Manual of Standards, Specifications, and Design 2025

Water Distribution

Reclaimed Water Distribution

Wastewater Collection

OWASA

Our community's trusted partner for clean water and environmental protection.

ORANGE WATER AND SEWER AUTHORITY

MANUAL OF SPECIFICATIONS, STANDARDS, AND DESIGN

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About OWASA

OWASA is the public, nonprofit water and sewer utility serving the Carrboro-Chapel Hill community. OWASA's 9-member Board of Directors is appointed by the Chapel Hill Town Council, the Carrboro Board of Aldermen and the Orange County Board of Commissioners.

OWASA has served the community since February 1977, when the University of North Carolina at Chapel Hill and the Towns of Carrboro and Chapel Hill transferred their water and wastewater facilities to OWASA.

Our services are funded entirely from our rates and fees, which reflect legal requirements to use the "cost of service" approach in setting rates, fees, and charges. OWASA provides services within a basic framework of State and Federal law, our 1977 Agreements of Sale and Purchase with the University and the Towns, certain contractual obligations to holders of OWASA Revenue Bonds, and agreements with the Towns and County regarding the extension and provision of public water and sewer services.

OWASA is an equal opportunity employer and a member of the American Water Works Association and the Water Environment Federation.

Manual Introduction

The latest approved version of OWASA’s Standard Specifications was prepared in August 2003. OWASA’s Standard Specifications explain the water and sewer extension and construction process and establish minimum acceptable guidelines or standards for the design and construction of water and sewer lines and appurtenances. Although the document still serves as a good reference manual and guide to contractors, there have been changes in materials, methods and procedures that need to be incorporated into a revised document. Since 1990, new and revised standard details had also been developed by OWASA staff and need to be incorporated as revised Standard Specifications.

This Standard Specifications Manual was prepared by Appian Consulting Engineers, PA, Rocky Mount, NC for the Orange Water and Sewer Authority and updated by OWASA. The manual contains specific technical information related to the proposed construction of infrastructure improvements within the OWASA service area.

The materials, improvement specifications, standard details, and design methodology contained herein are established as the minimum requirements for OWASA and have been determined to be reasonable as applicable to OWASA. This document has been compiled from current standards and practices used by OWASA, from improvement standards used in other areas of the State of North Carolina, and applicable enabling legislation of the State of North Carolina.

Manual Format

This manual was prepared to facilitate ease of use by both the design engineers and the contractor. The various elements that comprise this book have been compiled from adopted policies and procedures, both current and new standard details, specifications, and practices. This manual contains the information needed by design engineers, developers, and contractors to facilitate design, development, and construction within the OWASA service area. Additionally, the information contained herein is available on OWASA's website. Noteworthy updates since the last online version are reflected in RED TEXT. Typographical corrections, agency and product name updates, and updated detail sheets are made without highlight.

Standard Specifications

The standard specification section includes the following sections:
- Trenching, Backfilling and Compaction of Utilities,
- Water Distribution,
- Reclaimed Water, and
- Sanitary Sewer.

Technical Specifications and details excluded from this manual:

Erosion Control - permitting and plan review is administered by:
- NCDEQ,
- Division of Energy, Minerals, and Land Resources, and
- Erosion and Sediment Control Planning and Design Manual, latest revision.

Street Repair and Paving – The Town of Chapel Hill, Town of Carrboro and/or the NCDOT will provide review and permitting of their facilities.

The standard details provided herein are water and sewer construction details. All structures, as well as a few non-structure type standards, are high-quality drawings, when practical, in both isometric and exploded views.

Standard Details Sections included in manual:
- Sewer
- Water

Design Section

A design section has been provided which incorporates the following:
- regulatory requirements of the NCDEQ,
- Division of Water Resources,
- NCAC Title 15A 2H .0200: Waste not Discharged to Surface Waters,
- NCAC Title 15A Subchapter 18C: Rules Governing Public Water Supply Systems,
- ASCE–Manuals of Reports on Engineering Practice-No. 60 "Gravity Sanitary Sewer Design and Construction,"
- The "Recommended Standards for Sewage Works" by the Great Lakes-Upper Mississippi River Board of State Sanitary Engineers, and
- The applicable requirements specific to OWASA.

To the best of their ability, the authors have ensured that the information presented here is correct and that the procedures are reliable. The execution of an engineering design, however, involves the judgment of the design engineer, and only the engineer can ascertain whether a technique or item of information can be applied to a given situation.

Policy and Ordinance

Rather than include the specific policies and ordinance in their entirety, a reference sheet has been provided listing key policies and ordinances. These policies and ordinances can be obtained directly from OWASA.

Jurisdiction

On or after May 1, 2024, this Manual of Specifications, Standards and Design shall be applicable to all new improvements and alterations in existing improvements lying within the regulatory jurisdiction of OWASA.

Variance or Modification

Any variances, alternate designs, construction methods and materials, not specifically prescribed herein, shall be subject to the approval of the Executive Director or their designee.

