minutes. This is required to permit the temperature of the entering air to equalize with the temperature of the pipe wall.

When temperatures have been equalized and the pressure stabilized at 5.0 psig (greater than the average groundwater back pressure), the air hose from the control panel to the air supply shall be shut-off. The continuous monitoring pressure gauge shall then be observed while the pressure is decreased to no less than 4.5 psig (greater than the average groundwater back pressure). At a reading of 4.5 psig, or any convenient pressure reading between 4.5 psig and 5.0 psig (greater than the average groundwater back pressure), timing shall commence with a stopwatch on the section of line being tested.

If the time shown in the following table, for the designated pipe size length, elapses before the air pressure drops 0.50 psig; the section undergoing test shall have passed. The test will be discontinued on this section of line once the prescribed time has elapsed.



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If the pressure drops 0.50 psig before the appropriate time has elapsed (as shown in the following table), the air loss rate shall be considered excessive and this section of line has failed the test. If the section fails the test, the Contractor shall determine, at his own expense, the source(s) of leakage, and he shall repair or replace all defective material and/or workmanship to the satisfaction of the Engineer/PWS Representative.

The extent and type of repair which may be allowed, as well as the results of any subsequent tests, shall be subject to the approval of the Engineer/PWS Representative. Upon completion of the repair work, this section of line shall be retested and meet the requirements of the air testing as described above.

| SPECIFICATION TIME REQUIRED FOR A 0.5 PSIG PRESSURE DROP FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q=0.0015 | | | | | | | | | | | | |
|---|-----------------------------------|--|--|---|------------|------------|------------|---------|---------|------------|---------|---------|
| 1 Pipe Dia. (In.) | 2 Minimum Time (Min:Sec) | 3 Length for Minimum Time (Ft.) | 4 Time for Longer Length (Sec) | SPECIFICATION TIME FOR LENGTH (L) SHOWN (MIN:SEC) | | | | | | | | |
| | | | | 100 Ft. | 150 Ft. | 200 Ft. | 250 Ft. | 300 Ft. | 350 Ft. | 400 Ft. | 450 Ft. | 500 Ft. |
| 4 | 1:53 | 597 | .190 L | 1:53 | 1:53 | 1:53 | 1:53 | 1:53 | 1:53 | 1:53 | 1:53 | 1:53 |
| 6 | 2:50 | 398 | .427 L | 2:50 | 2:50 | 2:50 | 2:50 | 2:50 | 2:50 | 2:50 | 2:51 | 3:12 |
| 8 | 3:47 | 298 | .760 L | 3:47 | 3:47 | 3:47 | 3:47 | 3:48 | 4:26 | 5:04 | 5:42 | 6:20 |
| 10 | 4:43 | 239 | 1.187 L | 4:43 | 4:43 | 4:43 | 4:57 | 5:56 | 6:55 | 7:54 | 8:54 | 9:53 |
| 12 | 5:40 | 199 | 1.709 L | 5:40 | 5:40 | 5:42 | 7:08 | 8:33 | 9:58 | 11:24 | 12:50 | 14:14 |
| 15 | 7:05 | 159 | 2.671 L | 7:05 | 7:05 | 8:54 | 11:08 | 13:21 | 15:35 | 17:48 | 20:02 | 22:15 |
| 18 | 8:30 | 133 | 3.846 L | 8:30 | 9:37 | 12:49 | 16:01 | 19:14 | 22:26 | 25:38 | 28:51 | 32:03 |
| 21 | 9:55 | 114 | 5.235 L | 9:55 | 13:05 | 17:27 | 21:49 | 26:11 | 30:32 | 34:54 | 39:16 | 43:38 |
| 24 | 11:20 | 99 | 6.837 L | 11:24 | 17:57 | 22:48 | 28:30 | 34:11 | 39:53 | 45:35 | 51:17 | 56:59 |
| 27 | 12:45 | 88 | 8.653 L | 14:25 | 21:39 | 28:51 | 36:04 | 43:16 | 50:30 | 57:42 | 64:54 | 72:06 |
| 30 | 14:10 | 80 | 10.683 L | 17:48 | 26:43 | 35:37 | 44:31 | 53:25 | 62:19 | 71:13 | 80:07 | 89:02 |
| 33 | 15:35 | 72 | 12.926 L | 21:33 | 32:19 | 43:56 | 53:52 | 64:38 | 75:24 | 86:10 | 96:57 | 107:43 |
| 36 | 17:00 | 66 | 15.384 L | 25:39 | 38:28 | 51:17 | 64:06 | 76:55 | 89:44 | 102:34 | 115:23 | 128:12 |
| 42 | 19:54 | 57 | 20.942L | 34:54 | 52:21 | 69:49 | 87:15 | 104:42 | 122:10 | 139:37 | 157:04 | 174:32 |

SOURCE: Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe by UNI-Bell Plastic Pipe Association

c. Deflection Testing

All PVC sewer lines shall be tested for diametric deflection following installation. A “Go-No-Go” type mandrel will be an acceptable deflection testing device. The maximum diametric deflection allowable will be five (5) percent of the pipe base inside diameter as defined in ASTM Specification D3034 and F679. Deflection

testing will be performed prior to asphalt paving after all improvements, including road base, are in place. The mandrel shall be hand pulled only.

| Nominal Size | Pipe | Average Pipe ID | Base Pipe ID* | 5% Deflection Gauge OD |
|---|--------|-----------------|---------------|------------------------|
| Deflection Requirements: ASTM Specification D3034 (4"-15") | | | | |
| 6" | SDR 26 | 5.764 | 5.612 | 5.33 |
| 8" | SDR 26 | 7.715 | 7.488 | 7.11 |
| 10" | SDR 26 | 9.644 | 9.342 | 8.87 |
| 12" | SDR 26 | 11.48 | 11.102 | 10.55 |
| 15" | SDR 26 | 14.053 | 13.575 | 12.9 |

| Nominal Size | Pipe | Average Pipe ID | Base Pipe ID* | 5% Deflection Gauge OD |
|---|--------|-----------------|---------------|------------------------|
| Deflection Requirements: ASTM Specification F679 (18"-27") | | | | |
| 18" | SDR 26 | 17.177 | 16.586 | 15.76 |
| 21" | SDR 26 | 20.249 | 19.545 | 18.57 |
| 24" | SDR 26 | 23.296 | 22.48 | 21.36 |
| 27" | SDR 26 | 25.674 | 24.744 | 23.51 |
| 30" | SDR 26 | 29.306 | 28.763 | 27.32 |

*Base Inside Diameter (Base ID) - Allows for out of roundness and wall thickness tolerances as defined by ASTM standards.

d. Manhole Vacuum Testing

Manhole vacuum testing shall be conducted by the Contractor in coordination with and at the direction of PWS, in accordance with ASTM C1244. Each manhole shall be tested, after assembly, as follows: All pipe openings shall be sealed by installing suitable plugs that completely isolate the manhole structure; any other openings, such as lifting holes, shall be permanently sealed.

A suitable vacuum pump shall be connected to the manhole, and a vacuum of 10” of Hg drawn. The pump shall then be isolated from the manhole by valving, and the test period initiated. The test shall be successful if the vacuum remains at nine (9) inches of Hg or greater according to the following table:

| Manhole Diameter | Minimum Time (sec) |
|------------------|--------------------|
| 48” | 60 |
| 60” | 75 |
| 72” | 90 |

All manholes which fail the test or that have visible leaks, even if they pass the test, shall be repaired or replaced at the expense of the Contractor until the manholes pass the test, to the complete satisfaction of the Engineer/PWS Representative. Manholes which have any visible leaks will not be accepted.

e. Camera Testing of Sewer Mains and Laterals

All gravity sewer main and gravity sewer laterals shall be video recorded prior to acceptance. Video shall be recorded after the road base is installed and prior to paving. Before recording takes place, the gravity sewer mains and laterals shall be cleaned thoroughly and flushed. The sewer main and laterals shall be filled with water for the camera testing. A PWS Representative must be present when recording takes place. The video will be viewed by the PWS Representative to verify that the sewer was installed correctly. Gravity sewer mains will be allowed up to a 0.5-inch tolerance and laterals will be allowed up to a 0.25-inch tolerance. If these requirements are not met, then the sewer will be rejected. The Contractor shall make repairs as necessary at his expense and re-video the repaired sections.

The contractor shall inspect the sewer interior using a color closed-circuit television camera (CCTV) and document the inspection on a digital recorder. All inspection videos shall be captured in either MPEG or Windows Media Video (.WMV) file format and saved on portable hard drives for submittal, labeled as follows:

- Each inspected sewer main shall be referenced manhole to manhole.
- Each inspected sewer lateral shall be referenced to the property address (or Lot/Block) and corresponding sewer main.

3.3 PRESSURE PIPING

3.3.1 DESIGN STANDARDS

A. LOCATION

Force mains shall be located in dedicated rights-of-way or utility easements. When installed in right-of-way, force mains shall maintain a consistent alignment with respect to the centerline of the road. All force mains located outside of dedicated rights-of-way shall require a minimum 20-foot easement. If a force main is located adjacent to a road right-of-way, a minimum 10-foot easement shall be provided. Additional easement widths shall be provided if the pipe size or depth of cover so dictate. In general, force mains shall not be located along rear lot lines. Placement of a force main along a rear lot line may be allowed on a case-by-case basis, if such a force main configuration results in efficient placement and utilization of the sewer system.

B. DESIGN BASIS

1. Velocity and Diameter

At design pumping rates, a flow velocity of at least two (2) feet per second shall be maintained. Maximum velocity at design pumping rates should not exceed five (5) feet per second. The minimum force main diameter shall be four (4) inches.

2. Design Friction Losses

Friction losses through force mains shall be based on the Hazen-Williams formula. In the use of the Hazen-Williams formula, the value for “C” shall be 140 for HDPE pipe and shall be 120 for PVC pipe.

3. Design Pressure and Restraint

The force main and fittings, including all restrained joint fittings and thrust blocking, shall be designed to withstand pump operating pressures and pressure surges of two (2) times the normal operating pressure, but not less than 200 psi (including surge).

The length of pipe to be restrained shall be calculated for each bend. The bearing area of thrust blocks shall be adequate to prevent any movement of the fitting. See *Thrust Block Details WW-10* for typical thrust block requirements.

4. Termination

Force mains shall not terminate directly into a gravity sewer line. Force mains shall enter the sewer system at a point not more than one (1) foot above the flow line of the receiving manhole. Force mains shall never enter a manhole from a direction contrary to the direction of flow out of the manhole. When a proposed force main will discharge into an existing manhole, an update/rehab to the manhole will be required. See *Manhole Rehab with Fiberglass Liner Detail WW-5* for typical rehab requirements.

5. Air Release and Vacuum Relief Valves

Air release valves, or air/vacuum relief valves, shall be provided at all high points, as necessary, to prevent air locking and vacuum formation. Vacuum relief valves may be necessary to relieve negative pressures on force mains. The force main configuration and head conditions shall be evaluated as to the need for and placement of vacuum relief valves.

All such valves shall be clearly delineated on the force main drawings in plan and profile views. The developer's Engineer shall submit all calculations to PWS justifying the valve sizing. See *Air Release Vacuum Valve Detail WW-14* for typical valve requirements.

6. Aerial Crossings

Aerial crossings shall be avoided whenever possible but may be allowed on a case-by-case basis, as approved by PWS.

7. Underwater Crossing

A minimum cover of three (3) feet shall be provided over the pipe. The pipe material shall meet appropriate AWWA standards for use in submerged conditions.

Valves shall be provided at both ends of the water crossing so that the section can be isolated for testing or repair. The valves shall be easily accessible and not subject to flooding. Each crossing shall be clearly marked by permanent warning signs placed on the bank identifying the nature and location of the crossing.

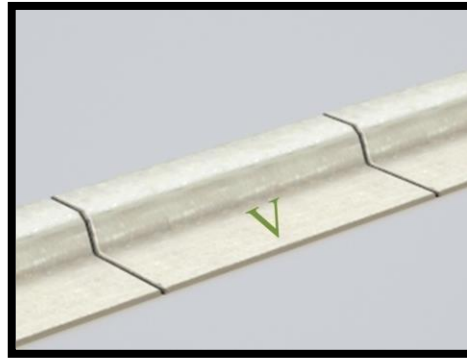
The design of crossings shall accommodate scour conditions and prevention of pipe flotation. Calculations demonstrating this shall be provided to PWS.

It shall be the responsibility of the developer to obtain all applicable regulatory permits, including dredge and fill permits.

Valves

Sufficient valves shall be provided on force main systems to facilitate effective isolation of the pipe system for repairs, maintenance, and future manifolds. Valves shall be installed at intervals not to exceed 1000 feet. Valves shall be provided where force mains intersect to facilitate isolation of pipe segments. Valves shall not be placed in the roadway or sidewalk in proposed developments.

Valve Locations shall be marked with a “V” of at least three (3) inches in size, cut into the curb and painted green, similar to the following figure:



8. Future Consideration

While designing force main systems, consideration shall be given to possible future connecting pumping stations. If applicable, this requirement shall be reviewed with PWS prior to finalization of the design.

C. LOW-PRESSURE SEWER MAINS

Low pressure sewer mains may be installed in areas where gravity sewer is not feasible. The size of low-pressure sewer main shall be calculated by the Engineer and approved by PWS. See *Residential and Commercial Low Pressure Service Connection Details WW-17* and *WW-18* for typical low-pressure commercial/residential sewer service installations.

Intermediate flushing devices/valves shall be installed at a minimum of every 1000 feet (see *In-Line Flushing Connection Detail WW-15*). Terminal flushing devices/valves shall be installed at the end of every line/extension (see *Terminal Flushing Connection Detail WW-16*). A minimum cover of 30” is required.

3.3.2 GUIDELINES AND TECHNICAL SPECIFICATIONS

A. PIPEWORK

This section includes furnishing and installing all pressure pipework and appurtenances for wastewater systems complete and fully operable in all respects.

1. Materials

All material shall be free from defects impairing strength and durability and be of the best commercial quality for the purpose specified. It shall have structural properties sufficient to safely sustain or withstand strains and stresses to which it is normally subjected and be true to detail.

All pipework shall be inspected upon delivery and such as does not conform to the requirements of these specifications, shall be rejected and must be immediately removed from the site by the Contractor.

The Contractor shall furnish and provide all labor necessary to assist the Engineer in inspecting the material.

The basis of rejection shall be as specified in applicable ASTM and AWWA specifications.

2. Unplasticized Polyvinyl Chloride (PVC) Pressure Pipe

PVC pipe shall meet AWWA C900 or ASTM D1785, with minimum designations per the table below. PVC pipe shall be provided with push-on joints with the bell integrally cast into the pipe. PVC pipe shall be installed with elastomeric gaskets meeting ASTM F477.

| Diameter | Required Standard | DR | OD | Pressure Class |
|-----------|-------------------|--------|----|----------------|
| 2" - 3" | ASTM D1785 | Sch-40 | IP | 200 |
| 4" - 8" | C-900 | 25 | DI | 100 |
| 10" - 12" | C-900 | 25 | DI | 100 |
| 14" - 24" | C-900 | 25 | DI | 165 |
| 30" - 42" | C-900 | 32.5 | DI | 125 |

PVC pipe shall be as manufactured by the JM Eagle, National Pipe and Plastics, Inc., North American Pipe Corporation, Vulcan Plastics Corporation, or approved equivalent. All force mains shall be green in color.

Standard laying lengths shall be 20 feet, and randoms shall not be less than 10 feet.

Each length of pipe shall be clearly marked with the following information at intervals of five (5) feet or less:

- Nominal pipe size and OD base.
- Material code designation.
- Dimension ratio.
- Pressure class or pressure rating.
- Manufacturer's name or trademark.
- Appropriate AWWA or ASTM standard number.

3. Ductile Iron Pipe (DIP)

Ductile iron pipe shall meet the requirements of ASTM A746. Pipe dimensions shall conform to Federal Specification WW-P-421, Class 150. Each pipe shall be conspicuously marked on the outside of the barrel to readily distinguish it from cast iron. Metal thickness shall conform to ANSI/AWWA C150/A21.50-02.

a. Mechanical Joints

All mechanical joints shall conform to ANSI/AWWA A21.11, Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.

b. Push-on Joints

All push-on joints shall conform to ANSI/AWWA A21.11, Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings, single gasket push-on type.

c. Flanged Joints

All flanged joints shall conform to ANSI/AWWA C115/A21.15-99, Ductile Iron Pipe Flanges and Flanged Fittings, 125 pounds and shall have screwed on flanges, faced and drilled to ANSI Class 125-pound template. The flanged joints shall be assembled by threading plain end pipe and screwing on long hub flanges.

The connection shall then be power tightened and refaced across both face of flange and end of pipe. Provide one-sixteenth-inch ring gaskets of red sheet rubber meeting the requirements of Grade I, Table I of ASTM Specification D1330-66, Rubber Sheet Gaskets. Connections shall be made with machine bolts and hexagonal nuts.

d. Fittings

All fittings shall be ductile iron mechanical joint meeting the requirements of ANSI/AWWA C153/A21.53. All sewer fittings shall be lined with P401, Tnemec, or approved equivalent. All fittings installed south of Sterling Way in the PWS service area shall be coated exteriorly with Permox PCS-9043 Type II glass flake epoxy pipe coating, or approved equivalent.

e. Linings and Coatings for Ductile Iron Sewer Mains

All pipe, valves, fittings and specials for sewer shall be lined with P401, Tnemec or approved equivalent. The exterior of buried pipe shall receive a coat of hot-dip coal tar as specified in ANSI A21.6. The exterior of all aboveground pipe shall receive a coat of rust inhibitor primer compatible with the finish paint schedule. All bolts, nuts, studs and other uncoated parts of joints for underground installation shall be 316 SS. All ductile iron sewer main installed south of Sterling Way in the PWS service area shall be coated exteriorly with Permox PCS-9043 Type II glass flake epoxy pipe coating or approved equivalent.

4. Polyethylene Pipe (HDPE)

HDPE pipe, three (3) inches and larger, shall meet or exceed AWWA C906; and ASTM D2513, D3035, D3350, and D1248, latest revisions. Each manufacturer shall supply a letter of certification stating compliance with all the above standards and requirements prior to shipping any material to the project site. All HDPE piping system components shall be the products of one manufacturer. The HDPE material shall have required ultraviolet inhibitors to resist degradation by direct and prolonged sunlight.

The design of all HDPE materials shall be based on the hydrostatic design basis (HDB) of 1600 psi at 73.4°F. The cell classification shall meet or exceed 345465C for all HDPE three (3) inches and larger and shall be manufactured with NSF-approved 4710 resins only. The pipe shall be SDR 11 with a ductile iron pipe OD and a pressure rating of 200 psi.

All HDPE, three (3) inches and larger, shall have three (3) green strips (1/4 inch wide) located at the 12, 4, and 8 o'clock positions with permanent ink along the entire length of the pipe with the wording size of pipe, SDR rating and pressure rating, manufacturer's

name, sewer pipe, ASTM F174, PE 4710, NSF, AWWA C906, and manufacturing date and location. This shall be at least ¼-inch tall lettering and shall run the entire length of the pipe. Print line markings shall include a production code from which the location and date of manufacture can be identified. Upon request, the manufacturer shall provide an explanation of his production code.

HDPE pipe /tubing, two (2) inches and smaller, shall comply with or exceed AWWA C901; ASTM D3350, D2737, D1248, and D2837, latest revisions. All HDPE tubing shall be manufactured of an outer layer of 4710 resins with green coloring and a virgin clear center of 4710 resins only. Tubing shall have NSF 14 certification. The cell classification shall be 445574E external pipe and 445574D for virgin center core. The pipe shall have UV stabilizers for direct sunlight protection, but all tubing shall be certified to resist direct sunlight such as that of Florida or Arizona for a minimum of five (5) years with no visible or physical effect to the tubing. All tubing shall be SDR 9 CTS pipe with a minimum pressure rating of 250 psi. The manufacturer shall issue a certification of compliance for purity of core and lifetime warranty for all the above-mentioned standards and cell classification.

5. Metallic Tracer Wire

Copper wire (12 gauge) shall be buried directly above all non-metallic pipes no deeper than 18 inches below ground level. The color of tracer wire shall be green for sewer. All connections shall be made with silicone sealed wire nuts. All stripped wire is to be inside the wire nut.

B. VALVES AND MISCELLANEOUS APPURTENANCES

This section includes furnishing and installing complete all equipment and materials necessary for a complete and fully operable system.

1. Materials

All material shall be free from defects impairing strength and durability and be of the best commercial quality for the purpose specified. It shall have structural properties sufficient to safely sustain or withstand strains and stresses to which it is normally subjected and be true to detail.

All pipe work will be inspected upon delivery, and such as does not conform to the requirements of these specifications, shall be rejected and must be immediately removed from the site by the Contractor.

The Contractor shall furnish and provide all labor necessary to assist the Engineer in inspecting the material.

The basis of rejection shall be as specified in applicable ASTM and AWWA Standards.

2. Valves

a. Gate Valves

Contractor shall provide gate valves meeting the following requirements:

Gate Valves Two Inches and Larger: Gate valves shall be of the resilient seated wedge type, epoxy coated to AWWA C550, cast iron body design. They shall comply with AWWA C509, latest revision. Valves shall be rated for zero leakage at 200 psi water working pressure and have a 400-psi hydrostatic test for structural soundness. All testing shall be conducted in accordance with AWWA C509. Gate valves shall be mechanical joint per AWWA C111.

All cast iron shall conform to ASTM A126. Castings shall be clean and sound without defects that will impair their service. No plugging or welding of such defects will be allowed. Bolts shall be in accordance with ASTM A307.

Valves shall be M & H Model 4067, American Series 2500 RW, Mueller A-2360 (Mueller A-2361 for valves over 12 inches), or approved equivalent.

Gate Valves Under Two Inches: Gate Valves under two (2) inches shall be bronze body, threaded ends, non-rising stem, solid wedge disc and shall be American Model 3FG, or approved equivalent.

b. Air Release and Vacuum Valves

All force mains and other pressure non-treated mains shall have combination air release valves installed as indicated on the approved plans. The body of these valves shall be conical shaped to maintain maximum air gap with the spring-loaded float and seal plug connection combining to ensure no contact between the sewage and the seal. The valve shall have a double float design with the upper float being enclosed in the upper section of the valve and shall be made of foam polypropylene. The lower float shall be in the main body of the valve and shall be constructed of foam polypropylene. The body, cover flange, and lower flange shall be constructed of reinforced nylon 6 or 316 stainless steel and shall have a funnel shaped lower body to automatically

drain sewage back into the system. All internal metal parts are to be made from corrosion resistant 316 stainless steel, with all operating parts, in the upper and lower sections, to be non-metallic plastic/rubber materials. The hinge for operation for the opening and closing of the seal on the orifice shall be made of EPDM rubber. The rolling resilient seal shall provide smooth positive opening, closing, and leak free sealing over the fluctuation of pressure differentials. The working pressure shall be 1.5 psi to 230 psi. The lower bowl of the ARV shall be funnel shaped to assure the raw sewage to run back into the pipe. All hardware shall be of stainless steel bolts and nuts, and the entire valve, except to upper outlet, shall be constructed of reinforced nylon 6 material. All valves shall be equipped for back flushing maintenance, and all valves shall be manufactured to allow for back flushing through all working parts – from top to bottom, and with easy connection or disassembly.

If room does not allow for a direct connection, the use of a 90° bend can be used to offset the connection to the side. This connection must have a grade that is a minimum of 5% increases as it leaves the connection at the pipe.

All combination air release valves shall be A.R.I. model D-025P, D-025S, D-025LP, D-26P, or approved equivalent. All automatic air release valves shall be A.R.I. model S-025P, or approved equivalent. All valves shall be installed in accordance with manufacturer recommendations and shall have an isolation valve connection for control. All ARVs shall have ISO 9002 certification.

c. Tapping Valves

Tapping valves shall meet the requirements of AWWA C500 and be designed for making taps to existing mains under pressure. Valve, tees, and boring equipment used shall be mutually compatible. Tapping tees, unless otherwise indicated, shall be constructed of cast or ductile iron with non-corrosive accessories. All stainless-steel bodied tees may be used. All nuts and bolts shall be non-corrosive and compatible with fitting materials.

d. Valve Locations

Valve locations shall be marked with a “V” cut into the curb and painted green. All valves shall be marked with valve markers. Valve markers shall be green, triangular and contain 4” wide reflective marker tape.

3. Miscellaneous Appurtenances

a. Valve Boxes

Cast iron valve boxes shall be provided for all underground valve installations. Valve boxes shall consist of a base covering the operating nut and head of the valve; a vertical shaft, at least 5-1/4 inches in diameter and with an adjustable length from 18 inches to 24 inches; and a top section extending to a point even with the finished ground surface. A cast iron cover marked "SEWER" shall be provided as required and placed concentrically over the operating nut. The assembly shall be suitable for highway traffic wheel loads.

Valve boxes shall be Clow, Mueller Company, Sigma, or Tyler Union screw type valve box, or approved equivalent.

b. Air Release Valve Housing (for above ground installations)

All air release valves installed above ground shall be enclosed in a Water Plus Model ARV-H-30 or larger unit, colored green for wastewater. For ARV's that are of a size larger than can be installed in the ARV-H-30 enclosure referenced above, a comparable Water Plus enclosure shall be used as recommended by the manufacturer.

All enclosures shall be constructed of quality, UV resistant poly-plastic with a galvanized stable bar in back. For aerial crossings, the stabilizing bar may be removed. All enclosures shall have the same shade and type of color as stated above. All enclosures shall have the same shade and type of color as stated above. All enclosures shall be equipped with a locking device as approved by PWS. The standard H-30 enclosures shall be equipped with a Pin Allen lock, and keys shall be provided with each installation. All ARVs and odor control units shall be installed above ground and enclosed in the Water Plus enclosures with locks.

c. In-Line/Terminal Flushing Devices

In-line flushing devices shall be furnished and installed every 1,000 LF of low-pressure sewer main (see *In-Line Flushing Connection Detail WW-15*). Terminal flushing devices shall be furnished and installed at the end of low-pressure sewer mains (see *Terminal Flushing Connection Detail WW-16*).

d. Low-Pressure Sewer Services

Low-pressure sewer service laterals shall be 1.5 inches for residential and commercial services connecting to mains less than three (3) inches and shall be two (2) inches for residential and commercial services connecting to mains three (3) inches and greater. Refer to *Residential and Commercial Low Pressure Service Connection Details WW-17 and WW-18* for installation and material requirements.

e. Submittals

The Contractor shall submit a minimum of four (4) copies of catalog data for approval by PWS for materials to be used and shall allow two weeks for submittal review. Submittals shall include, but not be limited to, the following:

- Pipe and Fittings
- Tubing
- Valves, Boxes and Concrete Collars
- All Service Materials
- Casing
- Tracer Wire and Silicone Wire Nuts
- In-Line/Terminal Flushing Devices

C. INSTALLATION OF FORCE MAIN AND LOW-PRESSURE SEWER MAINS

This section covers the installation of pressure pipework. Excavation and backfilling shall be in accordance with the *General Specifications* section of the specifications (see **Section 5.2 Earthwork**).

1. General

All pipe, fittings, and valves shall be carefully handled at all times to prevent damage to the pipe or other installation on the job site. All joints shall be wiped free of all dirt, sand and foreign material and the pipe shall be carefully examined for defects before installation. Cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe.

At times when pipe installation is not in progress, the open ends of the pipe shall be closed with a compatible pipe plug and shall remain closed until construction on that particular section is resumed, eliminating the possibility of any flow obstructions getting into the pipe.

Deviations from the piping location, line and grade indicated on the construction plans shall not be made without the prior approval of the Engineer or PWS Representative.

No pressure piping or fittings shall be allowed under any proposed paving, including sidewalks, flumes, roadways, etc., except for approved crossings.

2. Pipe Laying Procedures for Pressure Piping

Pressure piping shall be installed in strict accordance with the manufacturer's printed instructions. Before lowering the pipe into the trench, the bottom of the trench shall be graded so that when the pipe rests on the trench bottom it will have a uniform bearing for its entire length. The pipe shall be carefully examined for defects and the inside cleaned. After placing the pipe in the trench, the ends shall be wiped free from all dirt, sand and foreign material. The joints shall be made in accordance with the recommendations of the pipe manufacturer.

Suitable concrete reaction or thrust blocks shall be applied on all lines (except those having screwed or flanged joints); at all tees, plugs, caps, and bends deflecting 22-1/2 degrees or more; or movements shall be prevented by attaching metal rods or straps, as approved by the Engineer. Unless otherwise directed, the pipe shall be laid with bell ends facing in the direction of laying. Whenever it is necessary to deflect the pipe from a straight line, either in the vertical or horizontal plane, to avoid obstruction, to plumb stems, or where long radius curves are permitted, the degree at deflection shall be as recommended by the manufacturer of the pipe. Degree fittings are required on all long radius pipe runs as necessary.

The minimum allowable cover for pipe is 30 inches below top of curb and the maximum allowable cover is 48 inches, unless otherwise indicated on the approved plans or approved by PWS. The depth of cover shall be measured from the established street grades or the surface of the permanent improvement to the top of the barrel of the pipe. At street intersections or where the new pipe lines cross existing underground lines at the approximate same depth as the new line, the cover shall be increased and the new line laid below existing lines or structures. Where the existing lines or structures are of sufficient depth that the new lines when laid will have six (6) inches of separating earth between them and other pipe or structure and 30 inches of cover (below top of curb), the new lines may be laid above the existing lines.

a. Sub-Surface Explorations

Whenever necessary to determine the location of existing pipes, valves, or other underground structures, the Contractor shall examine all available records and shall make all explorations and excavations for such purpose. Where the locations of existing utilities are furnished by PWS, they should be considered approximate only. The Contractor is responsible for locating and protecting all existing utilities whether shown on the drawings or not shown.

b. Protecting Underground and Surface Structures

Temporary support, adequate protection, and maintenance of all underground and surface utility structures, drains, sewers, and other obstructions encountered in the progress of the work shall be furnished by the Contractor at his own expense, under the direction of the Engineer or PWS Representative.

c. Construction Equipment

Mechanical equipment may be used for trenching and excavating. However, in places where the operation of same will cause damage to trees, shrubbery, pavement or existing structures, above or below ground, hand methods shall be employed. Where a main is installed along paved streets, rubber-tired equipment is recommended; however, if track equipment is necessary for excavation due to depths, the Contractor will be permitted to use such equipment and will be responsible for any damage done to paved streets or lawns. Concrete driveways and asphalt pavement must be saw cut for final replacement.

d. Unsuitable Conditions

No pipe shall be laid in water or unsuitable soils conditions. Unsuitable soil, as determined by the Engineer, shall be removed or replaced with an approved material.

e. Trench Water

At times when pipe laying is not in progress, the open ends of pipe shall be closed with a compatible pipe plug, and no trench water shall be permitted to enter the pipe.

f. Setting Valves and Boxes

Valves and Fittings: Gate valves and pipe fittings shall be set and joined to new pipe in the manner as specified in this section.

Valve Boxes: Cast-iron valve boxes shall be firmly supported and maintained, centered and plumbed, over the wrench nut of the gate valve and box cover flush with the surface of the finished pavement or at such other level as may be directed. A concrete collar around the valve box shall be required for protection. Tracer wire shall be looped in the valve box and accessible at the top of the valve box (see *Valve Box Setting Detail WW-9*).

Valve Box Alignment Device (VBAD): All buried gate valves three (3) inches through 12 inches requiring a valve box or any valve boxes that are set on a three (3)-inch to 12-inch buried gate valve shall be furnished with a VBAD. The device shall be of HDPE and colored white. It shall be furnished in two pieces that will lock together under the operating nut without requiring the removal of the operating nut. The device shall not affect the operation of the valve. No one-piece device will be accepted. The device shall be BoxLok as manufactured by Emma Sales, LLC, or approved equivalent.

g. Dewatering

The Contractor shall provide all necessary pumps to dewater the site properly, shall provide all labor and materials required to keep any open excavation dewatered during construction; and shall provide all necessary sheeting, bulkheads, drains, etc., so that construction operations may be performed under dry conditions. Discharge from pumps shall be led to natural drainage channels, to drains, or to storm sewers. The Contractor is responsible for all permitting and testing of dewatering discharge.

h. Service Pipe

Service pipe shall have a minimum depth of 30 inches (below top of curb) at all highway crossings and 18 inches elsewhere. The requirements for trenching and backfilling as described in the *General Specifications* section of the utility design manual shall apply (see **Section 5.2 Earthwork**). Removal of pavement or sidewalk will not be permitted for water service lines. They may be installed by jacking, boring or pushing under sidewalks. All services shall be encased under all paving, including sidewalks, flumes, roadways, etc.

i. Plugging Dead Ends

Standard plugs shall be inserted into the bells of all dead ends of pipes, tees, or crosses, and spigot ends shall be capped. Plugs or caps shall be joined to the pipe or fittings in the appropriate manner. All plugged or capped dead-end joints shall be restrained for the length required by the pipe material used.

j. Concrete Encasement and Special Pipe Support

Concrete encasement or special pipe supports shall be provided, as shown on the drawings or directed by the Engineer or PWS Representative. Various pipe supports shall be as worked out in the field to suit local conditions and emergencies. Where, in the opinion of Engineer or PWS, pipe covering is inadequate, concrete encasement for protection shall be provided in accordance with the approved drawings (see *Detail WW-11*). Concrete encasement shall utilize concrete with a 28-day strength of 2000 psi and shall be to the dimensions indicated on the construction plans and as required by the applicable Department of Transportation or Department of Health regulations. All other concrete needed to build and protect the pipe work shall be used at the direction of the Engineer or PWS.

k. Separation of Water Mains and Sewers/Reclaimed Water

Water mains or sewer mains that are laid in the vicinity of each other shall meet the horizontal and vertical separations specified as follows (see *Detail WW-12*):

- Six (6)-foot horizontal separation between water main and sewer main
- Three (3)-foot horizontal separation between water main and reclaimed water main
- 18-inch vertical separation between water main and sewer/reclaimed water main

Separation is to be based on the outside diameter of each main.

l. Backfilling

Backfill material shall be free from rocks or boulders or any other objectionable material. Backfill shall be placed in the trench and compacted simultaneously on both sides of the pipe for the full width of the trench, and to an elevation level with ground on either side to densities indicated in *General Specifications* section of this utility design manual (see **Section 5.2 Earthwork**). The Contractor shall not cover any pipe or fittings until inspected by the PWS Representative.

m. Repaving

Pavement removal where required in the construction of project shall be done by the Contractor in a workmanlike manner. Care must be taken to make the saw cut in a straight line so the patch will be neat.

n. Clean-Up

Before final inspection and acceptance, the Contractor shall clean ditches, shape shoulders, and restore all disturbed areas, including street crossings and grass plots, to as good a condition as existed before work started. All trenches shall be leveled, and loose material removed from pavement, gutters, and sidewalks, employing hand labor if necessary.

3. Anchorage of Bends, Tees, and Plugs

a. Thrust Block Placement

Reaction or thrust blocking shall be placed on all pipe lines two (2) inches in diameter or larger at all tees, plugs, caps and at bends deflecting 22-1/2 degrees or more, or movement shall be prevented by attaching metal rods or straps as approved by the Engineer.

b. Materials for Thrust Blocking

Reaction or thrust blocking shall be of concrete that has a 28-day compressive strength of not less than 2000 psi. Reaction blocking will be placed in accordance with the details on the approved plans and *Detail WW-10*.

Thrust blocking shall be placed between solid ground and the fitting to be anchored. The block shall, unless otherwise directed, be so placed that the pipe and fitting joints will be accessible for repairs. No extra payment will be made for this material but shall be included in the unit price bid for the various sizes of pipe.

In some cases, the Engineer may direct the Contractor to provide backing using cables and "deadman" anchors where the soil conditions will not support the normal concrete type as described above.

D. TAPS ON FORCE MAIN PRESSURIZED LINES (WET TAP)

The contractor shall perform taps on force main pressurized lines for the installation of pipes in accordance with the following requirements:

All materials used for taps on reclaimed water pressurized lines shall meet the requirements in the Tapping Valve section. Tapping sleeves shall be properly sized for the pipe being tapped. Resilient seated tapping valves shall be furnished with special end connections. All other material used to complete the tap shall meet the AWWA standards for potable water construction.

The Contractor shall notify the PWS Representative 48 hours prior to the tap. The PWS Representative/Engineer must be present for the hydrostatic pressure testing and tapping of the main. The hydrostatic pressure test shall be 150 psi minimum for a duration of 15 minutes. As an alternate, air testing is permissible at 50 psi for a duration of 15 minutes. The following chart demonstrates the tapping machine shell cutter outside diameter:

| Nominal Main Size | Tapping Valve ID AWWA Standard | Tapping Machine Shell Cutter OD |
|-------------------|--------------------------------|---|
| 2" | 2-1/8" | 1-1/2" |
| 3" | 3-1/8" | 2-1/2" |
| 4" | 1-1/4" | 3-1/2" |
| 6" | 6-1/4" | 5-1/2" |
| 8" | 8-1/4" | 7-1/2" |
| 10" | 10-1/4" | 9-1/2" |
| 12" | 12-1/4" | 11-1/2" |
| 14" | 14-1/4" | Per Manufacturer's Recommendation Contractor shall submit shop drawings for valves and tapping machine for approval, prior to use. Per Manufacturer's Recommendation. |
| 16" | 16-1/4" | |
| 18" | 18-1/4" | |
| 20" | 20-1/4" | |
| 24" | 24-1/4" | |

The tap coupon shall be given to the PWS Representative. If the coupon is lost in the main, the Contractor shall, at his expense, dismantle the main to retrieve the coupon. The main shall be reassembled and pressure tested as required, at the Contractor's expense.

E. TESTING AND INSPECTION

1. General

During construction and at the completion of the work, the Contractor shall make such tests as required for wastewater pressure pipework. The PWS Representative or Engineer will observe the tests, but the Contractor shall furnish all apparatus required and shall pay all costs connected therewith. Defective work shall be repaired immediately at the Contractor's expense.

In general, tests shall conform to usually accepted testing practices for the specific type and class of test. All data, observations and results will be carefully recorded, and the PWS Representative and Engineer will be furnished with two signed copies of all data and reports. Project acceptance may be held contingent on receipt of satisfactory test reports.

All new construction shall be secured prior to acceptance by PWS. Valves between new systems and existing systems that are not yet accepted shall be closed while unattended (i.e., nights, weekends, and holidays).

2. Hydrostatic Tests of Force Main and Low-Pressure Sewer Pipework

a. Pressure During Test

After the pipe has been laid and backfilled as specified, each valved section of newly laid pipe shall, unless otherwise specified, be subjected to a hydrostatic pressure equal to the pressure rating of the pipe being tested but not less than 150 psig. The Contractor shall record the testing using a pressure recording gauge, and after all testing is complete, the recordings shall be turned over to the Engineer/PWS Representative for his files.

b. Duration of Pressure Test

The duration of each pressure test shall be at least two (2) hours.

c. Procedure

Each section of pipe shall be slowly filled with reclaimed water and the specified test pressure, measured at the lowest point of elevation, shall be applied by means of a pump connected to the pipe in a satisfactory manner. The pump, pipe connection, gauges, meter, and all necessary apparatus shall be furnished by the Contractor. The test shall be applied to each valved section to check the leakage through all valves.

d. Expelling Air Before Test

Before applying the specified test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made, if necessary, at points of highest elevation, and afterwards tightly plugged.

e. Definition of Leakage

Leakage is defined as the quantity of reclaimed water to be supplied into the newly laid pipe, or any valved section of it, necessary to maintain the specified leakage test pressure.

f. Permissible Leakage

Suitable means shall be provided by the Contractor for determining the quantity of reclaimed water lost by leakage under normal operating pressure. No pipe installation will be accepted until or unless this leakage (evaluation at specified pressure) is less than the figures stated in the following chart:

| Nominal Pipe Size | Gal/2 Hour per 1,000 FT of PVC |
|-------------------|--------------------------------|
| 2" | 0.34 |
| 3" | 0.50 |
| 4" | 0.66 |
| 6" | 1.00 |
| 8" | 1.32 |
| 10" | 1.66 |
| 12" | 1.98 |
| 14" | 2.32 |
| 16" | 2.64 |
| 18" | 2.98 |
| 20" | 3.32 |
| 24" | 3.98 |

Calculation will include the length of pipe divided by 1,000 and then multiplied by the factor supplied in the provided chart (according to pipe size) as demonstrated below:

$$\frac{\text{Length of Pipe (in FT)}}{1,000 \text{ FT}} \times \text{Factor}$$

g. Variation From Permissible Leakage

Should any test of combined sections of pipe disclose leakage greater than the specified limit, the Contractor shall, at his own expense, locate and repair the defective joints until the leakage is within the specified allowance.

h. Reclaimed Water for Testing

Reclaimed water for testing shall be provided by PWS at no cost to the Contractor for PWS projects only. Contractor shall make arrangements for water for testing with the developer for developer's projects.

i. Time for Making Test

Pipe may be subjected to hydrostatic pressure, inspected, and tested for leakage at any convenient time after partial completion of backfill. The Contractor may test the system with joints exposed or with backfilling complete at his option; however, not more than 300 feet of trench may be open at any time. The Engineer and PWS shall be notified at least 48 hours before beginning testing.

3.4 LIFT STATION

3.4.1 DESIGN STANDARDS

A. DESIGN BASIS

1. Design Flows

Design flows shall be based upon the total ultimate development flow from all contributory areas to the pump station. The design average daily flow and peak design flow shall be computed as outlined in the following:

a. Average Daily Flow

The required average daily flow for sanitary use in residential areas shall be based on 350 gallons per day per unit (100 gpcpd x 3.5 persons), or as approved by PWS.

The required flow for commercial, industrial, or other nonresidential areas shall be as determined by the Engineer and approved by PWS for each specific instance. Justification for such flows shall be documented within the design calculations.

b. Peak Design Flow

Gravity sewers shall be designed based on ultimate development maximum rates of flow, which shall be the product of selected peak factors times the accumulative average daily flow as calculated above. In general, the following minimum peak factors shall be applicable for the range of average daily flow rates:

| Flow Range | Minimum Peak Factor |
|----------------------------------|---------------------|
| Flows to 100,000 GPD | 4.0 |
| 100,000 GPD to 250,000 GPD | 3.5 |
| 250,000 GPD to 1,000,000 GPD | 3.0 |
| Flows greater than 1,000,000 GPD | 2.5 |

For design average daily flows above 2,000,000 GPD, peaking factors less than 2.5 may be considered if substantiated by extensive data. Under no circumstances shall peaking factors less than 2.0 be allowed.

The design pumping capability of the station shall be based upon the peak design flow.