Copyright

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OWASA

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SECTION 1 - INTRODUCTION

(Last revised 07/09/2021)

1.1 PURPOSE

This manual was created to explain the water and sewer extension process and to establish standards for design and construction of water and sewer lines and appurtenances.

1.2 OWASA

The Orange Water and Sewer Authority is a regional public water and sewer utility established in 1977 to serve the Chapel Hill-Carrboro community and nearby areas.

1.3 DEFINITIONS

Adjacent and Abutting
This policy for water and sewer projects ensures the orderly development of the system by requiring that each property benefiting from the water or sewer lines must have at least a part of that line abutting or adjacent to the property. This policy prevents properties from simply installing long laterals across neighboring properties or connecting to neighboring property's laterals to reach public sewer or water lines.

Applicant
The person or company which is proposing new connections to or extension of the water distribution and wastewater collection systems, also known as the developer.

Approved Equal
Approved equal is the annotation given to a product or material that has been approved by OWASA as a substitute for the product or material specified in the specifications or standard details. "Approved Equal" products and materials must be approved by the OWASA Product and Design Review Committee.

Availability Fees
These are fees collected for each new connection to the water and sewer systems. The availability charge is a charge to collect for the demand on the infrastructure of the system as represented by meter size and use.

Collector
A collector is a sewer pipe typically 8 inches in diameter into which the wastewater from two or more laterals (individual homeowner's pipe) is discharged and which subsequently discharges into a main, interceptor, or other collector.

Conditional Use Permit
This is a permit from a zoning authority (e.g. the Towns of Chapel Hill and Carrboro) which allows a plot of land to be used for a project provided specific conditions are met.

Contractor
The contractor is hired by the owner/developer or by OWASA to install the water and/or sewer lines and related infrastructure in accordance with approved plans. Only a licensed utility contractor may work on OWASA infrastructure, including coincident construction, abandonment, or excavation.

Cross Connection
Any physical connection between a potable water supply system and any other piping system, sewer fixture, container, or device, whereby water or other liquids, mixtures, or substances may flow into or enter the potable water supply system;

Any potable water supply outlet which is submerged or is designed or intended to be submerged in non-potable water or in any source of contamination or;

An air gap, providing a space between the potable water pipe outlet and the flood level rim of a receiving vessel of less than twice the diameter of the potable water pipe.

Developer
The person or company responsible for the design and construction of water and sewer lines to serve their property.

Director of Engineering
The Director of Engineering for OWASA or their designee.

Division of Water Resources (NCDWR)
Division of Water Resources is a division of the North Carolina Department of Environmental Quality. It is responsible for oversight of wastewater plant operations, collection systems, treatment plant effluent discharge, and sludge disposal including permitting for compliance with state and federal regulations. It is also responsible for oversight of water plant operations, water distribution, water supplies, water quality, and facility permitting for compliance with state and federal regulations.

Easement
A piece of private property which the owner grants to a public utility or government to use, maintain, access, and clear. The owner forfeits certain uses of the property. Easements are acquired through the owner's signing of an easement agreement, negotiation and monetary settlement or, if negotiations fail, condemnation under eminent domain statutes.

Elastomers (Gaskets, O-rings, etc.)
Approved elastomeric materials are: EPDM, fluorocarbon, silicone, or isobutylene-isoprene.

Executive Director
The Executive Director of OWASA.

Force Main
A force main is a pressure pipe joining the pump discharge at a wastewater pumping station with a point of gravity flow.

Gravity Flow System
This is a system of conduits in which no wastewater pumping is required. Sewage flows by gravity from service points to public sewer lines.

Grinder Pump
A grinder pump is a mechanical device that shreds solids and raises the fluid to a higher elevation through pressure sewers.

Interceptor
An interceptor is a sewer pipe which transports wastewater from collector sewers to a treatment facility.

Lateral
A water lateral is the pipe which connects a building to the water meter located on the customer's property. A sewer lateral is the pipe which connects a building to the collector sewer located in the street. In the OWASA system, both the water and sewer laterals are owned and maintained by the property owner.

Local Planning Unit
The local planning unit is the Planning Department and/or Planning Board of the Town of Chapel Hill, Town of Carrboro, Orange County, Durham County; or the appropriate planning office at the University of North Carolina at Chapel Hill or UNC Hospitals.

National Pollutant Discharge Elimination System (NPDES)
The federal government's system of controlling all discharge of pollutants from point sources into U.S. waterways. NPDES permits discharges into navigable waters from all point sources of pollution, including industries, municipal treatment plants, large agricultural feed lots, and return irrigation flows.

Lift Station
A lift station is a specific kind of pump station. It is a small sewer pump used when gravity can no longer carry wastewater through sewer. The lift station pumps wastewater from a lower elevation to a higher elevation so that gravity can again be used to carry the wastewater.

OWASA's Engineer
OWASA Engineering Department staff, or the Project Engineer or their authorized representative hired by OWASA for a Capital Improvement Project.

Plat
A plat is a map or chart of a subdivision or piece of land that provides survey information on lot size and location and often includes the tax identification code.

Professional Engineer
An engineer certified and licensed by the North Carolina Board of Examiners for Engineers and Surveyors.

Project Engineer

The Project Engineer is the engineer hired by the owner/developer to prepare a set of plans and specifications for the water and sewer utilities that serve the project. The Project Engineer is also responsible for construction administration of the project.

The Project Engineer will prepare plans in accordance with OWASA Standard Specifications; North Carolina Department of Environmental Quality, Division of Water Resources; and all other federal, state, and local regulations pertaining to the project.

The Project Engineer will submit plans for review to OWASA, make revisions as necessary to comply with OWASA guidelines, observe construction to ensure utilities are constructed in accordance with OWASA standards, and provide certification to OWASA and NCDEQ that utilities were installed in accordance with approved plans.

Public Sewer System
Sewer lines, manholes, pump stations, and force mains owned and maintained by OWASA.

Public Water System
Water mains and appurtenances owned and maintained by OWASA.

Pump Station
A pump station is a structure containing pumps, piping, valves, and other mechanical and electrical equipment for pumping water, wastewater, or other liquids. A pump station is used to pump wastewater from a sewer main of lower elevation to a sewer main of higher elevation. A lift station; often used synonymously with the term pump station, provides a vertical lift to sewage in order for it, in many instances, to again flow by gravity.

Punch List
The punch list identifies deficiencies of the water and sewer construction found during the pre-final inspection. A punch list is generated by the OWASA Inspector after a pre-final Inspection.

Right-of-Way
Right-of-way is land or property that has been dedicated to a public entity for use by the public, the entity itself, or both and is maintained by that entity.

Sanitary Sewer
A sewer that carries liquid and waterborne wastes from residences, commercial buildings, industrial plants, and institutions, together with minor quantities of ground, storm, and surface waters that are not admitted intentionally. The spent or used water of a community or industry which contains dissolved and suspended matter.

Service Area
This is an area that a utility serves or is authorized to serve.

Special Use Permit
This is a permit from a zoning authority (e.g. the Towns of Chapel Hill and Carrboro) which allows a plot of land to be used for a purpose other than its normally permitted use.

Supplemental Fire Protection
Fire protection services include fire lines that feed sprinkler systems and fire hydrants that are not a part of the general hydrant service supplied by OWASA to the public but at no charge.

Taps
The connection of a new main for extension or service line to public water or sewer lines that are in-service. OWASA must make all taps to in-service mains. A fee is charged to cover the expense of time and equipment.

Third Party Project
This is a water or sewer project that is being constructed by a developer or party other than OWASA. Third party projects are dedicated to OWASA upon completion and become part of the public water and/or sewer system.

1.4 ABBREVIATIONS

AASHTO	American Association of State Highway Transportation Officials
ACI	American Concrete Institute
ANSI	American National Standards Institute
AREMA	American Railway Engineering and Maintenance-Of-Way Association.
ASCE	American Society of Civil Engineers
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing Materials
AWWA	American Water Works Association
CRSI	Concrete Reinforcing Steel Institute
FM	Factory Mutual System
FS	Federal Specifications
NCDEQ	North Carolina Department of Environmental Quality
NCDWR	North Carolina Division of Water Resources
NCDOT	North Carolina Department of Transportation
NCMA	National Concrete Masonry Association
NFPA	National Fire Protection Association
NPCA	National Precast Concrete Association
NPDES	National Pollutant Discharge Elimination System
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Administration
OWASA	Orange Water and Sewer Authority
SDS	Safety Data Sheet
UL	Underwriters Laboratories, Inc.
UNC	University of North Carolina
USGS	United States Geological Survey
WEF	Water Environment Federation

1.5 REFERENCE STANDARDS

The current version at the time of compilation is provided, however, the latest version of each standard is to be used, unless specifically noted otherwise.

AASHTO: American Association of State Highway Transportation Officials
AASHTO *Codes and Specifications*

	Guidelines for H-20 traffic loads, 02510, 02530
AASHTO T99	*Standard Method of Test for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop.* [Active. 2019] 02275
AASHTO M145	*Standard Specification for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.* [Active. 1991] 02275
AASHTO T180	*Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.* [Active. 2020] 02275
AASHTO T191	*Standard Method of Test for Density of Soil In-Place by the Sand-Cone Method.* [Active. 2014] 02275
AASHTO T204	*Density of Soil In-Place by the Drive Cylinder Method.* [Inactive. 1990. ASTM D2937] 02275
AASHTO T205	*Density of Soil in Place by the Rubber-Balloon Method.* [Inactive. 1986. ASTM D2167] 02275.
AASHTO M199	*Standard Specification for Precast Reinforced Concrete Manhole Sections*. [Active. 2017] 02510, 02530
AASHTO M306	*Standard Specification for Drainage, Sewer, Utility, and Related Castings.* [Active. 2010] 02530