2. Number of Pumps

For pump stations with an ultimate peak design flow of 1500 GPM or less, a minimum of two pump units shall be provided. Where the peak design flow exceeds 1500 GPM, three or more units shall be provided in the design of the pump station. If initial flows dictate less than 1500 GPM, only two pumps need to be installed initially with provisions provided for future pump(s).

3. Pump Selection

The pump station shall be capable of pumping the peak design flow with the largest pump unit out of service. Pumps shall be capable of meeting all system hydraulic conditions without overloading the motors. In addition, a five (5)-hp (minimum) motor shall be required. Head capacity curves shall be prepared and submitted to PWS along with the pump station plans. Such curves shall be based upon the friction losses outlined as follows:

Friction losses through force mains shall be based on the Hazen-Williams formula. In the use of the Hazen-Williams formula, the value for “C” shall be 140 for HDPE pipe and shall be 120 for PVC pipe. When initially installed, force mains will have a significantly higher “C” factor. The effect of the higher “C” factor shall be considered in calculating maximum power requirements and duty cycle time to prevent damage to the motor. The effects of higher discharge rates on selected pumps and downstream facilities shall also be considered.

Head operating capacity curves shall verify that the pumps are operating at peak efficiency and are suitable for the design flow application. Pumps shall operate at no less than 70 percent of BEP and no more than 110 percent of BEP at all design conditions. For pumps greater than or equal to 20 hp, certified factory test curves shall be submitted to PWS to verify pump performance.

Pump and motor selection and head capacity curves shall reflect hydraulic conditions in cases where receiving force main systems are interconnected to additional pump stations. All interconnected pumping scenarios shall be demonstrated to PWS justifying the pump design basis and proving the ability of the selected pumps to achieve all operating conditions. Variation in flow when interconnected pump stations are running shall not exceed 20 percent of design on either station.

Only non-clog or vortex submersible pumps are acceptable. Submersible pumps shall be readily removable and replaceable without dewatering the wet well or disconnecting any piping in the wet well. Pumps shall be capable of handling raw sewage and passing spheres of at least three (3) inches in diameter. Pump suction and discharge openings shall be at least four (4) inches in diameter. Pumps shall be manufactured by Fairbanks Morse or KSB.

Selection shall be made based upon the most efficient pump for the system curve. Submersible pump selection shall be submitted to PWS for approval, and PWS shall have the final decision on pump selection.

All subdivisions and developments will require variable frequency drive (VFD) controlling capabilities for pumps.

4. Design Calculations/O&M Manuals

The developer’s engineer shall submit signed, sealed and dated design calculations for all wastewater pump stations. Calculations shall include both best- and worst-case head capacity curves with copies of manufacturer’s pump curves, hydraulic analysis for the force main system, operating cycle calculations with wet well sizing, and buoyancy calculations.

5. Accessibility, Flooding, Buoyancy

The pump station shall be readily accessible by maintenance vehicles during all weather conditions. An all-weather access road to the pump station shall be provided.

Wastewater pump station structures and electrical and mechanical equipment shall be protected from physical damage by the 100-year flood. Wastewater pump stations shall be designed to remain fully operational and accessible during the 100-year flood. The developer's engineer shall submit proof of the 100-year flood elevation. Regulations of local, state and federal agencies regarding flood plain obstruction shall be adhered to.

Buoyancy of the pump station structures shall be included in the design, and adequate provisions shall be made for protection. Calculations shall be provided for review by PWS as outlined in the Development Application, **Attachment B**.

6. Wet Well Requirements

The wet well shall be a minimum of eight (8) feet in diameter and shall have a minimum of eight (8) feet of depth below the lowest invert. Additional depth/diameter shall be provided based on station design and cycle time. All wet wells shall be fiberglass, or approved equivalent (see *Details WW-19 and WW-20*).

Pumping levels shall be set based upon manufacturer's duty cycle recommendations for minimum cycle time and shall also be based upon a maximum fill time of 30 minutes (pump off to lead pump on).

Pump-off water levels shall provide adequate submergence to preclude pump inlet vortexing or air binding and shall be based upon manufacturer's recommendations. High level alarm water levels shall not exceed the invert elevation of the lowest influent pipe. The FDEP requirement of 30 minutes minimum emergency storage shall be satisfied.

The wet well floor shall have a minimum slope of 1 to 1 to the hopper bottom. The horizontal area of the hopper bottom shall be no greater than necessary for proper installation and function of the pump inlet.

Pump discharge piping is to be installed approximately 30 inches above finished grade elevation (see *Detail WW-19*). Discharge piping/fittings shall be 316 stainless steel schedule 40, fabricated to ANSI dimensions.

If design flow meets or exceeds 350 GPM, the following requirements apply: installation of a flow meter and odor control unit.

7. Easement Requirements

All pump stations shall be located in dedicated rights-of-way or utility easements. An easement of a minimum of 30 feet by 30 feet shall be provided. Provisions for future connection to the pump station shall be provided. Larger sites may be required for the installation of the wet well and equipment, depending on capacity.

8. Site Fencing

Pump stations shall be enclosed with a green or black vinyl coated fence to discourage the entry of animals and unauthorized persons (see *Detail WW-21*).

9. Generator

All pump stations shall be provided with a properly sized generator. The generator shall be sized to run one pump under load for a minimum of 24 hours. The generator shall be powered by natural gas if available in the vicinity of the pump station site, and the contractor shall be responsible for the connection to the gas line prior to acceptance by PWS. If the generator is diesel powered, it shall be filled with fuel prior to acceptance by PWS. Generators shall be Taylor Power Systems, or approved equivalent.

10. Site Water Service

All lift stations shall include a 1-inch water service located no more than ten (10) feet from the wet well, with the exact location to be approved by PWS. All services shall be provided with an insulated reduced pressure backflow preventer, and all aboveground piping shall be insulated. Site water service for the lift station shall be in accordance with *Detail WW-20*.

Where reclaimed water service is available, lift station service shall be reclaimed water.

11. Adjacent Manhole

All pump stations shall have a manhole located adjacent to the wet well, within the fenced area, for bypass pumping in the event the lift station must be taken offline.

12. Future Odor Control Unit Location

The lift station site plan shall show the future location of an odor control unit along with piping and conduit location.

3.4.2 GUIDELINES AND TECHNICAL SPECIFICATIONS

A. GENERAL

Work under this Section applies to all sewage lift stations within the PWS wastewater collection system. Wastewater pump stations shall include a fiberglass wet well, aboveground stainless-steel piping, pumps, control panel, electrical service, control system, guide rails, SCADA system and all appurtenances or other items required to provide a fully operational system.

The installation shall comply with Florida Building Code, latest edition, along with all local, state, and federal laws and ordinances applicable to electrical installation. The installation shall also comply with the standards of the latest edition of the published National Electrical Code, where such standards do not conflict with local, state, and federal laws and ordinances. The Contractor shall obtain all permits, and after completion of the work, shall furnish the Engineer a certificate of final inspection and approval from the applicable local inspection departments.

At completion of the work, three (3) copies of written operation and maintenance manuals and certified pump curves and one (1) electronic copy shall be furnished to the Engineer or PWS Representative.

B. NON-CLOG SUBMERSIBLE PUMP STATIONS

Operating conditions for each lift station are provided in the construction plans on the lift station detail sheets. Each pump shall be suitable for installation in a wet well and passing spheres of at least three (3) inches in diameter. Pumps shall be manufactured such that they employ a guide rail-type system with a permanently mounted discharge elbow to allow removal and installation of pumps without entering the wet well. Each pump shall have a three (3)-phase, 60 cycle motor.

Selection shall be made based upon the most efficient pump for the system curve, not the price, and PWS shall have the final decision on pump selection. Approved pump manufacturers are Fairbanks Morse and KSB.

C. MOTORS AND PUMPS

The following description is intended to be a standard of construction for pumps and motors; however, approved equivalents will be accepted.

1. Pump Construction

The pumps shall be vertical submersible pump units designed and constructed to pump sewage, storm water, heavy sludge, and other fibrous materials without injurious damage during operation. The design shall be such that the lifting cover, stator housing, volute casing and impeller are constructed of ASTM 48, Class 30 gray cast iron. The volute shall be of the center discharge design and shall be fitted with ANSI 125-pound flanges and tested to Hydraulic Institute standards at 150 percent of shut-off head. The interfaces between the major castings are machined and fitted with BUNA-N O-RINGS. All nuts, bolts, washer and other fastening devices coming into contact with the sewage will be constructed of 316 stainless steel.

Pumps shall be rated and certified by FM or other recognized authority in the United States for use in Class 1, Division 1 spaces.

The impeller shall be of the non-clog design, double shrouded with a smooth, long thoroughfare having no acute angles. The wear ring system shall be constructed of series 400 stainless steel with a Brinell Hardness of 200-310. The system shall provide efficient sealing between the volute and impeller.

The pump shall be provided with a balanced tandem mechanical seal cartridge. The seal case shall be constructed of 316 stainless steel with all seal faces and springs immersed in oil. Both sets of faces (both upper and lower sets) shall be tungsten-carbide silver-soldered to stainless steel retainers. Seal faces shall be self-aligning, positively driven, and each is held by separate spring systems. The construction shall be such that no spring is exposed to the pumped media and no handling of the seal faces can occur during removal or replacement of the seal.

The pump and motor shaft shall be of Series 400 stainless steel with a Brinell hardness of 200. The shaft diameter where it passes through the lower seal shall be of sufficient size so that the maximum shaft deflection due to axial and radial thrust loads is 0.16 mm. The shaft shall not extend more than 2-1/2 times its diameter below the nearest support bearing and shall be supported by double-row lower and single-row upper ball bearings with a B-10 life of 50,000 hours at a minimum.

Each pump shall be supplied with a universal coupling, ANSI 125 cast iron, which bolts to the pump discharge flange and accepts the discharge elbow provided by the pump manufacturer. The seal of the pump at the discharge flange shall be

accomplished by a simple downward linear motion of the pump with the entire weight of the pump guided to and pressing against the discharge connection; no part of the pump shall bear directly on the sump floor, and no rotary motion of the pump shall be required for sealing. Sealing at the discharge shall be provided by a replaceable rubber seal form-fitted to the machine discharge coupling to ensure and guarantee a positive leakproof system and for ease of removal of the pump.

2. Motors

The pump motor shall be integral to the pump for submersible operation. The squirrel cage induction type motor shall be of Class F insulation, NEMA B design, class H slot liners with a service factor of 1.15. The dual voltage copper wound stator, which will allow field changeability of voltage, shall be triple dipped in epoxy enamel to withstand a heat rise to 155° C as defined in NEMA standard MG-1. The NEMA starting code shall be G or less. The rotor shall be constructed of laminated steel plates with poured aluminum shoring bars. The rotor shall be both statically and dynamically balanced. All castings shall be machine fit utilizing metal to metal contact. All machine fits shall be additionally protected with BUNA-N O-RINGS.

The motor power cable shall be of adequate length (± 50 feet) to reach the control panel without splices or strain and allowing a minimum of 10 feet of slack of the SJO type insulated cable with a double jacketed protection system, neoprene outside, synthetic rubber inside, exceeding industry standards for oil, gas and sewage resistance. Individual conductors shall be of the type RUM.

The power cable shall enter the pump through a Vellums type cable entry constructed of cast alloy metal and galvanized for corrosion resistance. The heavy-duty cable entry with strain relief shall be provided with an integral rubber grommet to protect against leakage once the cable is secured. The power cable leads shall be connected to terminals on an isolated terminal board. The terminal board shall be constructed of Bake-o-lite and shall include individually O-ringed brass lugs on both the upper and lower side of the terminal board. The terminal board shall be totally isolated from the motor using small BUNA-N O-RINGS fitted to the terminal board and mating with the machine terminal board housing in the motor. This system will prevent moisture from entering the motor should leakage occur through the cable entry.

All items required for the manufacturer's warranty shall be provided, and pumps and motors shall include a five-year, 100 percent warranty on all parts and labor. Motors and pumps shall be designed to be non-overloading at any point on the curve. Pumps shall also be designed to run dry or shall provide protection to the motor in the event of dry operation.

Moisture sensor probes and indicators and heat sensor probes and indicators shall be provided.

Any special relays or monitors required by the pump manufacturer shall be provided and incorporated in the control panel.

D. WET WELL AND PIPING

Fiberglass reinforced polyester wet wells shall be manufactured from commercial grade polyester resin or vinyl ester resin, with fiberglass reinforcements. The resin system shall be suitable for atmospheres containing hydrogen sulfide and dilute sulfuric acid as well as other gases associated with the wastewater collection system. The wet well shall be a one-piece unit manufactured to meet or exceed all specifications of ASTM D3753, latest revision, as manufactured by L.F. Manufacturing, Inc., Associated Fiberglass Enterprises, Containment Solutions, or approved equivalent.

1. Materials

a. Resin

The resins used shall be commercial grade, unsaturated polyester resin.

b. Reinforcing Materials

The reinforcing materials shall be commercial Grade "E" type glass in the form of mat, continuous roving, chopped roving, roving fabric or a combination of the above, having a coupling agent that will provide a suitable bond between the glass reinforcement and the resin.

c. Surfacing Materials

If reinforcing materials are used on the surface exposed to the contained substance, it shall be a commercial grade chemical-resistant glass that will provide a suitable bond with the resin and leave a resin rich surface.

d. Fillers and Additives

Fillers, when used, shall be inert to the environment and wet well construction. Additives, such as thixotropic agents, catalysts, promoters, etc., may be added as required by the specific manufacturing process to be used. The resulting reinforced plastic material must meet the requirement of this specification.

2. Fabrication

a. Exterior Surface

The exterior surface shall be relatively smooth with no sharp projections. Handwork finish is acceptable if enough resin is present to eliminate fiber show. The exterior surface shall be free of blisters larger than 1/2 inch in diameter, delamination and fiber show. For a UV inhibitor, the resin on the exterior surface of the manhole shall have gray pigment added for a minimum thickness of 0.125 inches.

b. Interior Surface

The interior surface shall be resin rich with no exposed fibers. The surface shall be free of grazing, delamination, and blisters larger than 1/2 inch in diameter, and wrinkles of 1/8 inch or greater in depth. Surface pits shall be permitted up to six (6) square feet if they are less than 3/4 inch in diameter and less than 1/16 inch deep.

c. Fiberglass Reinforced Bottom

The materials and installation of the fiberglass wet well bottom shall be as stated in **Section 3.2.2 B., Manholes**. The bottom shall be attached to the wet well pipe with fiberglass layup to comply with ASTM D3299. When reinforcement is necessary for strength, the reinforcement shall be fiberglass channel laminated to the wet well bottom per ASTM D3299.

d. Integral Internal Fiberglass Fillet

Fiberglass wet wells and basins may have an internal sloped fillet bottom. The fillet shall be constructed of the same fiberglass material as the wet well or basin and shall be integral to the wet well or basin. The fiberglass fillet shall have a 1:1 slope and shall not interfere with pump mounting in the wet well or basin.

e. Fiberglass Reinforced Top

The materials and installation of the fiberglass wet well top shall be as stated in **Section 3.2.2 B., Manholes**. The top shall be attached to the wet well pipe with fiberglass layup to comply with ASTM D3299. When reinforcement is necessary for strength, the reinforcement shall be fiberglass channel laminated to the wet well top per ASTM D3299.

f. Installation of Stub Outs

Effluent, service, or discharge lines may be factory installed. Approved methods are PVC sewer pipe, QwikSeal fittings, or Kor-N-Seal boots. Installation of stub outs shall be fiberglass layup to comply with ASTM D3299.

g. Defects not Permitted

The following defects are not permitted:

- Exposed Fibers: Glass fibers not wet out with resin.
- Resin Runs: Runs of resin and sand on the surface.
- Dry Areas: Areas with glass not wet out with resin.
- Delamination: Separation in the laminate.
- Blisters: Light colored areas larger than ½ inch in diameter.
- Crazing: Cracks caused by sharp objects.
- Pits or Voids: Air pockets.
- Wrinkles: Smooth irregularities in the surface.
- Sharp Projection: Fiber or resin projections necessitating gloves for handling.

3. Physical Requirements

a. Load Rating

The complete wet well shall have a minimum dynamic-load rating of 16,000 ft-lbs when tested in accordance with **Section 3.2.2 B., Manholes**. To establish this rating, the complete wet well shall not leak, crack, or suffer other damage when load tested to 40,000 ft-lbs and shall not deflect vertically downward more than 1/4 inch at the point of load application when loaded to 24,000 lbs.

- b. Stiffness:** The wet well cylinder shall have a minimum pipe stiffness value meeting ASTM D3753, latest revision.

4. Test Methods

Tests shall be performed as specified in ASTM D3753 Section 8, latest revision.

5. Installation

a. Excavation

- **General:** The excavation shall achieve the depth of undercut and backfilling, as specified by the geotechnical Engineer-of-Record. The limit of excavation

shall be such to allow for placing and removing forms, installing sheeting, shoring, bracing, etc. The Contractor shall pile excavated material in a manner that will not endanger the work and will avoid obstructing sidewalks, driveways, power poles, etc. Drainage shall be kept clear.

The excavation shall be inspected and approved by the Engineer and PWS Representative before work on the structure is started. It is the intent of these specifications that the Contractor provide a relatively smooth, firm foundation bed for footings and slabs that bear directly on the undisturbed earth with no additional cost to PWS, regardless of the soil conditions encountered. The geotechnical Engineer-of-Record will be the sole judge as to whether these conditions have been met.

- **Vertical Sides:** When necessary to protect existing or proposed structures or other improvements, the Contractor shall maintain vertical sides of the excavation. The limit shall not exceed three (3) feet outside the footing on a vertical plane parallel to the footing except where specifically approved otherwise by the Engineer. The Contractor shall provide and install any sheeting, shoring, and bracing as necessary to provide a safe work area to protect workmen, structures, equipment, power poles, etc. The Contractor shall be responsible for the design and adequacy of all sheeting, shoring, and bracing. The sheeting, shoring, and bracing shall be removed as the excavation is backfilled in such a manner as to prevent injurious caving.
- **Sloping Sides:** Where sufficient space is available, the Contractor shall be allowed to back slope the sides of the excavation. The back slope shall be such that the excavation shall be safe from caving. The type of material being excavated shall govern the back slope used, but in any case, the back slope shall be no steeper than 1 foot horizontal to 1 foot vertical. In cases where sloping is not practical, separate certified sheeting and shoring design calculations shall be submitted to PWS before work may begin.
- **Dewatering:** The Contractor shall keep the excavation free from water by use of cofferdams, bailing, pumping, well pointing, or any combination as the situation may warrant. All dewatering devices shall be installed in such a manner as to provide clearance for construction, removal of forms, and inspection of exterior of form work. It is the intent of these specifications that the foundation be placed on a firm dry bed. The foundation bed shall be kept in a dewatered condition for a sufficient period of time to ensure the safety of the structure. All dewatering methods and procedures are subject to approval of the Engineer and PWS. The excavation shall be protected from excessive rainfall, drainage and drying.

- **Unauthorized Over Excavation:** Excavation for slabs, footings, etc., that bear on earth shall not be carried below the elevation shown on the drawings. In the event the excavation is carried on below the indicated elevation, the Contractor shall bring the slab, footing, etc., to the required grade by filling with concrete having a minimum compressive strength of at least 3,000 psi at 28 days.
- **Handling:** The wet well shall not be dropped or impacted. Wet wells shall be chocked if stored horizontally. If wet wells must be moved by rolling, the ground transversed shall be smooth and free of rocks, debris, etc. FRP wet wells may be lifted by the installation of two lifting lugs as specified by the manufacturer on the outside surface near the top or by a sling or "choker" connection around the center. Use of chains or cables in contact with the wet well surface is prohibited. Wet wells may be lifted horizontally using one support point.
- **Closed Bottom Wet Well Installation:** The bottom of the excavation shall be compacted as per the wet well manufacturer's recommendations or per the Engineer's specifications. The fiberglass wet well shall be lowered into the bottom and brought to plumb. Backfill requirements shall be as determined by the Engineer.
- **Cutouts:** Cutouts in the wet well wall should be made with proper cutting tools, such as a jig saw or hole saw. Axes or other impact-type tools are prohibited for making cutouts.

b. Installation of Sewer Pipe

- **Type 1:** The Contractor shall make the cutout in the wet well wall to equal the outside diameter of pipe, plus 1/2 inch maximum. The outside surface of the pipe and both the inside and the outside surfaces of the cutout in the wet well wall shall be grinded. A priming agent shall be applied to any PVC pipe that might be used before fiberglass lay-up. The pipe shall be inserted through the cutout in the wall of the wet well. Fiberglass putty shall be applied to the inside and the outside of the wet well wall cutout, filling openings between pipe and cutout. The appropriate radius shall be made for the fiberglass lay-up. After the putty has set-up, the pipe shall be fiberglassed into place, using one layer of woven roving sandwiched between two layers of fiberglass mat. The fiberglass shall be completely set-up before backfilling. The fiberglass layup method shall comply with ASTM D3299.

- **Type 2:** QwikSeal type fittings shall be installed per manufacturer's instructions.

c. Backfill

Backfill Material: Unless otherwise shown on the approved construction drawings or specified by the geotechnical Engineer-of-Record, suitable material from the excavation site shall be used for backfill around the wet well. The material chosen shall be free of large lumps or clods which will not readily break down under compaction. Backfill material shall be free of vegetation or other extraneous material. This material shall be subject to approval by the Engineer/PWS Representative. Excavated materials which are to be used for fill or backfill may be stockpiled on the site. Location of stockpiles shall be approved by the Engineer/PWS Representative. Topsoil should be stockpiled separately and used for finish grading around the structure. A certified copy of the backfill testing report shall be provided to PWS prior to acceptance.

- **Schedule of Backfilling:** The Contractor may begin backfilling of the wet well as soon as the concrete has been allowed to cure and the forms removed.
- **Backfill Lifts:** Backfill shall be placed in layers of not more than 12 loose measure inches and mechanically tamped to at least 95 percent Standard Proctor Density. Flooding will not be permitted. Backfill shall be placed in such a manner as to prevent any wedging action against the structure.
- **Top Slab:** A reinforced concrete top slab shall be poured a minimum of six (6) inches thick, and shall have #4 rebar laid on 12-inch centers, in accordance with the approved construction plans.
- **Marking and Identification:** Each wet well shall be marked with the following information.
 - Manufacturer's name
 - Manufacturing special number
 - Total length and nominal diameter
 - ASTM designation
- **Certifications:** As a basis of acceptance, the manufacturer shall provide certification, which shall consist of a copy of the manufacturer's test report accompanied by a copy of the test results stating the wet well/lift station has been sampled, tested, and inspected in accordance with the provisions of this utility design manual and meets all requirements. The wet well must also be third party certified.

d. Guide Rail System

The wet well shall include guide rail systems with cast iron base elbows, sealing flange and stainless-steel components. Guide rails systems must be dual rail type with two (2)-inch diameter 316 stainless steel pipe and intermediate bracing every 10 linear feet.

Penetrations through the top of the wet well shall have FRP sleeves. The sleeves must be large enough in diameter to allow the flange of the pipe to pass through. Innerlynx seals, as manufactured by Advance Products & Systems, LLC, or approved equivalent, must be used with the FRP sleeve.

A 316 stainless-steel guide rail for future mixer shall be included in the wet well.

E. CHECK VALVE AND PIPING

All piping in the wet well shall be welded Flange X Flange Schedule 40 316 stainless steel. Discharge piping shall exit the top of the wet well with a minimum of 30 inches above finished grade elevation. Air release valves, check valves, pressure gauges, full port plug valves and pump out connections shall be installed per *Fiberglass Lift Station Section Detail WW-19*. The air release valve shall be located in the upper discharge piping past the 90-degree elbow and attached to a 316 stainless-steel tee with companion flange.

A four (4)-inch (minimum) oil-filled pressure gauge with diaphragm and stainless-steel nipple/stainless steel ball valve shall be included in the stainless-steel spool piece located between plug valves and check valves. The pressure gauge range shall be site dependent.

A non-clog full port check valve with lever weight, or approved equivalent, shall be provided in the discharge piping of each pump to prevent backflow.

All new non-stainless-steel parts (valves) shall be painted with Macropoxy 646 fast cure epoxy and Sherwin Williams Acrolon Ultra Acrylic Polyurethane. The approved color shall be "Tower Gray."

F. SUPPORTS

Enclosure supports shall be made of ¼-inch thick 316 stainless steel. Enclosures shall be arranged for a neat appearance, per approved construction plans.

G. OPERATION OF A DUPLEX PUMP STATION

The operation of the panel shall be as follows: When the wet well level reaches the second lowest setting (lead) of the level controller, one pump will come on, after a time delay, and start pumping the station down. A sealing circuit using the level relays will keep the pump running until the level in the wet well reaches the bottom setting (stop). Once that level is reached, the pump will turn off and the alternator will toggle to cause the other pump to become lead. If the level rises to the third lowest setting (lag), whichever pump is the lag pump will start. If the level continues to rise to the top setting (high alarm), a relay will energize a light and horn and alarm key personnel through the SCADA System. A high-level float shall be installed for backup.

The control panel shall contain the controls for a mixer/aerator. When in automatic mode, the mixer will come on when the pumps are off and during a preset on/off time. There shall also be a 3-phase breaker for a separate odor scrubber system.

H. ELECTRICAL

The electrical portion consists of the electrical service/meter box, main fusible disconnect, generator auto transfer switch, control panel, level controls, telemetry unit, conduit and wiring, and supports.

1. Electrical Service Meter

The electrical service/meter for all lift stations shall be 3-phase, 4 wire, 60 cycle. The voltage shall be 480 volts unless prior approval of 240 volt is obtained from PWS. No 208 volts is permitted. The Contractor shall be responsible for providing the service and coordination with the power company and for obtaining all permits. Underground power to the lift station is required.

2. Main Fusible Disconnect

The main fusible disconnect switch shall be heavy duty, NEMA 3R or 4X rating (depending on site location), 3 pole, 4 wire, Square D or Eaton. Fuses shall be rated according to pump size and incoming voltage and be Class R. The enclosure shall be supplied with a lockable hasp. The load side of the disconnect switch shall have multiple lugs per phase to prevent double lugging of power, lighting and surge arrestors wires.

3. Surge Protection Device (SPD)

A surge protector, model series SDLA, manufactured by Surge Suppression, Inc.; M series by Citel, Inc.; or approved equivalent shall be installed per wiring diagrams with Myers hubs at the Main Fusible Disconnect.

Wiring for the surge protector shall be mounted on the bottom of the main disconnect and shall be easily detachable.

4. Generator/Auto Transfer Switch

The generator shall be Taylor Power Systems, or approved equivalent, using diesel fuel or natural gas, if available. A full tank shall be provided at start-up.

The auto transfer switch shall be Eaton and shall be NEMA 3R or 4X stainless, depending on site location.

5. Control Panel

The control panel shall be supplied by the pump manufacturer to provide single source responsibility. The control panel shall be manufactured by ECS Control Systems (Jacksonville, FL), or approved equivalent. Components shall be as specified herein. It will be the panel manufacturer's responsibility to ensure all components and wiring are sized for the application.

6. Wet Well Level Controls

The wet well level controls consist of a submersible transducer and backup floats.

a. Submersible Transducers

A submersible transducer shall provide a 4/20 milliamp signal based on the level in the wet well. The transducer shall be mounted in a stilling well made of two (2)-inch schedule 20 316 stainless steel pipe located near the access hatch. The transducer shall be Endress and Hauser Waterpilot FMX21 rated for lift station applications. The length of cable shall be long enough to go from the wet well to the control panel with splice in air brake enclosure.

The brackets and hooks for the power cords and floats in the lift station shall be separate. The bracket for incoming power shall be adjacent to the control panel. The transducer shall be provided by the panel manufacturer.

b. Floats

Floats shall be sealed normally open, and pipe mounted with sufficient cable to terminate in the air break enclosure. Floats are to be attached to a stainless-steel pipe that can easily be removed for cleaning.

7. Security Lighting

A minimum of one (1) LED security light (two [2] lights for large stations) shall be installed as shown on *Detail EL-1*. The security light shall be 120 vac with a photoelectric switch. The light fixture shall be a 18-watt high performance LED, suitable for wet locations, 100,000-hour LED lifespan based on IES LM-80 results and TM-21 calculations Ingress Protection rating shall be IP66 for dust and water. A five (5)-year warranty shall be provided. The manufacturer shall be RAB, model FXLED18, or approved equivalent. Light poles shall be 12 feet and manufactured by RAB, or approved equivalent.

8. Conduit and Wiring

All conduit and wiring shall meet or exceed all local, state, and national codes and be installed by a qualified licensed electrician. All conduit and wiring shall be inspected by the PWS I&E department prior to pouring concrete, and any questions regarding conduit and wiring shall be directed to the PWS I&E department.

Conduit shall be PVC, with all above ground conduit to be schedule 80. Aluminum or stainless-steel straps shall be installed per all applicable codes. Conduit from the wet well to the wet well junction box shall be as short and direct as possible to minimize pipe bends.

Equipment grounding shall include a minimum of three (3) 10-foot copper ground rods to be placed near the service meter and the SCADA tower, as shown on *Detail EL-1*. The equipment bonding to all panels and SCADA tower shall be a continuous, 4 gauge (minimum) bare copper wire. Wiring shall be stranded, and no solid wire shall be allowed. Wire gauge shall be sized based on the breaker/fuse rating on power wiring. Color coding of the 3-phase power wiring shall be black, orange (stinger leg), blue on 240 voltage; and brown, orange, yellow on 480 voltage. The wiring shall be routed to not interfere with any operation and component removal.

a. Air Break Enclosure and Wet Well Conduit

If required, air break enclosures shall incorporate an air gap ventilated mounting pedestal. The enclosure shall house the terminal and power blocks for electrical devices in the wet well. Morris type PVC cord grip connectors shall be used and sized for each cable from the wet well. Non-hardening putty shall be used on all

conduits. Control wiring from the control panel shall be stranded THHN minimum 14 awg.

Analog signals shall be two (2) conductor 18 awg shielded wire. Pump power wires shall be XHHW and sized for the appropriate application. The junction box shall contain box lug type terminal blocks sized for application. Identification of the terminal blocks shall be engraved into the backplate. A corrosion inhibitor shall be used on each wire.

The minimum conduit size shall be two (2) inches. Wiring within the conduits shall not exceed 50 percent of the fill capacity. Four (4), two (2)-inch minimum diameter PVC conduits shall be installed from the junction box to the wet well (one for each pump, one for level controls and one for the mixer).

9. Supports/Hardware

Enclosure supports shall be made of 1/8-inch box tubing with ¼-inch aluminum plate and single sided per *Detail EL-1*. Any supports below ground shall be protected with a corrosion preventative coating. The backplate shall be secured by welds, and all sides of the backplate shall be enclosed. Enclosures shall be arranged for a neat appearance, per diagrams. The backplate shall be drilled and tapped so that no bolts are protruding on the opposite side.

10. Telemetry (SCADA)

The Remote Telemetry Unit (RTU) shall be provided by the panel supplier. PWS will program the RTU and the Central Unit and do startup and testing on the RTU. The panel supplier shall also provide the antenna, mast, tower, and antenna cable.

The Contractor shall be responsible for erecting the tower, mounting the RTU enclosure, and installing conduit, wiring, and grounding. The Contractor shall meet with PWS's telemetry technicians to coordinate installation.

I. START-UPS

A minimum of 48 hours notice shall be provided to all parties prior to all lift station start-ups, with no exception. The following parties shall be present at each start-up: Contractor, PWS Representative, Pump Supplier, and Developer's Engineer.

At the start-up, the pump manufacturer shall provide a certified test of each pump to include pump model, serial number, pump head pressures, pump flow rates, and pump curves.

Additionally, all stations shall be pre-tested by the Developer and the Developer's representative to ensure that the pumps are operating correctly prior to calling PWS for an official start-up. Only one (1) lift station start-up shall be called for by the Developer. Additional start-up visits due to lack of pre-testing, lift station failure, or excessive punch list items will be at the expense of the Developer and will be billed by PWS at \$500.00 for each additional visit.

Prior to start-up, the wet well and entire lift station site shall be cleaned. The wet well shall have clear water in the tank prior to turning the pumps on.

J. SUBMITTALS

The Contractor shall submit a minimum of two (2) copies of catalog data for approval by the Engineer and PWS for materials to be used. Submittals shall include, but not be limited to the following:

- Wet Well
- Hatches
- Pumps
- Motors
- Level Controls
- Electrical Control Panel
- Valves
- Piping

3.4.1 GRINDER INSTALLATIONS

A. GENERAL

Grinder installations shall only be approved for privately owned, operated, and maintained lift stations.

B. RESIDENTIAL GRINDERS

Single pump grinders may be approved for single family detached units (houses and trailers). The Homeowner is responsible for the complete cost of the grinder system, including the electrical service, the grinder unit, the force main to the main in the public right-of-way, the plumbing connection to the house, the abandonment of an existing septic tank, operation of

the grinder station, and maintenance of the grinder station. The Homeowner shall employ a licensed electrician and a qualified plumber for the work.

The Homeowner is responsible for the design of the system such that it is capable of pumping into the wastewater collection or transmission system.

C. COMMERCIAL GRINDERS

All privately owned, operated, and maintained multi-family and commercial units shall be served by duplex grinder installations. The Owner/Developer is responsible for the complete cost of the grinder system including the electrical service, the grinder unit, the force main to the main in the public right-of-way, the plumbing connection to the structure and the abandonment of any existing septic tank. The Owner/Developer shall employ a licensed electrician and a qualified plumber for the work.

The grinder lift station service connection shall be as shown on *Details W-17* and *WW-18*. PWS will not own, operate, or maintain the grinder units, even those external to the establishment.

D. PERMITS

All permits for grinder installations shall be obtained by the Homeowner or Owner/Developer.

3.5 DETAILS

END OF CHAPTER 3

180°

(A)
DEGREE
DEFLECTION
OUT

(B)
90° In

COMPOSITE RING AND COVER
SHALL BE MARKED AS SHOWN IN
PWS DETAIL WW-6

15" MAX

24" MIN.

0°

VIEW A-A



A

A

TBD

TBD

MANHOLES LOCATED IN PAVING SHALL HAVE A
CONCRETE RING CONSTRUCTED AROUND RING
AND COVER. CONCRETE RING TO BE 5,000 PSI
WITH FIBERGLASS MESH.

(A)

18"
TYP.

6"

EL. 0.00

B

EL. 0.10

6"

48" I.D.
54" O.D.

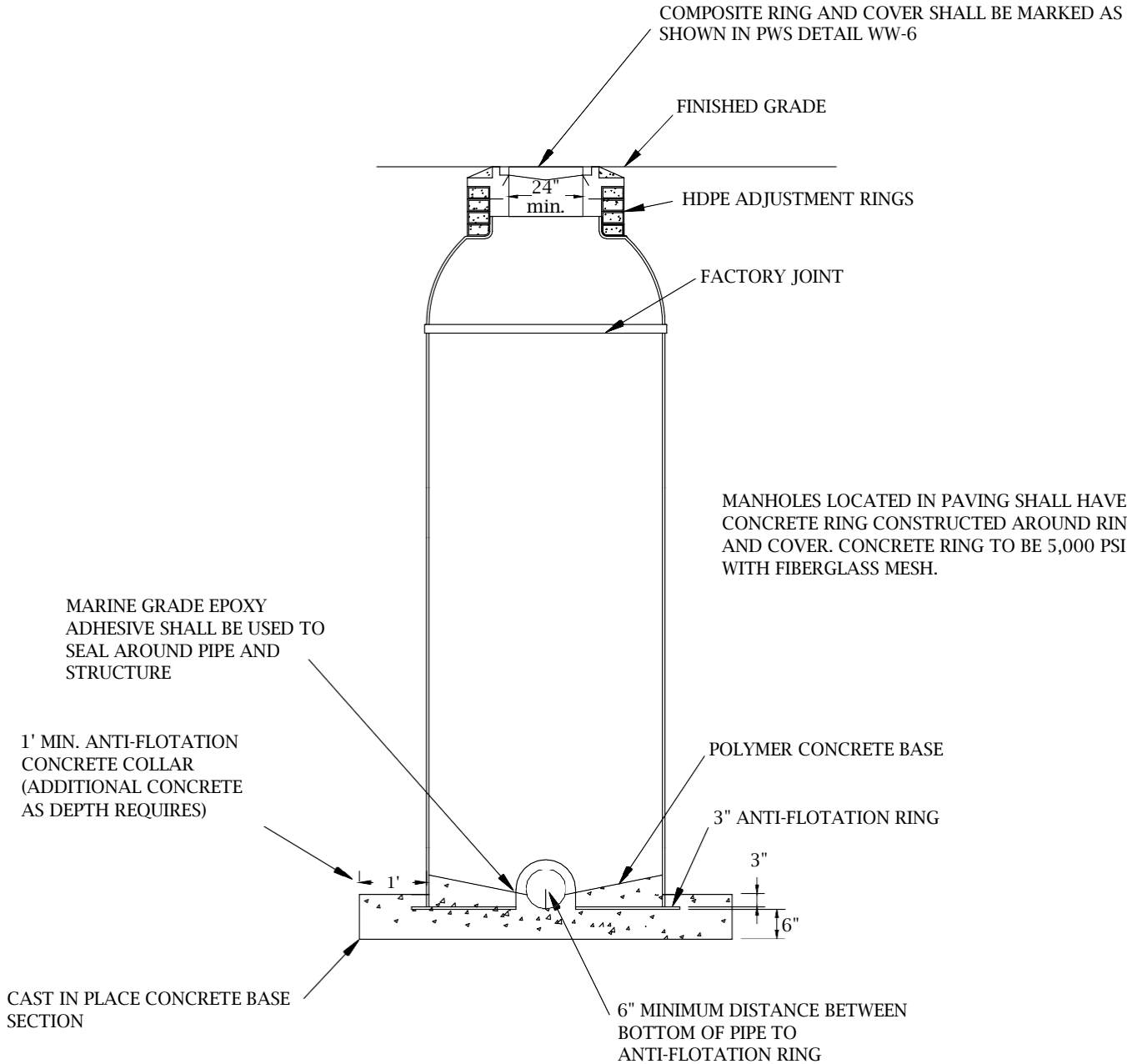
NOT TO SCALE



FIBERGLASS MANHOLE

Revision Date:
2024

Detail #:
WW-1



NOTES:

1. MANHOLE EXTERIOR TO BE GRAY IN COLOR.
2. FRP RESIN TO BE ORTHOPHTHALIC.
3. MANHOLE TO BE DESIGNED, FABRICATED, INSPECTED, TESTED AND MARKED IN ACCORDANCE WITH A.S.T.M. D-3753 SPECIFICATIONS.
4. SIGNED AND APPROVED DRAWING REQUIRED BEFORE START OF MANUFACTURING.

NOT TO SCALE



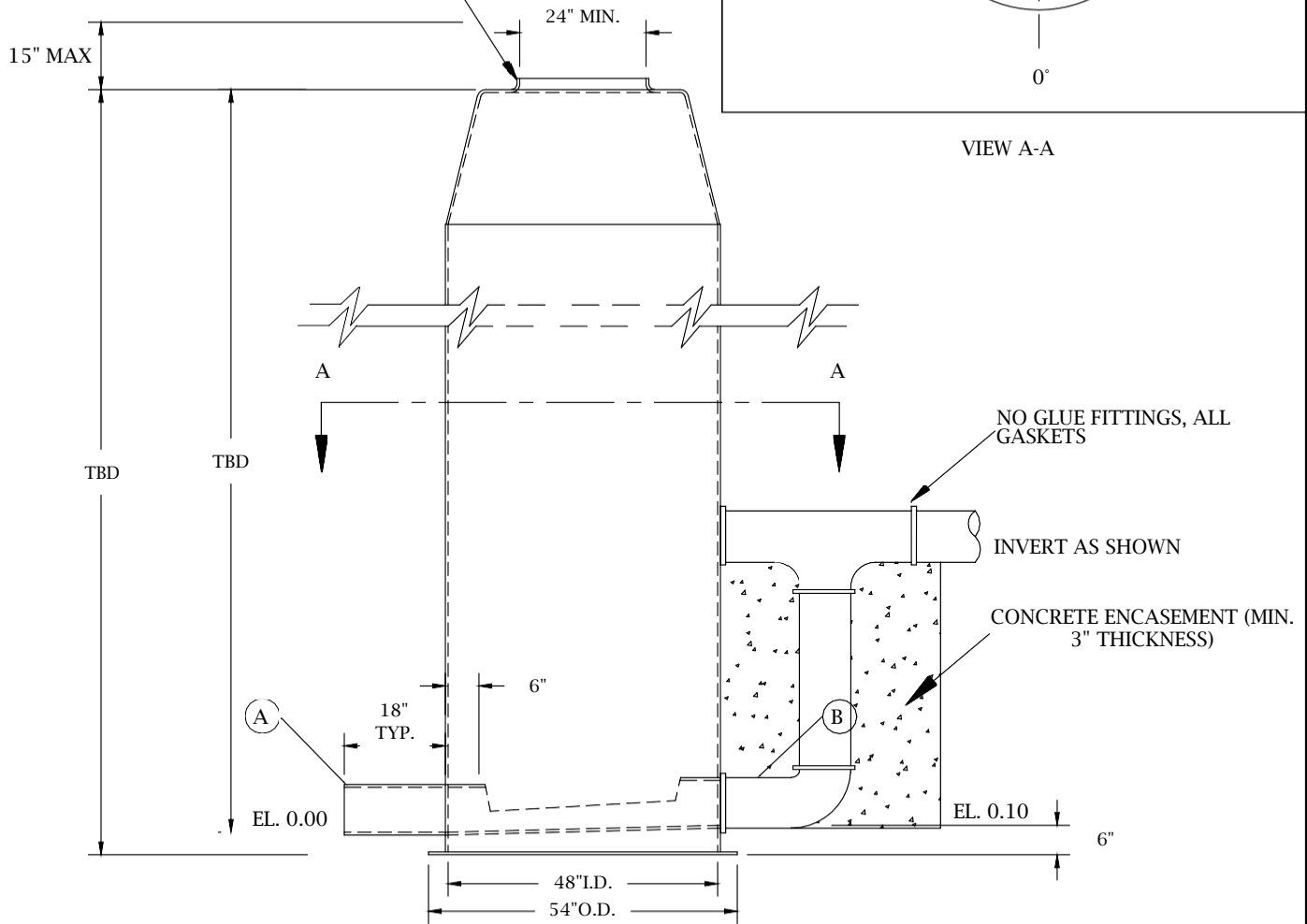
**FIBERGLASS DOGHOUSE
MANHOLE**

**Revision Date:
2024**

**Detail #:
WW-2**

MANHOLES LOCATED IN PAVING SHALL HAVE A CONCRETE RING CONSTRUCTED AROUND RING AND COVER. CONCRETE RING TO BE 5,000 PSI WITH FIBERGLASS MESH.

COMPOSITE RING AND COVER SHALL BE MARKED AS SHOWN IN PWS DETAIL WW-6



NOTES:

1. MANHOLE EXTERIOR TO BE GRAY IN COLOR.
2. FRP RESIN TO BE ORTHOPHTHALIC.
3. MANHOLE TO BE DESIGNED, FABRICATED, INSPECTED, TESTED AND MARKED IN ACCORDANCE WITH A.S.T.M. D-3753 SPECIFICATIONS.
4. MANHOLE TO HAVE FRP BENCH AND INVERT.
5. SIGNED AND APPROVED DRAWING REQUIRED BEFORE START OF MANUFACTURING.

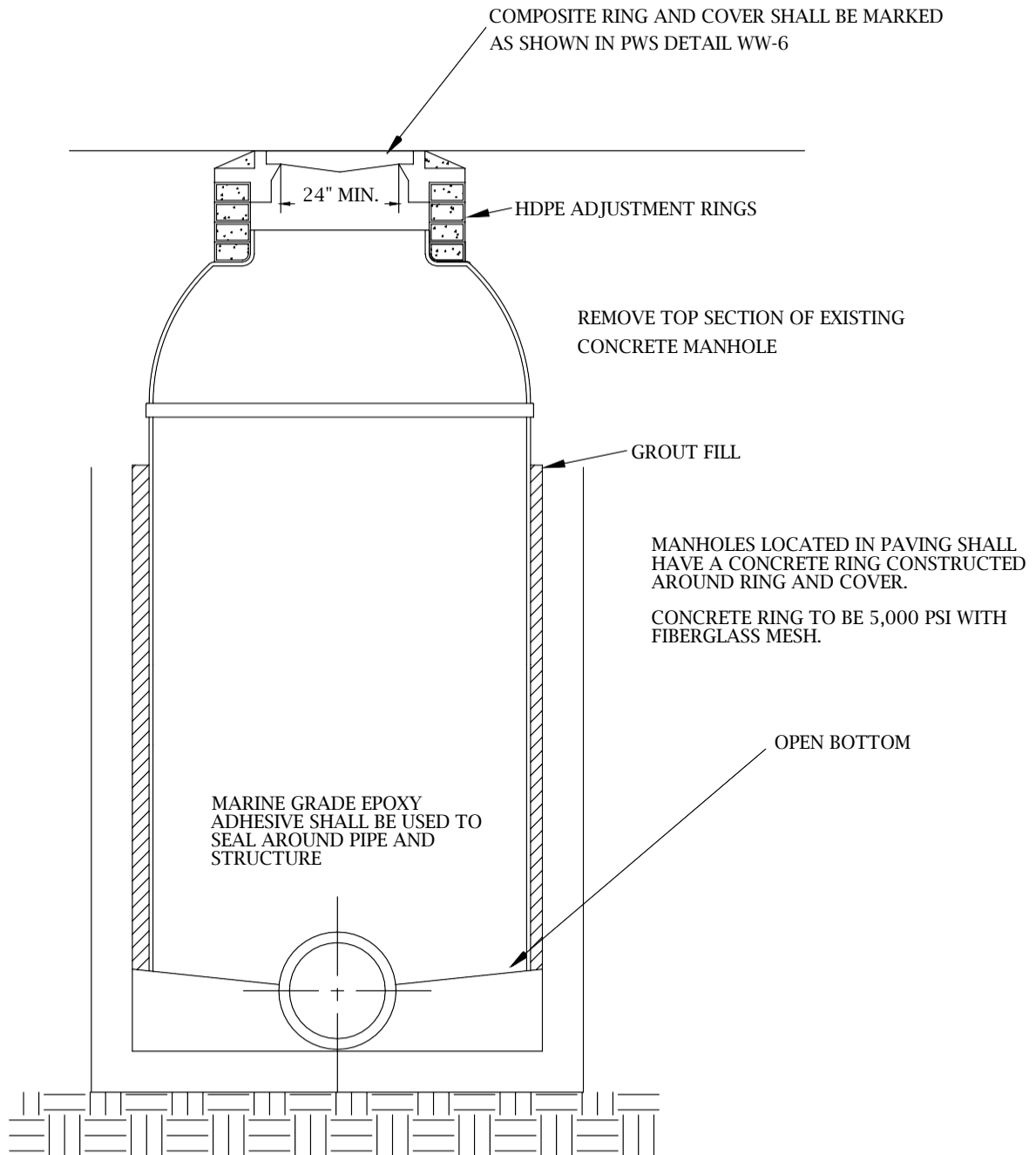
NOT TO SCALE



FIBERGLASS DROP MANHOLE

**Revision Date:
2024**

**Detail #:
WW-3**



NOTES:

1. MANHOLE EXTERIOR TO BE GRAY IN COLOR.
2. FRP RESIN TO BE ORTHOPHTHALIC.
3. MANHOLE TO BE DESIGNED, FABRICATED, INSPECTED, TESTED AND MARKED IN ACCORDANCE WITH A.S.T.M. D-3753 SPECIFICATIONS.
4. SIGNED AND APPROVED DRAWING REQUIRED BEFORE START OF MANUFACTURING.
5. IF BENCH NEEDS REPAIR, F-121 SHALL BE UTILIZED AND THEN COATED WITH A 100% SOLIDS, TWO-PART EPOXY (SUCH AS DURAL 452 GEL).

NOT TO SCALE



**MANHOLE REHAB WITH
FIBERGLASS LINER**

**Revision Date:
2024**

**Detail #:
WW-4**

MANHOLES LOCATED IN PAVING SHALL HAVE A CONCRETE RING CONSTRUCTED AROUND RING AND COVER. CONCRETE RING TO BE 5,000 PSI WITH FIBERGLASS MESH.

COMPOSITE RING AND COVER SHALL BE MARKED AS SHOWN IN PWS DETAIL WW-6

FORCE MAINS SHALL BE INSERTED IN MANHOLES VIA FRP SLEEVE OR APPROVED EQUAL PER FIBERGLASS MANHOLE MANUFACTURER'S RECOMMENDATIONS

24" MIN.

30" MIN. COVER

316 STAINLESS STEEL (TYP.)

316 STAINLESS STEEL

FLOW

FORCEMAIN (PVC TYP.)

PIPE RESTRAINTS (316 STAINLESS STEEL)

NOTE: ALL FITTINGS AND HARDWARE SHALL BE 316 STAINLESS STEEL

DIVERT OUTFALL FORCEMAIN TOWARDS OUTGOING SEWER GRAVITY LINE.

2' MAX.

SEWER FLOW

EL. 0.00

EL. 0.10

NOTES:

1. MANHOLE EXTERIOR TO BE GRAY IN COLOR.
2. FRP RESIN TO BE ORTHOPHTHALIC.
3. MANHOLE TO BE DESIGNED, FABRICATED, INSPECTED, TESTED AND MARKED IN ACCORDANCE WITH A.S.T.M. D-3753 SPECIFICATIONS.
4. MANHOLE TO HAVE FRP BENCH AND INVERT.
5. SIGNED AND APPROVED DRAWING REQUIRED BEFORE START OF MANUFACTURING.
6. THIS DETAIL SHALL BE UTILIZED FOR MANHOLES THAT HAVE LATERALS COMING IN HIGHER THAN 2' OFF BENCH.

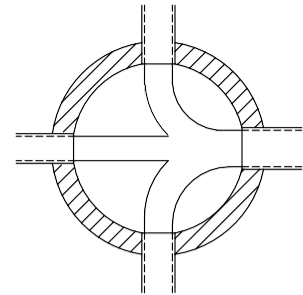
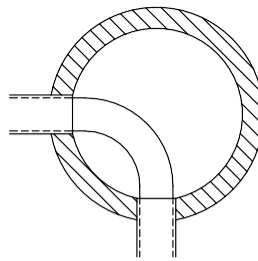
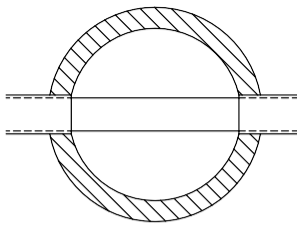
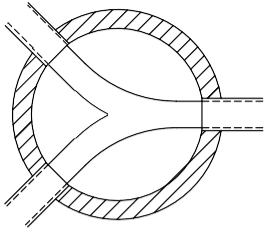
NOT TO SCALE



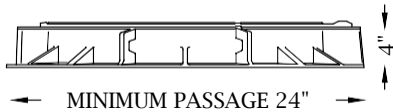
FIBERGLASS MANHOLE WITH FORCEMAIN CONNECTION

**Revision Date:
2024**

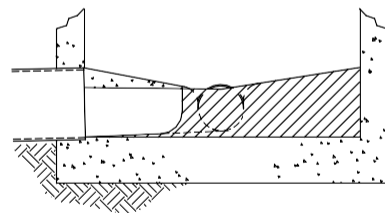
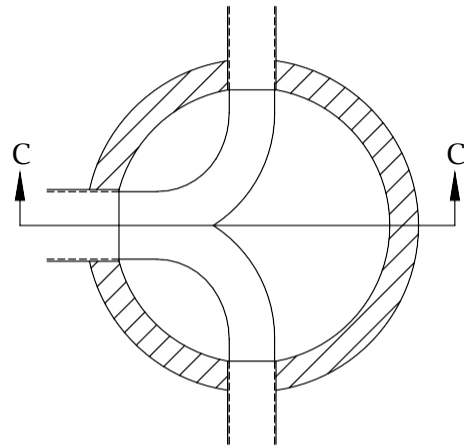
**Detail #:
WW-5**



MANHOLE INVERTS



SECTION A - A



SECTION C - C

MANHOLE FRAME AND COVER

INVERT CHANNELS

NOTES:

1. FRAME AND COVER SHALL BE COMPOSITE MATERIAL WITH A MINIMUM PASSAGE OF 24".
2. MANHOLE COVER IS TO BE NON-VENTING.
3. CONCRETE COLLAR SHALL BE POURED AROUND ALL MANHOLES LOCATED IN ROADWAY. CONCRETE COLLAR SHALL BE 5,000 PSI WITH FIBERGLASS MESH. MINIMUM WIDTH SHALL BE 2' AROUND MH COVER AND SHALL HAVE A MINIMUM DEPTH OF 8".

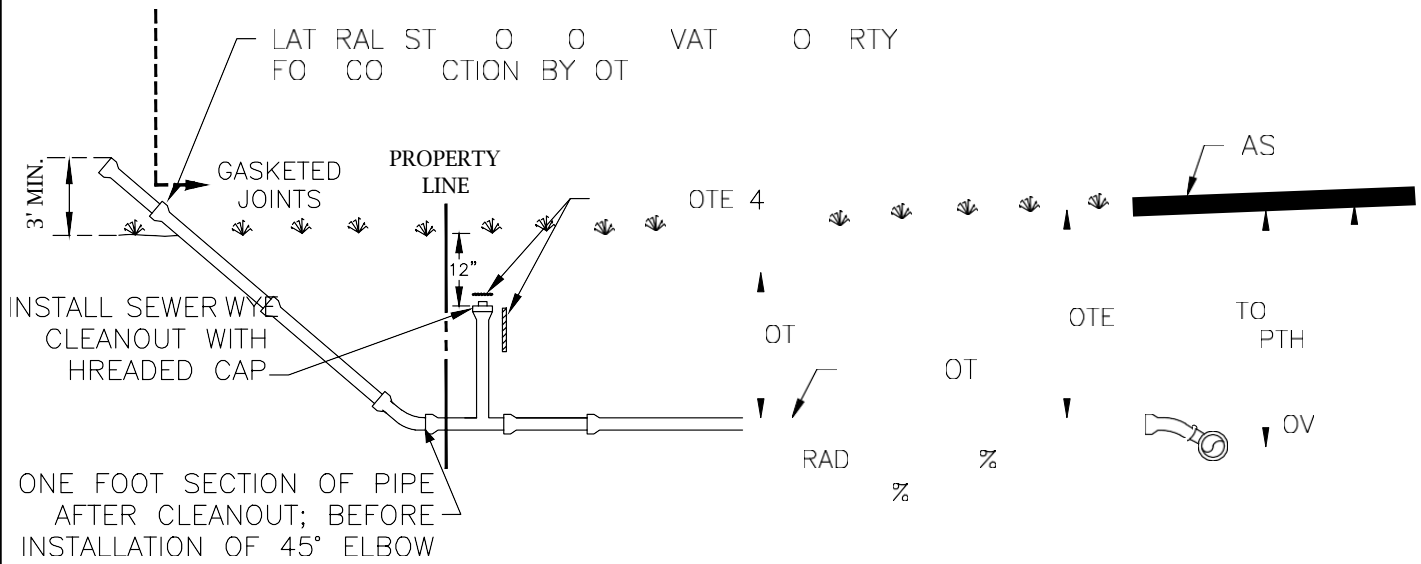
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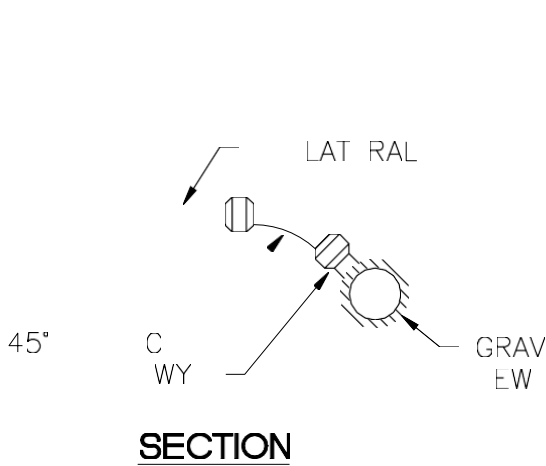
COMPOSITE MANHOLE DETAIL

**Revision Date:
2024**

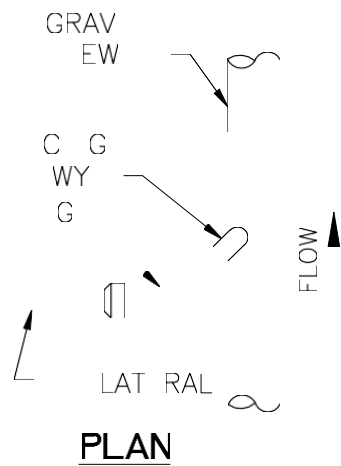
**Detail #:
WW-6**



WYE CONNECTION (TYP.)



SECTION



PLAN

NOTES:

1. MAINTAIN 18" MINIMUM IF DITCH IS PRESENT.
2. MAINTAIN 36" MINIMUM IF NO DITCH IS PRESENT.
3. ALL LATERALS TO BE 4" DIA. UNLESS PLANS SHOW LARGER DIAMETER.
4. INSTALL #4 REBAR, 12" LONG, 12" COVER, NEXT TO CLEANOUT.
5. ALL SEWER LATERALS TO BE VIDEO RECORDED PRIOR TO PWS ACCEPTANCE.
6. ALL SEWER LATERALS SHALL BE MARKED WITH AN ARROW INTO THE CURB, PAINTED GREEN, PER THE SPECIFICATIONS.
7. PLUMBERS SHALL CONNECT TO LATERAL PIPING UPSTREAM OF CLEANOUT AND NOT TO CLEANOUT.
8. ASTM D3034 DR 26 PIPE WITH HEAVY WALL FITTINGS. (SDR 35 SHALL NOT BE USED)
9. SEWER BOX TO BE INSTALLED OVER CLEANOUT. BOX SHALL BE A CARSON BOX WITH A GREEN LID DENOTED "SEWER".

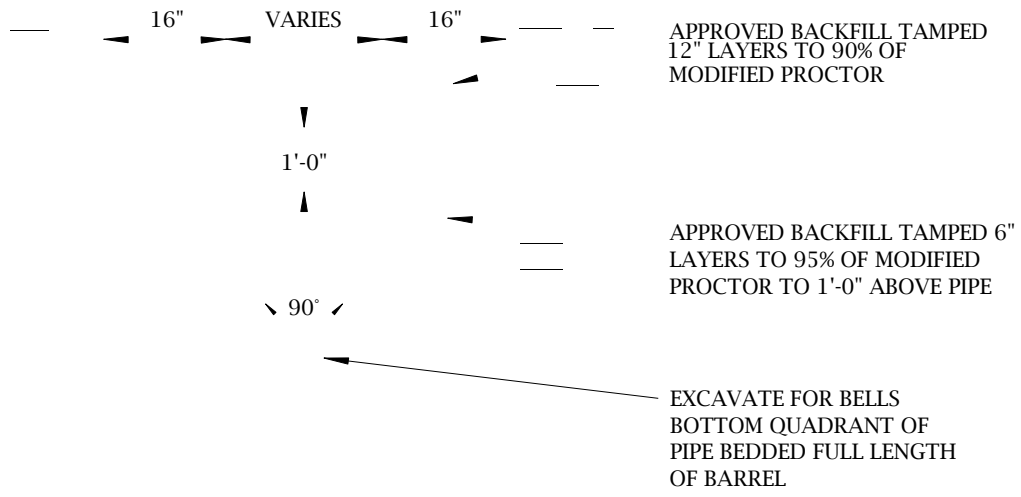
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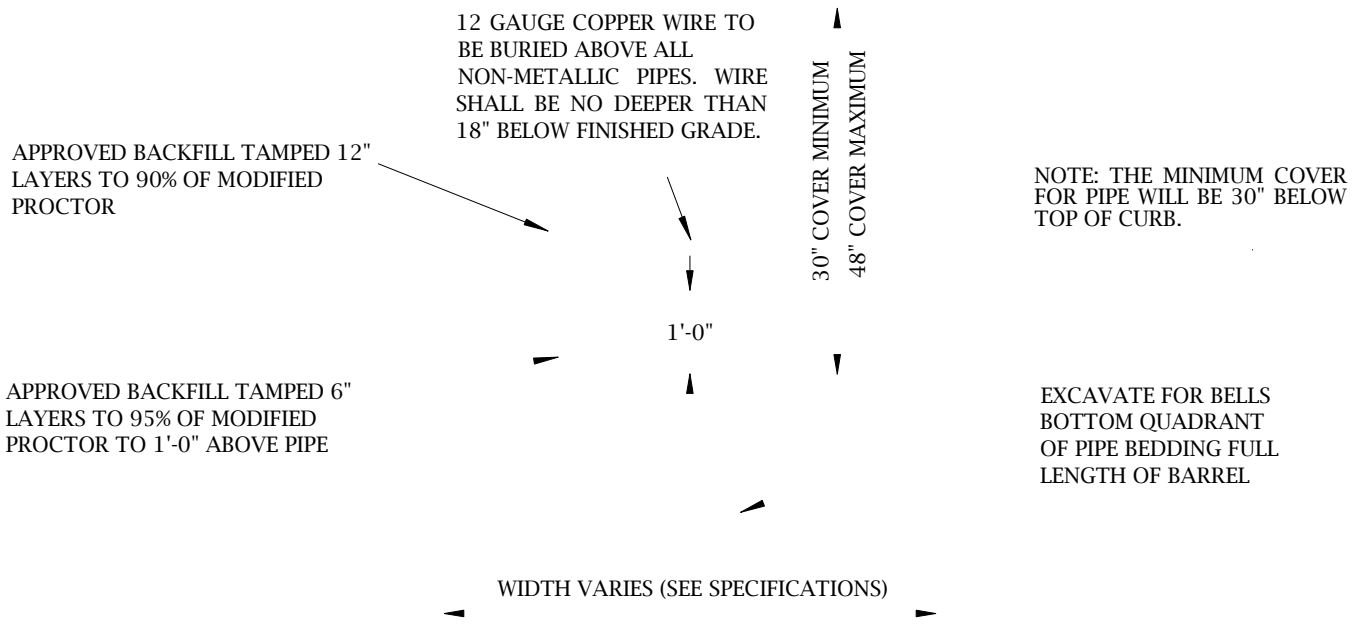
TYPICAL SEWER LATERAL CONNECTION

**Revision Date:
2024**

**Detail #:
WW-7**



PIPE BEDDING



TYPICAL PRESSURE PIPE INSTALLATION

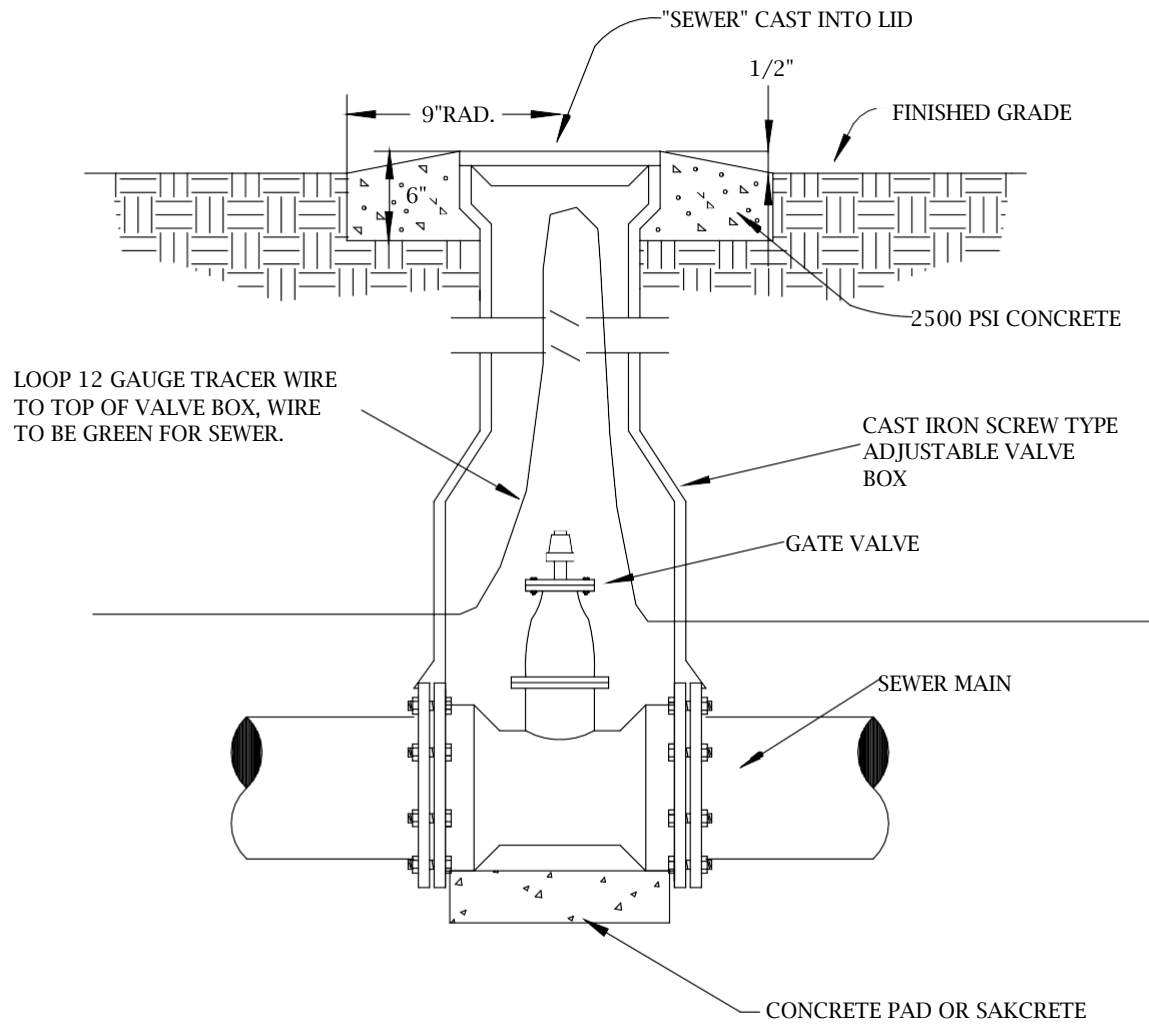
NOT TO SCALE



PIPE BEDDING & TYPICAL PRESSURE PIPE INSTALLATION DETAIL

Revision Date:
2024

Detail #:
WW-8



NOTE: VALVE BOX ALIGNMENT DEVICE (VBAD) SHALL BE UTILIZED PER SPECIFICATIONS.

NOT TO SCALE

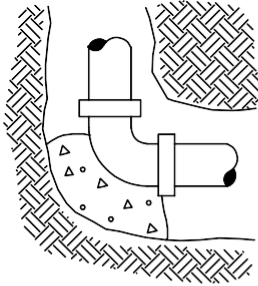


VALVE BOX SETTING DETAIL

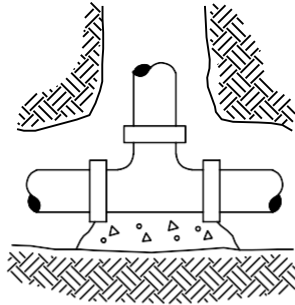
Revision Date:
2024

Detail #:
WW-9

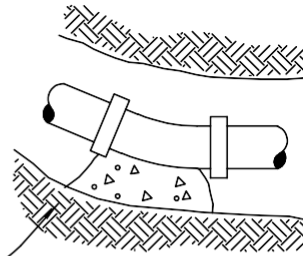
90° BEND



STANDARD TEE

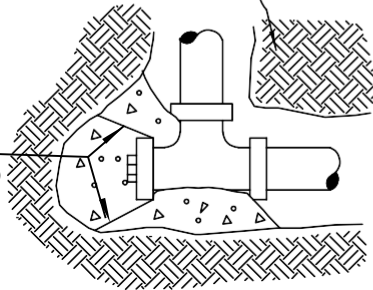


22.5° BEND

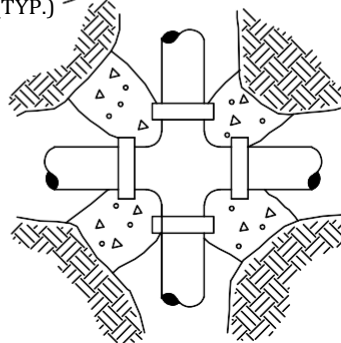


UNDISTURBED EARTH (TYP.)

WRAP PLASTIC SHEETING AROUND FITTING



PLUG



CROSS

BEARING AREAS

| TEE OR CAP | 90° BEND | 45° BEND | 22.5° BEND |
|---------------|-------------|-------------|---------------|
| 1.0 S.F. | 1.0 S.F. | 1.0 S.F. | 1.0 S.F. |
| 1.3 S.F. | 1.8 S.F. | 1.0 S.F. | 1.0 S.F. |
| 2.7 S.F. | 3.7 S.F. | 1.9 S.F. | 1.0 S.F. |
| 4.9 S.F. | 6.9 S.F. | 3.7 S.F. | 1.9 S.F. |
| 8.1 S.F. | 11.3 S.F. | 6.2 S.F. | 3.2 S.F. |
| 11.7 S.F. | 16.4 S.F. | 8.9 S.F. | 4.6 S.F. |
| 17.6 S.F. | 24.6 S.F. | 13.4 S.F. | 6.9 S.F. |

NOTE: MINIMUM THICKNESS OF THRUST BLOCKS TO BE 12" WITH AREA AS ABOVE.

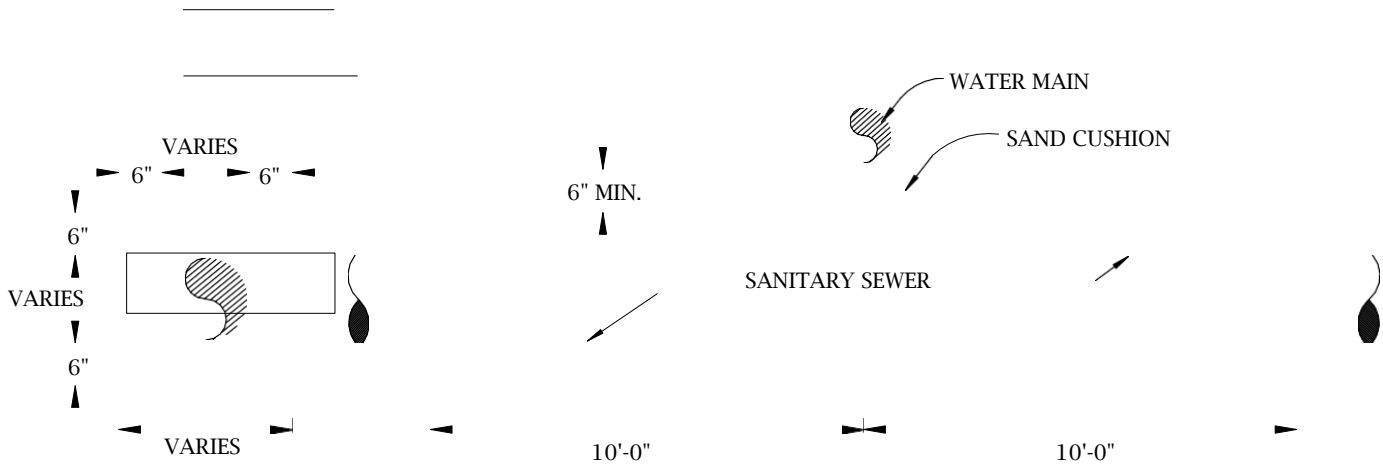
NOT TO SCALE



THRUST BLOCK DETAILS

Revision Date:
2024

Detail #:
WW-10



NOTES:

PIPE CROSSING

USE CONCRETE ENCASEMENT WHERE A SEWER MAIN CROSSES OVER A WATER MAIN OR WHERE A WATER MAIN CROSSES OVER A SEWER MAIN WITH LESS THAN 18" OF VERTICAL CLEARANCE BETWEEN THE BOTTOM OF THE WATER MAIN AND THE TOP OF THE SEWER MAIN.

PARALLEL MAINS

CONTACT ENGINEER IN LOCATIONS WHERE WATER AND SEWER MAINS ARE PLACED WITH LESS THAN 6' HORIZONTAL SEPARATION AND LESS THAN 18" VERTICAL SEPARATION FOR INSTRUCTION ON REQUIRED ENCASEMENT.

NOT TO SCALE

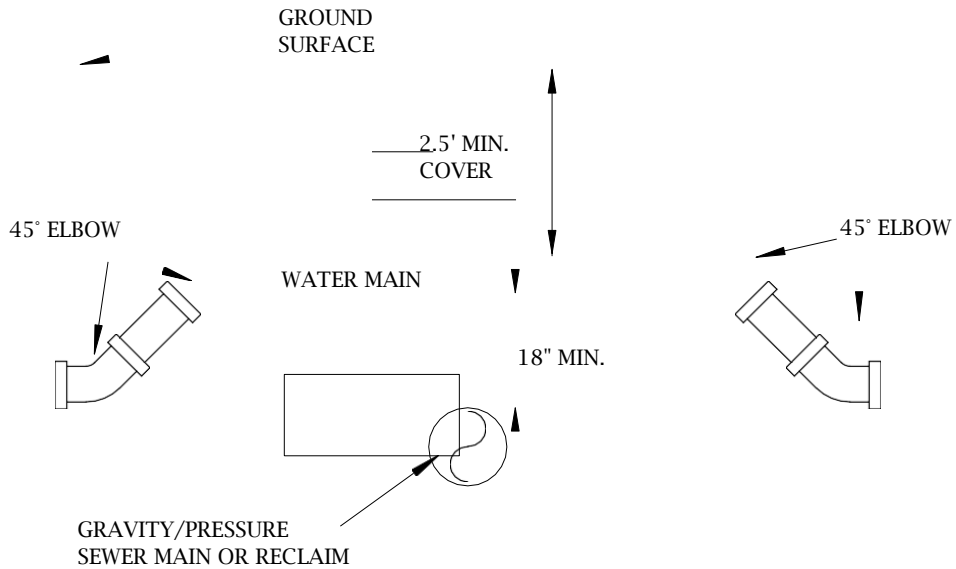


CONCRETE ENCASEMENT

**Revision Date:
2024**

**Detail #:
WW-11**

C_L OF WATER/SEWER MAIN



ALL 45° FITTINGS TO BE DUCTILE IRON

NOTES:

CENTERING A 20' SECTION OF SANITARY SEWER/ WATER MAIN PIPE AT CROSSING MAY BE USED IN LIEU OF ENCASEMENT.

POTABLE WATER IS TO BE ROUTED ABOVE SANITARY SEWER COLLECTION MAIN IF MINIMUM COVERAGE SPECIFIED CAN BE OBTAINED. IF SAID MINIMUM COVERAGE IS NOT POSSIBLE, POTABLE WATER IS TO BE ROUTED BELOW SANITARY SEWER LINE.

NOT TO SCALE



CONFLICT DETAIL

Revision Date:
2024

Detail #:
WW-12

RIGHT OF WAY VARIES

5'
MIN.

3' MIN. COVER

HDPE DIRECTIONAL BORE OR CASING

SEWER/WATER MAIN

| Carrier Pipe I.D. | | Steel Casing | Minimum Wall Thickness | |
|-------------------|-----------|--------------|------------------------|----------|
| Gravity | Pressure* | Diameter | Highway | Railroad |
| N/A | 4" | 10" | 0.188" | 0.188" |
| 4" | 6" | 12" | 0.188" | 0.188" |
| 6" | 8" | 14" | 0.250" | 0.250" |
| 8" | 10" | 16" | 0.250" | 0.250" |
| 10" | 10" | 18" | 0.250" | 0.250" |
| 12" | 12" | 20" | 0.250" | 0.250" |
| 14" | 14" | 24" | 0.250" | 0.281" |
| 16" | 16" | 24" | 0.250" | 0.281" |
| 18" | 18" | 30" | 0.312" | 0.312" |
| 20" | 20" | 30" | 0.312" | 0.344" |
| 24" | 24" | 36" | 0.312" | 0.406" |
| 30" | 30" | 42" | 0.375" | 0.469" |
| 36" | 36" | 48" | 0.500" | 0.532" |
| 42" | 42" | 60" | 0.500" | 0.563" |
| 48" | 48" | 72" | 0.625" | 0.625" |

CASING PIPE SIZE CHART

NOTES:

1. ALL ROAD CROSSINGS UNDER NEW/PROPOSED ROADWAY SHALL BE CASED ACCORDING TO CURRENT COUNTY STANDARDS.
2. ROAD CROSSING UNDER EXISTING ROADWAY SHALL BE HDPE VIA DIRECTIONAL BORE OR CASED PER COUNTY STANDARDS. REFER TO TABLE FOR SIZING OF CASING. IF CASED, CASING SPACERS REQUIRED.
3. NO HDPE JOINTS ALLOWED UNDER PAVEMENT.
4. HDPE MUST BE ONE PIPE DIAMETER SIZE LARGER THAN WATER/SEWER MAIN WHEN DIRECTIONAL BORE IS UTILIZED.
5. DETAILS MAY VARY BETWEEN COUNTY AND STATE ROADS, CHECK FOR CURRENT COUNTY AND STATE STANDARDS.

NOT TO SCALE



ROAD CROSSING DETAIL

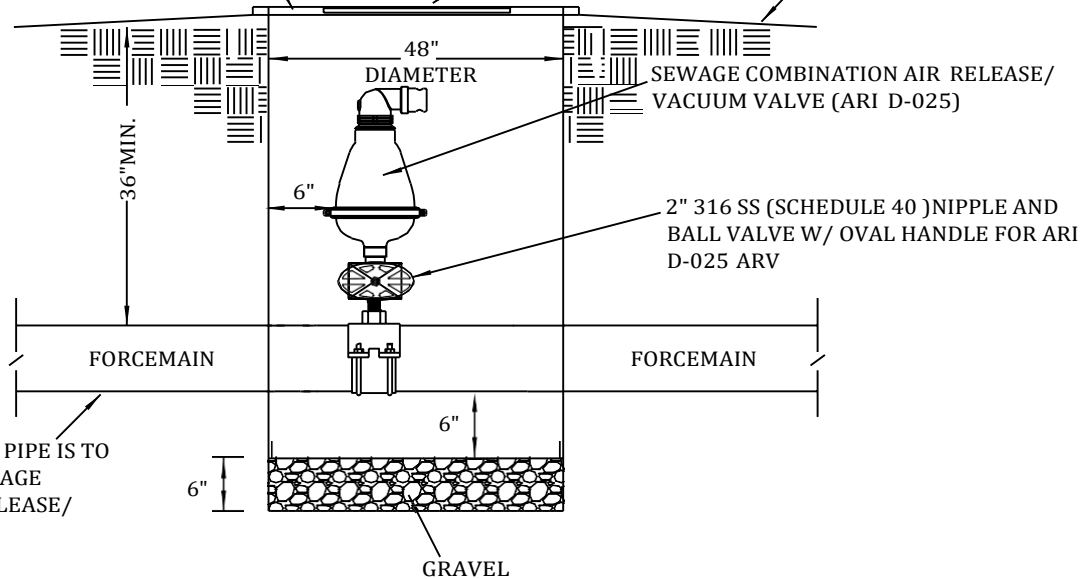
Revision Date:
2024

Detail #:
WW-13

ALUMINUM TOP BOLTED TO FIBERGLASS VAULT WITH TRAFFIC RATED SUPPORTS

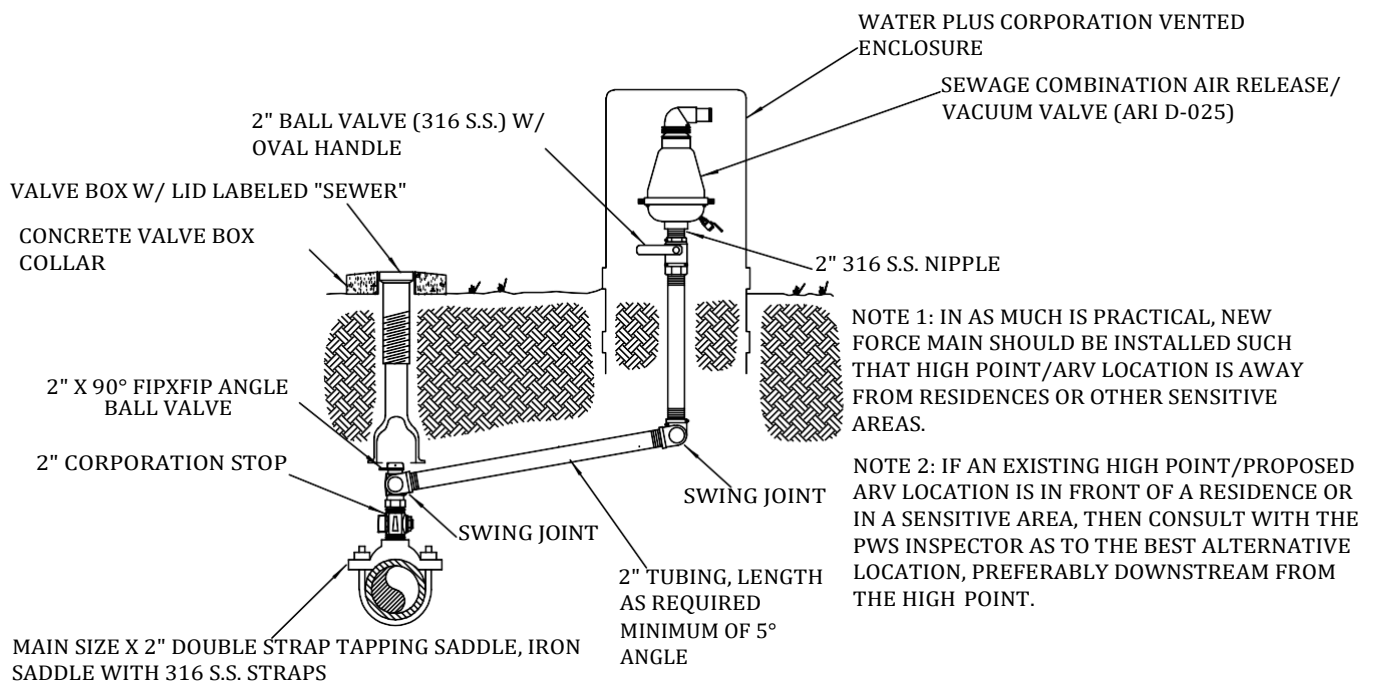
TRAFFIC RATED ALUMINUM HATCH SIZE AS REQUIRED

EXISTING GRADE



NOTE: 20' SECTION OF PIPE IS TO BE CENTERED AT SEWAGE COMBINATION AIR RELEASE/ VACUUM VALVE.

VAULT DETAIL



NOTE 1: IN AS MUCH IS PRACTICAL, NEW FORCE MAIN SHOULD BE INSTALLED SUCH THAT HIGH POINT/ARV LOCATION IS AWAY FROM RESIDENCES OR OTHER SENSITIVE AREAS.

NOTE 2: IF AN EXISTING HIGH POINT/PROPOSED ARV LOCATION IS IN FRONT OF A RESIDENCE OR IN A SENSITIVE AREA, THEN CONSULT WITH THE PWS INSPECTOR AS TO THE BEST ALTERNATIVE LOCATION, PREFERABLY DOWNSTREAM FROM THE HIGH POINT.