ACI: American Concrete Institute

ACI 229	*Report on Controlled Low-Strength Materials* [Active. 2013] 02275

ANSI: American National Standards Institute

ANSI A21.4	*Cement-Mortar Lining for Ductile-Iron Pipe and Fittings*. [Active. 2016. AWWA C104] 02510, 02530
ANSI A21.5	*Polyethylene Encasement for Ductile-Iron Pipe Systems.* [Active. 2018. AWWA C105] 02520
ANSI A21.10	*Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (76 mm Through 1,219 mm), for Water.* [Active, 2021. AWWA C110] 02510, 02530
ANSI A21.11	*Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.* [Active. 2017. AWWA C111] 02510, 02530
ANSI A21.50	*Thickness Design of Ductile-Iron Pipe.* [Active. 2021. AWWA C150] 02510, 02530
ANSI A21.51	*Ductile-Iron Pipe, Centrifugally Cast.* [Active. 2017. AWWA C151] 02510, 02530
ANSI A21.53	*Ductile-Iron Compact Fittings.* [Active. 2019. AWWA C153] 02510, 02530
ANSI B1.1	*Unified Inch Screw Threads.* [Active. 2018. ASME B.1.1] 02510
ANSI B16.1	*Gray Iron Pipe Flanges and Flanged Fittings*. [Active. 2020. ASME B16.1] 02510
ANSI B18.2.1	*Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)*. [Active. 2012] 02510
ANSI B18.2.2	*Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)*. [Active. 2015] 02510
ANSI C200	*Steel Water Pipe, 6 In. (150 mm) and Larger.* [Active. 2017. AWWA C200] 02530
ANSI C203	*Coal-Tar Protective Coatings and Linings for Steel Water Pipe*. [Active. 2020. AWWA C203] 02530
ANSI C206	*Field Welding of Steel Water Pipe.* [Active. 2017. AWWA C206] 02510

ANSI C219	*Bolted Sleeve-Type Couplings for Plain-End Pipe.* [Active. 2017. AWWA C219] 02510
ANSI C502	*Dry-Barrel Fire Hydrants.* [Active. 2018. AWWA C502] 02510
ANSI C504	*Rubber-Seated Butterfly Valves.* [Active. 2020. AWWA C504] 02510
ANSI C508	*Swing-Check Valves for Waterworks Service, 2-In. Through 48-In. (50-mm Through 1,200-mm) NPS.* [Active. 2017. AWWA C508] 02510
ANSI C509	*Resilient-Seated Gate Valves for Water Supply Service.* [Active. 2015. AWWA C509] 02510
ANSI C515	*Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service.* [Active. 2020. AWWA C515] 02510
ANSI C550	*Protective Interior Coatings for Valves and Hydrants.* [Active. 2017. AWWA C550] 02510
ANSI C600	*Installation of Ductile-Iron Mains and Their Appurtenances.* [Active. 2017. AWWA C600] 02275, 02510, 02530
ANSI C651	*Disinfecting Water Mains.* [Active. 2014. AWWA C651] 02510, 02530
ANSI C800	*Underground Service Line Valves and Fittings.* [Active. 2021. AWWA C800] 02510
ANSI C900	*Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm)*. [Active. 2021. Replaced C900-07 and C905-10. AWWA C900] 02530
ANSI C901	*Polyethylene (PE) Pressure Pipe and Tubing, ¾ In. (19 mm) Through 3 In. (76 mm), for Water Service.* [Active. 2021. AWWA C901] 02510
ANSI C906	*Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 65 In. (100 mm Through 1,650 mm), for Waterworks.* [Active. 2015. AWWA C906] 02510
ANSI D1248	*Polyethylene Plastic Extrusion Materials for Wire and Cable*. [Active. 2016. ASTM D1248] 02520
ANSI Standard 61	*Drinking Water Systems Components – Health Effects*. [Active. 2016. NSF Standard 61] 02510

<u>AREMA: American Railway Engineering and Maintenance-Of-Way Assoc. (formerly AREA)</u>

AREMA	*Codes and Specifications.* 02275, 02510, 02530
AREMA	*Manual for Railway Engineering.* [Active. 2020] 02510, 02530

<u>ASCE: American Society of Civil Engineers</u>

ASCE	*Gravity Sanitary Sewer Design and Construction*, ASCE Manuals and Reports on Engineering Practice – NO. 60, WEF Manual of Practice NO. FD-5. [Active. 2007] 02275, 02530

<u>ASTM: American Society for Testing and Materials</u>

ASTM	*Codes and Specifications.* 02510, 02530
ASTM A36	*Standard Specification for Carbon Structural Steel.* [Active. 2019] 02510
ASTM A48	*Standard Specification for Gray Iron Castings.* [Active. 2022] 02510, 02520, 02530
ASTM A53	*Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.* [Active. 2022] 02510
ASTM A126	*Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.* [Active. 2019] 02510
ASTM A139	*Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over).* [Active. 2016] 02510, 02530
ASTM A153	*Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel*