ABOVE GROUND DETAIL

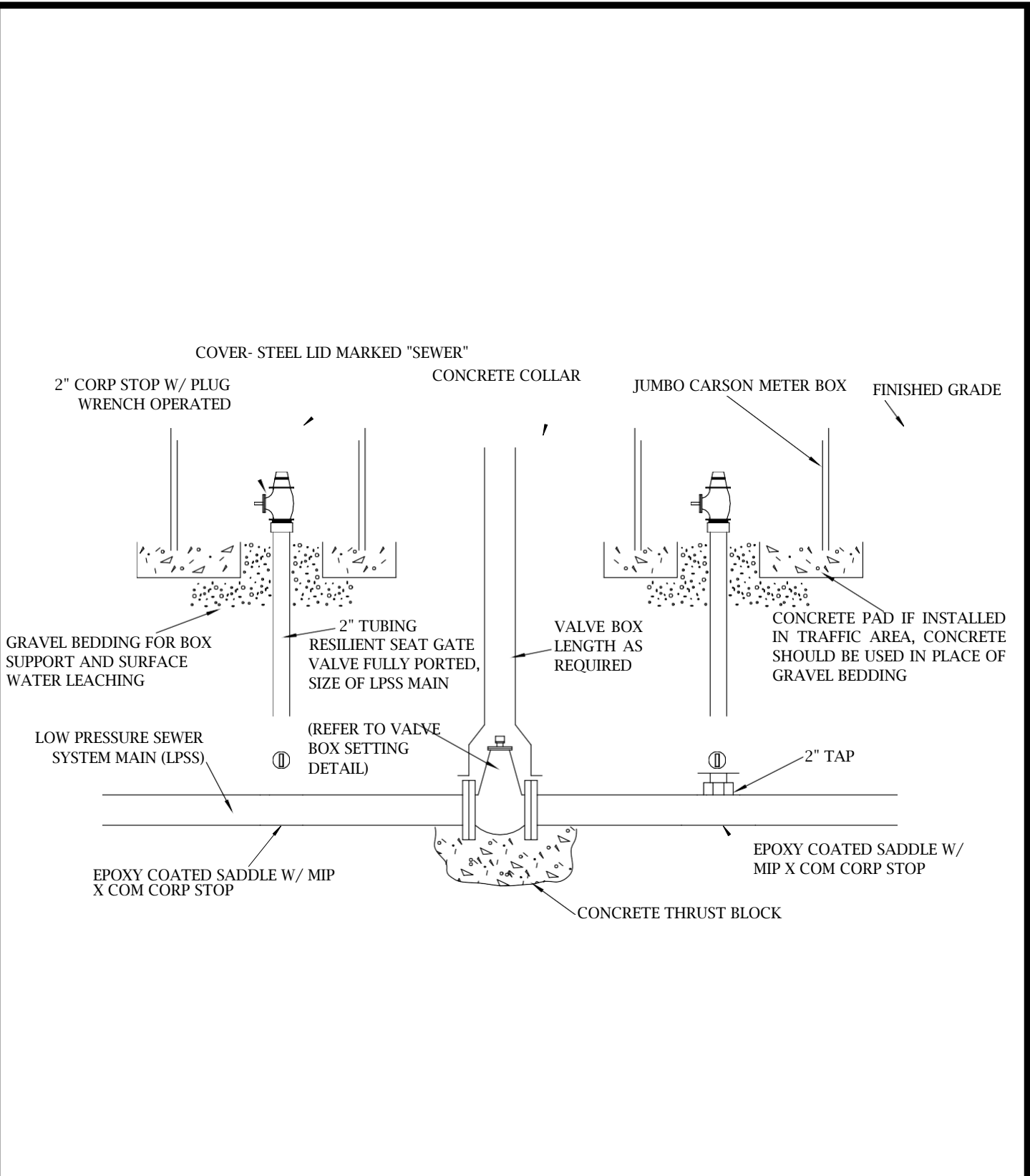
NOT TO SCALE



AIR RELEASE/VACUUM VALVE

Revision Date:
2024

Detail #:
WW-14



NOT TO SCALE

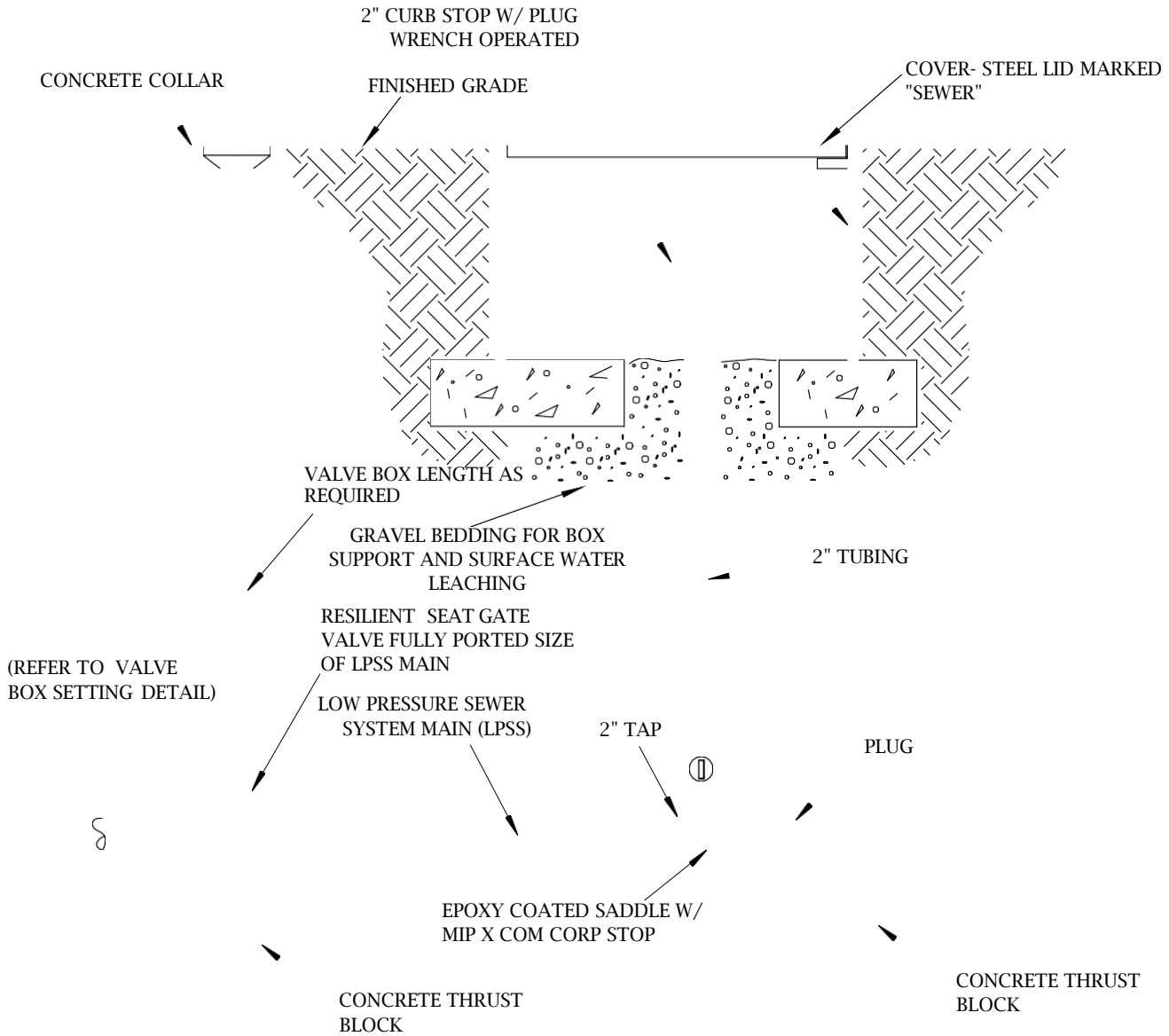


IN-LINE FLUSHING CONNECTION

**Revision Date:
2024**

**Detail #:
WW-15**

JUMBO CARSON METER BOX



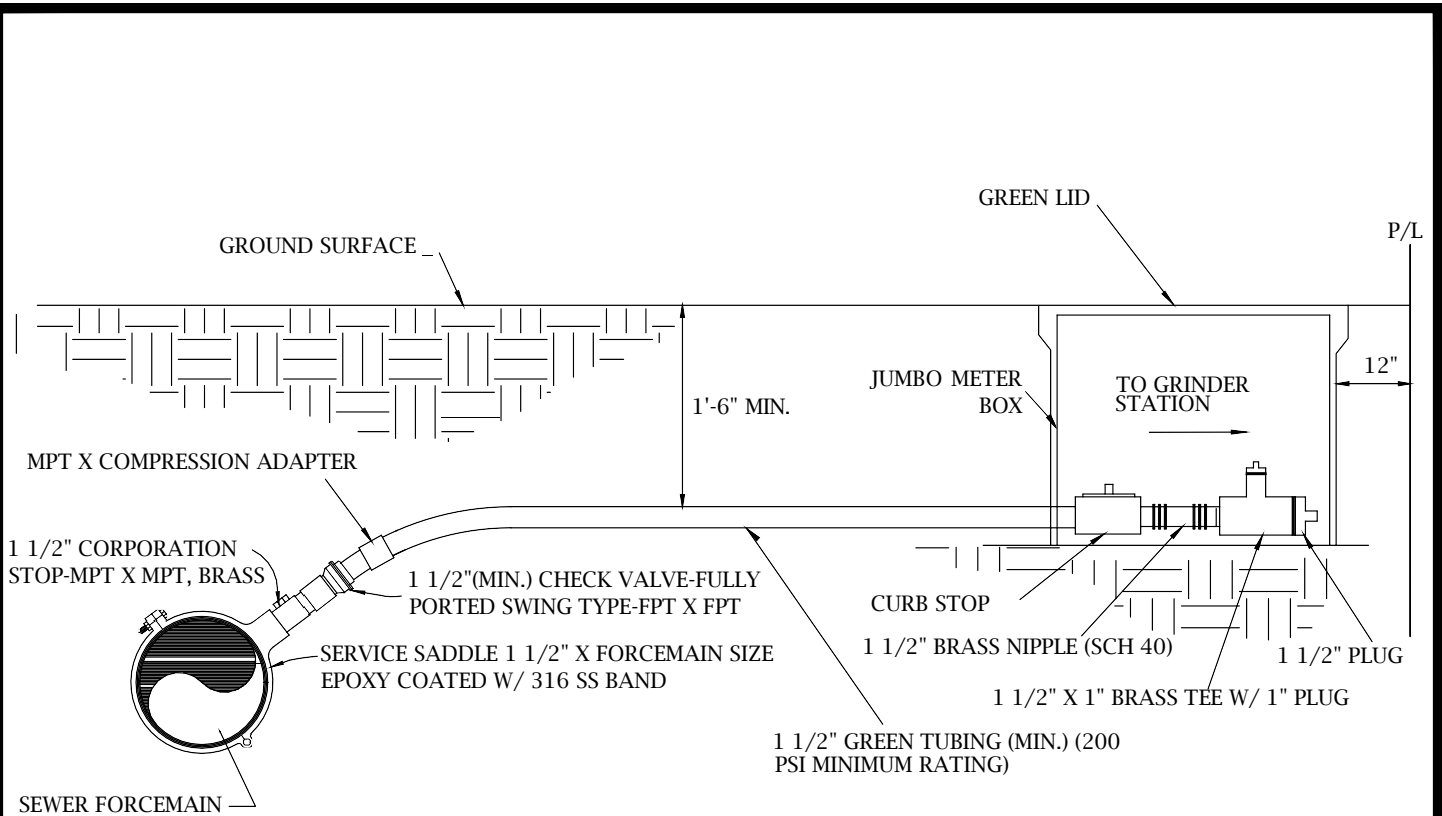
NOT TO SCALE



TERMINAL FLUSHING CONNECTION

**Revision Date:
2024**

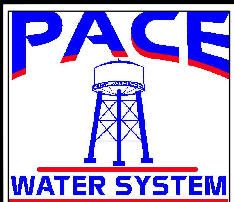
**Detail #:
WW-16**



NOTES FOR RESIDENTIAL SERVICES

1. CONTRACTOR TO MARK LOCATION OF SERVICES WITH A 2X4 STAKE 4' ABOVE THE GROUND AND PAINTED GREEN.
2. SERVICE LINE CONNECTIONS ACROSS ROADWAY SHALL BE BORED UNDER ROADWAY. SERVICE LINE SHALL BE ENCASED IN 2" PVC PIPE. CASING TO EXTEND 5' BEYOND EDGE OF PAVEMENT.
3. CONTRACTOR SHALL INCLUDE ALL LATERALS IN THE PRESSURE TEST OF THE PROPOSED LOW PRESSURE FORCEMAIN.

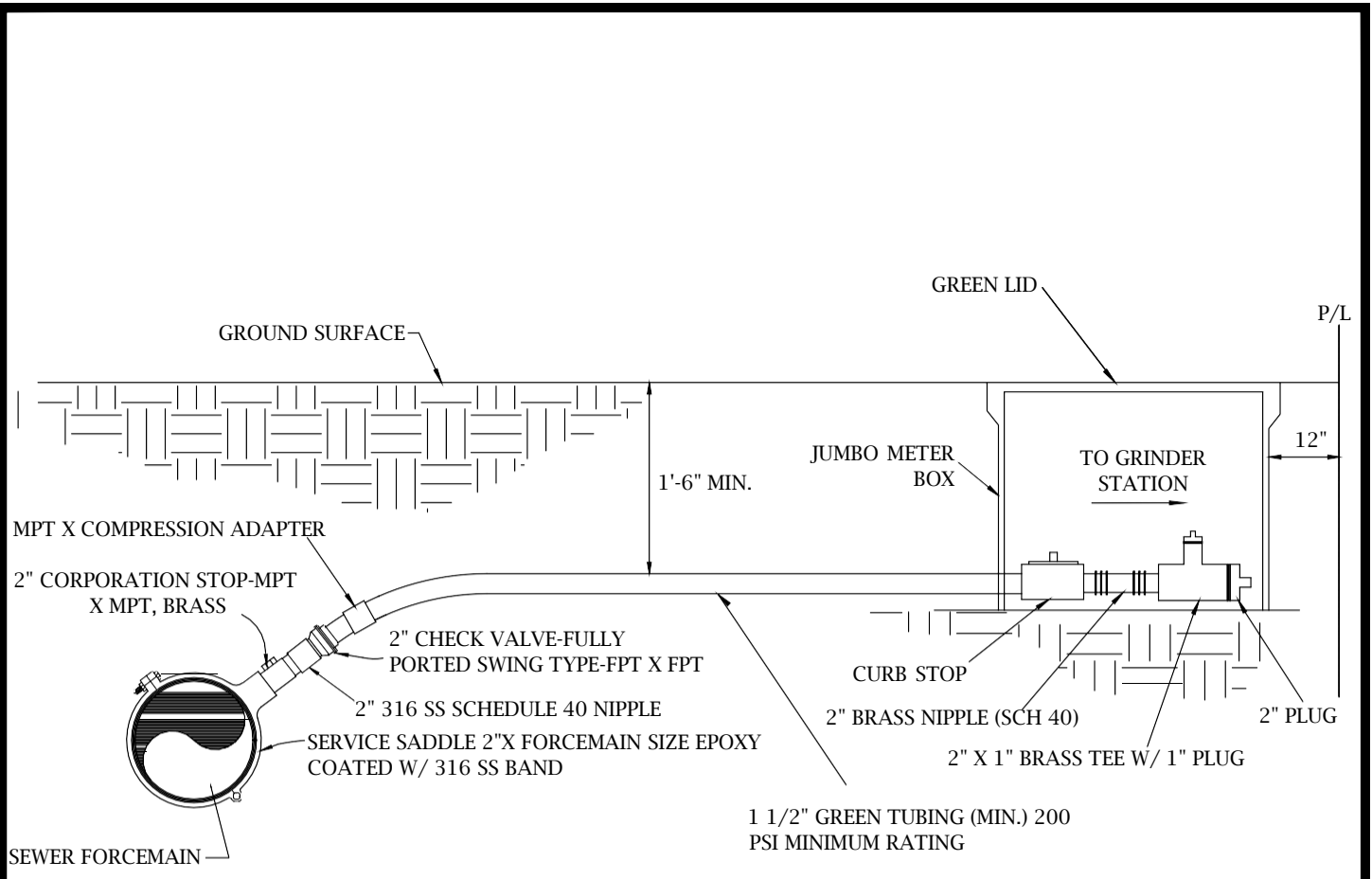
NOT TO SCALE



**RESIDENTIAL AND COMMERCIAL
LOW PRESSURE SERVICE
CONNECTION
ON MAINS LESS THAN 3"**

**Revision Date:
2024**

**Detail #:
WW-17**



NOTES FOR RESIDENTIAL SERVICES

1. CONTRACTOR TO MARK LOCATION OF SERVICES WITH A 2X4 STAKE 4' ABOVE THE GROUND AND PAINTED GREEN.
2. SERVICE LINE CONNECTIONS ACROSS ROADWAY SHALL BE BORED UNDER ROADWAY. SERVICE LINE SHALL BE ENCASED IN 3" PVC PIPE. CASING TO EXTEND 5' BEYOND EDGE OF PAVEMENT.
3. CONTRACTOR SHALL INCLUDE ALL LATERALS IN THE PRESSURE TEST OF THE PROPOSED LOW PRESSURE FORCEMAIN.

NOTES FOR COMMERCIAL SERVICES

1. SERVICE LINE CONNECTIONS ACROSS ROADWAY SHALL BE BORED UNDER ROADWAY. SERVICE LINE SHALL BE ENCASED IN 3" PVC PIPE. CASING TO EXTEND 5' BEYOND EDGE OF PAVEMENT.

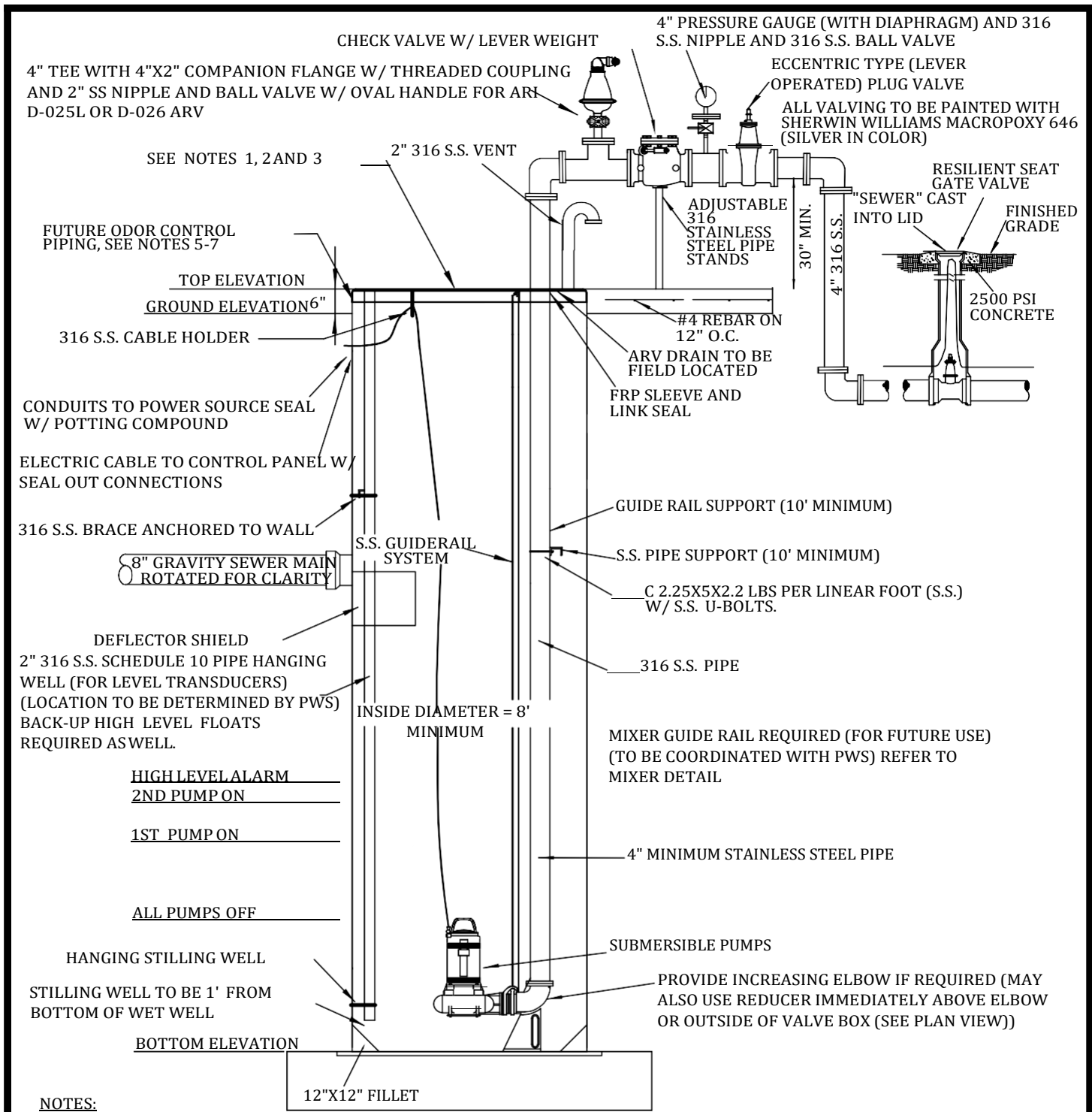
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**RESIDENTIAL AND COMMERCIAL
LOW PRESSURE SERVICE
CONNECTION
ON MAINS 3"AND GREATER**

**Revision Date:
2024**

**Detail #:
WW-18**



- NOTES:**
1. ABOVE GROUND PIPE SUPPORT LOCATION AND MOUNTING HARDWARE ARE TO BE FIELD DETERMINED.
 2. ALL BOLTS REQUIRE S.S. LOCK WASHERS.
 3. ADD (1) 2" CONDUIT FROM CONTROL PANEL TO FUTURE ODOR CONTROL.
 4. ADD (1) 2" PVC DRAIN PIPE FOR FUTURE ODOR CONTROL (WITH CHECK VALVE) INTO WET WELL.
 5. ADD (1) 6" SCHEDULE 40 PVC AIR PIPE.
 6. FIBERGLASS WET WELL TO INCLUDE A 12" NECK FOR CONDUIT INSTALLATION.

NOT TO SCALE

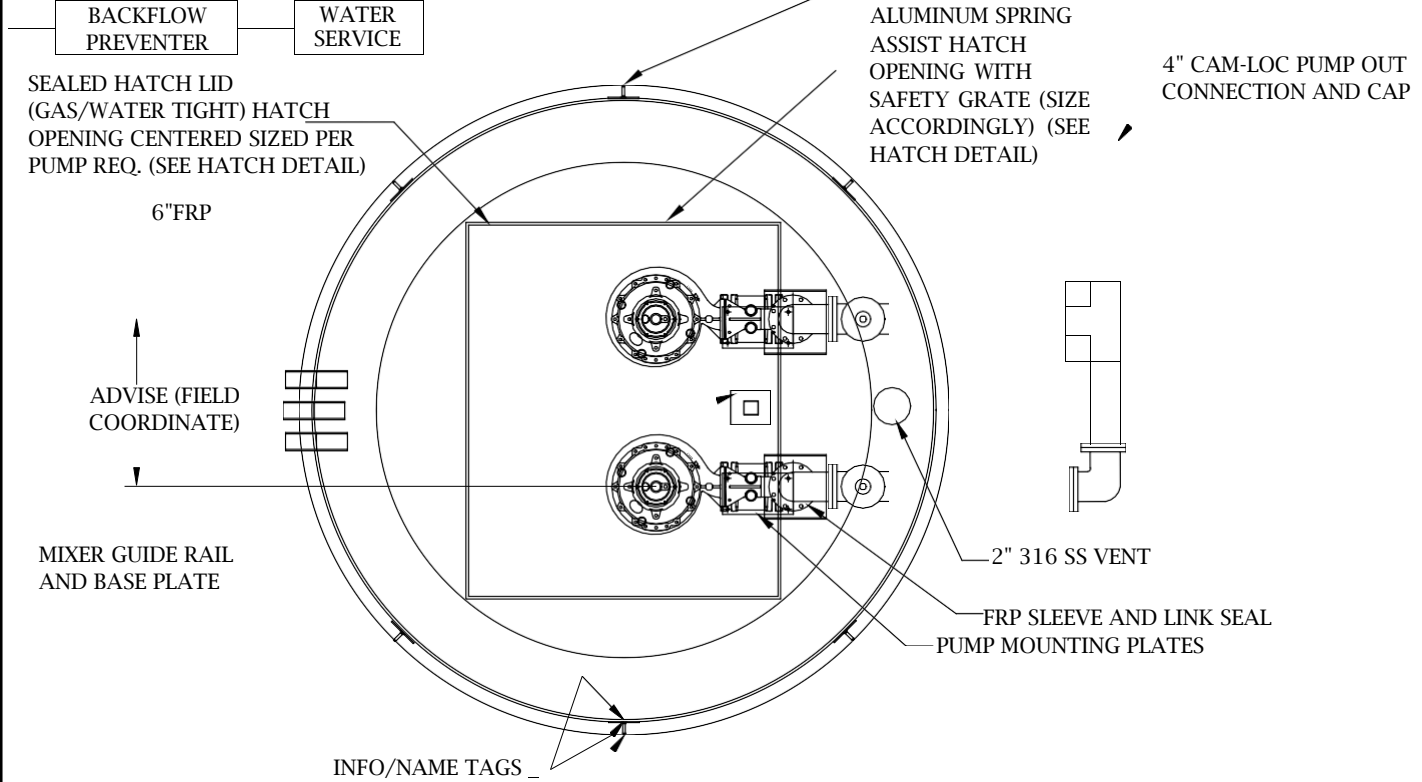


FIBERGLASS LIFT STATION SECTION DETAIL

Revision Date:
2024

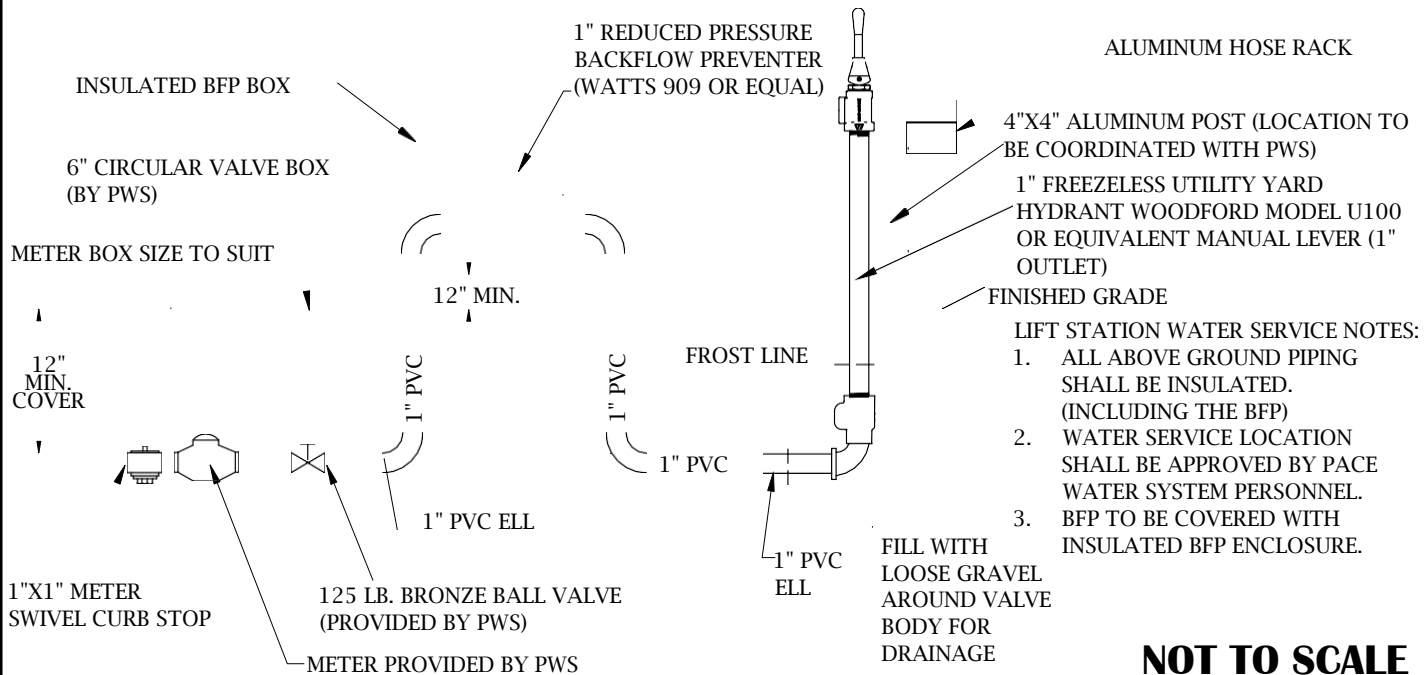
Detail #:
WW-19

SEE 'LIFT STATION WATER SERVICE ASSEMBLY' DETAIL BELOW



LIFT STATION PLAN VIEW NOTES:

1. LOCATE BACKFLOW PREVENTER AWAY FROM TRAFFIC AREAS. WATER SERVICE AND BACKFLOW PREVENTER LOCATION SHALL BE APPROVED BY PACE WATER SYSTEM, INC.
2. A MANHOLE SHALL BE INSTALLED ADJACENT TO THE WETWELL AND LOCATED WITHIN THE LIFT STATION SITE FENCING TO FACILITATE BYPASS PUMPING IF THE WETWELL REQUIRES TAKING OFFLINE.



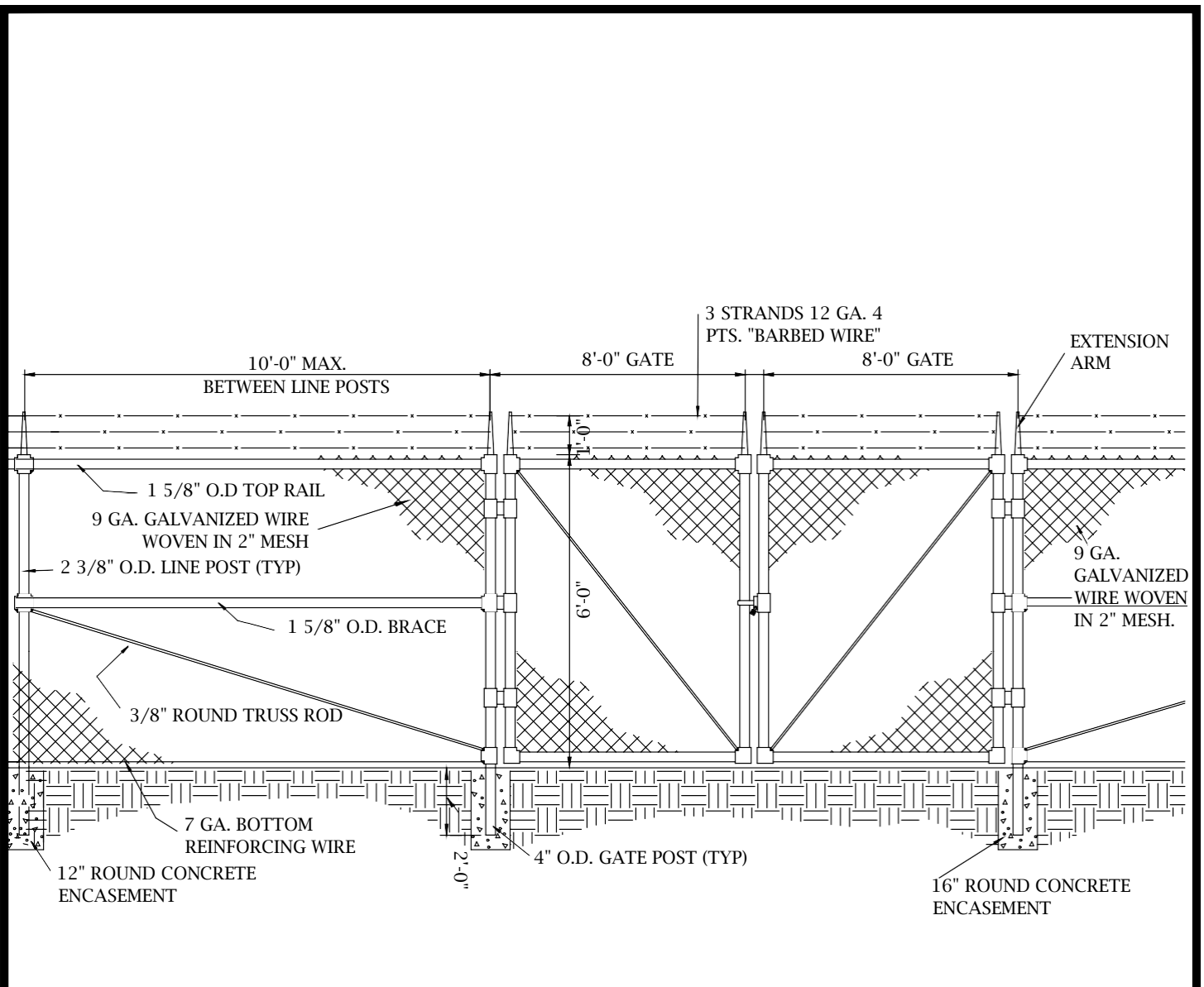
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**LIFT STATION PLAN DETAIL
INCLUDING LIFT STATION WATER SERVICE
ASSEMBLY DETAIL**

**Revision Date:
2024**

**Detail #:
WW-20**



NOTE: ENTIRE FENCE AND GATE TO BE GREEN OR BLACK VINYL COATED AS APPROVED BY PWS.

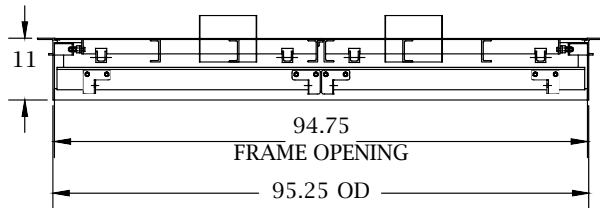
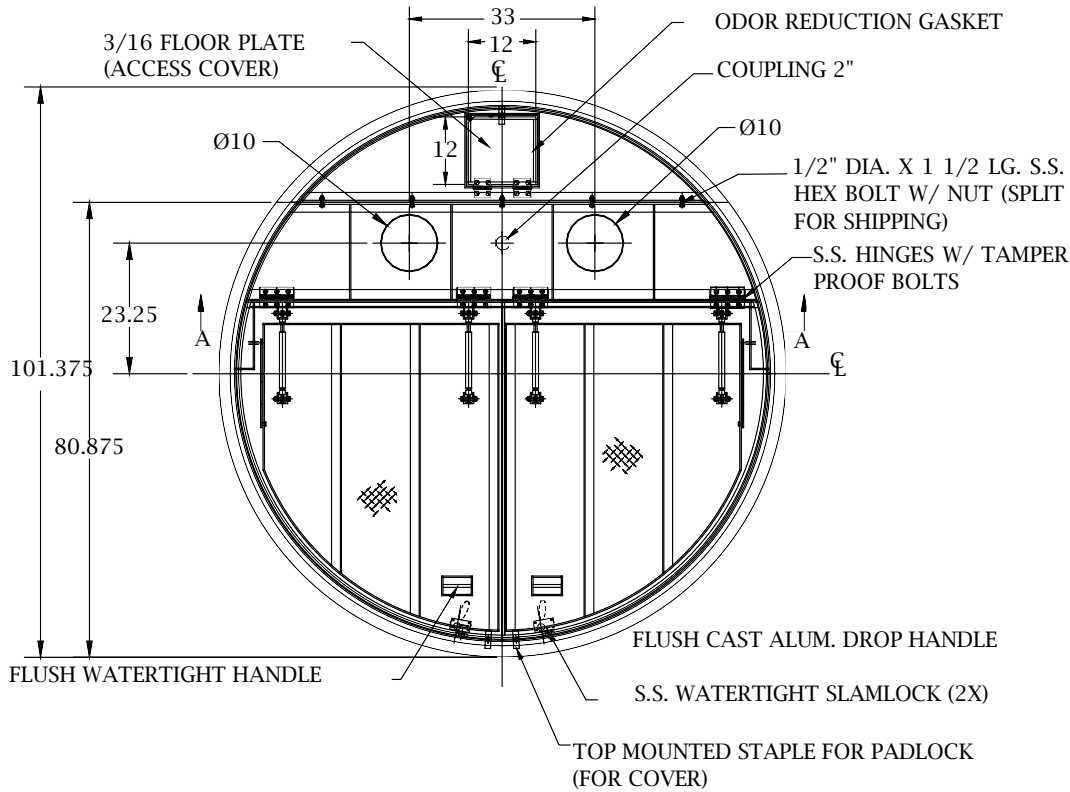
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**TYPICAL CHAIN LINK FENCE
(GREEN OR BLACK VINYL
COATED)**

**Revision Date:
2024**

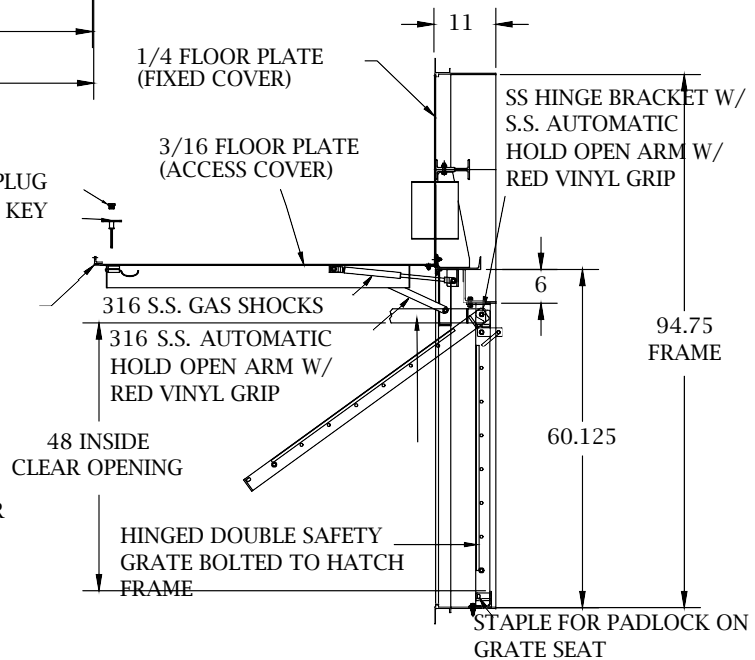
**Detail #:
WW-21**



SECTION A-A

SLAMLOCK PLUG
SLAMLOCK KEY

1/8 THICK X 3/4 WIDE GASKET
ALONG PERIMETER OF COVER



NOT TO SCALE

NOTES:

1. MATERIAL: ALUMINUM
2. LOADING: 300 LBS. PER SF
3. 316 SS NUTS & BOLTS
4. HATCH SPLIT FOR SHIPPING AND BOLTED TOGETHER IN FIELD
5. SAFETY GRATING TO BE PAINTED W/ SAFETY ORANGE POWDER COAT
6. APPROXIMATE WEIGHT: 685 LBS.



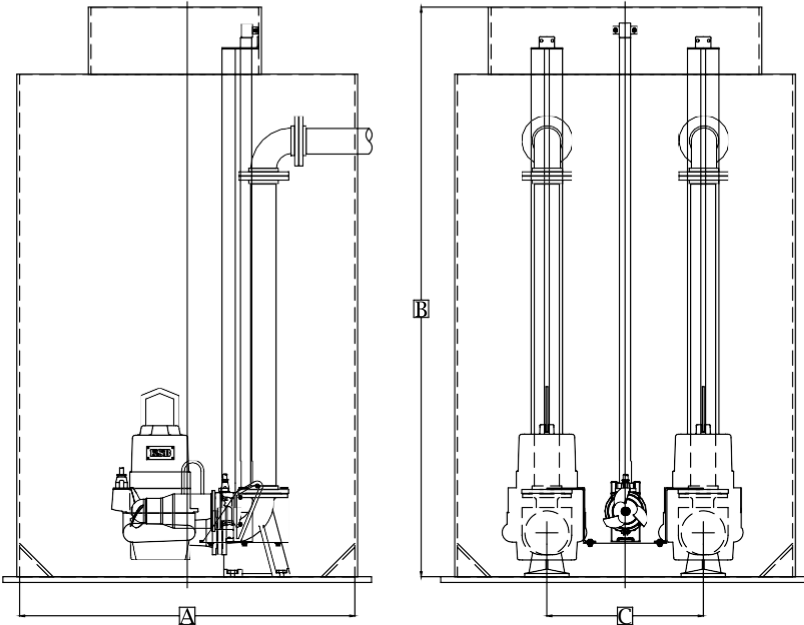
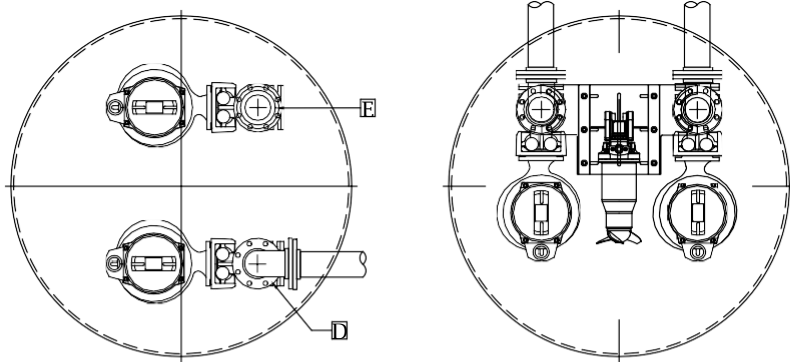
**HATCH DETAIL
FOR 8' DIAMETER LIFT STATION**

Revision Date:

2024

Detail #:

WW-22



| STATION DATA TABLE | | | | |
|--------------------|----------------|-------------------------|--------------------------------|----------------------|
| WET WELL DIAMETER | WET WELL DEPTH | PUMP TO PUMP CENTERLINE | DISCHARGE PIPE FLANGE DIAMETER | BOLT CIRCLE DIAMETER |
| A | B | C | D | E |
| | | | | |

KEY WELDED TO MAST FITS INTO CENTER SLOT TO PREVENT ROTATION (SEE DETAIL BELOW)

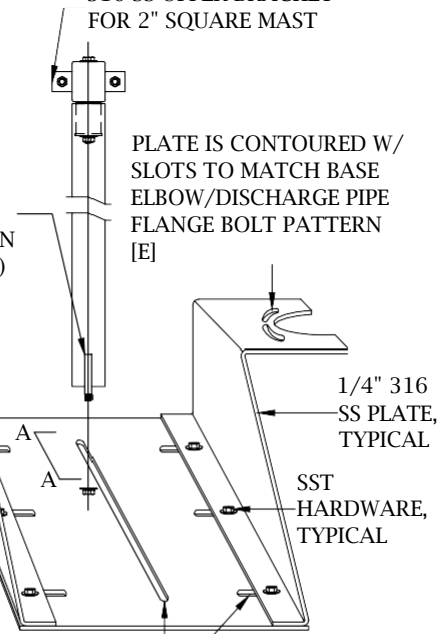
316 SS UPPER BRACKET FOR 2" SQUARE MAST

PLATE IS CONTOURED W/ SLOTS TO MATCH BASE ELBOW/DISCHARGE PIPE FLANGE BOLT PATTERN [E]

2" SQUARE MAST
 WELDED KEY
 BOTTOM PLATE
 LOCKING NUT

**DETAIL
 A - A**

CENTER SLOT IN BOTTOM PLATE PROVIDES MIXER & MAST ADJUSTMENT, AND RECEIVES KEY TO PREVENT MAST ROTATION



1/4" 316 SS PLATE, TYPICAL
 SST HARDWARE, TYPICAL

SIDE SLOTS PROVIDE PUMP ϕ ADJUSTMENT

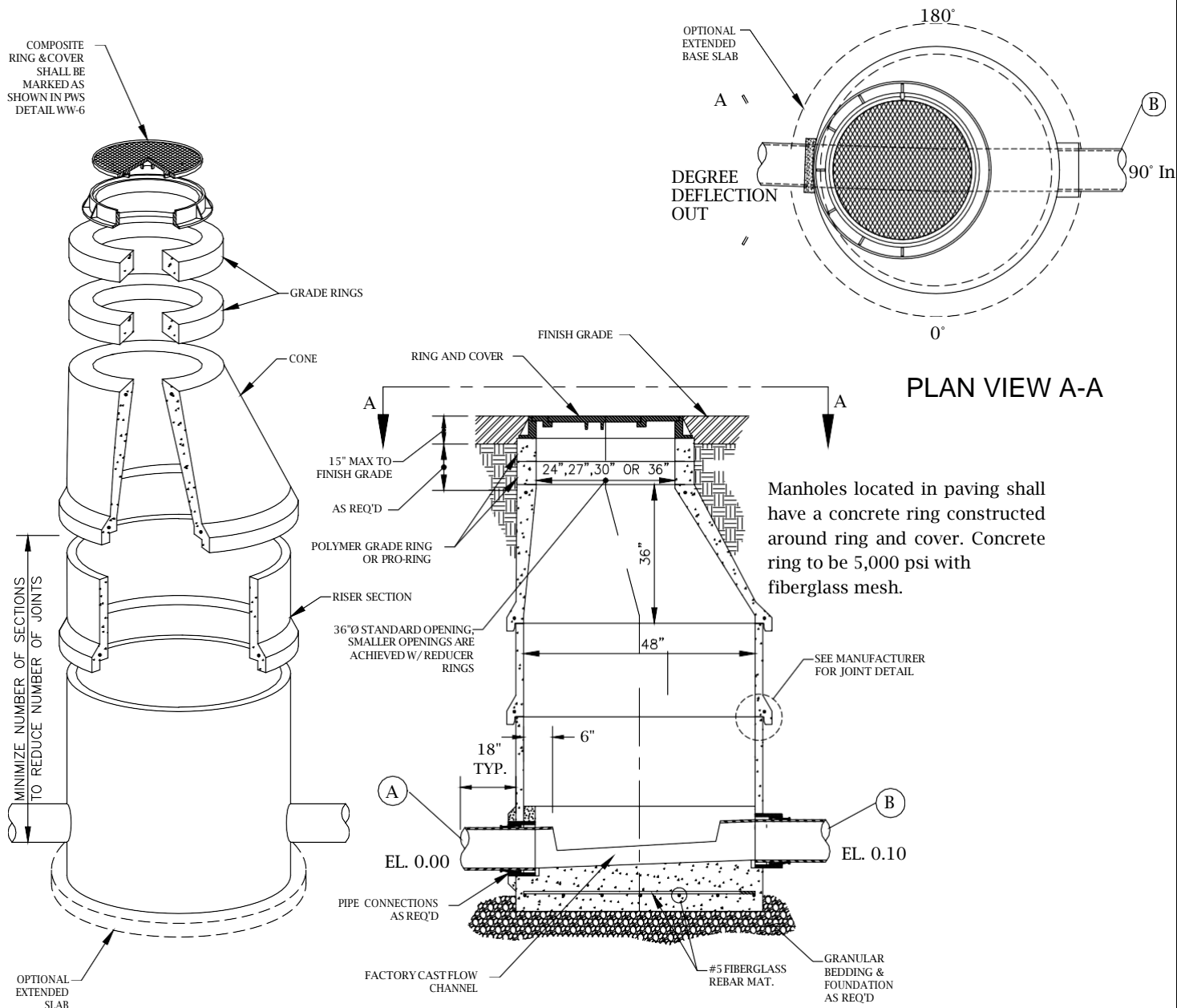
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MIXER DETAIL

**Revision Date:
 2024**

**Detail #:
 WW-23**



Manholes located in paving shall have a concrete ring constructed around ring and cover. Concrete ring to be 5,000 psi with fiberglass mesh.

NOTES:

1. MANHOLE TO BE DESIGNED, FABRICATED, INSPECTED, TESTED AND MARKED TO MEET THE INTENT OF A.S.T.M. C-478 SPECIFICATIONS.
2. NO PORTLAND CEMENT SHALL BE ALLOWED AS PART OF THE POLYMER MIX DESIGN
3. MANHOLE TO HAVE POLYMER CONCRETE BENCH AND INVERT.
4. SIGNED AND APPROVED DRAWING REQUIRED BEFORE START OF MANUFACTURING.

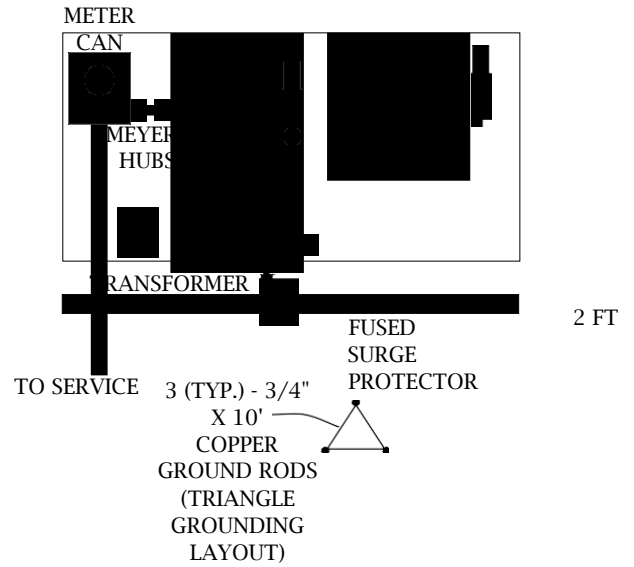
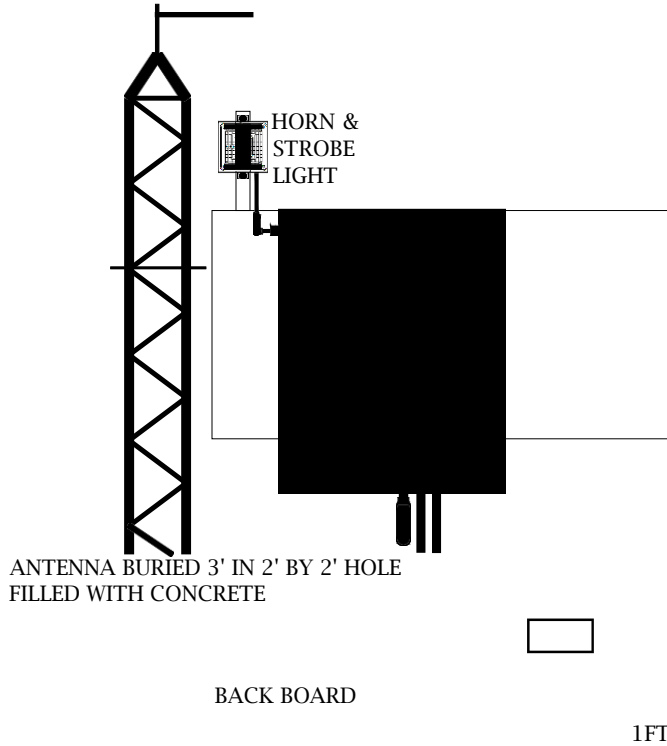
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POLYMER MANHOLE

**Revision Date:
2024**

**Detail #:
WW-24**



NOTE:
 - AT SMALL LIFT STATIONS, (1) LED SECURITY LIGHT SHALL BE INSTALLED AT THE SITE.
 - AT LARGE LIFT STATIONS, (2) LED SECURITY LIGHTS SHALL BE INSTALLED AT THE SITE.
 - LOCATIONS TO BE COORDINATED WITH PWS PERSONNEL MANUFACTURER TO BE RAB MODEL FXLED18 OR APPROVED EQUIVALENT)

8 FT

WW



VFD BACKBOARD & SITE LAYOUT

Revision Date:
2024

Detail #:
EL-1



CHAPTER 4 – RECLAIMED WATER SYSTEM

4.1 GENERAL REQUIREMENTS AND DESIGN STANDARDS

A. GENERAL

The following minimum requirements are considered acceptable to PWS in the distribution of reclaimed water for non-restricted access public reuse as defined by FDEP.

Deviations from these standards may be allowed on a case-by-case basis. If the deviation is in accordance with sound engineering practice and will not create a problem for PWS, the deviation may be approved. No deviation will be allowed unless it is clearly noted on the approved construction plans.

When these standards differ from county, state and/or federal requirements, the more stringent requirement shall apply.

The distribution system of reclaimed water includes the mains, valves, hydrants, customer service pipes to the meter, meters, and other appurtenances. The system shall be designed to provide an adequate supply of reclaimed water to the customers at all times.

B. STANDARDS

1. NSF Standards

Materials and methods of construction shall comply with the latest published editions of the National Sanitation Foundation (NSF) Standard 61.

2. ASME/ANSI Standards

Materials and methods of construction shall comply with the latest published editions of the American Society of Mechanical Engineers (ASME) and the American National Standards Institute (ANSI) Standards.

| | |
|---------------|---|
| B16.20 | Metallic Gaskets for Pipe Flanges: Ring-Joint, Spiral-Wound, and Jacketed |
| B16.1 | Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250 |
| B 1.1 | Unified Inch Screw Threads, UN, UNR and UNJ Thread Form |



UTILITY DESIGN MANUAL

| | |
|-----------------|--------------------------------------|
| B 1.20.1 | Pipe Threads, General Purpose (Inch) |
| B 1.20.3 | Dryseal Pipe Threads (Inch) |

3. ASTM Standards

Materials and methods of construction shall comply with the latest published editions of the American Society for Testing and Materials (ASTM) Standards.

| | |
|--------------|---|
| A126 | Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings |
| A307 | Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength |
| A746 | Standard Specification for Ductile Iron Gravity Sewer Pipe |
| B584 | Standard Specification for Copper Alloy Sand Castings for General Applications |
| B62 | Standard Specification for Composition Bronze or Ounce Metal Castings |
| B88 | Standard Specification for Seamless Copper Water Tube |
| D1248 | Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable |
| D1330 | Standard Specification for Rubber Sheet Gaskets |
| D1598 | Standard Test Method for Time-to Failure of Plastic Pipe Under Constant Internal Pressure |
| D1599 | Standard Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings |
| D1693 | Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics |
| D1785 | Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Schedules 40, 80, and 120 |
| D2241 | Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series) |
| D2513 | Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings |
| D2737 | Standard Specification for Polyethylene (PE) Plastic Tubing |
| D2837 | Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products |
| D3035 | Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter |
| D3261 | Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing |
| D3350 | Standard Specification for Polyethylene Plastics Pipe and Fittings Materials |



UTILITY DESIGN MANUAL

| | |
|--------------|---|
| D429 | Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates |
| F477 | Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe |
| F714 | Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter |
| F1055 | Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked Polyethylene (PEX) Pipe and Tubing |

4. Environmental Protection Agency and U.S. Public Health Service

The governing standards of these agencies will be followed when applicable.

5. Florida Department of Environmental Protection

The reclaimed water distribution system shall conform to the applicable Florida Department of Environmental Protection laws, policies, standards, rules and regulations for reclaimed water systems.

6. Plumbing Codes

The provisions of the Florida Building Code as it pertains to reclaimed water supply and distribution, service line locations and materials, except as provided for elsewhere in these criteria, shall apply.

7. AWWA Standards

Materials and methods of construction shall comply with the latest published editions of the American Water Works Association (AWWA) Standards.

| | |
|-------------|---|
| C104 | Cement-Mortar Lining for Ductile-Iron Pipe and Fittings |
| C105 | Polyethylene Encasement for Ductile-Iron Pipe Systems |
| C110 | Ductile-Iron and Gray-Iron Fittings |
| C111 | Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings |
| C115 | Flanged Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Fittings |
| C116 | Protective Fusion-Bond Coatings for the Interior and Exterior Surfaces of Ductile Iron and Gray Iron Fittings |
| C150 | Thickness Design of Ductile Iron Pipe |
| C151 | Ductile Iron Pipe, Centrifugally Cast |
| C153 | Ductile Iron Compact Fittings, for Water Service |



UTILITY DESIGN MANUAL

| | |
|-------------|--|
| C213 | Fusion-Bonded Epoxy Coating for Steel Water Pipe and Fittings |
| C301 | Prestressed Concrete Pressure Pipe, Steel-Cylinder Type |
| C500 | Metal-Seated Gate Valves for Water Supply Service |
| C502 | Dry Barrel Fire Hydrants |
| C504 | Rubber Seated Butterfly Valves 3-in. (75 mm) Through 72-in. (1,800 mm) |
| C509 | Resilient Seated Gate Valves for Water Supply Service |
| C510 | Double Check Valve Backflow Prevention Assembly |
| C511 | Reduced-Pressure Principle Backflow Prevention Assembly |
| C512 | Air Release, Air/Vacuum, and Combination Air Valves for Water and Wastewater Service |
| C515 | Reduced-Wall, Resilient Seated Gate Valves for Water Supply Service |
| C550 | Protective Interior Coatings for Valves and Hydrants |
| C600 | Installation of Ductile Iron Water Mains and Their Appurtenances |
| C605 | Underground Installation of Polyvinyl Chloride (PVC) And Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings |
| C651 | Disinfecting Water Mains |
| C800 | Underground Service Line Valves and Fittings |
| C900 | PVC Pipe and Fabricated Fittings, 4-in. Through 60-in. (100 mm through 1500 mm), For Water Transmission and Distribution |
| C901 | Polyethylene (PE) Pressure Pipe and Tubing 3/4-in. (19 mm) through 3-in. (76 mm), For Water Service |
| C906 | Polyethylene (PE) Pressure Pipe & Fittings, 4-in. (100 mm) through 65-in. (1650 mm) for Water Distribution and Transmission |

8. Pace Water System, Inc.

All reclaimed water distribution systems that are to become a part of PWS shall be designed and constructed in accordance with these standards. Materials, installation, construction methods, and procedures shall be in accordance with this utility design manual and attachments thereof.

C. LOCATION/FUTURE CONNECTION

Reclaimed mains shall be located in dedicated rights-of-way or utility easements. When installed in rights-of-way, reclaimed water mains shall, in general, maintain a consistent alignment with respect to the centerline of the road. All reclaimed water mains located outside of dedicated rights-of-way shall require a minimum 20-foot easement. If a reclaimed

water main is located adjacent to a road right-of-way, a minimum 10-foot easement shall be provided. Additional easement width shall be provided if the pipe size or depth of cover so dictate. Reclaimed water mains shall not be placed under any structures. In general, reclaimed water mains shall not be located alongside of rear lot lines. Placement of a reclaimed water main along side or rear lot line may be allowed on a case-by-case basis if such a reclaimed water main configuration results in efficient placement and utilization of the reclaimed water main network.

Provisions for future connecting mains shall be made by extending construction of all reclaimed water mains to the exterior boundaries of the subdivision wherever future connections to adjacent subdivisions or lots are anticipated or are required to form an interconnected grid system or reduce the number of dead ends.

D. DESIGN BASIS

1. Pressures

The system shall be designed to maintain a minimum pressure of 45 psi at all points in the distribution system under design flow. The normal working pressure in the distribution system should be approximately 60 psi but not less than 35 psi on the downstream side of a meter. All design pressures shall be based upon the average supply pressure as determined by PWS. Where the average supply pressure is below 60 psi, the required design meter pressure shall not be lower than 15 psi below the supply pressure. Design flow shall be determined as the flow rate equal to one-half inch per hour of flow applied to the projected irrigatable area of one-third of the residences in a residential development or to one-third the irrigatable area of any commercial site. The Board may consider variances to this criterion on a case-by-case basis.

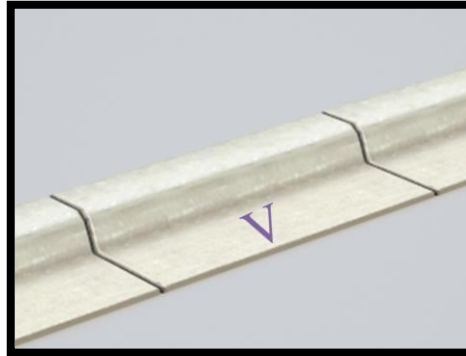
2. Diameter of Mains

Only reclaimed water mains of three (3) inches in diameter and larger shall be permitted.

3. Valves

Sufficient valves shall be provided on reclaimed water mains so that inconvenience will be minimized during repairs. Valves should be located at not more than 1000 feet intervals in all areas. Appropriate valving shall also be provided at all areas where reclaimed water mains intersect to ensure effective isolation of reclaimed water lines for repair, maintenance or future extension. In-line valves shall be located at property corners to avoid future driveways. Valves shall not be placed in the roadway or sidewalk in proposed developments.

Valve locations shall be marked with a “V” of at least three (3) inches in size, cut into the curb and painted purple, similar to the following schematic:



4. Aerial or Underwater Crossings

Aerial crossings shall be avoided whenever possible. Underwater/stream crossings shall be performed by directional drilling. PWS should be consulted before final plans are prepared.

a. Above-Water Crossings

The pipe shall be adequately supported and anchored, protected from vandalism, damage and freezing, and accessible for repair or replacement.

b. Underwater Crossings

A minimum cover of five (5) feet shall be provided over the pipe. When crossing water courses which are greater than 15 feet in width, the following shall be provided:

- The pipe shall be of special construction, having flexible, restrained or welded watertight joints.
- Valves shall be provided at both ends of water crossings so that the section can be isolated for testing or repair; the valves shall be easily accessible, and not subject to flooding.
- Permanent taps or other provisions to allow insertion of a small meter to determine leakage and obtain water samples shall be made on each side of the valve closest to the supply source.

5. Air Relief

At high points in reclaimed water mains where air can accumulate, provisions shall be made to remove the air by means of hydrants or automatic air relief valves. Automatic air relief valves shall not be used in situations where flooding of the valve box may occur.

6. Fire Hydrant/Flush Hydrant

Fire hydrants shall be located along public rights-of-way. A six (6)-inch gate valve shall be installed between the reclaim line and each fire hydrant. Fire hydrants shall be the dry barrel, breakaway traffic type. Fire hydrants/flush hydrants shall be spaced approximately every 1000 feet along rights-of-way or in each valved section of pipe located throughout the distribution system for flushing purposes. All fire/flush hydrants to be Pantone 522C or approved equivalent in color.

7. Dead Ends

To provide increased reliability of service and reduce head loss, dead ends shall be minimized by making appropriate tie-ins to loop the network whenever practical, as determined by PWS.

Where dead-end mains occur, they shall be provided with a fire hydrant or approved flush hydrant. Extended reclaimed water mains for the sole purpose of future connection may utilize a flush hydrant upon approval of PWS. Flushing devices shall be sized to provide flows which will give a velocity of at least 2.5 feet per second in the reclaimed water main being flushed. No flushing device shall be directly connected to any sewer.

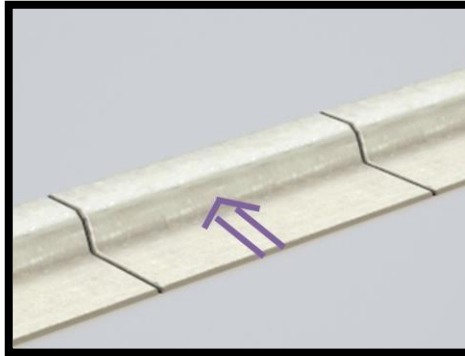
8. Reclaimed Water Services

a. Customer Service Lines

Customer service lines shall be provided to all lots and grassed/landscaped medians within a subdivision. All meters shall be centered in the lot and readily accessible to PWS personnel. Each meter shall be located approximately three (3) feet from any sewer lateral.

Customer service lines shall be limited to 55 feet in length. In areas where the right-of-way is wider than 60 feet, the developer shall provide a reclaimed water main on each side of the right-of-way. All new service lines must be cased under paved areas and sidewalks.

Reclaimed water service locations shall be marked with a double arrow of at least three (3) inches in size, cut into the curb and painted purple (see example below).



b. Meter Installations

All meters 1-1/2 inches and less will be installed by PWS after payment of applicable fees and charges. The service tap, corp stop, tubing, curb stop and meter box shall be installed by the Contractor prior to installation of the meter for commercial sites and new subdivisions.

All meters less than two (2) inches in size will be installed underground in an approved meter box. Meters two (2) inches and larger shall be installed below ground by the Contractor in a fiberglass or concrete vault. In commercial applications, meters larger than two (2) inches shall be located in a meter easement located adjacent to the public right-of-way.

The size of all meters shall be determined by the developer's Engineer and approved by PWS. The developer's Engineer shall provide sufficient information on estimated peak flows and low flows so that the meter size can be verified. The developer's Engineer shall include head loss through metering device when designing the reclaimed water system.

c. Cross Connection Control

In accordance with the PWS Cross Connection Control Program, **Attachment D**, reclaimed water service shall not be activated until the appropriate backflow prevention (BFP) device is installed on the potable water service, to protect public water supplies from contamination or pollution by isolating such contaminants or pollutants which could backflow into the public water system.

Only Reduced Pressure Principle (RP or RPZ) BFP devices shall be used at sites with reclaimed water.

The backflow prevention device shall be provided, installed, tested, and maintained by the customer. Testing shall be performed by backflow tester certified by one of the organizations/schools as listed in the PWS Cross Connection Control Program, **Attachment D**, and as approved by PWS.

4.2 GUIDELINES AND TECHNICAL SPECIFICATIONS

A. PRESSURE PIPING FOR RECLAIMED WATER

This section includes furnishing and installing all pressure pipework and appurtenances for the reclaimed water system, complete and fully operable in all respects.

1. Materials

All material shall be free from defects impairing strength and durability and be of the best commercial quality for the purpose specified. It shall have structural properties sufficient to safely sustain or withstand strains and stresses to which it is normally subjected and be true to detail.

All pipework will be inspected upon delivery, and such as does not conform to the requirements of these specifications shall be rejected and must be immediately removed from the site by the Contractor. The Contractor shall furnish and provide all labor necessary to assist the Engineer in inspecting the material.

The basis of rejection shall be as specified in applicable ASTM and AWWA Specifications.

2. Unplasticized Polyvinyl Chloride (PVC) Pressure Pipe

PVC pipe shall meet AWWA C900, or ASTM D1785, with minimum designations per the table below. PVC pipe shall be provided with push-on joints with the bell integrally cast into the pipe. PVC pipe shall be installed with elastomeric gaskets meeting ASTM Standard F477.

| Diameter | Required Standard | DR | OD |
|----------|-------------------|--------|----|
| 2" - 3" | ASTM D-1785 | Sch-40 | IP |
| 4" - 36" | C-900-16 | 18 | DI |

PVC pipe shall be as manufactured by the JM Eagle, National Pipe and Plastics, Inc., North American Pipe Corporation, Vulcan Plastics Corporation, or approved equivalent. All reclaimed water mains shall be Pantone 522C or approved equivalent in color.

All fittings for PVC pressure pipe shall be ductile iron mechanical joint meeting the requirements of ANSI/AWWA C153/A21.53-84. Fittings for two (2)-inch pipe may be Schedule 40.

The working pressure rating for fittings shall be 350 psi. Fittings shall be furnished with an asphaltic outside coating in accordance with ANSI/AWWA C153/A21.53 and shall be cement lined and seal coated with an asphaltic material in accordance with ANSI/AWWA C104/A21.4.

Restraint lengths for PVC pipe vertical bends, horizontal bends and appurtenances shall be calculated using the Uni-Bell Handbook of PVC Pipe, section 11.5.3.5. All valves shall be considered dead ends for thrust restraint length calculations.

Standard laying lengths shall be 20 feet and randoms shall not be less than 10 feet.

Each length of pipe shall be clearly marked with the following information at intervals of five feet or less:

- Nominal pipe size and OD base.
- Material code designation.
- Dimension ratio.
- Pressure class or pressure rating.
- Manufacturer's name or trademark.
- National Sanitation Foundation (NSF) approval seal.
- Appropriate AWWA or ASTM standard number.

3. Ductile Iron Pipe (DIP)

Ductile iron pipe shall meet the requirements of ASTM A746. Pipe dimensions shall conform to ANSI/AWWA C151/A21.51, Pressure Class 250. Each pipe shall be conspicuously marked on the outside of the barrel to readily identify it from cast iron. Metal thickness shall conform to ANSI/AWWA C150/A21.50-02.

a. Mechanical Joints

All mechanical joint pipe shall conform to ANSI/AWWA C111/A21.11.

b. Push-on Joints

All push-on joint pipe shall conform to ANSI/AWWA A21.11 and shall be single gasket push-on type.

c. Restrained Joints

DIPRA Thrust Restraint Design for Ductile Iron Pipe shall be used to calculate required restrained joint lengths at all vertical bends, horizontal bends and appurtenances. All valves shall be considered dead ends for restrained joint length calculations.

d. Flanged Joints

All flanged joint pipe shall conform to ANSI/AWWA C115/A21.15-99, 125 pounds, and shall have screwed on flanges, faced and drilled to the ANSI Class 125-pound template. The flanged joints shall be assembled by threading plain end pipe and screwing on long hub flanges. The connection shall then be power tightened and refaced across both face of flange and end of pipe. Gaskets shall be 1/16-inch ring gaskets of red sheet rubber meeting the requirements of Grade I, Table I of ASTM D1330. Connections shall be made with machine bolts and hexagonal nuts.

e. Fittings

All fittings shall be ductile iron mechanical joint meeting the requirements of ANSI/AWWA C153/A21.53. The working pressure rating for fittings shall be 350 psi. Fittings shall be furnished with an epoxy coating in accordance with ANSI/AWWA C116/A21.16 and shall be cement lined and seal coated in accordance with ANSI/AWWA C104/A21.4.

f. Linings, Coatings and Hardware for Ductile Iron Pipe

All pipe, valves, fittings and specials for reclaimed water shall be cement mortar lined, and the lining shall comply with ANSI/AWWA C104/A21.4. The exterior of buried pipe shall receive a zinc coating as specified in ISO 8179 at an application rate of 200 grams per square meter and coated with an outer protective coating prior to shipment. The exterior of all aboveground pipe shall receive a coat of rust inhibitor primer compatible with the finish paint schedule.

All bolts, nuts, studs and other uncoated parts of joints for underground installation shall be 316 Stainless Steel.

4. Polyethylene Pipe (HDPE)

HDPE pipe three (3) inches and larger shall meet or exceed AWWA C906; and ASTM D2513, D3035, D3350, and D1248, latest revisions. Each manufacturer shall supply a letter of certification stating compliance with all the above standards and requirements prior to shipping any material to the project site. All HDPE piping system components shall be the products of one manufacturer. The HDPE material shall have required ultraviolet inhibitors to resist degradation by direct and prolonged sunlight.

The design of all HDPE materials shall be based on the hydrostatic design basis (HDB) of 1600 psi at 73.4°F. The cell classification shall be or exceed 345465C for all HDPE three (3) inches and larger and shall be manufactured with 4710 resins only. The pipe shall be SDR 11 ductile iron pipe OD with a pressure rating of 200 psi.

All HDPE, three (3) inches and larger shall have three (3) purple strips (1/4 inch in width) located at the 12, 4, and 8 o'clock positions with permanent ink along the entire length of the pipe. Labeling shall include size of pipe, SDR rating and pressure rating, manufacturer's name, reclaimed water pipe, ASTM F174, PE 4710, NSF, AWWA C906, and manufacturing date and location. This shall be at least 1/4-inch tall lettering and shall run the entire length of the pipe. Print line markings shall include a production code from which the location and date of manufacture can be identified. Upon request, the manufacturer shall provide an explanation of his production code.

HDPE pipe /tubing, two (2) inches and smaller, shall comply with or exceed AWWA C901; ASTM D3350, D2737, D1248, and D2837, latest revisions. All HDPE tubing shall be manufactured of an outer layer of 4710 resins with purple coloring and a virgin clear center of 4710 resins only. Tubing shall have NSF 14 certification. The cell classification shall be 445574E external pipe and 445574D for virgin center core. The pipe shall have UV stabilizers for direct sunlight protection, but all tubing shall be certified to resist direct sunlight such as that of Florida or Arizona for a minimum of five (5) years with no visible or physical effect to the tubing. All tubing shall be SDR 9 CTS pipe with a minimum pressure rating of 250 psi. The manufacturer shall issue a certification of compliance for purity of core and lifetime warranty for all the above-mentioned standards and cell classification.

All HDPE fittings shall comply with the same cell classification and pressure rating utilizing 4710 resins only. All fittings shall be within one DR of the pipe's specified DR to assure compatible fusion and to the pipe manufacturer's recommendations. Molded butt-type fittings shall meet the requirements of ASTM D3261. At the point of fusion, the outside diameter and minimum wall thickness of fitting butt fusion outlets shall meet the outside diameter and minimum wall thickness specifications of ASTM F714 for the same size of pipe. Electrofusion-type fittings shall meet the requirements of ASTM F1055.

Fabricated fittings are to be manufactured using Data Loggers. Reference to the Data Logger Quality Control records shall be made from an indented stamp in each fusion bead of each fitting. Temperature, fusion pressure and a graphic representation of the fusion cycle shall be part of the Quality Control records.

Transition fittings shall be used to terminate all HDPE pipe and shall be fusion welded HDPE/PVC mechanical joint adapters with stainless steel stiffeners. Fittings shall have the same pressure rating as the pipe unless otherwise specified on the plans.

5. Metallic Tracer Wire

Copper wire (12 gauge) shall be buried directly above all non-metallic pipes no deeper than 18 inches below ground level, and the color of tracer wire shall be purple for reclaimed water. All connections shall be made with silicone sealed wire nuts. All stripped wire is to be inside the wire nut.

B. VALVES, HYDRANTS, METERS AND MISCELLANEOUS APPURTENANCES

This section includes furnishing and installing complete all equipment and materials necessary for a complete and fully operable system.

1. Materials

All material shall be free from defects impairing strength and durability and be of the best commercial quality for the purpose specified. It shall have structural properties sufficient to safely sustain or withstand strains and stresses to which it is normally subjected and be true to detail.

All pipe work will be inspected upon delivery and such as does not conform to the requirements of these specifications shall be rejected and must be immediately removed from the site by the Contractor. The Contractor shall furnish and provide all labor necessary to assist the Engineer in inspecting the material.

The basis of rejection shall be as specified in applicable ASTM and AWWA Specifications.

2. Valves

a. Gate Valves

Gate valves shall be provided that meet the following requirements.

- **Gate Valves Two Inches and Larger:** Gate valves shall be of the resilient seated wedge type, epoxy coated to AWWA C550, cast iron body design. They shall comply with AWWA C509, latest revision. Valves shall be rated for zero leakage at 200 psi water working pressure and have a 400-psi hydrostatic test for structural soundness. All testing shall be conducted in accordance with AWWA C509. Gate valves shall be mechanical joint per AWWA C111.

All cast iron shall conform to ASTM A126. Castings shall be clean and sound without defects that will impair their service. No plugging or welding of such defects will be allowed. Bolts shall be in accordance with ASTM A307.

Valves shall be M & H Model 4067, American Model 2500, Mueller A-2360 (Mueller A-2361 for valves over 12 inches), or approved equivalent.

- **Gate Valves under Two Inches:** Gate Valves under two (2) inches shall be bronze body, threaded ends, non-rising stem, solid wedge disc and shall be American Model G300, or approved equivalent.

b. Air Release and Vacuum Valve

The combination air release and vacuum valve shall be furnished with both a large and small orifice and shall meet requirements specified in ANSI/AWWA C512 (see Detail RW-XXXX). The valve shall automatically function to release to atmosphere both large and small amounts of air that accumulate in the pipeline. Once the air has been exhausted, both the large and small valves shall seat tightly to prevent water leakage. The valve shall also function to admit air into a line, tank, or chamber under emergency conditions or when it is being drained. The valve body and cover shall be of semi-steel; floats of stainless steel; levers of bronze; and resilient seats. The air and vacuum valve shall be manufactured by A.R.I., Model S-025, or approved equivalent.

3. Hydrants

All fire hydrants shall be 5-1/4-inch hydrants with two (2) 2-1/2-inch connections and one pumper connection designed for 250 psi working pressure, and shall conform to the requirements of AWWA C502.

Hydrants shall have mechanical joint inlets, shall be for a three (3)-foot bury, and shall be breakaway or traffic model, dry barrel type (see **Detail RW-2**). A six (6)-inch gate valve shall be installed with anchor coupling between the reclaimed water main and each fire hydrant.

All hydrant coatings shall meet or exceed the requirements of AWWA C-550. The exterior color shall be Pantone 522C, or approved equivalent.

4. Reclaimed Water Services

a. Meter Boxes

Meter boxes shall be furnished and installed by the Developer and shall be the Carson Standard Meter Box with pre-drilled solid lid to accept touch/radio read equipment and Pantone 522C in color, or approved equivalent.

b. Meters

Commercial meters up to and including 1 ½ inches in size shall be provided by PWS. Larger sized meters shall be purchased by the developer through PWS. All meters two (2) inches and larger shall be installed in a fiberglass or concrete vault (see **Detail RW-10**).

c. Service Saddles

Service saddles shall meet requirements specified in AWWA C800 with an epoxy-coated stainless-steel band and shall be Ford Model FC202, or approved equivalent.

d. Corporation Stops

Corporation stops shall meet requirements specified in AWWA C800 and shall be Ford Model No. F-1000, or approved equivalent. Inlets shall have CC threads and outlets shall have compression connections.

e. Curb Stops

Curb stops shall meet requirements specified in AWWA C800 and shall be Ford Model No. BRW43, or approved equivalent. Inlets shall have compression connections and outlets shall have meter swivel nut. Valves shall be equipped with padlock eyes or approved equivalent. The tee head shall be stamped with "Reclaimed Water" lettering for easy identification.

f. Service Tubing

Service tubing shall be polyethylene (PE) and meet the requirements of ASTM D2737, SDR 9 and shall be listed as having the approval of the NSF for water distribution. Service tubing shall have the NSF approval designation stamped on the tubing and shall be purple/lavender in color. It shall be delivered in rolls and cut to required lengths.

g. Service Tees

Service tees for double services are to be pack joint or compression tees and are to meet requirements specified in ANSI/AWWA C800. Service tees shall be Ford Model No. T444, Mueller H-15381, Mueller P-15381, or approved equivalent.

5. Valve Boxes

Cast iron valve boxes shall be provided for all underground valve installations (see **Detail RW-4**). They shall consist of a base covering the operating nut and head of the valve; a vertical shaft, at least 5-1/4 inches in diameter and with an adjustable length from 18 inches to 24 inches; and a top section extending to a point even with the finished ground surface. A cast iron cover marked "REUSE" shall be provided and placed concentrically over the operating nut along with a valve box alignment device, as manufactured by Boxlok or approved equivalent.

The assembly shall be suitable for highway traffic wheel loads. Valve boxes shall be Clow, Mueller Company, Sigma, or Tyler Union screw type, or approved equivalent.

6. Backflow Preventer

BFPs are not utilized on reclaimed water service lines; however, RP (RPZ) devices are required on potable water connections prior to reclaimed service activation in accordance with the PWS Cross Connection Control Program, **Attachment D**. RP devices shall meet ASSE Standard 1013 and shall be Watts, Zurn Wilkins, or approved equivalent.

7. Tapping Valves

Tapping valves shall meet the requirements of AWWA C500, Metal Seated Gate Valves for Water Supply Service, and be designed for making taps to existing mains under pressure. Valve, tees, and boring equipment used shall be mutually compatible. Tapping tees, unless otherwise indicated, shall be constructed of cast or ductile iron with non-corrosive accessories. All stainless steel bodied tees may be used. All nuts and bolts shall be non-corrosive and compatible with fitting materials.

8. Submittals

The Contractor shall submit a minimum of four (4) copies of catalog data for approval by PWS for materials to be used and shall allow two (2) weeks for submittal review. This submittal shall include but not be limited to the following:

- Pipe and Fittings
- Tubing
- Valves, Boxes and Concrete Collars
- Hydrants
- All Service Materials
- Casing
- Backflow Preventers
- Tracer Wire and Silicone Wire Nuts

C. INSTALLATION OF PRESSURE PIPEWORK

This section covers the installation of pressure pipework. Excavation and backfilling shall be in accordance with the *General Sitework* section of the specifications (see **5.2 Earthwork** starting on sheet **5-4**).

1. General

All pipe, fittings, and valves shall be carefully handled at all times to prevent damage to the pipe or other installation on the job site. All joints shall be wiped free of all dirt, sand, and foreign material and the pipe shall be carefully examined for defects before installation. Cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe.

At times when pipe installation is not in progress, the open ends of the pipe shall be closed with a compatible pipe plug and shall remain closed until construction on that particular section is resumed, eliminating the possibility of any flow obstructions getting into the pipe.

Deviations from the piping location, line and grade indicated on the construction plans shall not be made without the prior approval of the Engineer or PWS Representative.

No pressure piping or fittings shall be allowed under any proposed paving, including sidewalks, flumes, roadways, etc., except for approved crossings.

2. Pipe Laying Procedures for Pressure Piping

Pressure piping shall be installed in strict accordance with the manufacturer's printed instructions and as per **Detail RW-1**. Before lowering the pipe into the trench, the bottom of the trench shall be graded so that when the pipe rests on the trench bottom it will have a uniform bearing for its entire length. The pipe shall be carefully examined for defects and the inside cleaned. After placing the pipe in the trench, the ends shall be wiped free from all dirt, sand and foreign material. The joints shall be made in accordance with the recommendations of the pipe manufacturer.

Suitable concrete reaction or thrust blocks shall be applied on all lines (except those having screwed or flanged joints), at all tees, plugs, caps, and bends deflecting 22-1/2 degrees or more, or movements shall be prevented by attaching metal rods or straps approved by the Engineer. Unless otherwise directed, the pipe shall be laid with bell ends facing in the direction of laying. Whenever it is necessary to deflect the pipe from a straight line, either in the vertical or horizontal plane, to avoid obstruction, to plumb stems, or where long radius curves are permitted, the degree at deflection shall be as recommended by the pipe manufacturer. Degree fittings are required on all long radius pipe runs as necessary.

The minimum cover for pipe shall be 30 inches below top of curb and the maximum cover shall be 48 inches, unless otherwise indicated on the construction plans and approved by PWS. The depth of cover shall be measured from the established street grades or the surface of the permanent improvement to the top of the barrel of the pipe. At street intersections or where the new pipe line crosses existing underground lines at the approximate same depth as the new line, the cover shall be increased and the new line laid below existing lines or structures. Where the existing lines or structures are of sufficient depth that the new line when laid will have six (6) inches of separating earth between it and other pipe or structure and 30 inches cover below top of curb, the new line may be laid above the existing pipe or structure.

a. Road Crossings

In all new developments, pressure piping for road crossings shall be HDPE under paving. HDPE must be one pipe diameter size larger than pressure piping utilized on either side of the road crossing. No joints shall be allowed under paving.

b. Sub-Surface Explorations

Whenever necessary to determine the location of existing pipes, valves, or other underground structures, the Contractor shall examine all available records and shall make all explorations and excavations for such purpose. Where the locations of existing utilities are furnished by PWS or other utility owners, they

should be considered approximate only. The Contractor is responsible for locating and protecting all existing utilities whether shown on the drawings or not shown.

c. Protecting Underground and Surface Structures

Temporary support, adequate protection, and maintenance of all underground and surface utility structures, drains, sewers, and other obstructions encountered in the progress of the work shall be furnished by the Contractor at his own expense under the direction of the Engineer or PWS.

d. Construction Equipment

Mechanical equipment may be used for trenching and excavating. However, in places where the operation of same will cause damage to trees, shrubbery, pavements or existing structures, above or below ground, hand methods shall be employed. Where a main is installed along paved streets, rubber-tired equipment is recommended; however, if track equipment is necessary for excavation due to depths, the Contractor will be permitted to use such equipment and will be responsible for any damage done to paved streets or lawns. Concrete driveways and asphalt pavement must be saw cut for final replacement.

e. Unsuitable Conditions

No pipe shall be laid in water or unsuitable soils conditions. Unsuitable soil, as determined by the Engineer or PWS, shall be removed or replaced with an approved material.

f. Trench Water

At times when pipe laying is not in progress, the open ends of pipe shall be closed with a compatible pipe plug, and no trench water shall be permitted to enter the pipe.

g. Setting Valves and Boxes

- **Valves and Fittings:** Gate valves and pipe fittings shall be set and joined to new pipe in the manner as specified in this specification.
- **Valve Boxes:** Cast-iron valve boxes shall be firmly supported and maintained, centered and plumb, over the wrench nut of the gate valve and box cover flush with the surface of the finished pavement or at such other

level as may be directed. A concrete collar around the valve box shall be required for protection. Tracer wire shall be looped in valve box and accessible at the top of valve box.

- **Valve Box Alignment Device (VBAD):** All buried gate valves three (3) inches through 12 inches requiring a valve box or any valve boxes that are set on a three (3)-inch to 12-inch buried gate valve shall be furnished with a VBAD. The device shall be of HDPE and colored white. It shall be furnished in two (2) pieces that will lock together under the operating nut without requiring the removal of the nut. No one-piece device will be accepted. The device shall not affect the operation of the valve. The device shall be the

h. Dewatering

The Contractor shall provide all necessary pumps to dewater the site properly; shall provide all labor and materials required to keep any open excavation dewatered during construction; and shall provide all necessary sheeting, bulkheads, drains, etc., so that construction operations may be performed under dry conditions. Discharge from pumps must be led to natural drainage channels, to drains, or to storm sewers. The Contractor is responsible for all permitting and testing of dewatering discharge.

i. Service Pipe

Service pipe shall have a minimum depth of 30 inches at all highway crossings and 18 inches elsewhere. The requirements for trenching and backfilling as described in the *General Sitework* section of the utility design manual (see **5.2 Earthwork**) shall apply. Removal of pavement or sidewalk will not be permitted for reclaimed water service lines. They may be installed by jacking, boring, or pushing under sidewalks. All services shall be encased under all paving including sidewalks, flumes, roadways, etc. (see **Details RW-8 and RW-9**).

j. Plugging Dead Ends

Standard plugs shall be inserted into the bells of all dead ends of pipes, tees, or crosses, and spigot ends shall be capped. Plugs or caps shall be joined to the pipe or fittings in the appropriate manner.

k. Concrete Encasement and Special Pipe Support

Concrete encasement or special pipe supports shall be provided as shown on the drawings or directed by the Engineer or PWS. Various pipe supports shall be as

worked out in the field to suit local conditions and emergencies. Where, in the opinion of Engineer or PWS, pipe covering is inadequate, concrete encasement for protection shall be provided in accordance with the details on the approved drawings. Concrete encasement shall be made using concrete with a 28-day strength of 2000 psi. Encasement shall be to the dimensions indicated on the construction plans and as required by the applicable Department of Transportation or Department of Health regulations. All other concrete needed to build and protect the pipe work shall be used at the direction of the Engineer or PWS.

l. Separation of Water Mains and Sewers/Reclaimed Water

Water mains or sewer mains that are laid in the vicinity of each other shall meet the horizontal and vertical separations specified herein (see **Detail RW-7**). Separation is to be based on the outside diameter of each main.

m. Backfilling

Backfill material shall be free from rocks or boulders or any other objectionable material. Backfill shall be placed in the trench and compacted simultaneously on both sides of the pipe for the full width of the trench, and to an elevation level with ground on either side to densities indicated in the *General Specifications* section of this utility design manual (see **5.2 Earthwork**).

n. Repaving

Pavement removal where required in the construction of the project shall be done by the Contractor in a workmanlike manner. Care must be taken to make the saw cut in a straight line so the patch will be neat.