	Hardware. [Active. 2016] 02510, 02530
ASTM A283	*Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.* [Active. 2018] 02510, 02530
ASTM A307	*Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.* [Active. 2021] 02510, 02530
ASTM A449	Standard *Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use.* [Active. 2020] 02510, 02530
ASTM A536	*Standard Specification for Ductile Iron Castings.* [Active. 2019] 02510, 02530
ASTM A615	*Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.* [Active. 2022] 02275
ASTM A746	*Standard Specification for Ductile Iron Gravity Sewer Pipe.* [Active. 2018] 02530
ASTM A1008	*Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable.* [Active. 2021] 02510, 02530
ASTM A1011	*Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.* [Active. 2018] 02510, 02530
ASTM A1064	*Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete*. [Active. 2018. Superseded A185]
ASTM B88	*Standard Specification for Seamless Copper Water Tube.* [Active. 2020] 02510
ASTM C32	*Standard Specification for Sewer and Manhole Brick (Made From Clay or Shale.)* [Active. 2018. Superseded AASHTO M91] 02530
ASTM C33	*Standard Specification for Concrete Aggregates.* [Active. 2018] 02275, 02510, 02530
ASTM C94	*Standard Specification for Ready-Mixed Concrete.* [Active. 2022] 02510, 02530
ASTM C139	*Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.* [Active. 2017] 02530
ASTM C144	*Standard Specification for Aggregate for Masonry Mortar.* [Active. 2019] 02530
ASTM C150	*Standard Specification for Portland Cement*. [Active. 2022] 02510, 02530
ASTM C270	*Standard Specification for Mortar for Unit Masonry.* [Active. 2019] 02530
ASTM C443	*Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.* [Active. 2021] 02510, 02530
ASTM C478	*Standard Specification for Circular Precast Reinforced Concrete Manhole Sections.* [Active. 2022] 02510, 02530
ASTM C857	*Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.* [Active. 2019] 02510
ASTM C858	*Standard Specification for Underground Precast Concrete Utility Structures.* [Active. 2019] 02510
ASTM C923	*Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.* [Active. 2020] 02530

ASTM C990	*Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.* [Active. 2019] 02510, 02530
ASTM C1244	*Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill.* [Active. 2020] 02530
ASTM D412	*Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension.* [Active. 2021] 02530
ASTM D698	*Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).* [Active. 2021] 02275
ASTM D751	*Standard Test Methods for Coated Fabrics.* [Active. 2019] 02275
ASTM D1248	*Standard Specification for Polyethylene Plastics Extrusion Material for Wire and Cable*. [Active. 2018] 02520
ASTM D1556	*Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.* [Active. 2016] 02275
ASTM D1557	Standard *Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 2,700 kN-m/m^3)).* [Active. 2021] 02275
ASTM D1784	*Standard Classification System and Basis for Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds*. [Active. 2020] 02275, 02530
ASTM D2122	*Standard Method of Determining Dimensions of Thermoplastic Pipe and Fittings*. [Active. 2022] 02275, 02530
ASTM D2167	*Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber-Balloon Method.* [Active. 2016] 02275
ASTM D2241	*Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).* [Active. 2020] 02510, 02530, Section 3
ASTM D2321	*Practice for Underground Installation of Thermoplastic Pipe for Sewer and Other Gravity-Flow Applications. [Active. 2020] 02275, 02530*
ASTM D2487	*Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)*. [Active. 2020] 02275
ASTM D2657	*Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings*. [Active. 2017] 02510
ASTM D2665	*Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.* [Active. 2020] 02275
ASTM D2683	*Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing*. [Active. 2020] 02510
ASTM D2837	*Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.* [Active. 2022] 02510
ASTM D2937	*Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method.* [Active. 2018] 02275
ASTM D3034	*Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.* [Active. 2022] 02275, 02530
ASTM D3139	*Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals*. [Active. 2020] 02275, 02530
ASTM D3212	*Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.* [Active. 2021] 02275, 02530
ASTM D3261	*Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing*. [Active. 2020] 02510
ASTM D3350	*Standard Specification for Polyethylene Plastic Pipe and Fittings Materials*. [Active. 2021] 02510

ASTM D3740	*Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.* [Active. 2019] 02275
ASTM D4253	*Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table*. [Active. 2019. Replaced D2049] 02275
ASTM D4254	*Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density*. [Active. 2016] 02275
ASTM D4318	Standard *Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils*. [Active. 2018] 02275
ASTM D4491	*Standard Test Methods for Water Permeability of Geotextiles by Permittivity.* [Active. 2022] 02275
ASTM D4632	*Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.* [Active. 2016] 02275
ASTM D4751	*Standard Test Methods for Determining Apparent Opening Size of a Geotextile.* [Active. 2021] 02275
ASTM D4759	*Standard Practice for Determining the Specification Conformance of Geosynthetics.* [Active. 2021] 02275
ASTM D4833	*Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.* [Active. 2020] 02275
ASTM D6938	*Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)*. [Active. 2021. Replaced ASTM D2922]
ASTM E329	*Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.* [Active. 2021] 02275
ASTM F477	*Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe*. [Active. 2020] 02275, 02530
ASTM F593	*Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.* [Active. 2017] 02510
ASTM F594	*Standard Specification for Stainless Steel Nuts*. [Active. 2020] 02510
ASTM F679	*Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings*. [Active. 2021] 02275, 02530
ASTM F794	*Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter*. [Active. 2021] 02275, 02530
ASTM F1055	*Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked Polyethylene (PEX) Pipe and Tubing*. [Active. 2017] 02510
ASTM F1336	*Standard Specification for Poly(Vinyl Chloride) (PVC) Gasketed Sewer Fittings*. [Active. 2020] 02275, 02530
ASTM F1417	*Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air.* [Active. 2020] 02530

AWWA: American Water Works Association

AWWA C104	*Cement-Mortar Lining for Ductile-Iron Pipe and Fittings*. [Active. 2016. ANSI A21.4] 02510, 02530
AWWA C105	*Polyethylene Encasement for Ductile-Iron Pipe Systems.* [Active. 2018. ANSI A21.5] 02520
AWWA C110	*Ductile-Iron and Gray-Iron Fittings.* [Active. 2021. ANSI A21.10] 02510, 02530
AWWA C111	*Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.* [Active. 2017. ANSI A21.11] 02510, 02530

AWWA C115	*Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges*. [Active. 2020. ANSI A21.15]
AWWA C150	*Thickness Design of Ductile-Iron Pipe*. [Active. 2021. ANSI A21.50] 02510, 02530
AWWA C151	*Ductile-Iron Pipe, Centrifugally Cast.* [Active, 2017. ANSI A21.51] 02510, 02530
AWWA C153	*Ductile-Iron Compact Fittings.* [Active. 2019. ANSI A21.53] 02510, 02530
AWWA C200	*Steel Water Pipe, 6 In. (150 mm) and Larger.* [Active. 2017. ANSI C200] 02530
AWWA C203	*Coal-Tar Protective Coatings and Linings for Steel Water Pipe*. [Active. 2020. ANSI C203] 02530
AWWA C206	*Field Welding of Steel Water Pipe.* [Active. 2017. ANSI C206] 02510
AWWA C219	*Bolted Sleeve-Type Couplings for Plain-End Pipe.* [Active. 2017. ANSI C219] 02510
AWWA C502	*Dry-Barrel Fire Hydrants.* [Active. 2018. ANSI C502] 02510
AWWA C504	*Rubber-Seated Butterfly Valves.* [Active. 2015. ANSI C504] 02510
AWWA C508	*Swing-Check Valves for Waterworks Service, 2-In. Through 48-In. (50-mm Through 1,200-mm) NPS.* [Active. 2017. ANSI C508] 02510
AWWA C509	*Resilient-Seated Gate Valves for Water Supply Service.* [Active. 2015. ANSI C509] 02510
AWWA C515	*Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service*. [Active. 2020. ANSI C515] 02510
AWWA C550	*Protective Interior Coatings for Valves and Hydrants.* [Active. 2017. ANSI C550] 02510
AWWA C600	*Installation of Ductile-Iron Mains and Their Appurtenances.* [Active. 2017. ANSI C600] 02275, 02510, 02530
AWWA C605	*Standard for Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings* [Active. 2021. ANSI C605] 00275
AWWA C651	*Disinfecting Water Mains.* [Active. 2014. ANSI C651] 02510, 02530
AWWA C800	*Underground Service Line Valves and Fittings.* [Active. 2021. ANSI C800] 02510
AWWA C900	*Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm)*. [Active. 2021. Replaced C900-07 and C905-10. ANSI C900] 02530
AWWA C901	*Polyethylene (PE) Pressure Pipe and Tubing, ¾ In. (19 mm) Through 3 In. (76 mm), for Water Service.* [Active. 2020. ANSI C901] 02510
AWWA C906	*Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 65 In. (100 mm Through 1,650 mm), for Waterworks.* [Active. 2021. ANSI C906] 02510
AWWA M23	*PVC Pipe – Design and Installation.* [Active. 2020] 02275, 02510, 02530

CRSI: Concrete Reinforcing Steel Institute

CRSI	*Codes and Specifications*

CSA Group

B137.1	*Polyethylene (PE) Pipe, Tubing, and Fittings for Cold-Water Pressure Services*. [Active. 2020] 02510

Ductile Iron Pipe Association

DIPRA — *Design of Ductile Iron Pipe.* [Active. 2016] 02275, 02530

FM: Factory Mutual System

FM — *Approval Guide*

FM 1510 — Fire Hydrant (Dry Barrel Type) for Private Fire Service. [Active. 1990] 02510

FS: Federal Specifications

FS WW-T-799 — *Tube, Copper, Seamless, Water (For Use With Solder-Flared- or Compression-Type Fittings* [Cancelled and superseded by ASTM B88] 02510

NCDOT: North Carolina Department of Transportation

NCDOT — *Codes and Specifications*

NCDOT — *Roadway Design Manual [Active. 2023] 02275*

NCDOT — *Standard Specifications for Roads and Structures* [Active. 2018] 02275, 02510, 02530

NCDOT — *Utilities Accommodation Manual [Active. 2022] 02275*

NSF: National Sanitation Federation International

NSF Standard 14 — *Plastic Piping Components and Related Materials*. [Active. 2021. ANSI 14] 02510