Asphalt paving shall be replaced as described in the *General Specifications* section of this utility design manual (see **5.1 Sitework**) and in accordance with the approved construction plans. Concrete driveways and pavement shall be replaced using concrete with high early strength so that traffic may be resumed quickly. Concrete must be finished to conform with existing pavement.

o. Clean-Up

Before final inspection and acceptance, the Contractor shall clean ditches, shape shoulders, and restore all disturbed areas, including street crossings and grass plots, to as good a condition as existed before work started. All trenches shall be leveled, and loose material removed from pavement, gutters, and sidewalks, employing hand labor if necessary.

3. Anchorage of Bends, Tees, and Plugs

a. Thrust Block Placement

Suitable concrete reaction or thrust blocks shall be placed on all pipe lines two (2) inches in diameter or larger at all tees, plugs, caps and at bends deflecting 22-1/2 degrees or more, or movement shall be prevented by attaching metal rods or straps as approved by the Engineer.

b. Materials for Thrust Blocking

Reaction, or thrust blocking shall be of concrete that has a 28-day compressive strength of not less than 2000 psi. Reaction backing will be placed in accordance with the details on the approved construction plans and **Detail RW-5**.

Blocking shall be placed between solid ground and the fitting to be anchored. The restraint shall, unless otherwise directed, be so placed that the pipe and fitting joints will be accessible for repairs. No extra payment will be made for this material, but all costs shall be included in the unit price bid for the various sizes of pipe.

In some cases, the Engineer may direct the Contractor to provide backing using cables and "deadman" anchors where the soil conditions will not support the normal concrete type as described above.

D. TAPS ON RECLAIMED WATER PRESSURIZED LINES (WET TAP)

Tapping valves shall be as specified in this section of the PWS utility design manual. The Contractor shall notify the Engineer and PWS Representative 48 hours prior to the tap. The PWS Representative/Engineer must be present for the hydrostatic pressure testing and tapping of the main. The hydrostatic pressure test shall be 150 psi minimum for a duration of 15 minutes. As an alternate, air testing is permissible at 50 psi for a duration of 15 minutes.

The following chart demonstrates the tapping machine shell cutter outside diameter:

| Nominal Main Size | Tapping Valve ID AWWA Standard | Tapping Machine Shell Cutter OD |
|-------------------|--------------------------------|---|
| 2" | 2-1/8" | 1-1/2" |
| 3" | 3-1/8" | 2-1/2" |
| 4" | 1-1/4" | 3-1/2" |
| 6" | 6-1/4" | 5-1/2" |
| 8" | 8-1/4" | 7-1/2" |
| 10" | 10-1/4" | 9-1/2" |
| 12" | 12-1/4" | 11-1/2" |
| 14" | 14-1/4" | Per Manufacturer's Recommendation Contractor shall submit shop drawings for valves and tapping machine for approval, prior to use. Per Manufacturer's Recommendation. |
| 16" | 16-1/4" | |
| 18" | 18-1/4" | |
| 20" | 20-1/4" | |
| 24" | 24-1/4" | |

The tap coupon shall be given to the PWS Representative. If the coupon is lost in the main, the Contractor shall at his expense, dismantle the main to retrieve the coupon. The main shall be reassembled and pressure tested as required at the Contractor's expense.

E. TESTING AND INSPECTION

1. General

During construction and at the completion of the work, the Contractor shall make such tests as required for reclaimed water pressure pipework. The PWS Representative or Engineer will observe the tests, but the Contractor shall furnish all apparatus required and shall pay all costs connected therewith. Defective work shall be repaired immediately at the Contractor's expense.

In general, tests shall conform to usually accepted testing practices for the specific type and class of test. All data, observations and results will be carefully recorded, and the PWS Representative and Engineer will be furnished two (2) signed copies of all data and reports. Project acceptance may be held contingent on receipt of satisfactory test reports.

All new construction shall be secured prior to acceptance by PWS. Valves between new systems and existing systems that are not yet accepted shall be closed while unattended, i.e., nights, weekends, and holidays.

2. Hydrostatic Tests of Reclaimed Water Pressure Pipework

a. Pressure During Test

After the pipe has been laid and backfilled as specified, each valved section of newly laid pipe shall, unless otherwise specified, be subjected to a hydrostatic pressure equal to the pressure rating of the pipe being tested but not less than 150 psig. The Contractor shall record the testing using a pressure recording gauge, and after all testing is complete, the recordings shall be turned over to the Engineer and PWS Representative for their files.

b. Duration of Pressure Test

The duration of each pressure test shall be at least two (2) hours.

c. Procedure

Each section of pipe shall be slowly filled with reclaimed water and the specified test pressure, measured at the lowest point of elevation, shall be applied by means of a pump connected to the pipe in a satisfactory manner. The pump, pipe connection, gauges, meter and all necessary apparatus shall be furnished by the Contractor. The test shall be applied to each valved section to check the leakage through all valves.

d. Expelling Air Before Test

Before applying the specified test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made, if necessary, at points of highest elevation, and afterwards tightly plugged.

e. Definition of Leakage

Leakage is defined as the quantity of reclaimed water to be supplied into the newly laid pipe, or any valved section of it, necessary to maintain the specified leakage test pressure.

f. Permissible Leakage

Suitable means shall be provided by the Contractor for determining the quantity of reclaimed water lost by leakage under normal operating pressure. No pipe installation will be accepted until or unless this leakage (evaluation at specified

pressure) is less than the specified allowance calculated using the nominal factors in the following table:

| Nominal Pipe Size | Gal/2 Hour per 1,000 FT of PVC |
|-------------------|--------------------------------|
| 2" | 0.34 |
| 3" | 0.50 |
| 4" | 0.66 |
| 6" | 1.00 |
| 8" | 1.32 |
| 10" | 1.66 |
| 12" | 1.98 |
| 14" | 2.32 |
| 16" | 2.64 |
| 18" | 2.98 |
| 20" | 3.32 |
| 24" | 3.98 |

Calculation of the specified allowance is based on the length of pipe divided by 1,000 and then multiplied by the factor supplied in the above table (according to pipe size) as demonstrated below:

$$\frac{\text{Length of Pipe (in FT)}}{1,000 \text{ FT}} \times \text{Factor}$$

g. Variation From Permissible Leakage

Should any test of combined sections of pipe laid disclose leakage greater than the specified limit, the Contractor shall, at his own expense, locate and repair the defective joints until the leakage is within the specified allowance.

h. Reclaimed Water for Testing

Reclaimed water for testing shall be provided by PWS at no cost to the Contractor.

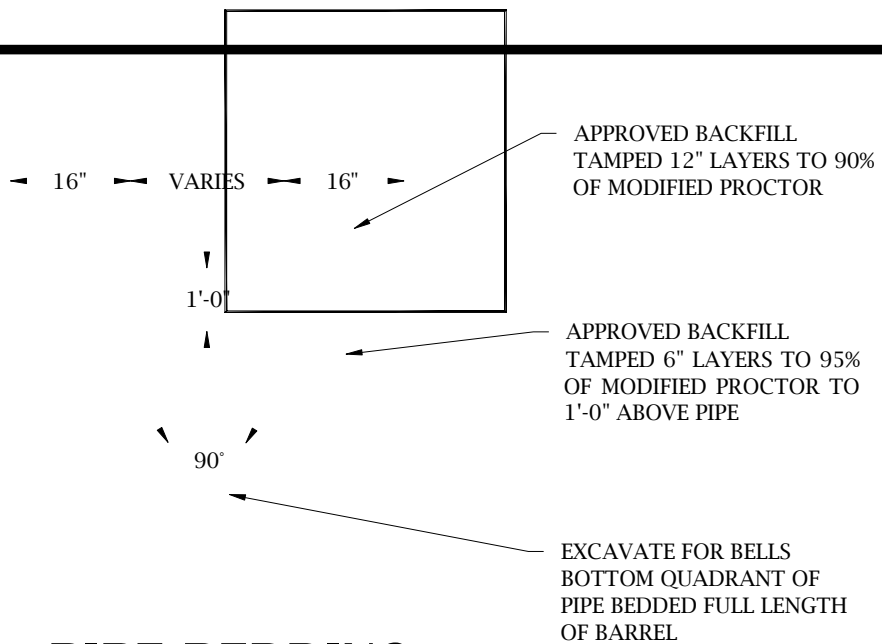


i. Time for Making Test

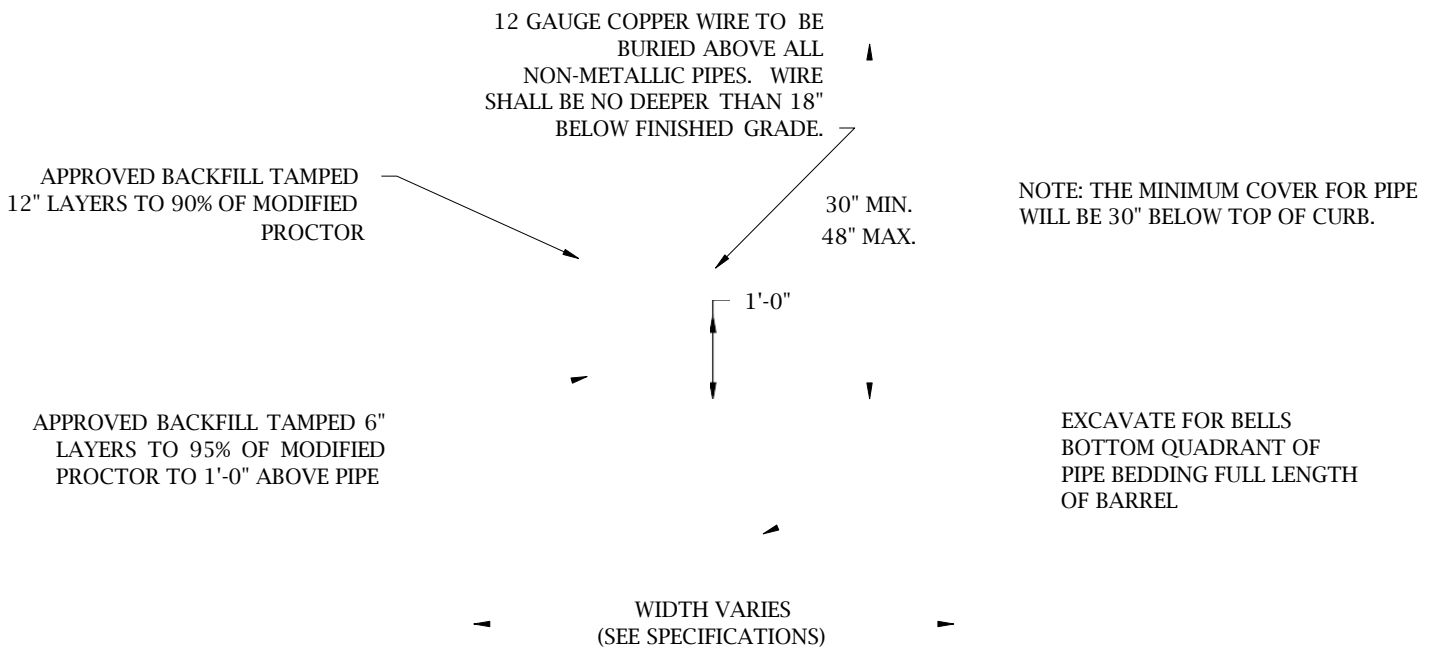
Pipe may be subjected to hydrostatic pressure, inspected, and tested for leakage at any convenient time after partial completion of backfill. The Contractor may test the system with joints exposed or with backfilling complete at his option; however, not more than 300 feet of trench may be open at any time. The Engineer and PWS shall be notified at least 48 hours before beginning testing.

4.2 DETAILS

END OF CHAPTER 4



PIPE BEDDING



TYPICAL PRESSURE PIPE INSTALLATION

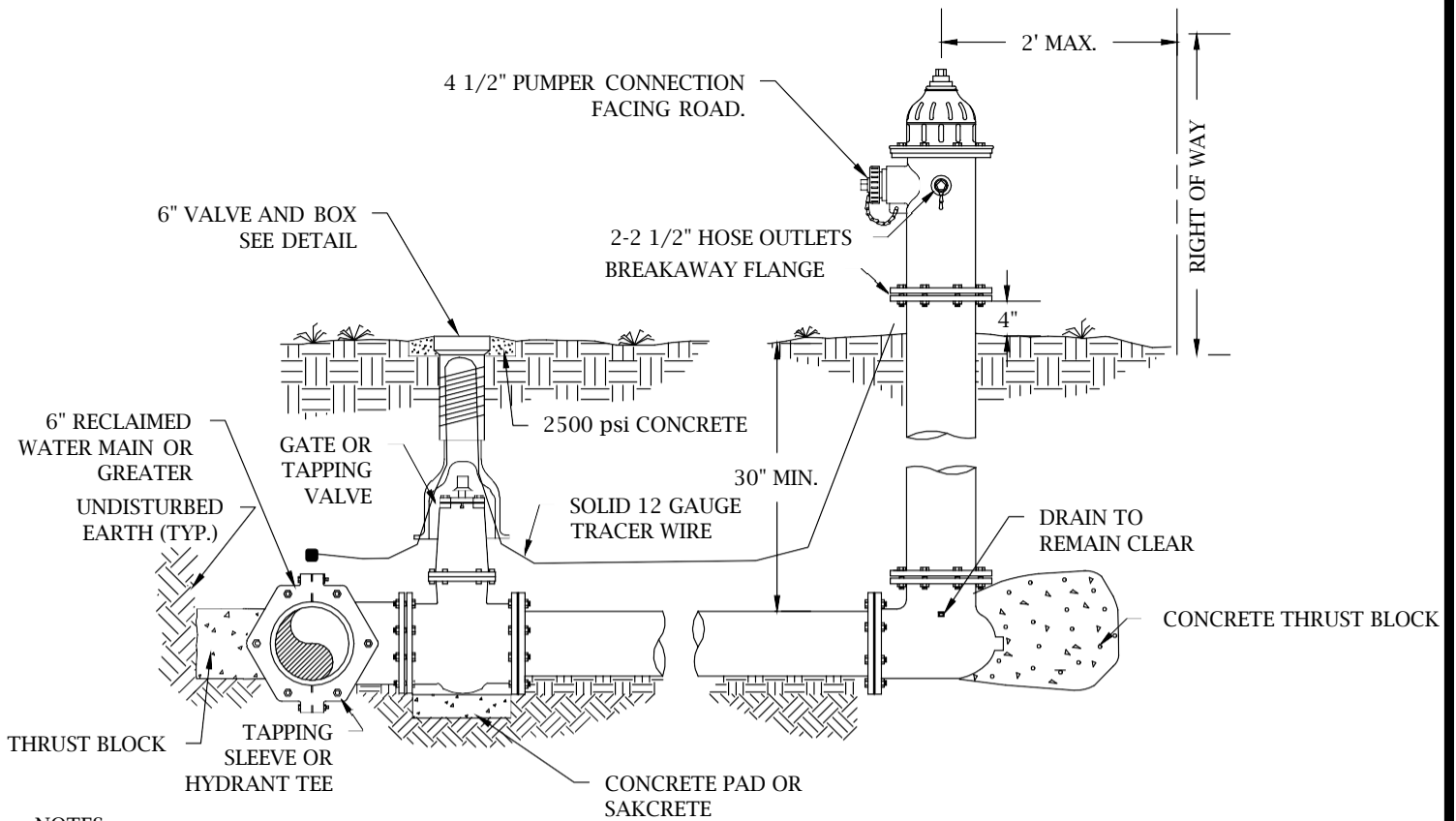
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PIPE BEDDING & TYPICAL PRESSURE PIPE INSTALLATION DETAIL

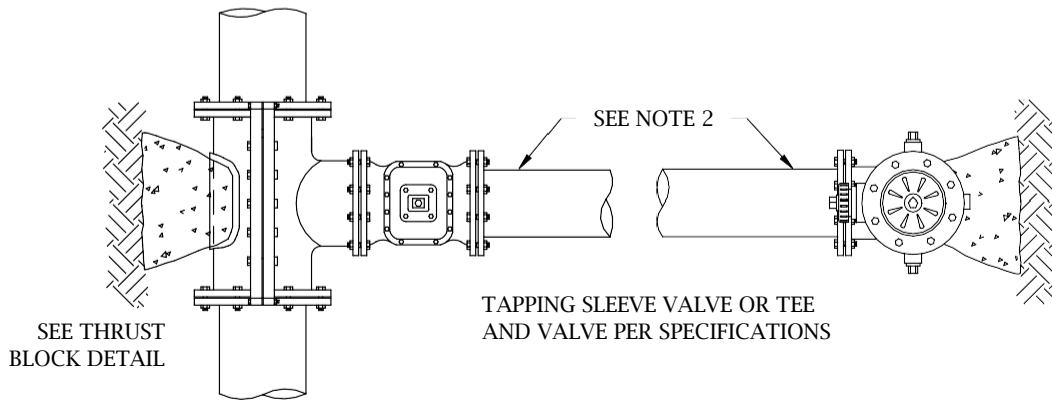
**REVISION DATE:
2024**

**DETAIL #:
RW-1**

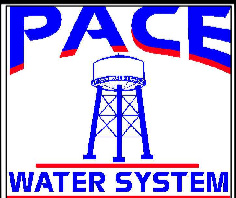


NOTES:

- 1) ALL JOINTS FROM THE HYDRANT THRU THE TEE AT THE MAIN ARE TO BE RESTRAINED D.I. M.J. WITH RETAINER RINGS.
- 2) HYDRANT CONNECTORS OR DIP HYDRANT SPOOLS OR C900 PVC WITH MEGALUG JOINT RESTRAINTS OR APPROVED EQUAL.
- 3) CONTRACTOR TO ADJUST FIRE HYDRANT TO FINISHED GRADE.
- 4) HYDRANT SHALL BE "PANTONE" IN COLOR.



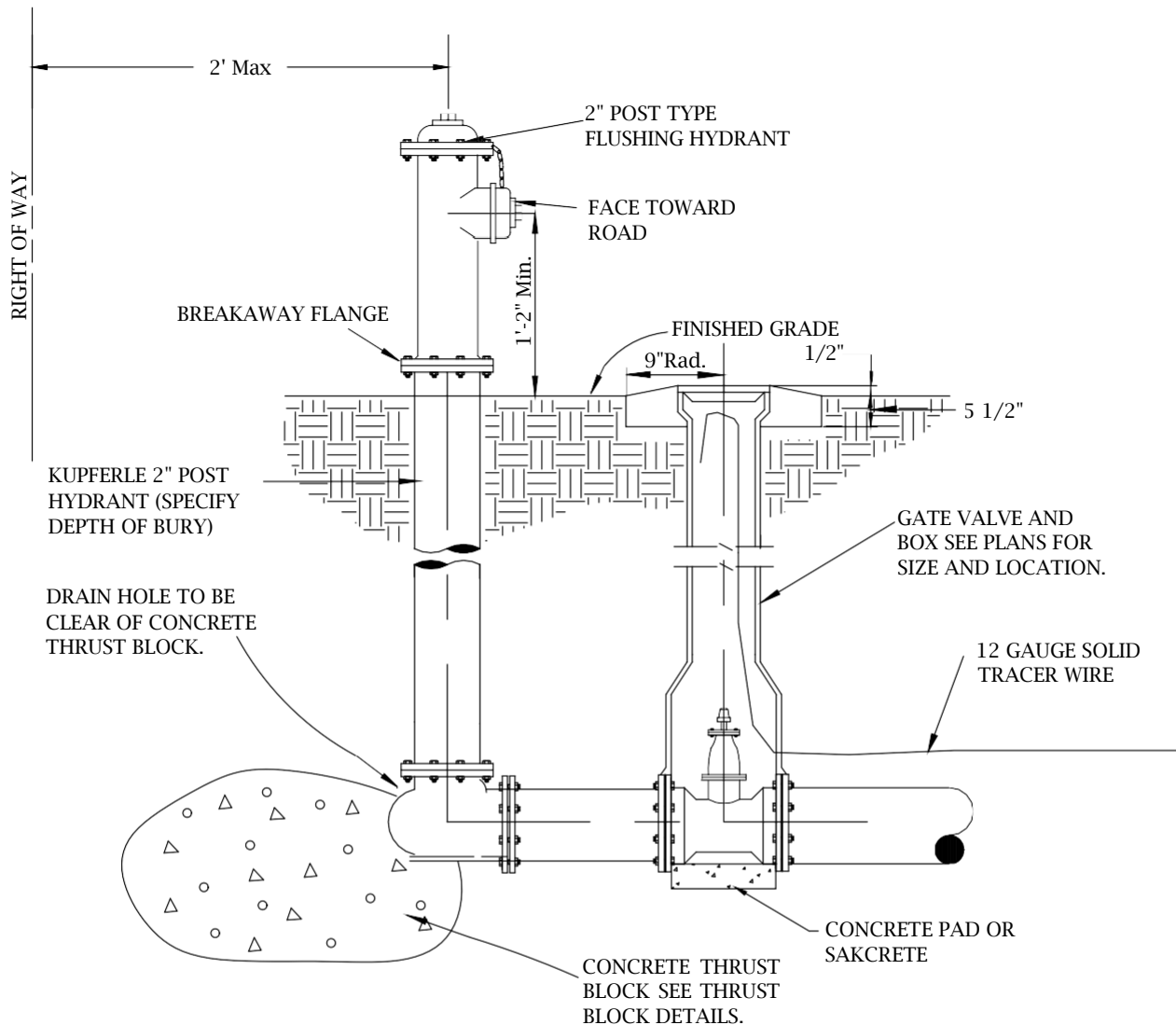
NOT TO SCALE



TYPICAL FIRE HYDRANT ASSEMBLY

**REVISION DATE:
2024**

**DETAIL #:
RW-2**



NOTES:

- 1) HYDRANTS SHALL BE SELF-DRAINING, NON-FREEZING, COMPRESSION TYPE WITH 2-3/16" MAIN VALVE OPENING. INLET CONNECTION SHALL BE (2" MJ OR 3" MJ). OUTLET SHALL BE (2-1/2" NST).
- 2) HYDRANTS SHALL HAVE A 3" DUCTILE IRON PIPE RISER WITH A CAST IRON TOP STOCK AND BOLTED FLANGE. EPOXY COATED CAST IRON BOTTOM SHOE, AND NON-TURNING OPERATING ROD. PRINCIPAL INTERIOR PARTS SHALL BE BRASS AND REMOVABLE FROM AND BE REMOVABLE FROM WITHOUT EXCAVATING THE HYDRANT.
- 3) HYDRANT SHALL BE "PANTONE" IN COLOR.

NOT TO SCALE



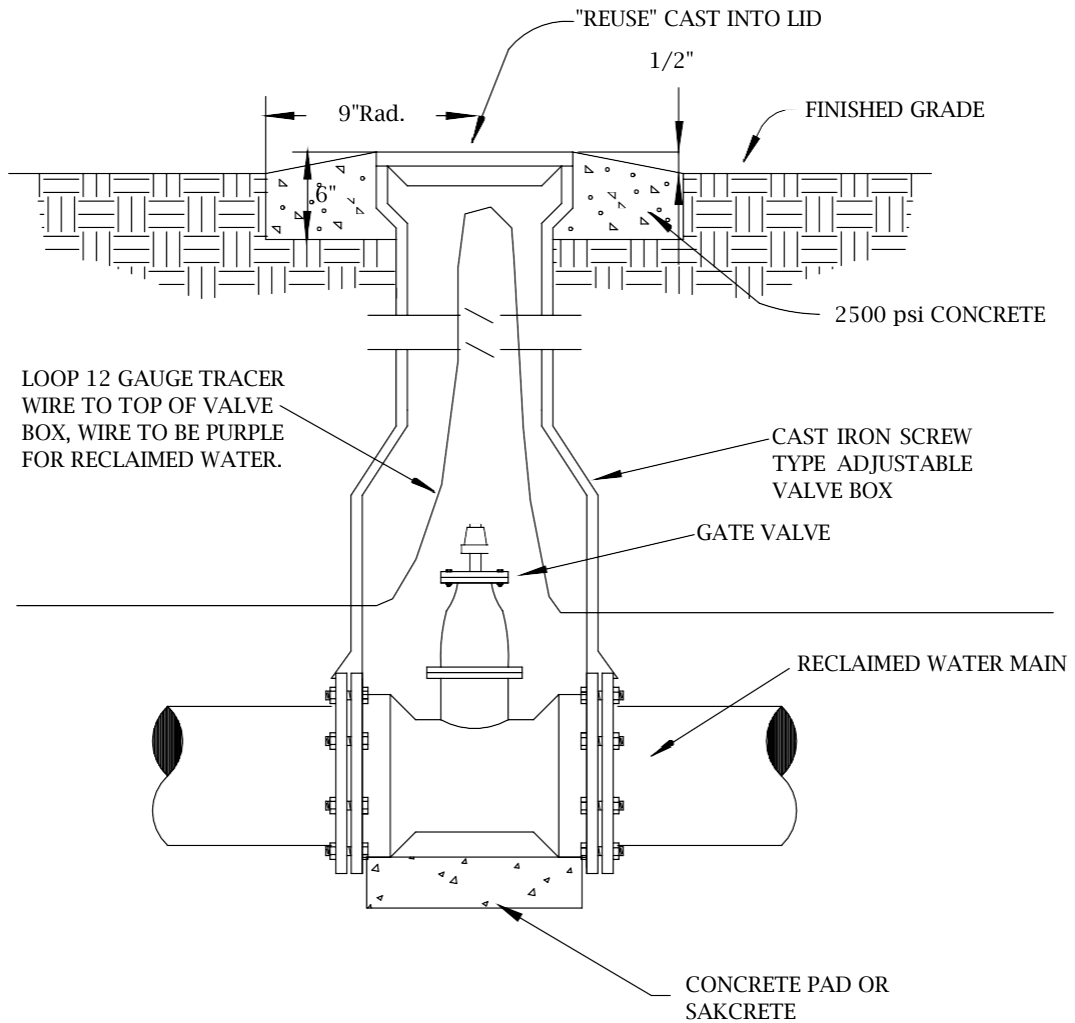
TYPICAL FLUSH HYDRANT ASSEMBLY

REVISION DATE:

2024

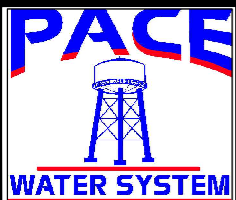
DETAIL #:

RW-3



NOTE: VALVE BOX ALIGNMENT DEVICE (VBAD) SHALL BE UTILIZED PER SPECIFICATIONS.

NOT TO SCALE

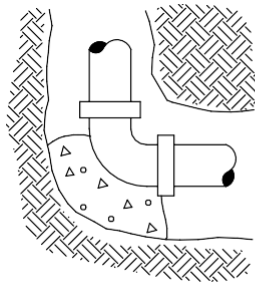


VALVE BOX SETTING DETAIL

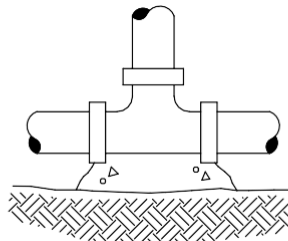
**REVISION DATE:
2024**

**DETAIL #:
RW-4**

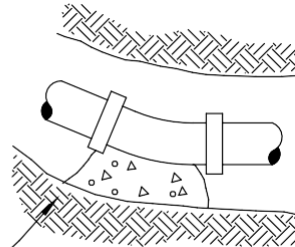
90° BEND



STANDARD TEE

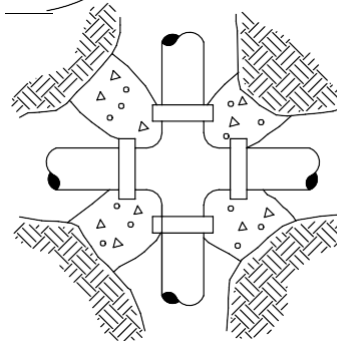
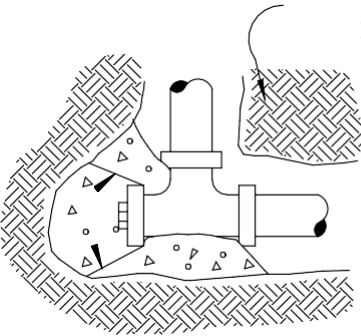


22.5° BEND



UNDISTURBED
EARTH (TYP.)

WRAP
PLASTIC
SHEETING
AROUND
FITTING



PLUG

CROSS

BEARING AREAS

| | Tee or Cap | 90° Bend | 45° Bend | 22.5° Bend |
|-----|---------------|-------------|-------------|---------------|
| 2" | 1.0 S.F. | 1.0 S.F. | 1.0 S.F. | 1.0 S.F. |
| 3" | 1.3 S.F. | 1.8 S.F. | 1.0 S.F. | 1.0 S.F. |
| 4" | 2.7 S.F. | 3.7 S.F. | 1.9 S.F. | 1.0 S.F. |
| 6" | 4.9 S.F. | 6.9 S.F. | 3.7 S.F. | 1.9 S.F. |
| 8" | 8.1 S.F. | 11.3 S.F. | 6.2 S.F. | 3.2 S.F. |
| 10" | 11.7 S.F. | 16.4 S.F. | 8.9 S.F. | 4.6 S.F. |
| 12" | 17.6 S.F. | 24.6 S.F. | 13.4 S.F. | 6.9 S.F. |

NOTE:
MINIMUM THICKNESS OF THRUST BLOCKS TO BE 12" WITH AREA AS ABOVE.

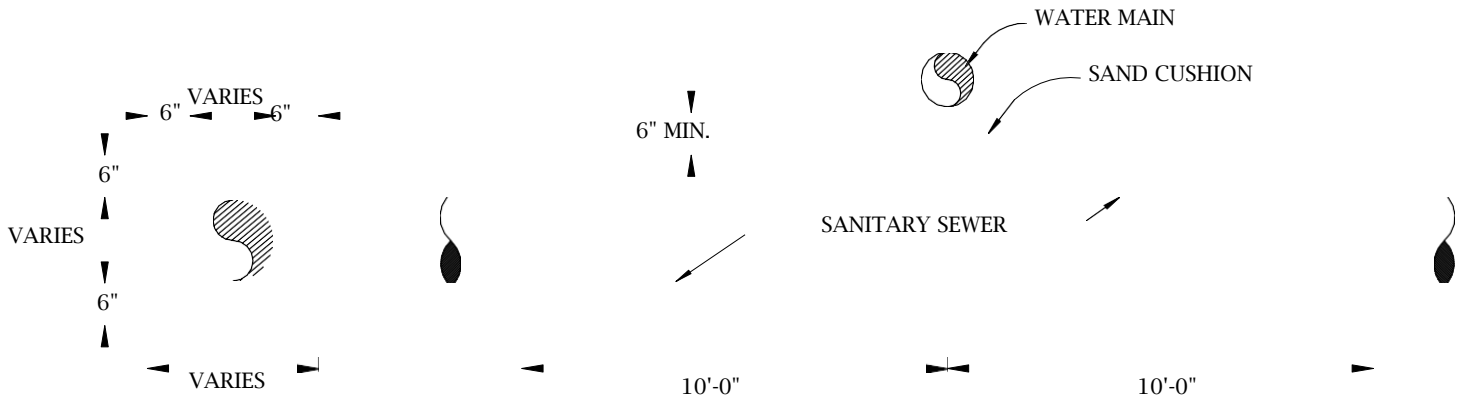
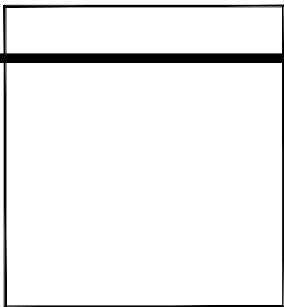
NOT TO SCALE



THRUST BLOCK DETAILS

**REVISION DATE:
2024**

**DETAIL #:
RW-5**



NOTES:

PIPE CROSSING

USE CONCRETE ENCASEMENT WHERE A SEWER MAIN CROSSES OVER A REUSE MAIN OR WHERE A REUSE MAIN CROSSES OVER A SEWER MAIN WITH LESS THAN 18" OF VERTICAL CLEARANCE BETWEEN THE BOTTOM OF THE WATER MAIN AND THE TOP OF THE SEWER MAIN.

PARALLEL MAINS

CONTACT ENGINEER IN LOCATIONS WHERE WATER AND SEWER MAINS ARE PLACED WITH LESS THAN 6' HORIZONTAL SEPARATION AND LESS THAN 18" VERTICAL SEPARATION FOR INSTRUCTION ON REQUIRED ENCASEMENT.

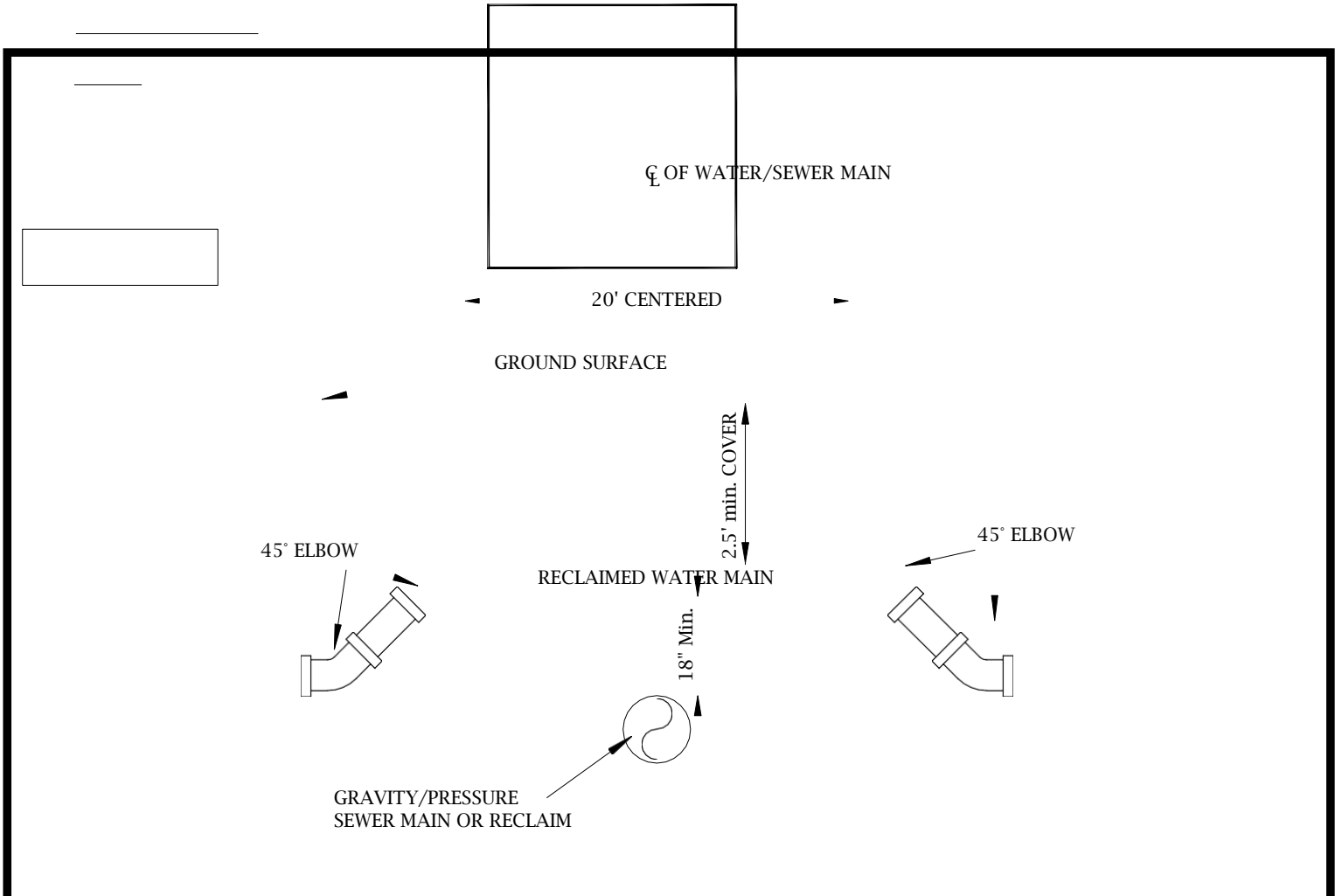
NOT TO SCALE



CONCRETE ENCASEMENT

**REVISION DATE:
2024**

**DETAIL #:
RW-6**



RECLAIMED WATER IS TO BE ROUTED ABOVE SANITARY SEWER COLLECTION MAIN IF MINIMUM COVERAGE SPECIFIED CAN BE OBTAINED. IF SAID MINIMUM COVERAGE IS NOT POSSIBLE, RECLAIMED WATER IS TO BE ROUTED BELOW SANITARY SEWER LINE.

NOTES:
 CENTERING A 20' SECTION OF SANITARY SEWER/ WATER MAIN PIPE AT CROSSING MAY BE USED IN LIEU OF ENCASEMENT.

ALL 45° FITTINGS TO BE DUCTILE IRON.

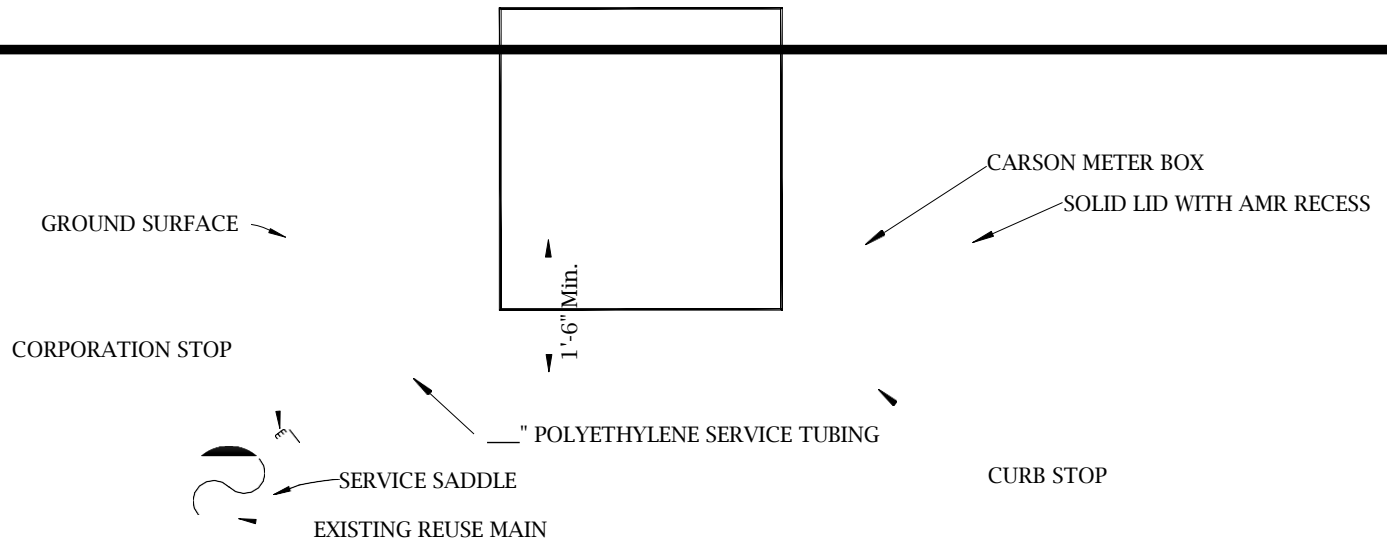
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CONFLICT DETAIL

**REVISION DATE:
 2024**

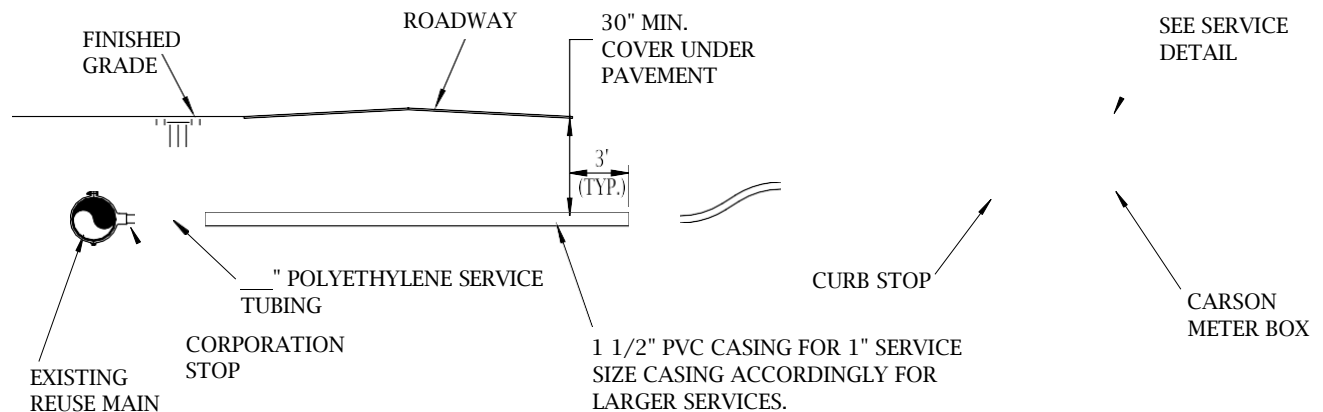
**DETAIL #:
 RW-7**



NOTES

- 1) ACCEPTABLE ABOVE GROUND BACKFLOW PREVENTION DEVICE SHALL BE INSTALLED ON THE PROPERTY OWNER SIDE OF ALL COMMERCIAL CONNECTIONS AND ALL RESIDENTIAL CONNECTIONS WITH SECONDARY WATER SOURCE.
- 2) ALL COMMERCIAL TAPS WILL BE MADE BY CONTRACTOR WITH PWS INSPECTOR PRESENT. CONTRACTOR TO FURNISH ALL MATERIALS EXCEPT METER (5/8" TO 1-1/2" BY PWS). METERS 2" AND GREATER SHALL BE PURCHASED BY CONTRACTOR THRU PWS.
- 3) CONTRACTOR TO MARK LOCATION OF SERVICES WITH A TREATED 2"X4" STAKE 6' ABOVE THE GROUND AND PAINTED PURPLE.
- 4) SERVICE LINE CONNECTIONS ACROSS ROADWAY SHALL BE BORED UNDER ROADWAY. SERVICE LINE SHALL BE ENCASED IN 1 1/2" PVC. CASING TO EXTEND 3' BEYOND EDGE OF PAVEMENT.
- 5) CONTRACTOR SHALL INCLUDE ALL SERVICES IN THE PRESSURE TEST OF THE PROPOSED RECLAIMED WATER MAIN.

COMMERCIAL/RESIDENTIAL WATER SERVICE CONNECTION



NOTE

- 1) IF SERVICE IS UNDER SIDEWALK EXTEND CASING PAST SIDEWALK.