NSF Standard 61 — *Drinking Water Systems Components – Health Effects*. [Active. 2016. ANSI 61] 02510

NSF Standard 372 — *Drinking Water System Components – Lead Content*. [Active. 2020. ANSI 372] 02510

NFPA: National Fire Protection Association

NFPA — *Regulations*. Section 3: Standard for Commissioning of Fire Protection and Life Safety Systems [Active. 2021]

NFPA 24 — *Standard for the Installation of Private Fire Service Mains and Their Appurtenances.* [Active. 2022] 02510

NFPA 495 — *Explosive Materials Code.* [Active. 2018] 20510

OSHA: Occupational Safety and Health Administration

OSHA Standard 29 CFR part 1910.109 — *Explosives and Blasting Agents*. [Active. 1998]

OSHA Standard 29 CFR Part 1926, Subpart P — *Excavations*. [Active. 2020]

PPI: Plastic Pipes Institute

PPI TR-3 — *Policies and Procedures for Developing Hydrostatic Design Bases (HDB), Pressure Design Bases (PDB), and Minimum Required Thermoplastic Pipe Materials*. [Active. 2004] 02510

PPI TR-4 — *HSB Listing of Hydrostatic Design Basis (HDB), Hydrostatic Design Stress (HDS), Strength Design Basis (SDB), Pressure Design Basis (PDB), Minimum Required Strength (MRS) Ratings and Categorized Required Strength (CRS) For Thermoplastic Piping Materials or Pipe*. [Active. 2021] 02510

UL: Underwriters Laboratories, Inc.

UL 246 — *Hydrants for Fire-Protection Service* [Active. 2011] 02510

UL — *Fire Protection Equipment Directory* [Active. 2012]

Uni-Bell PVC Pipe Association

UNI-B-6	*Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe.* [Active. 1998] 02275, 02530
UNI-PUB-6	*Installation Guide for PVC Solid Wall Sewer Pipe (4-48 in.)* [Active. Undated] 02275, 02530
UNI-TR-3	*Maintenance of PVC Sewer Pipe.* [Active. 2017] 02275, 02530
Uni-Bell	*Handbook of PVC Pipe Design and Construction.* [Active. 2012] 02275, 02530

SECTION 2 – STANDARD SPECIFICATIONS

02275 - TRENCHING, BACKFILLING AND COMPACTION OF UTILITIES

(Last revised 1/1/2025)

SUGGESTED SEARCH WORDS FOR THIS SECTION

Part 1-- General
Part 2 – Products
Part 3 – Execution
Backfilling
Bedding Definitions
Bedding for Pipe
Blasting
Cleanup & Restoration
Clearing and Grubbing
Common Trench Backfill
Compaction – Min Requirements
Initial Backfill Backfill
Detectable Warning Tape/Wire
Dewatering
Erosion Control, NPDES
Flowable Fill Concrete
Foundation Preparation
Highway Crossings
Minimum Pipe Cover
Pavement Repair
River & Creek Crossings
Rock Excavation
Seeding & Groundcover
Select Earth Backfill
Trench Backfilling
Unclassified Trench Excavation

PART 1 – GENERAL

1.1 GENERAL

The Contractor shall furnish all labor, materials, tools, equipment, and perform all work and services necessary for or incidental to the furnishing and installation, complete, of all operations in connection with excavation, trenching, and backfilling of underground utilities as shown on drawings and as specified, in accordance with provisions of the Contract Documents, and completely coordinated with work of all other trades.

Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure, complete and compatible installation.

Work included in the project consists of, but is not necessarily limited to, methods of installation of the following:

- Sanitary Sewer Pipe Installation & appurtenances.
- Water Distribution Pipe Installation & appurtenances.
- Reclaimed Water Pipe Installation & appurtenances.
- Relocation of piping systems.

1.2 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this specification.

Section 02510– WATER DISTRIBUTION.

Section 02520—RECLAIMED WATER.

Section 02530 – SANITARY SEWER.

1.3 SUMMARY

This section includes:

- Excavating and backfilling trenches for buried water and sewer, buried utility structures, and appurtenances.
- Preparing subgrade for buried water and sewer, buried utility structures, and appurtenances.

1.4 DEFINITIONS

For the purposes of this specification, the following definitions refer to sanitary sewer and water distribution systems that come under the authority of OWASA as specified within this section and other sections of this manual.

A. BACKFILL

Soil materials used to support the pipe and fill an excavated trench:

1. **Initial Backfill** (Carefully Compacted Select Earth Backfill): Backfill placed beside and over the top 12-inches of the pipe in a trench, and above the top of the bell ends, including haunches to support sides of pipe.

2. **Final Backfill** (Common Trench Backfill): Backfill placed over the initial backfill and to the final grade to fill a trench.

B. BEDDING COURSE

Layer of clean coarse stone placed over the excavated subgrade or Foundation Stone in a trench before laying pipe to provide uniform support and cushioning for the pipe.