TYPICAL SERVICE LINE ROADWAY CROSSING

NOT TO SCALE



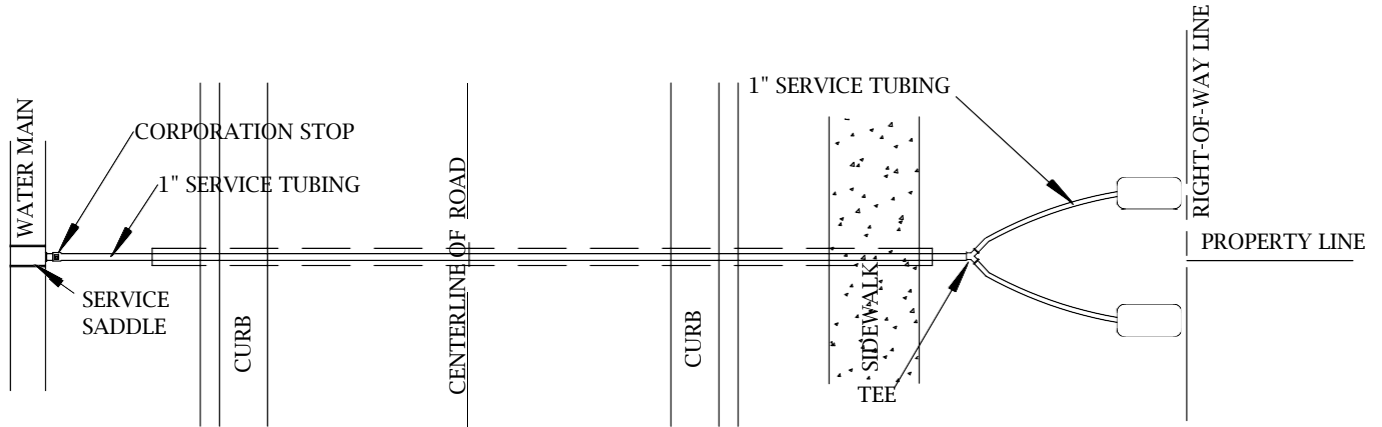
WATER SERVICE DETAILS

REVISION DATE:

2024

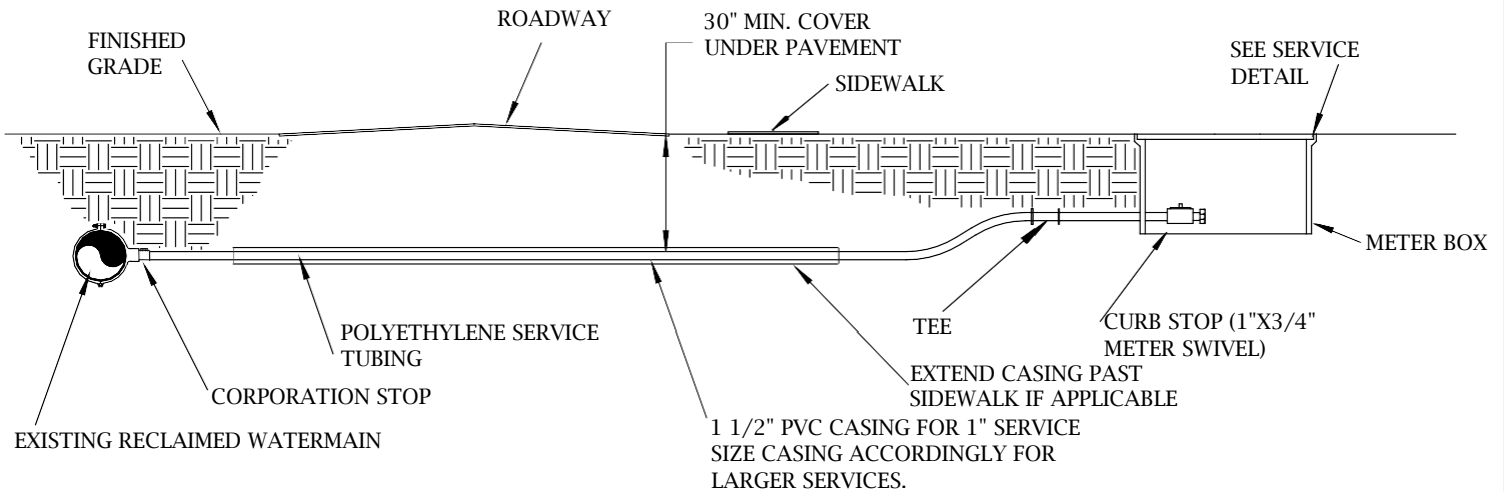
DETAIL #:

RW-8



NOTE: IF SERVICE IS UNDER SIDEWALK EXTEND CASING PAST SIDEWALK.

DOUBLE WATER SERVICE CONNECTION DETAIL



DOUBLE WATER SERVICE ROADWAY CROSSING

NOT TO SCALE

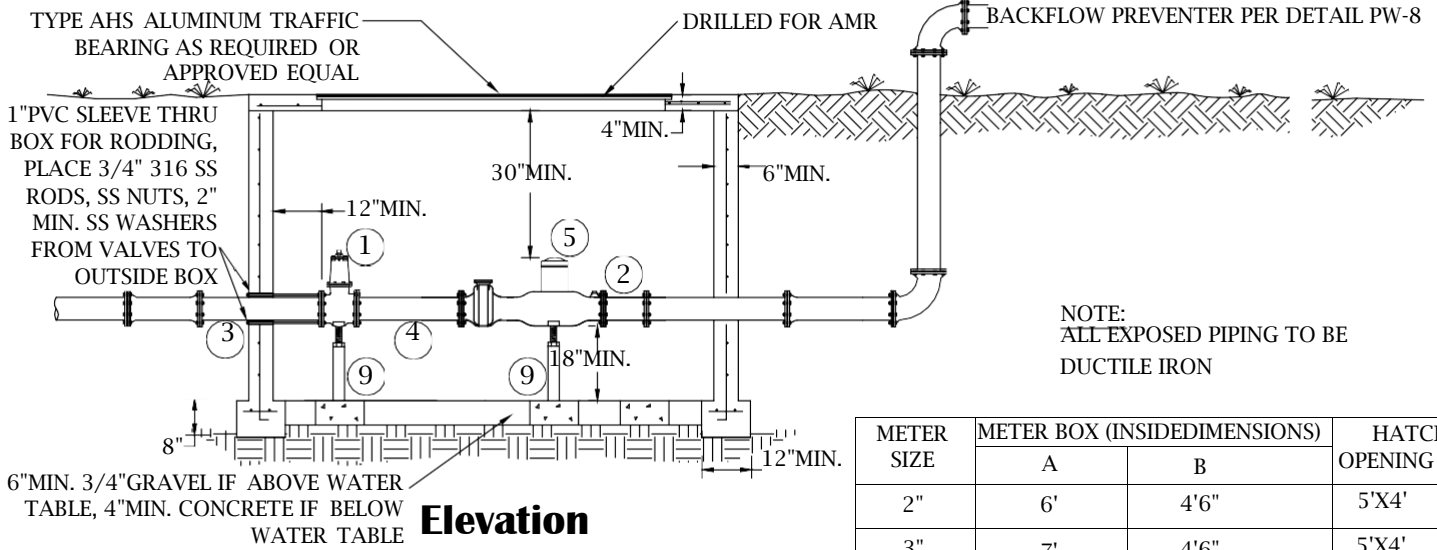
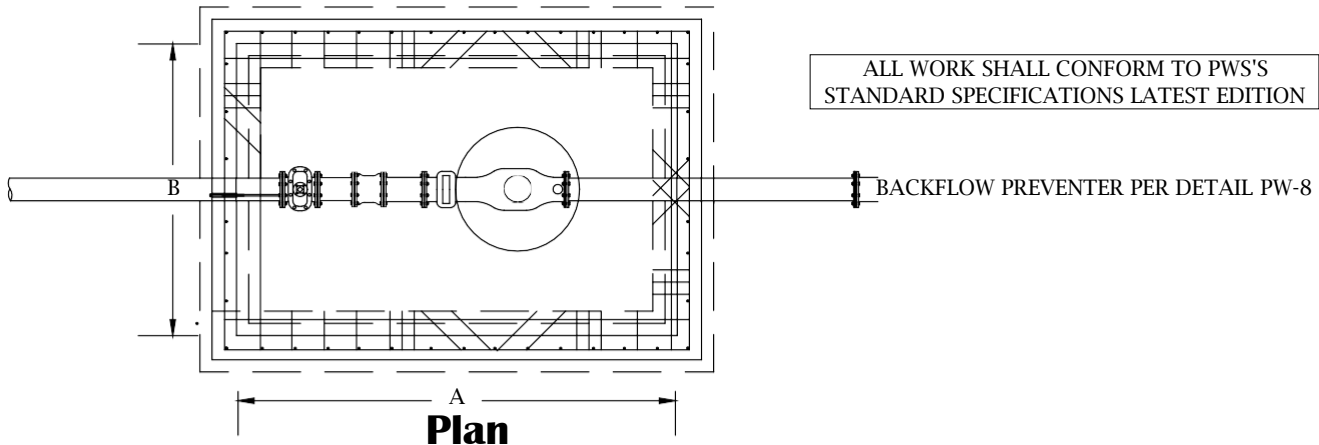


DOUBLE WATER SERVICE CONNECTION

**REVISION DATE:
2024**

**DETAIL #:
RW-9**

ALL WORK SHALL CONFORM TO PWS'S
STANDARD SPECIFICATIONS LATEST EDITION



NOTE:
ALL EXPOSED PIPING TO BE
DUCTILE IRON

| METER SIZE | METER BOX (INSIDE DIMENSIONS) | | HATCH OPENING SIZE |
|------------|-------------------------------|------|--------------------|
| | A | B | |
| 2" | 6' | 4'6" | 5'X4' |
| 3" | 7' | 4'6" | 5'X4' |
| 4" | 7' | 5' | 5'X4' |
| 6" | 7' | 5' | 5'X4' |

*SIZE TO BE APPROVED BY PWS

- ① M.J. GATE VALVE (3" OR LARGER) OR WHEEL VALVE (2" ONLY)
- ② DISMANTLING JOINT
- ③ FLANGED BY PLAIN END DUCTILE IRON CEMENT LINED PIPE
- ④ FLANGED BY FLANGED DUCTILE IRON CEMENT LINED PIPE
- ⑤ METER (BY PWS)
- ⑥ HATCH OPENING CENTERED IN VAULT
- ⑦ VAULT TO BE CONCRETE OR FIBERGLASS
- ⑧ ALL SERVICES 3" OR GREATER MUST BE HARD PIPED (INSTALL TEE BY SERVICE SIZE EXCEPT FOR EXISTING MAINS, THEY MAY BE WET TAPPED)
- ⑨ 316 SS ADJUSTABLE JACK STAND

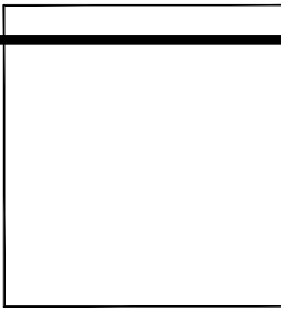
NOT TO SCALE



COMMERCIAL METER DETAIL 2" AND LARGER

**REVISION DATE:
2024**

**DETAIL #:
RW-10**

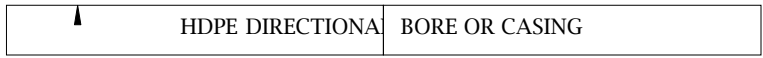


RIGHT OF WAY VARIES

5' MIN.



3' MIN.
COVER



SEWER/WATER MAIN/REUSE MAIN

*STEEL CASING OR FUSIBLE PVC MAY BE UTILIZED AS AN ALTERNATIVE.

NOTES:

1. NO HDPE/FUSIBLE PVC JOINTS ALLOWED UNDER PAVEMENT.
2. HDPE MUST BE ONE PIPE DIAMETER SIZE LARGER THAN WATER MAIN.
3. DETAILS MAY VARY BETWEEN COUNTY AND STATE ROADS, CHECK FOR CURRENT STANDARDS.

NOT TO SCALE



ROAD CROSSING DETAIL

**REVISION DATE:
2024**

**DETAIL #:
RW-11**



CHAPTER 5 – GENERAL SPECIFICATIONS

5.1 SITEWORK

A. SCOPE

This section includes clearing and grubbing for all required areas, including the disposal of materials, grassing, paving, and clean-up as indicated on the drawings or specified herein.

B. EXISTING FACILITIES

During the course of construction, the Contractor shall provide adequate facilities to protect all structures and utilities underground, on the ground surface, or above ground. The Contractor shall hold PWS harmless against damage and claims for damage resulting from construction activity. Unless approval in writing is secured from the Utility Company or PWS, there shall be no interruption of existing services to present customers.

C. TRAFFIC

The Contractor shall provide, erect, and maintain effective barricades, danger signals, and signs in locations where required for the protection of the work and the safety of the public. Barricades or obstructions that encroach on, or are adjacent to, public rights-of-way shall be provided with lights that shall be kept burning at all times between sunset and sunrise. The Contractor shall conform to all applicable state and local laws and regulations regarding the use of streets and highways and shall be responsible for all damages resulting from any neglect or failure to meet these requirements. Watchmen and flagmen shall be provided if necessary. Work shall be arranged to cause minimum disturbance to normal pedestrian and vehicular traffic.

D. TREES AND SHRUBS

The Contractor shall clear all construction areas as necessary to provide adequate work space. Trees and permanent structures in construction areas shall be removed as indicated on the approved construction plans or as directed. Removal of valuable trees or shrubs, if required, shall be done in cooperation with PWS or the property owner in order that they may be replanted by others.

Privately owned trees and shrubs bordering the construction area(s) shall be protected from damage, and the Contractor shall take full responsibility thereof.

Preservation of trees and other vegetation is of utmost importance. The Contractor shall familiarize himself with the site and shall protect all trees not indicated for removal by PWS or Engineer.

E. CONSTRUCTION ON STREETS, RIGHT-OF-WAYS AND EASEMENTS

All obstructions along pipe lines and street rights-of-way shall be removed and the area cleared as specified to provide adequate space for the work and for control stakes and hubs. Work shall be limited to the area of the street, right-of-way or easement. Survey reference points and bench marks shall not be disturbed.

F. CLEARING AND GRUBBING

Clearing and grubbing shall be performed in all the following areas: within the rights-of-way, within the limit of work lines, in ditches, within areas where fill will be placed, around new street construction, where structures will be erected, and in all other areas indicated on the approved construction plans. It shall include the complete removal and satisfactory disposal of all timber, stumps, brush, weeds, rubbish, pavement, curb and gutter, sidewalks, driveways, and all other obstructions resting on or protruding through the surface of the existing ground. All such material shall be removed to a depth of two (2) feet below the finished grade, except as noted otherwise on the approved plans or as otherwise directed by the Engineer. All timber, logs, stumps, roots, brush, pavement, concrete, and other waste from clearing and grubbing operations shall be removed to a disposal area, obtained and permitted (if required) by the Contractor.

G. PAVEMENT REMOVAL AND REPLACEMENT

The Contractor shall cut and remove all concrete and asphalt street and alley pavement along straight lines and for such width only as is necessary for the excavation of the trench or for new road construction. Payment for asphalt repair will be limited to the width shown on the approved construction plans. Existing pavement removed, disturbed, or destroyed by the pipe construction work shall be repaired or replaced by methods and materials that will provide a finished pavement at least equal in all respects to the pavement existing before construction commenced. All pavement repair shall be completed within 30 days of cutting unless weather conditions interfere. Pavement repair shall consist of six (6) inches of crushed aggregate and two (2) inches compacted thickness of Type SI or Type III asphaltic



UTILITY DESIGN MANUAL

concrete conforming to the latest edition of Florida Department of Transportation “Standard Specifications for Road and Bridge Construction.” Crushed aggregate shall be placed upon compacted backfill and the street or alley then opened to traffic. After all existing pavement has been sawed or cut along straight lines, surfacing material shall be placed as directed by the Engineer. Until the surfacing material is placed, the surface of the trench shall be maintained in smooth riding condition with all potholes and depressions filled to surface to the satisfaction of the Owner. Unauthorized removal of pavement shall be replaced at the Contractor’s expense. In addition, all Santa Rosa County requirements for pavement removal and replacement shall be met.

H. SIDEWALK, DRIVEWAY AND CURB AND GUTTER REPLACEMENT

Existing sidewalks and paved driveways, including curb and gutter, that are removed, disturbed or destroyed by construction shall be replaced or repaired. The finished work shall be equal or superior in all respects to the original. Stone, shell or slag driveways shall be repaired or replaced in the same manner. All concrete sidewalks and driveways shall be replaced to the nearest construction joint. Concrete for sidewalks, driveways and curb and gutter shall be 2500 psi. Sidewalks shall be four (4) inches thick, and driveways shall be five (5) inches thick. Unauthorized removal of sidewalk, driveway or curb and gutter material shall be replaced at the Contractor’s expense.

I. GRASSING

All disturbed areas not paved or covered by structures shall be grassed or sodded except as otherwise indicated on the construction plans. Seed or sod shall match existing established grass. In other cases, seed and fertilizer shall be applied as specified in the following table:

| DEC thru FEB Mix 1A | Seed | Rates per 1,000 Square Feet | | |
|---------------------------|------------------|-----------------------------|-----------|---------------|
| | | Fertilizer | Limestone | Maintenance** |
| Pensacola Bahiagrass | 25 lbs. per acre | 30 lbs. | 100 lbs. | 10 lbs. |
| Reseeding Crimson Clover* | 30 lbs. per acre | 15-10-15 | | 10-10-10 |
| Bermuda Grass (Unhulled) | 25 lbs. per acre | | | |
| Annual Ryegrass | 20 lbs. per acre | | | |
| MAR thru AUG Mix 2A | Seed | Rates per 1,000 Square Feet | | |
| | | Fertilizer | Limestone | Maintenance** |
| Pensacola Bahiagrass | 20 lbs. per acre | 30 lbs. | 100 lbs. | 10 lbs. |
| Bermuda Grass (Hulled) | 20 lbs. per acre | 5-10-15 | | 10-10-10 |
| Brown Top Millet | 25 lbs. per acre | | | |



UTILITY DESIGN MANUAL

| SEP thru NOV Mix 3A | Seed | Rates per 1,000 Square Feet | | |
|---------------------------|------------------|-----------------------------|-----------|---------------|
| | | Fertilizer | Limestone | Maintenance** |
| Pensacola Bahiagrass | 25 lbs. per acre | 30 lbs. | 100 lbs. | 10 lbs. |
| Reseeding Crimson Clover* | 30 lbs. per acre | 5-10-15 | | 10-10-10 |
| Bermuda Grass (Unhulled) | 30 lbs. per acre | | | |
| Annual Ryegrass | 20 lbs. per acre | | | |

* Requires inoculation

** Maintenance fertilizer shall be applied in early spring following initial establishment of cover

The mulch material shall be Pangola, peanut, wheat straw, oat straw, Bermuda or Bahia grass hay. The mulch shall be spread at a rate of nine (9) tons per acre and cut into the soil or anchored in a satisfactory manner. Mulch shall be free from undesirable weeds and other undesirable grasses. The Contractor will be required to repair, at his own expense, any significant damage due to washout, erosion, or other causes that occur within 60 days of acceptance by PWS.

J. CLEANUP

Debris, unused material, and waste material shall be removed from the site as soon as practicable during construction. Immediately upon completion of backfilling, the site shall be cleaned and regraded and all debris and surplus materials removed. Trenches not properly filled and embankments not properly completed shall be refilled or replaced and made to conform to the original grade, line and surface.

The Contractor shall repair any areas paved or unpaved where settlement occurs at his expense. Paved areas shall be kept clean at all times and left broom clean upon completion of the work.

K. EROSION CONTROL

The Contractor shall take all measures necessary to control stormwater and erosion during construction. Silt fencing shall be employed in all locations adjacent to FDEP Jurisdictional Wetlands to ensure that sedimentation does not wash from any portion of the construction into the wetlands. Silt fencing and/or hay bales shall be used for sedimentation control in all locations as shown on plans or as directed by PWS or the Engineer. Silt fencing is to be constructed in accordance with Florida Department of Transportation specifications contained in the Florida Department of Transportation publication "Instructions for Design Standards," latest edition.

L. VIDEO OF PROJECT SITE

The entire construction area, including all structures, shall be videoed prior to commencement of any construction activities. Two (2) copies of the video shall be provided to PWS on USB flash drives before “Notice to Proceed” will be issued (applies to PWS projects).

5.2 EARTHWORK

A. SCOPE

This section includes dewatering, excavating, shoring, filling, backfilling, compacting, and grading as indicated on the drawings and specified herein.

B. SOIL CONDITIONS

The Contractor shall satisfy himself as to the character and number of different materials and the subsurface conditions to be encountered prior to commencement of work.

C. UNDERGROUND FACILITIES

Underground structures and utilities shall be shown on the drawings and located according to the most recent edition of ASCE Standard 38-02, “Standard Guidelines for the Collection and Depiction of Existing Subsurface Utility Data,” Quality Level B. It shall be the Contractor’s responsibility to locate all underground structures and utilities along the line of work in advance of construction so that conflict with existing facilities is avoided. The Contractor shall create a ticket with Sunshine 811 a minimum of two (2) days prior to beginning excavation operations to have existing underground utilities located in areas of excavation. The Contractor shall not hold PWS accountable for inaccuracies or omissions in the location of underground facilities. If utilities are indicated on the approved construction plans to remain in place, the Contractor shall provide adequate means of support and protection during earthwork operations.

D. CONFLICTS

Where conflicts with existing facilities are unavoidable, work shall be performed to cause as little interference with existing services as possible. Facilities damaged in the prosecution of the work shall be repaired immediately in conformance with the best standard practices or according to the direction of the owner of such facility, up to and including replacement.

E. DEWATERING

Equipment shall be provided and employed to maintain the excavation in a dry condition while construction is in progress. Areas to be excavated at any one time shall be limited to those that can be properly dewatered by the equipment in use. The ground adjacent to the excavation shall be sloped to prevent water from running into the excavation. Water from the excavation shall be discharged such that it will not injure or interfere with the normal drainage of the area in which the work is being performed and will not cause damage to any part of the work or to public or private property. All gutters, drains, inlets, culverts, and sewers shall be kept clean and open for surface drainage. Water shall not be directed across pavement except through approved pipes or other means. The Contractor shall obtain permission from the owner of the property involved before digging ditches or constructing water courses for the removal of water and shall provide for discharge of the water without creating a public nuisance. The Contractor shall provide complete standby equipment for use if any portion of the dewatering equipment should fail or not operate acceptably.

The Contractor shall be responsible for and ensure all effluent water from the dewatering operations meets or exceeds FDEP water quality standards prior to entering jurisdictional water bodies.

F. SHORING

When necessary to protect workers, banks, adjacent paving, structures, and utilities, excavations shall be shored and braced by members of suitable size and arrangement. Shoring, bracing, and sheeting shall be removed as excavations are backfilled, in a manner to prevent injurious caving. Where directed by the Engineer, the sheeting shall be left in place in the backfill with proper bracing to provide lateral support.

G. EXCAVATION

1. General

Excavation shall be performed in accordance with all applicable federal, state, and local regulations. Blasting will be permitted only on an individual case by case basis. Muck and other soft unsuitable material occurring within or below the limits of the structure or other facility shall be completely removed and replaced with approved, suitable material at the Contractor's expense. Excavations carried below depths indicated, without specific direction from the Engineer, shall be backfilled to the proper grade with thoroughly compacted suitable fill, except that in excavations for footings, the concrete shall be extended to the bottom of the excavation, all at no additional cost to PWS.

2. Excavation for Pipework

All excavations shall be made along straight lines by open cuts unless otherwise authorized by the Engineer or otherwise shown on the approved construction plans. Holes for pipe bells shall be hand-excavated to ensure that the pipe rests upon the bottom of the trench for its entire length. If the bottom of the excavation is found to consist of any material that cannot be excavated to give a uniform bearing surface, the material shall be removed to a depth at least six inches below established bottom grade and backfilled to grade with thoroughly compacted sand at the Contractor's expense. Any excavations carried below the depths indicated, without specific direction from the Engineer, shall be backfilled in the same manner at no additional cost to PWS. Trench width measured at one (1) foot above the top of pipe for all pipe other than that approved for assembly prior to installation in the trench shall be the outside diameter of the pipe plus 16 inches. Where sheeting or shoring is used, the allowable width shall be measured between the inside faces of the sheeting or shoring.

For all pressure line piping approved for complete assembly prior to installation in the trench, the minimum trench width shall be the outside diameter of the coupling or joint plus two (2) inches.

Excavated material to be used for backfill shall be neatly deposited at the sides of the trenches where space is available. Where stockpiling of excavated material is required, the Contractor shall obtain the sites to be used and maintain operations to provide for natural drainage and not present an unsightly appearance. Rock, shell, or other base materials for roads and alleys shall be carefully selected and kept separate. Grade and line stakes shall be protected. No excavated material shall be placed on private property without prior consent of the property owner.

3. Dewatering for Pipework

Dewatering, if required, shall continue during construction to keep groundwater below the level of the backfill at all times until the backfill is completed. Water settling may be approved or required and shall consist of continuing the well points in service and applying water as directed to the excavation during backfill. Well point holes may be placed in undisturbed pavement only upon approval in writing by the Engineer.

4. Rock Cut for Pipework

Where the grade line of the pipe is in rock cut, initial backfill to a depth of one (1) foot over the pipe shall be with loose, dry earth or sand, compacted in accordance with this utility design manual. The remaining depth of the trench shall be backfilled using the best available material from the excavation. Excavated rock may be used, provided it is broken into pieces not larger than three (3) inches in size and sufficient fine material is included to fill the voids. No rock material shall be used within the subgrade of new road beds.

5. Topsoil

Material from the excavation suitable for topsoil shall be deposited in piles separate from other excavated material. Piles of topsoil shall be located so that the material can be used readily for the finished surface grading or as directed by PWS and shall be protected and maintained until needed. At the option of the Contractor, topsoil material for use in finished grading may be obtained from other locations, at the Contractor's expense.

H. FILLING AND BACKFILLING

1. General

All fill and backfill shall be free from organic matter such as roots, stumps, trees, refuse, or other objectionable material. Except as specified otherwise, fill and backfill shall be placed in layers not more than 12 inches thick, and each layer shall be compacted thoroughly and evenly. The moisture content of the fill material shall be such that proper compaction will be obtained. Backfill shall not be placed against concrete within seven (7) days after it has been poured and only when directed by the Engineer. In areas to be grassed, the top three (3) inches shall not be compacted.

2. Backfilling Trenches

Backfilling of trenches shall not begin prior to inspection by PWS. The initial backfill shall be carefully deposited on both sides of the pipe at the same time in well compacted

six (6)-inch layers to a density not less than 95 percent of the Modified Proctor Density until enough has been placed to provide a cover of one foot above the bell of the pipe. The remainder of the trench shall be backfilled in well-compacted eight (8)-inch layers under roadways and well-compacted 12-inch layers elsewhere. Backfill shall be compacted to a density not less than 95 percent of the Modified Proctor density for trenches under roadways and compacted to a density not less than 90 percent of the Modified Proctor elsewhere, with approved mechanical tampers to the top of the trench.

Water settling may be used where approved and shall be used where directed by the Engineer. The top material shall be used last and the surface of the trench restored to its original elevation. Under no conditions is construction debris to be included with the backfill. Excavated material consisting of mulch, mud, clay or other unstable material shall not be utilized in the backfill.

Where sheeting is withdrawn, all cavities remaining in or adjoining the trench shall be solidly filled and thoroughly compacted. Where sheeting is to remain in place, all cavities behind it shall be backfilled in the same manner as specified for trench backfill. No sheeting that has been driven below the pipe invert may be removed. Before backfilling is completed all sheeting to remain shall be cut off at a line two (2) feet below finished grade.

3. Backfill and Embankment

Compaction of general backfill and embankment shall be accomplished by means of mechanical rollers or other suitable means approved by the Engineer. Each layer or lift of embankment or backfill shall not exceed 12 inches and shall be compacted individually so that upon completion, the backfill or embankment shall have attained a compaction of 95 percent of Modified Proctor Density in accordance with ASTM D1557.

I. TESTING

1. Fill

Density of fill under structures and road beds, where permitted or indicated on the drawings, shall be determined by in-place density tests performed in accordance with ASTM D1556. The in-place densities actually obtained shall equal or exceed 95 percent of laboratory maximum densities at optimum moisture content (Modified Proctor). One test shall be performed for each 2500 square feet per layer of fill placed under each structure or roadway with a minimum of one test per layer for each structure and roadway. In-place density tests for trenches that are not under roadbeds shall be made for

each 1000 linear feet of trench, per layer of fill, with a minimum of one test per layer and shall equal or exceed 95 percent of laboratory maximum densities at optimum moisture content (Modified Proctor).

2. Laboratory Tests

Maximum densities at optimum moisture content shall be determined in accordance with ASTM D1557. The test procedure shall be in accordance with the soil type encountered.

3. Procedure

Tests shall be performed by an independent testing laboratory approved by the Engineer and reports of results shall be sent directly to the Engineer. For each test that fails to meet the specified density, one (1) additional test shall be made after additional compaction work is performed. The associated cost of all soil testing shall be paid by the Contractor.

J. GRADING

The Contractor shall grade all areas as necessary to maintain proper drainage. Fill shall be brought to finish grades indicated and shall be graded to drain water away from structures. Roadway grading shall include all required grading within the roadway rights-of-way, construction limits and/or limit of work lines as indicated on the approved construction drawings and/or directed by the Engineer. Grading shall include all excavating, hauling, shaping, sloping, mixing and compacting necessary for the construction, preparation and completion of all embankments, subgrades, shoulders, ditches, slopes, intersections, and turn-outs, all in accordance with the required alignment, grade, cross sections, and notes shown on the drawings.

K. OVERALL AREA GRADING FOR WHICH NO GRADES ARE INDICATED

Within the limits of construction and outer limits of clearing and grubbing, all holes and other depressions shall be filled, all mounds and ridges cut down, and the area brought to sufficiently uniform contour that PWS's or the owner's subsequent mowing operations will not be hindered by irregular terrain. This work shall be done regardless of whether the irregularities were the result of the Contractor's operations or originally existed. Permanent ponds or other permanent water areas, as so designated by the Engineer, will not be required to be filled.

L. BORROW

Should there be insufficient satisfactory material from the excavation to meet the requirement for fill material, borrow shall be obtained by the Contractor, at his expense and subject to approval by the Engineer.

M. EXCESS MATERIAL

Excess excavated material and material not suitable for reuse as backfill, shall be immediately disposed of at an off-site location at the Contractor's expense.

5.3 CONCRETE

A. SCOPE

The ed herein, and subject to the terms and conditions of the Contract. These specifications shall not apply to concrete used for construction of buildings.

B. RESPONSIBILITIES AND COOPERATION

1. The Contractor shall be held responsible for all material meeting all requirements as herein specified, for the adequacy of all formwork, and for all workmanship.
2. The Contractor shall cooperate with all other trades, whether or not in his control, in permitting the forming and setting of sleeves, inserts, bolts, hangers, openings, or any other items that may be necessary.
3. The Contractor shall cooperate fully with the Engineer and PWS Representative. The Engineer and PWS Representative shall be notified sufficiently in advance of all pours so they, or any designated representative, may inspect and approve the placement of all reinforcing steel, formwork, and the concrete operation.
4. The Contractor shall comply with the provisions of the following codes, specifications and standards, except where more stringent requirements are shown or specified:
 - American Concrete Institute (ACI) 302 "Guide to Concrete Floor and Slab Construction"
 - ACI 318 "Building Code Requirements for Structural Concrete"
 - Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice"

- ACI 350R “Code Requirements for Environmental Engineering Concrete Structures and Commentary”
- 5. The Contractor shall employ, at Contractor’s expense, a testing laboratory acceptable to the Engineer and PWS to perform material evaluation tests and to design concrete mixes.
- 6. Materials and installed work may require testing and retesting, as directed by the Engineer and/or PWS Representative, at any time during progress of the work. The Contractor shall allow free access to material stockpiles and facilities. Tests, not specifically indicated to be done at PWS’ expense, including retesting of rejected materials and installed work, shall be done at the Contractor’s expense.

C. MATERIALS

ASTM or other standards and specifications indicate the latest edition.

1. Portland Cement

Portland cement shall be ASTM C595, Type IS (MS) or IS-A (MS or Type II [the C₃A content of the cement shall not be less than eight (8) percent]).

2. Concrete Aggregate

Concrete aggregate shall conform to ASTM C33.

a. Fine Aggregate

Fine aggregate shall consist of natural sand. All sand shall react to ASTM Colorimetric Test for Organic Matter, with a color not darker than the standard referenced color of ASTM C40.

b. Coarse Aggregate

Coarse aggregate shall consist of crushed stone, gravel, or other approved material (slag shall not be used) having clean, hard, durable uncoated particles. The maximum size of aggregate shall pass through a ¾-inch screen, except the maximum size of aggregate for concrete in pile caps, footings, slabs-on-grade, or concrete with no reinforcing, may be 1-1/2 inches. All are to be graded from coarse to fine within limits required by ASTM C33. Dust or other fine particles in excess of two (2) percent will not be permitted.

3. Water

Water for concrete shall be clean and free from deleterious substances.

4. Metal Reinforcing

a. Bars

Bars shall be new conforming to ASTM A615, Grade 60. All reinforcing bars shall be bent cold and shall be free from scale, oil, dirt and structural defects. Fabrication shall be performed in accordance with ACI Standard Practices. Bars shall be stored at least six (6) inches above the ground. Three (3) copies of mill tests of all steel shall be submitted to the Engineer and PWS before shipment is made.

b. Welded Wire Fabric

Welded wire fabric shall conform to ASTM A185.

c. Wire

Wire for tying bars shall be 16-gauge annealed iron wire.

d. Accessories

Accessories for metal reinforcement shall include chairs, bolsters, or other apparatus as specified by the fabricator and shall be sufficiently strong to maintain bars in position. Stainless steel or plastic tip accessories shall be used where accessory support is in the same plane as the face of concrete surfaces which will remain exposed to view.

5. Preformed Expansion Joints

Preformed expansion joint filler shall meet ASTM D1751 or D1752 and requirements as shown on the approved construction plans.

6. Joint-Sealing Material

Joint-sealing materials shall comply with ASTM C920.

7. Concrete Admixtures

a. Water Reducing Admixture

Water reducing admixtures shall be “Eucon WR 75” by the Euclid Chemical Company, “Pozzolith 200N” by Master Builders Solutions Admixtures, or “Plastocrete” by Sika Corporation. The admixture shall conform to ASTM C494, Type A, and not contain more chloride ions than are present in municipal drinking water.

b. Water Reducing, Retarding Admixture

Water reducing, retarding admixtures shall be “Eucon Retarder 75” by the Euclid Chemical Company, “Pozzolith 100XR” by Master Builders Solutions Admixtures, or “Plastiment” by Sika Corporation. The admixture shall conform to ASTM C494, Type D, and not contain more chloride ions than are present in municipal drinking water.

c. High Range Water Reducing Admixture (Superplasticizer)

High range water reducing admixtures shall be “Eucon 37” by the Euclid Chemical Company or “Sikament” by Sika Corporation. The admixture shall conform to ASTM C494, Type F or G, and not contain more chloride ions than are present in municipal drinking water.

d. Non-Chloride Accelerator

Non-chloride accelerators shall be “Accelguard 80” by the Euclid Chemical Company, or approved equivalent. The admixture shall conform to ASTM C494, Type C or E, and not contain more chloride ions than are present in municipal drinking water.

e. Air Entraining Admixture

Air entraining admixtures shall conform to ASTM C260.

f. Calcium Chloride

Calcium chloride or admixtures containing more than 0.1 percent chloride ions are not permitted.

g. Certification

Written conformance to all above-mentioned requirements from the admixture manufacturer shall be provided by the Contractor, including the chloride ion content prior to mix design review by the Engineer.

8. Forms

Plywood complying with U.S. Product Standard PS-1 “B-B (Concrete Form) Plywood”, Class I, exterior grade or better, mill-oiled and edge-sealed shall be used for all formwork which will be in contact with all poured concrete, except as otherwise specified. Standard board lumber may be used for concrete below grade. Form ties for walls shall be 1” breakback, crimped snap ties.

9. Curing and Sealing Compound

The material used to cure and seal new concrete surfaces shall be Increte Clear Seal by the Euclid Chemical Company, MasterSeal 610 by the Sika Chemical Company, or approved equivalent. The compound shall conform to ASTM C309, 30 percent solids content minimum, and have test data from an independent laboratory indicating a maximum moisture loss of 0.030 grams per square centimeter when applied at a coverage rate of 300 square feet per gallon. The manufacturer’s certificate shall be provided prior to approval by the Engineer and PWS.

10. Curing and Hardening Compound

Eucosil by the Euclid Chemical Company, or approved equivalent shall be utilized. The compound shall be a sodium silicate type.

11. Bonding Compound

Euroweld by the Euclid Chemical Company, Weld-Crete by the Larsen Company, or approved equivalent shall be utilized. The compound shall be polyvinyl acetate, rewettable type.

12. Epoxy Adhesive

Euco #452 by the Euclid Chemical Company, Sikadur Hi-Mod by Sika Chemical Corporation, or approved equivalent shall be utilized. The compound shall be a two (2) component, 100 percent solids, 100 percent reactive compound suitable for use on dry or damp surfaces.

13. Epoxy Grout

High strength grout by the Euclid Chemical Company, or approved equivalent shall be utilized.

14. Non-Shrink Grout

NS Grout (non-metallic) by the Euclid Chemical Company, Masterflow 713 (non-metallic) by Sika Corporation, or approved equivalent shall be utilized. The grout shall conform to ASTM C1107.

D. CONCRETE

1. Ready-Mixed Concrete

All concrete shall be ready-mixed, either central plant mixed or transit mixed. Equipment, mixing methods, and materials must conform to ASTM C94 and other applicable ASTM standards. If directed by the Engineer or PWS Representative, the Contractor shall employ an independent testing laboratory to inspect the mixing plant to insure conformance with ASTM C94.

2. Concrete Compressive Strengths

All concrete for foundations, retaining walls, and slabs on grade shall achieve a compressive strength of 3000 psi at 28 days.

3. Design Mix

All mix designs shall be proportioned in accordance with Section 4.4 (trial batches) of ACI 318-83. The concrete manufacturer, immediately after the award of the project, shall prepare mix designs and shall submit them to the Engineer for approval. If trial batches are used, an independent laboratory, approved by the Engineer or PWS Representative, shall be used. Concrete mixes shall be designed in accordance with ACI 211.1., "Selecting Proportions for Normal-Density and High-Density Concrete Guide".

If trial batches are used, the proposed mix design shall achieve an average strength that is 1200 psi greater than the specified strength ($f'c$). The laboratory shall prove each design mix by breaking two (2) test cylinders at seven (7) days and two (2) cylinders at 28 days in conformance with ASTM C39. The seven (7)-day compressive strength must be in excess of 80% of the 28-day strength, and in excess of 115% of the specified 28-day strength for these test cylinders. The laboratory shall submit test reports to Contractor (2), Engineer (1), structural engineer (1), and concrete manufacturer (1).

The concrete design mixes shall be reviewed and approved after seven-day test cylinder results, if Contractor's time schedule requires.

The minimum cement content of all 3000-psi concrete shall be 470 lbs. per cubic yard.

4. Field Testing

The Contractor shall have an independent testing laboratory conduct tests and submit reports promptly to the Engineer/PWS Representative on the field testing of concrete, as described herein, without additional cost to PWS.

Four (4) standard test cylinders shall be made at the job site for each 50 cubic yards, or fraction thereof, of each class of concrete placed each day. The procedures of sampling, making, curing and testing shall be in strict accordance with ASTM C172, C31, C192, and C39, latest editions, respectively, and shall be properly identified as to date, time, placement location, and slump. Slump tests shall be made at the same time cylinders are made in conformance with ASTM C143. Samples shall be made by the laboratory only.

Two (2) cylinders are to be tested at seven (7) days and two (2) cylinders at 28 days, unless otherwise directed. The laboratory shall submit one copy of the report directly to the Engineer and two (2) copies to the Contractor.

The strength level shall be considered satisfactory so long as the averages of all sets of three consecutive strength test results equal or exceed the specified strength f'_c , and no individual test result falls below the specified strength f'_c by more than 500 psi.

The testing service shall make additional tests of in-place concrete when test results indicate the required strength level has not been achieved and other characteristics have not been attained in the structure, as directed by the Engineer. The testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42, or by other methods as directed. The Contractor shall pay for such tests conducted, and any additional testing as may be required, when unacceptable concrete is verified.

5. Concrete Quality

a. Air Content

All concrete exposed to freezing and thawing and/or required to be watertight shall have an air content of 4.5 percent to 7.5 percent.

b. Water-Cement Ratio

All concrete subjected to freezing and thawing shall have a maximum water-cement ratio of 0.50.

c. Slump

All concrete containing the high range water reducing admixture (superplasticizer) shall have a maximum slump of eight (8) inches unless otherwise approved by the Engineer. The concrete shall arrive at the job site at a slump of two (2) inches or three (3) inches, be verified, then the high range water reducing admixture added to increase the slump to the approved level. All other concrete shall have a maximum slump of three (3) inches for slabs and four (4) inches for other members.

d. Admixture Usage:

All concrete shall contain the specified water reducing admixture or water reducing, retarding admixture and/or high range water reducing admixture (superplasticizer). All thin concrete slabs, less than eight (8) inches in thickness, placed at air temperatures below 50 degrees F shall contain the specified non-chloride accelerator. All concrete required to be air entrained shall contain an approved air entraining admixture. When air temperature exceeds 85 degrees F and/or placing and humidity conditions dictate, the Engineer may require or approve the use of the water reducing, retarding admixture.

E. FORMWORK

1. Design and Construction

Design and construction of formwork shall be in accordance with ACI 347-78. Forms shall be sufficiently strong to carry the dead weight of the concrete as a liquid without deflection, and tight enough to prevent leakage of mortar. Wood forms shall be thoroughly cleated together with corrosion resistant devices. Bevel strips shall be provided in form angles and in corners of boxes for chamfering of all corners. If any forms show bulge or deflection, which in the opinion of the Engineer is excessive, the concrete shall be removed and the work shall be rebuilt.

Before reinforcing is placed, the inside of wood forms for all exposed concrete shall be coated with plastic coating. Wood forms for concrete that will not be exposed shall be coated with form oil or plastic coating or shall be thoroughly wetted.

Forms shall not be removed until members have acquired sufficient strength to safely support their own weight, or any weight that will be applied.

Where soil permits, excavation for footings shall be formed to the exact dimensions of footings. Where soil does not permit straight and true excavations, the sides of the footings shall be formed. The bottom of all footing excavations shall be mechanically tamped prior to placing concrete.

F. REINFORCEMENT

1. Placing

Metal reinforcement shall be accurately placed in accordance with the approved construction plans and shall be adequately supported and secured in position. Concrete or clay brick shall be used for supporting reinforcement in slabs-on-grade and footings, when reinforcing is bars. Supports shall be removed as the pour progresses. Where welded wire fabric is used, reinforcing shall be pulled up to the center of the member as the concrete pour progresses.

Unless otherwise shown, all bars shall lap at least 24 diameters. All welded wire fabric shall be lapped at least one (1) full mesh and tie.

All slabs-on-grade shall be at least four (4) inches thick and shall be reinforced with 6x6 W1.4 x W1.4 welded wire fabric unless otherwise indicated.

2. Protection

Unless otherwise indicated, reinforcement shall have the following concrete protection:

Footings: 3 inches clear, sides and bottom

Walls: 2 ½ inches clear, top, bottom, sides

Slabs: 2 inches clear, top, 3 inches clear, bottom

G. PLACING CONCRETE

Concrete shall be conveyed to the place of final deposit by methods that will prevent separation or loss of the materials. Equipment for chute conveyance of concrete shall be of such size and design as to ensure a practically continuous flow of concrete at the delivery end.

Concrete shall be deposited as near as possible to its final position to avoid segregation due to handling or flowing. No concrete that has partially hardened or has been contaminated by foreign materials shall be deposited in the work nor shall retempered concrete be used, unless approved by the Engineer. Concrete in walls shall be poured with the use of a tremie and shall not be dropped more than eight (8) feet.

When concrete placement is started, it shall be carried on as a continuous operation until the placement of the section has been completed. The top surface shall be generally level. When construction joints are necessary, they shall be made as approved by the Engineer.

Where conditions make consolidating difficult or where reinforcement is congested, the specified high range water reducing admixture (superplasticizer) shall be used. The concrete shall be plastic at all times and flow readily into the space between the bars.

Concrete shall be placed with the aid of mechanical vibrating equipment, placed in the concrete at the point of deposit, and in strict accordance with ACI 309. Lower frequency vibrators may be used with “flowing” concrete.

Where not practical in the opinion of the Engineer to use a mechanical vibrator, concrete shall be thoroughly compacted by puddling with suitable tools during the placing.

When air temperature has fallen or is expected to fall below 40 degrees F, all water and aggregates shall be heated uniformly before mixing so that the concrete at point of placement will have a temperature of not less than 50 degrees F nor more than 80 degrees F. Only the specified non-chloride accelerator shall be used. Calcium chloride or admixtures containing more than 0.1 percent chloride ions are not permitted.

H. CURING AND PROTECTION

All concrete shall be kept continuously moist and above 50 degrees F for seven (7) days after placement. The temperature requirement may be reduced to three days if high early strength concrete is used.

All slabs shall be cured with the specified curing and hardening compound. The compounds must be applied immediately after final finishing.

I. FINISHING CONCRETE

1. General

If after the removal of forms there is any excessive honey-combing or other imperfections, the member shall be repaired by the Contractor by removal and replacement at no extra cost to PWS.

2. Cast-in-Place Concrete

Except as otherwise specified, all fins and projections shall be removed and small voids filled by the dry pack method. The top of cracks shall be grooved and holes cut out to sound concrete. Any dust, dirt and loose particles shall be cleaned off. Concrete surfaces shall be dampened and then the specified bonding compound applied.

Dry pack shall be placed after the bonding compound has dried. The dry pack mix shall consist of one part Portland cement to two parts fine aggregate passing a No. 16 sieve, using only enough water as required for handling and placing. The dry pack mixture shall be compacted in place and finished to match adjacent concrete. Patched areas shall be kept continuously moist for not less than 72 hours. All vertical surfaces above finish grade shall be hand rubbed.

3. Finish for Sidewalks and Exterior Slabs

The surface of the concrete shall be screeded and shall then be hand-finished with a wood float to produce a smooth, gritty surface. Edges and joints shall be rounded with an edger to a radius of $\frac{1}{4}$ inch. Scored joints shall be provided at five (5) to six (6) feet on center unless otherwise shown on the approved construction plans. Expansion joints shall be provided at 30-foot intervals. The texture shall be approved by the Engineer from sample panels.

J. CONSTRUCTION JOINTS

Joints not indicated on the approved construction plans shall be approved by the Engineer only in locations least likely to impair the strength of the structure. Where a joint is to be made, the surface of the concrete shall be thoroughly cleaned and all laitance removed, by sandblasting if necessary. Waterstops shall be installed in the center of wall or slab at all construction joints. In addition, vertical joints shall be thoroughly wetted and slushed with a coat of neat cement grout immediately before placement of new concrete. All reinforcement shall be continued across or through construction joints.

K. WATERSTOPS

Waterstops shall be either of those described in the following at the Contractor's option.

1. Polyvinyl Chloride

Polyvinyl chloride waterstops shall be 9x12 inches minimum and shall be produced from a compound, the base resin of which shall be virgin PVC. The compound shall not contain any reclaimed material whatsoever.

The waterstop shall have the following properties:

2,000 psi min. tensile strength.....ASTM D638
350 percent min. elongation.....ASTM D638
-35 degrees F min. low temperature brittleness_ASTM D746
65-75 shore > A = durometer hardness.....ASTM D2240
0.15 percent max. water absorption.....ASTM D570

Splicing one section of waterstop to another shall be made in accordance with the manufacturer's specifications. All furnished splices shall have a tensile strength of not less than 80 percent of the unspliced material.

All PVC waterstops shall be Greenstreak by Sika, or approved equivalent.

2. Permeable grout tubes

Permeable grout tubes shall be composed of a reinforcing spiral, inner fiber membrane and an outer protective synthetic membrane. The tubes shall be completely permeable for the injected sealing materials and impermeable for cement particles. The grout tubes shall be DE NEEF INJECTO as distributed by GCP, or approved equivalent.

All materials shall be delivered to the site in undamaged, unopened packings, bearing the manufacturer's labels.

The polyurethane grout shall have the ability to react with water and will expand up to ten (10) times in volume. The accelerator shall be able to control the reaction time from one (1) minute to one (1) hour. After reaction, the polyurethane grout shall form a flexible, closed cell polyurethane foam.

Mixing and handling of the chemical grout and the accelerator shall be in accordance with the recommendations of the manufacturer and all applicable safety codes and shall be performed in such a manner as to minimize hazards to personnel. It is the

responsibility of the Contractor to provide appropriate protective measures to ensure that chemicals or foam produced by said chemicals are under the control of the Contractor at all times.

Plastic or metal mixing tanks shall be used, and tanks of concrete or wood will not be allowed.

Hand operated, air driven, or electrical positive displacement pumps are to be used as per the manufacturer's instructions.

The permeable grout tubes are required at all formed joints in concrete walls and slabs which separate habitable spaces, machinery, and equipment areas from groundwater, water, or water-filled tanks, basins, flumes, manholes, etc. Grout tubes shall also be placed in vertical joints in tank walls and in other joints as shown on the approved construction plans.

The Contractor shall submit the manufacturer's instructions on placement of tubes and data on sealing materials for approval by the Engineer.

L. LOAD TESTS

In addition to all testing as previously specified, load tests, as directed by the Engineer, may be required at the expense of the Contractor if there is evidence of faulty workmanship or violations of these specifications.

Load tests shall be conducted as indicated in Chapter 20 of ACI Code 318-83.

M. REPAIR OF DEFECTIVE AREAS

Repair of defective areas shall conform to ACI 301 and shall be in accordance with the structural engineer's specifications. All methods and procedures for repairs shall be approved by the structural engineer prior to the repairs taking place.

5.4 MASONRY

A. WORK REQUIRED

Work under this Section consists of furnishing all material, labor, and equipment necessary to construct all masonry units specified or shown to be constructed on the approved construction plans.

B. MATERIALS

1. Concrete Blocks

Concrete blocks used shall be hollow concrete masonry block with plain facing and shall comply with ASTM C90 Grade N, Type 1, for load-bearing type and ASTM C129, Type 1, for non-load-bearing type. Samples of the block proposed for use shall be submitted to the Engineer for approval. Certificates of compliance shall be furnished by the Contractor. Interior walls shall be six (6) inches thick standard concrete block in lieu of the eight (8)-inch block used for the exterior walls, except where shown on the approved construction plans. Chipped or broken block shall not be used.

2. Wall Reinforcing

Wall reinforcement shall be provided as directed by the licensed structural engineer on the approved construction plans.

3. Mortar Materials

The materials used in mortar for masonry work shall be type “M” or type “S”, and shall comply with current requirements of the following specifications:

| | |
|------------------------------|--------------------|
| Mortar for Unit Masonry..... | ASTM C270 |
| Masonry Cement..... | ASTM C91 |
| Portland Cement..... | ASTM C150, Type II |
| Hydrated Lime..... | ASTM C207 |
| Aggregate..... | ASTM C144 |

| Proportion By Volume | | | |
|-----------------------------|------------------------|-------------------------------|------------------------------------|
| Mortar Type | Portland Cement | Masonry Cement Type II | Hydrated Lime or Lime Putty |
| M | 1 | --- | ¼ |
| | 1 | | --- |
| S | 1 | --- | Over ¼ to ½ |
| | ½ | 1 | --- |

Damp loose aggregate not less than 2 ¼ or more than three (3) times the sum of the volumes of the cements and lime shall be used.

All mortar shall be thoroughly mixed, and retempering will not be permitted. All mortar that shows evidence of having obtained its initial set shall be washed. All mortar used throughout shall be the same kind.

Clean, sharp, well-graded aggregate shall be provided that is free from injurious amounts of dust, saline, alkaline, organic, or other deleterious substances. If requested by the Engineer or PWS Representative, the Contractor shall be required to furnish certified test reports from an independent laboratory certifying the analysis of the aggregate and its suitability for the intended purpose. The water used for mortar shall be potable water.

C. CONSTRUCTION

1. Concrete Block

Concrete block walls and partitions shall be of staggered joint construction, built plumb and true to dimensions shown on the approved construction plans with running bond pattern with full mortar coverage on the vertical and horizontal surfaces, vertical joints shoved tight. All horizontal joints in exposed work, unless otherwise specified, shall be raked. All joints in walls to receive plaster or stucco shall be struck off flush with the face of the blocks. Particular care shall be exercised in laying block to maintain wall plumb and true with smooth, uniform joints of 3/8 inch in thickness. At all points of juncture of walls and wall to partitions, all masonry shall be properly bonded and anchored with wall reinforcement.

2. Wall Joint Reinforcement

Unless otherwise noted, joint reinforcement shall be placed every third bed joint (24 inches c-c) in walls and in every first and second bed joint above openings. In the first bed joint above openings, the reinforcement shall be continuous. In the second bed joint, the reinforcement shall extend two feet beyond each side of the opening before splices are made to ensure continuity. Corners shall be formed by cutting the inside bar and bending. Reinforcement shall not pass through vertical masonry control joints.

3. Building Openings

The Contractor shall build in all metal door frames, access doors, frames, beams, lintels, thimbles, brackets, anchor bolts, or other items. All bearing plates, etc., or work to be built in by the Contractor shall be done in a careful manner and all anchors, etc., drawn tight and made secure without masonry spalls.

4. Execution

Special care shall be exercised during the course of construction, and all block units with chipped faces or edges shall be discarded. All external corners and openings shall be protected by corner guards, if necessary, against harm after walls are in place. Such protective measures shall remain intact.

5.5 DETAILS

Not included in this section of the utility design manual.

END OF CHAPTER 5

CHAPTER 6 – SPECIAL PIPE INSTALLATION

6.1 PIPE BORING, DRILLING, JACKING AND PUSHING

A. GENERAL

The work described in this section includes the installation of gravity sewer mains, potable water mains, reclaimed water mains, sewer force mains and service laterals by boring, drilling, jacking, moleing or pushing in areas where trenching is not feasible or permitted, or as indicated on the approved construction plans.

B. INSTALLATION TYPES AND REQUIREMENTS

1. Gravity Sewer Mains

Where indicated on the plans, gravity sewer mains shall be installed by sledding through steel casing. The steel casing shall be installed by boring, jacking, and drilling methods.

2. Potable Water Mains, Reclaimed Water Mains and Sewer Force Mains

Where indicated on the plans, potable water mains, reclaimed water mains, and sewer force mains shall be installed by directional bore using high density polyethylene (HDPE) pipe.

3. Service Laterals

Service laterals crossing streets shall be installed without open cutting of asphalt roads. Open cutting for service lateral installation will be allowed only on a case-by-case basis in areas where the Engineer deems other methods impractical. Service laterals may be installed by boring or accupunch type methods. Solvent welded joints may be utilized. In the case of gravity main, laterals shall be air tested.

C. PRODUCTS

1. Steel Casing

All steel casing used for the work shall be new material. The steel casing shall be seamless or electric resistance-welded tubing for sizes under 24 inches outside diameter

(OD) and standard double-submerged arc-weld for sizes over 24 inches. The casing shall be installed by either jacking or boring at the option of the Contractor.

All casing used for borings and bridge crossings shall be wrought steel ASTM A53, Grade B, with a minimum yield strength of 35,000 psi. Bore casings shall have an exterior protective coating of Coal-Tar Enamel in accordance with AWWA C204. Ends shall be free from splits or other rough edges which might damage the carrier pipe. The exterior of bridge crossing casings shall be painted with two (2) coats of rust prohibiting paint, light gray.

The following table shall be used for determining minimum casing size:

| Carrier Pipe I.D. | | Steel Casing | Minimum Wall Thickness | |
|-------------------|-----------|--------------|------------------------|----------|
| Gravity | Pressure* | Diameter | Highway | Railroad |
| N/A | 4" | 10" | 0.188" | 0.188" |
| 4" | 6" | 12" | 0.188" | 0.188" |
| 6" | 8" | 16" | 0.250" | 0.250" |
| 8" | 10" | 20" | 0.250" | 0.250" |
| 10" | 10" | 20" | 0.250" | 0.250" |
| 12" | 12" | 24" | 0.250" | 0.250" |
| 14" | 14" | 30" | 0.250" | 0.281" |
| 16" | 16" | 32" | 0.250" | 0.281" |
| 18" | 18" | 36" | 0.312" | 0.312" |
| 20" | 20" | 42" | 0.312" | 0.344" |
| 24" | 24" | 48" | 0.312" | 0.406" |
| 30" | 30" | 60" | 0.375" | 0.469" |
| 36" | 36" | 72" | 0.500" | 0.532" |
| 42" | 42" | 84" | 0.500" | 0.563" |
| 48" | 48" | 96" | 0.625" | 0.625" |

**Use next larger casing for mechanical joint pipe.*

D. EXECUTION

1. Boring and Jacking

Boring shall be performed to alignment and grade as shown on the approved construction plans. The earth and/or rock augers shall not exceed the OD of the steel casing by more than ¼ inch. The boring and insertion of the steel casing shall be performed with equipment capable of simultaneous operations.

Every effort shall be made to avoid loss of earth.

Excavation material shall be removed from the casing as excavation progresses, and no accumulation of such material within the casing shall be permitted.

Upon completion of the boring operations, all voids around the outside face of the casing shall be filled by grouting. Grouting equipment and materials shall be on the job site before boring operations are started so that grouting around the bored casing may be started immediately after the boring operations have finished.

The allowable tolerance as to grade and alignment of the installed casing shall not exceed 1/10 foot per 100 feet of casing length.

The Contractor shall be responsible for protecting any underground utilities and for any resulting damage to located utilities.

The Contractor shall be fully responsible for producing a sound, tight installation, true to line and grade. Gravity pipe shall be skidded through the casing on redwood or pressure-treated, stainless-steel tied skids. Skids shall also be installed to prevent floating.

2. Installation Details

Prior to the start of the boring operation, the Contractor shall submit the following details to the Engineer when requested:

- Boring pit bracing.
- Casing boring head.

Only workers experienced in boring operations shall perform the work.

3. Drilling and Jacking for Conduit

Metallic conduit shall be installed under existing pavement by approved boring and jacking methods.

Jacking or drilling pits shall be at least five (5) feet from the edge of any type of pavement, measured from the side of the pit nearest to the pavement.

a. Jacking

If the grade of the pipe at the jacking end is below the ground surface, suitable pits or trenches shall be excavated for the purpose of conducting the jacking operations and for placing end joints of the pipe.

Such work shall be sheeted securely and braced in a manner to prevent earth caving and to provide a safe, stable work area.

Heavy duty jacks suitable for forcing the pipe through the embankment shall be provided. In operating jacks, even pressure shall be applied to all jacks used so that pressure will be applied to the pipe uniformly around the ring of the pipe.

A suitable jacking frame or backstop shall be provided. The pipe to be jacked shall be set on guides properly braced together, to support the section of the pipe and to direct it in the proper line and grade.

The whole jacking assembly shall be placed to line up with the direction and grade of the pipe. In general, embankment material shall be excavated just ahead of the pipe and material removed through the pipe and the pipe forced through the embankment with jacks, into the space thus provided.

The excavation for the underside of the pipe, for at least 1/3 of the circumference of the pipe, shall conform to the contour and grade of the pipe. A clearance of not more than two (2) inches may be provided for the upper half of the pipe. This clearance is to be tapered off to zero at the point where the excavation conforms to the contour of the pipe.

The distance that the excavation shall extend beyond the end of the pipe depends on the character of the material, but it shall not exceed two (2) feet in any case. This distance shall be decreased if the character of the material being excavated makes it desirable to keep the advance closer to the end of the pipe.

Preferably, the pipe shall be jacked from the low or downstream end. Lateral or vertical variation in the final position of the pipe from the line and grade established by the Engineer will be permitted only to the extent of one (1) inch in 10 feet, provided that such variation shall be regular, in only one direction, and that the final grade or flow line shall be in the direction indicated.

The Contractor may use a cutting edge of steel plate around the head end of the pipe extending a short distance beyond the end of the pipe with inside angles or lugs to keep the cutting edge from slipping onto the pipe.

When jacking of pipe has begun, the operation shall be carried on without interruption, insofar as practical, to prevent the pipe from becoming firmly set in the embankment.

Any pipe damaged in jacking operations shall be immediately removed and replaced by the Contractor at his expense.

Immediately after jacking is complete and the carrier or encasement pipe is accurately positioned and approved for line and grade, the entire clearance space between the pipe and soil shall be filled by pressure grouting for the entire length of the installation.

The pits and trenches excavated to facilitate jacking operations shall be backfilled immediately after the jacking of the pipe has been completed.

b. Pipe Sleds

Where carrier pipe is sledged through steel casing, the Contractor shall install wood skids to support the pipe. There shall be two sets of skids for each pipe with metal bands. Skids shall be pressure-treated lumber.

6.2 DIRECTIONAL BORING

A. GENERAL

The work described in this section includes the installation of water main, force mains and service laterals by directional boring as described herein and the extent of which is shown on the approved construction plans. The Contractor will furnish all labor, equipment, materials and supplies and will perform all work necessary to provide PWS with a complete, finished crossing via horizontal directional drilling (trenchless installation). Crossings must conform to applicable requirements of state and local agencies, as well as all affected utility companies.

The Contractor shall be thoroughly experienced in directional drilling projects of the size and nature of this project. The Contractor must demonstrate expertise in trenchless methods by providing a list of five (5) references for whom similar work has been performed within the last two years. Two (2) of the references shall be from projects where the same size or larger pipe than the largest carrier pipe specified in the contract documents was successfully installed at a linear distance greater than or equal to the longest bore required by the contract documents. The references shall include a name and telephone number where contact can be made to verify capability. Conventional trenching experience will not be considered applicable.

B. INSTALLATION TYPES AND REQUIREMENTS

The proposed alignment, length, profile, and grade to which the main shall be installed are as defined on the approved construction plans. The profile indicates the minimum grade to which the pipe shall be installed.

C. SUBMITTALS

1. Drilling Plan

The Contractor shall prepare a drilling plan indicating equipment proposed for each location and pullback forces anticipated. The Contractor shall verify that the DR of the pipe specified is adequate to withstand the anticipated pullback forces in addition to the earth, line and groundwater loads.

2. Technical Data

Technical data of equipment to be utilized shall be provided to the Engineer for approval.

3. Experience

Prior to approval, the names of supervisory field personnel and historical information of directional boring experience shall be provided to the Engineer by the Contractor. All supervisory personnel must be adequately trained and have prior, direct supervisory experience in directional boring. Each directional boring crew shall have a reasonable proportion of experienced men.

An approved superintendent and/or engineer experienced in directional boring methods and techniques, and who represents the boring subcontractor, shall be present at all times while work is proceeding. He shall also be responsible for the frequent checking of line and grade.

4. Material Safety Data Sheets

A complete list of all drilling fluid additives and mixtures to be used in the directional operation will be submitted to the Engineer, along with their respective Safety Data Sheets (SDS).

5. Disposal Plan

The disposal plan shall describe the Contractor's plans for disposal of the drilling fluid and the names, addresses and telephone numbers of all subcontractors who will be performing any portion of the disposal activities. At a minimum, the plan shall include:

- Disposal method
- Disposal hauler(s)
- Disposal location(s)
- Estimated quantity to be disposed
- Type of vehicle hauling drilling fluids
- Signed statement that all hauling equipment (i.e., vehicle, tanker, dump truck, trailer, etc.) meets all requirements of state agencies
- Letter from proposed disposal site(s) accepting the material

6. Erosion Control Plan

The erosion control plan shall be submitted to the Engineer prior to the preconstruction conference. It shall be a written, detailed plan for the accomplishment of acceptable erosion control on the project. The plan shall describe all necessary temporary measures to be implemented for preventing soil erosion from the construction site until permanent erosion control and finished surfaces are installed.

The plan shall comply with all state and local requirements. Any additional soils reports as required by jurisdictional agencies beyond those already provided by PWS, shall be obtained by the Contractor at no additional expense to PWS.

7. Pipe Connection Procedures

The Contractor shall submit pipe connection procedures to the Engineer prior to connecting any pipe. For HDPE pipe, the Contractor shall submit the pipe manufacturer's written approval of his procedures.

D. QUALITY ASSURANCE

1. Pipe Manufacturer's Quality Control

The pipe manufacturer shall have an ongoing Quality Control program for incoming and outgoing materials. HDPE resins for manufacturing of pipe shall be checked for density, melt flow rate, and contamination. These incoming resins shall be approved by NSF before being converted to pipe. Pipe shall be checked for outside diameter, wall thickness, length, roundness, and surface finish on the inside and outside and end cut.

2. Fittings Manufacturer's Quality Control

The fitting manufacturer shall have an ongoing Quality Control program for incoming and outgoing materials. Molded fittings shall be inspected for voids and knit lines. All fabricated fittings shall be inspected for joint quality and alignment. All fabricated fitting welds shall be made using a Data Logger. A record of the temperature, pressure and graph of the fusion cycle shall be maintained by the fitting manufacturer.

E. PRODUCT DELIVERY, STORAGE, AND HANDLING

The pipe and fitting manufacturers shall package products for shipment in a manner suitable for safe transport on commercial carriers. When delivered, a receiving inspection shall be performed and any shipping damage reported to the pipe and fittings manufacturers. Pipe and fittings shall be handled, installed, and tested in accordance with manufacturer's recommendations and the requirements of this utility design manual.

All materials shall be delivered to and stored within the limits of rights-of-way and/or property lines. The Contractor shall be responsible for securing all project materials and shall bear the cost of replacing any materials which may have been misplaced or stolen.

F. JOB CONDITIONS

The Contractor shall be held fully responsible for protecting against surface subsidence, damage, or disturbance of adjacent property and facilities from his construction methods. The Contractor shall be held responsible for the coordination and scheduling of all construction work with all affected parties.

G. SAFETY

All drilling equipment shall have a permanent, inherent alarm system capable of detecting an electrical current. The ground system shall be equipped with an audible alarm to warn the operator when the drill head nears electrified cable.

All crews shall be provided with grounded safety mats, heavy gauge ground cables with connectors, and hot boots and gloves.

H. MATERIALS

1. Drilling Fluid

Drilling fluid shall be a gel-forming colloidal fluid consisting of at least 10 percent high-grade bentonite, which is totally inert and poses no environmental risk. The clay lining shall be adequate to maintain tunnel stability and provide lubrication in order to reduce frictional drag while the pipe is being installed.

2. Carrier Pipe

HDPE bore pipe and fittings conveying potable water shall conform to **Section 2** of this utility design manual. HDPE bore pipe and fittings conveying wastewater shall conform to **Section 3** of this utility design manual. HDPE bore pipe and fittings conveying reclaimed water shall conform to **Section 4** of this utility design manual.

3. Butt Fusion Fittings

Butt fusion fittings for water shall conform to **Section 2** of this utility design manual. Butt fusion fittings for wastewater shall conform to **Section 3** of this utility design manual. Butt fusion fittings for reclaimed water shall conform to **Section 4** of this utility design manual.

4. Transition Fittings

Transition fittings for water shall conform to **Section 2** of this utility design manual. Transition fittings for wastewater shall conform to **Section 3** of this utility design manual. Transition fittings for reclaimed water shall conform to **Section 4** of this utility design manual.

I. EQUIPMENT

1. General

The directional drilling equipment shall consist of a direction drilling rig of sufficient capacity to perform the bore and pull back the pipe, a drilling fluid mixing, delivery and recovery system of sufficient capacity to successfully complete the installation, a drilling fluid recycling system to remove solids from the drilling fluid so that the fluid can be reused (if required), a magnetic guidance system or walk over system to accurately guide boring operations, a vacuum truck of sufficient capacity to handle the drilling fluid volume, and trained and competent personnel to operate the system. All equipment shall

be in good, safe condition with sufficient supplies, materials and spare parts on hand to maintain the system in good working order for the duration of the project.

2. Drilling Rig

The directional drilling machine shall consist of a hydraulically powered system to rotate and push hollow drilling pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill (bore) head. The machine shall be anchored to the ground to withstand the pulling, pushing and rotating pressure required to complete the installation. The hydraulic power system shall be self-contained with sufficient pressure and volume to power drilling operations, and the hydraulic system shall be free of leaks. The rig shall have a system to monitor and record maximum pullback pressure during pullback operations. There shall be a system to detect electrical current from the drill string and an audible alarm which automatically sounds when an electrical current is detected.

3. Drill Head

The drill head shall be steerable by changing its rotation and shall provide necessary cutting surfaces and drilling fluid jets.

J. GUIDANCE SYSTEM

An electronic walkover tracking system or a Magnetic Guidance System (MGS) probe or proven gyroscopic probe and interface shall be used to provide a continuous and accurate determination of the location of the drill head during the drilling operation. The Contractor shall supply all components and materials to install, operate, and maintain the guidance system.

The guidance system shall be capable of tracking at all depths up to 50 feet and in any soil condition, including hard rock. It shall enable the driller to guide the drill head by providing immediate information on the tool face, azimuth (horizontal direction), and inclination (vertical direction). The guidance system shall be accurate and calibrated to the manufacturer's specifications of the vertical depth of the borehole at sensing position at depths up to 50 feet and accurate to two (2) feet horizontally.

The guidance system shall have a proven performance record for the type(s) of drilling for the project and shall be set up and operated by personnel trained and experienced with the system. If the Contractor is using an MGS, the drill path will be surveyed for any surface geo-magnetic variations or anomalies, and any such anomalies shall be considered in the operation of the guidance system.

K. JOINING METHODS

1. Butt Fusion Joining

Plain end pipe and fittings shall be made using butt fusion. The butt fusion procedures shall be in accordance with the manufacturer or the Plastics Pipe Institute (PPI). The fusion equipment shall be equipped with a Data Logger. Records of the welds (heater temperature, fusion pressure, and a graph of the fusion cycle) shall be maintained for five (5) years. Fusion beads shall not be removed.

The fusion equipment operator shall receive training using the manufacturer's recommended procedures. The Contractor shall be responsible for verifying that the fusion equipment is in good operating condition and that the operator has been trained in all procedures for the fusion equipment within the past 12 months.

2. Mechanical Joining

Pipe and fittings may be joined together using flanges or mechanical joint (MJ) adapters. Flanged and MJ adapters shall have a pressure rating equal to the pipe unless otherwise specified on the approved construction plans.

3. Electrofusion Couplings

Polyethylene pipe and fittings may be joined using approved electrofusion couplings. Fittings shall be PE 3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350. Electrofusion fittings shall have a manufacturing standard of ASTM F1055. Fittings shall have a pressure rating equal to the pipe unless otherwise specified on the plans. All electrofusion fittings shall be suitable for use as pressure conduits, and per AWWA C906, shall have nominal burst values of 3.5 times the working pressure rating of the fitting.

L. EXECUTION

The Contractor shall perform the necessary general earthwork operations (**Section 5** of this utility design manual) as required for the directional drilling and pipe pulling operations. The methods used to complete the directional drill shall conform to the requirements of all applicable permits.

The Contractor shall be responsible for constructing all means of temporary access to the designated work site(s) and shall be liable for all damage caused either directly or indirectly by the work.

The Contractor shall be responsible for setting all grade stakes, lines, and levels. The Contractor shall coordinate the locations of underground utilities with appropriate companies and advise the Engineer and PWS Representative immediately if a conflict exists.

The Contractor shall operate and maintain all equipment as required to keep the work free from excessive spoil and environmental risks. Siltation fences, sediment barriers, etc., shall be installed by the Contractor in accordance with the erosion control plan as required by this section of the utility design manual. Additional environmental protection necessary to contain any hydraulic or drilling fluid spills shall be put in place, including berms, liners, turbidity curtains and other measures. Fuel may not be stored in bulk containers within 200 feet of any water body or wetland.

All drilling fluids and loose cuttings shall be contained in pits or holding tanks for recycling or disposal. The Contractor shall have a mobile vacuum spoils recovery vehicle on site to remove the drilling spoils from the access pits/tanks. The spoils shall then be transported from the job site and properly disposed in accordance with the disposal plan as required by this section of the utility design manual. Under no circumstances shall the drilling spoils be disposed into sanitary, storm, or other public or private drainage systems.

The Contractor shall be responsible for restoring all areas impacted by the Contractor's work effort to pre-work conditions.

M. INSTALLATION

Installation shall be in a trenchless manner producing continuous bores. The tunneling system shall be remotely steerable and permit electronic monitoring of tunnel depth and location. Tunneling shall be performed by a fluid-cutting process (high pressure, low volume) utilizing a liquid clay (i.e., bentonite).

Mechanical, pneumatic, or water-jetting methods will be considered unacceptable due to the possibility of surface subsidence.

The pilot hole shall be drilled on bore path with no deviations greater than five (5) feet of depth over a length of 100 feet. If the pilot hole does deviate from the bore path more than five (5) feet of depth in 100 feet, the Contractor will notify the Engineer, and the Engineer may require the Contractor to pull back and re-drill from the location along the bore path before the deviation. If a drilling fluid fracture, inadvertent return, or returns loss occurs during pilot hole drilling operations, the Contractor shall cease drilling, wait at least 30 minutes, inject a quantity of drilling fluid with a Marsh funnel viscosity exceeding 120 seconds, and wait another 30 minutes. If a drilling fluid fracture or return loss continues, the Contractor shall cease drilling and discuss additional options with the Engineer prior to continuing the work.

After an initial bore has been completed, a reamer will be installed at the termination pit and the pipe will be pulled back to the starting pit. The reamer must also be capable of discharging liquid clay to facilitate the installation of the pipe into a stabilized and lubricated tunnel.

Proper alignment and elevation of the borehole shall be consistently maintained throughout the directional drilling operation. The entire drill path shall be accurately surveyed with entry and exit stakes placed in the appropriate locations within the areas indicated on the approved construction plans.

Readings shall be recorded after advancement of each successive drill pipe (no more than 15 feet), and the readings plotted on a scaled drawing of one (1) inch equals five (5) feet, both vertical and horizontal. Access to all recorded readings and plan and profile information shall be available to the Engineer and PWS Representative at all times. At no time shall the deflection radius of the drill pipe exceed the deflection limits of the carrier pipe as specified herein. The Contractor shall be liable for retrieving or sealing any pipe that becomes lodged in the drill hole.

The pipe manufacturer shall provide visual guidelines for inspecting butt, saddle, and socket fusion joints. Socket and saddle fusions shall be tested by a bent strap test as prescribed by the pipe manufacturer.

Flange/MJ adapters shall be attached to pipe and fittings using butt fusion. The flanges/MJ adapters shall be aligned and centered relative to the pipe and installed in accordance with the manufacturer's recommendations. Flanges/MJ adapters shall be square with the valve or other flange before the tightening of bolts, and bolts shall not be used to draw flanges into alignment. Bolt threads shall be lubricated, and flat washers shall be used under flange nuts. Bolts shall be tightened using a star tightening pattern, and then re-tightened using the same star tightening pattern 24 hours later. The final tightening torque shall be as indicated by the manufacturer.

On each day butt fusions are to be made, the first fusion of the day shall be a trial fusion. Butt fusion of pipe to be installed shall not commence until a trial fusion has passed the bent strap test. The trial fusion shall be allowed to cool completely, then a fusion test strap shall be cut out. The test strap shall be 12 inches or 30 times the wall thickness in length (minimum) and one (1) or 1.5 times the wall thickness in width (minimum). The test strap shall be bent until the ends of the strap touch. If the fusion fails at the joint, a new trial fusion shall be made, cooled completely and tested.

N. PIPE PULLING OPERATIONS

The adapter shall be bolted to the fusion-welded flange suitable for the transitional material. Restrained joints or Megalug joint restraint shall be provided as required.

O. TESTING

The HDPE main shall be included in the hydrostatic testing requirements for the entire system, as described in **Sections 2, 3, and 4** of this utility design manual.

P. DAMAGED OR IMPROPERLY INSTALLED PIPE

If the pipe is damaged before installation, or does not meet the specifications, it shall be removed and replaced at no expense to PWS. If the pipe is damaged during installation by the Contractor's operations, placed at the improper grade or line, or cannot be advanced because of an unseen obstruction or any other reason, it shall, at the discretion of the Engineer, be retrieved or abandoned in place and the void filled with concrete by pressure grouting as soon as possible. The cost for retrieval or abandonment of pipe shall be at the expense of the Contractor. No additional payment shall be made for pipe which is retrieved, abandoned, or damaged beyond use, including dewatering, excavation, drilling, backfilling, etc.

If it becomes necessary to drill another hole, an alternate installation shall be made as directed by the Engineer. The Contractor shall re-drill the hole and furnish all additional labor and materials required to complete the job as indicated in the approved contract documents at no additional cost to PWS.

6.2 PIPE BURSTING

Not included in this utility design manual.

6.3 DETAILS

Not included in this section of the utility design manual.

END OF CHAPTER 6

Appendix A

RESOLUTION NO. 2017-1

A RESOLUTION OF THE PACE WATER SYSTEM ESTABLISHING A CROSS-CONNECTION CONTROL PROGRAM

WHEREAS, a community water system is responsible for supplying its customers with water that meets federal and State drinking water standards;

WHEREAS, a community water system is responsible for the protection of its water distribution system from contamination or pollution due to backflow of contaminants or pollutants through water service connections; and

WHEREAS, Rule 62-555.360, Florida Administrative Code, requires that each community water system shall establish and implement a cross-connection control program utilizing backflow protection at or for service connections in order to protect the community water system from contamination caused by cross-connections on customer's premises.

WHEREAS, a Cross-Connection Program Plan for the Pace Water System dated March 2017 has been drafted to detail Pace Water System's plan to implement its cross-connection contamination prevention.

NOW, THEREFORE, be it resolved that the Board of Directors of the Pace Water System accept, adopt, and implement the Cross-Connection Control Program Plan for the Pace Water System dated March 2017 in its entirety, and specifically:

Component II in the Cross-Connection Control Program Plan for the Pace Water System, dated March 2017, shall establish where backflow protection at or for service connections is mandatory.

Component III in the Cross-Connection Control Program Plan for the Pace Water System, dated March 2017, shall establish requirements regarding ownership, installation, inspection/testing, and maintenance of mandatory backflow protection at or for service connections.

Upon the effective date of this resolution, all prior and conflicting resolutions, or parts of resolutions, establishing a cross-connection control program, or parts of a cross-connection control program, shall be repealed, rescinded, superseded, and replaced by this resolution.

This resolution shall become effective April 11, 2017.

PASSED AND ADOPTED by the Pace Water System on the 11th day of April, 2017.

Pace Water System

By:

Paul Hinson, President



Damon Boutwell, General Manager



Appendix B

Installation Criteria for a Dual Check Device (DuC)

- A DuC must be installed in the orientation as it was approved by the testing agency.
- A DuC must not be subjected to conditions that would exceed its maximum working water pressure and temperature rating. The increased pressure that can happen from creation of a closed system also must be evaluated because excessive pressure can damage the device or other plumbing components.
- A DuC should be sized hydraulically, taking into account both volume requirements and pressure loss through the device.
- A pipeline should be thoroughly flushed before a DuC is installed to ensure that no dirt or debris is delivered into the device because dirt or debris might adversely affect the DuC's working abilities.
- A DuC shall be installed where it can be inspected or replaced as necessary.

Installation Criteria for a Double Check Valve Assembly (DC) or Double Check Detector Assembly (DCDA)

- A DC or DCDA must be installed in the orientation as it was approved by the testing agency with no field modifications allowed.
- A DC or DCDA must not be subjected to conditions that would exceed its maximum working water pressure and temperature rating. The increased pressure that can happen from the creation of a closed system also must be evaluated to prevent damage to the assembly or other plumbing-system components.
- A DC or DCDA shall be sized hydraulically, taking into account both volume requirements and pressure loss through the assembly.
- A DC or DCDA should not be installed in a pit or below grade when possible. If the DC or DCDA must be installed in a vault, adequate space for testing and maintenance must be provided. If the DC or DCDA must be installed below grade, the test cocks shall be sealed or plugged so water or debris cannot collect in the test cock.
- A pipeline should be thoroughly flushed before a DC or DCDA is installed to ensure that no dirt or debris is delivered to the assembly because dirt or debris might adversely affect the assembly's working abilities.
- A DC or DCDA shall be installed a minimum of 12 inches above the surrounding grade and floodplain. The installation shall not be installed where platforms, ladders, or lifts are required for access. If an assembly must be installed higher than 5 feet above grade, a permanent platform shall be installed around the assembly to provide access for workers.
- A DC or DCDA shall be installed where it can be easily field-tested and repaired as necessary. The assembly shall have adequate clearance around it to facilitate testing, disassembly, and assembly of the DC or DCDA.
- If a DC or DCDA must be subjected to environmental conditions that could freeze or heat the assembly beyond working temperatures, some means of protection should be installed to provide the correct temperature environment in and around the assembly.

Installation Criteria for a Pressure Vacuum Breaker Assembly (PVB)

- A PVB must be installed in the orientation as it was approved by the testing agency.
- A PVB must not be subjected to conditions that would exceed its maximum working water pressure and temperature rating. The increased pressure that can happen from the creation of a closed system also must be evaluated because a PVB cannot be exposed to backpressure.
- A PVB shall not be installed where it is subjected to backpressure.
- A PVB should be sized hydraulically, taking into account both volume requirements and pressure loss through the assembly.
- A pipeline should be thoroughly flushed before a PVB is installed to ensure that no dirt or debris is delivered into the assembly because dirt or debris might affect the PVB's working abilities.
- A PVB must not be installed in a pit or below grade where the air inlet could become submerged in water or where fumes could be present at the air inlet because this installation might allow water or fumes to enter the assembly.
- A PVB shall be installed a minimum of 12 inches above the highest point of use and any downstream piping supplied from the assembly. The installation should not be installed where platforms, ladders, or lifts are required for access. If an assembly must be installed higher than 5 feet above grade, a permanent platform should be installed around the assembly to provide access for workers.
- A PVB shall be installed where it can be easily field-tested and repaired as necessary. The assembly shall have adequate clearance around it to facilitate disassembly, repairs, testing, and other maintenance.
- A PVB may periodically discharge water from the air inlet. The effect of this discharge on the area around the assembly must be evaluated.
- If a PVB must be subjected to environmental conditions that could freeze or heat the assembly beyond its working temperatures, some means of protection should be installed to provide the correct temperature environment in and around the assembly.

Installation Criteria for a Reduced-Pressure Principle Assembly (RP) or Reduced-Pressure Principle Detector Assembly (RPDA)

- An RP or RPDA must be installed in the orientation as it was approved by the testing agency.
- An RP or RPDA must not be subjected to conditions that would exceed its maximum working water pressure and temperature rating. The increased pressure that can occur because of the creation of a closed system also must be evaluated because excessive backpressure can damage the assembly or other plumbing components.
- An RP or RPDA should be sized hydraulically, taking into account both volume requirements and pressure loss through the assembly.
- A pipeline should be thoroughly flushed before an RP or RPDA is installed to ensure that no dirt or debris is delivered into the assembly because dirt or debris might adversely affect the assembly's working abilities.
- An RP or RPDA must not be installed in a pit or below grade where the relief valve could become submerged in water or where fumes could be present at the relief-valve discharge because this installation might allow water or fumes to enter the assembly.
- An RP or RPDA shall be installed a minimum of 12 inches above the relief-valve discharge-port opening and the surrounding grade and floodplain. The installation should not be installed where platforms, ladders, or lifts are required for access. If an assembly is installed higher than 5 feet above grade, a permanent platform should be installed around the assembly to provide access for workers.
- An RP or RPDA shall be installed where it can be easily tested and repaired as necessary. The assembly shall have adequate clearance around it to facilitate disassembly, repairs, testing, and other maintenance.
- An RP or RPDA might periodically discharge water from the relief valve. The effect of this discharge from the relief valve around the assembly must be evaluated. If the RP or RPDA discharge is piped to a drain, an air-gap separation must be installed between the relief-valve discharge opening and the drain line leading to the drain.
- If an RP or RPDA must be subjected to environmental conditions that could freeze or heat the assembly beyond its working temperatures, some means of protection should be installed to provide the correct temperature environment in and around the assembly.

Air Gap Description

- An air gap is a piping arrangement that provides an unobstructed vertical distance through free atmosphere between the lowest point of a water supply outlet and the overflow rim of an open, nonpressurized receiving vessel into which the outlet discharges.
- These vertical separations must be at least twice the effective opening (inside diameter) of the water supply outlet but never less than 1 inch.
- In locations where the outlet discharges within three times the inside diameter of the pipe from a single wall or other obstruction, the air gap must be increased to three times the effective opening but never less than 1.5 inches.
- In locations where the outlet discharges within four times the inside diameter of the pipe from two intersecting walls, the air gap must be increased to four times the effective opening but never less than 2 inches.
- Air gaps should not be approved for locations where there is potential for the atmosphere around the air gap to be contaminated nor should the inlet pipe be in contact with a contaminated surface or material.