C. FOUNDATION STONE

Clean well-graded stone, authorized by OWASA's Engineer, used to strengthen and/or provide support to an otherwise weak subgrade. Foundation stone is placed, and the subgrade improved before bedding stone is placed. Foundation stone shall be required when soil conditions are unsuitable.

D. ROCK EXCAVATION

Removal and satisfactory disposal of all unsuitable materials, which, in the opinion of OWASA's Engineer, cannot be excavated except by drilling, blasting, wedging, jack hammering or hoe ramming. It shall consist of undecomposed stone, hard enough to ring under hammer. All boulders containing a volume of more than ½ cubic yard and/or solid ledges, bedded deposits, unstratified masses and conglomerations of material so firmly cemented as to possess the characteristics of solid rock which cannot be removed without systematic drilling and blasting, will be classified as rock.

E. STRUCTURES

Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

F. SUBGRADE

Surface or elevation remaining after completing the trench excavation or, the top surface of a backfill (stone or soil) immediately below the pipe conduit or pipe bedding, as applicable.

G. TRENCH BORROW

Trench borrow shall consist of approved material imported from off-site for use as fill or backfill required to be placed in trenches either as initial carefully controlled select earth backfill or final common trench backfill. Trench borrow shall trench, unless authorized by OWASA's Engineer.

H. UNCLASSIFIED EXCAVATION

Removal and disposal of any and all material above subgrade elevation, except solid rock and undercut excavation, located within the limits of construction.

I. UNDERCUT EXCAVATION

Undercut excavation shall consist of the removal and satisfactory disposal of all unsuitable material located below subgrade elevation. Where excavation to the finished grade section results in a subgrade or slopes of muck, peat, matted roots, etc., the Contractor shall remove such material below the grade shown on the plans or as directed; and areas so excavated shall be backfilled with approved select earth trench borrow or stone as ordered by OWASA's Engineer.

J. INDUSTRY ABBREVIATIONS FOR PIPE MATERIALS

AC:	Asbestos Cement Pipe
DIP:	Ductile Iron Pipe
HDPE:	High Density Polyethylene Pipe
PVC:	Polyvinyl Chloride Plastic Pipe
RCP:	Reinforced Concrete Pipe

1.5 SUBMITTALS

A. PRODUCT DATA AND SAMPLES

Submit product data and a sample of drainage fabric or separation fabric and fully document each with specific location or stationing information, date, and other pertinent information.

B. MATERIAL TEST REPORTS

Provided from a qualified testing agency which either indicate or interpret test results for compliance of the following requirements indicated:

1) Classification according ASTM D2487 of each on-site or borrow soil proposed for backfill, unless otherwise directed by OWASA's Engineer.
2) Laboratory compaction curve according to ASTM D698 for each on-site or borrow soil material proposed for backfill.

C. BLASTING

1) Insurance Certificate naming OWASA's Engineer as "additional Insured." See paragraph 3.8.A – *Blasting* for other blasting insurance requirements.
2) Qualifications, proposed procedures, and schedule shall be submitted at least 2 weeks prior to commencing any blasting operations.
3) Permits from local Fire Department and Town officials.
4) Blasters shall, at all times, have their license and blasting permits on the job site, and shall allow examination of same by any official that may have jurisdiction.
5) If required by OWASA's Engineer, seismic survey agency report, for record purposes.

D. BURY DEPTH COMPUTATIONS

Computations justifying pipe bury when bury depth exceeds the allowable depth shown in this specification. Provide method, applicable charts/graphs, printouts, assumptions, etc. used in justifying the adequacy of the pipe to withstand the loads imposed by the excessive depth.

E. PRODUCT DATA

1) Each type of plastic warning tape
2) Stabilization/Separation fabric
3) Drainage Fabric

1.6 QUALITY ASSURANCE

A. GEOTECHNICAL TESTING AGENCY QUALIFICATIONS

An independent testing agency qualified according to ASTM E329 to conduct soil materials and rock-definition testing as documented according to ASTM D3740.

B. JURISDICTIONAL AUTHORITIES

Comply with all codes, laws, ordinances, and regulations of governmental authorities having jurisdiction over this part of the work.

C. STANDARDS

1) The contractor shall comply with North Carolina Department of Environmental Quality, "Erosion and Sedimentation Control Handbook," latest revision.

2) Comply with applicable requirements of NFPA 495, *"Explosive Materials Code."*

3) *"Gravity Sanitary Sewer Design and Construction*," ASCE Manuals and Reports on Engineering Practice – NO. 60, WEF Manual of Practice NO. FD-5.

4) Comply with Uni-Bell PVC Pipe Association "*Handbook of PVC Pipe: Design and Construction,"* 4th Ed. Dallas: UNI, August 2001 for the installation of PVC piping.

1.7 QUALITY STANDARDS

Materials and operations shall comply with the latest revision of the Codes and Standards listed below. Additional Reference Standards in Section Introduction 1.5.

American Society for Testing and Materials

ASTM C33	*Standard Specification for Concrete Aggregates*
ASTM D698	*Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3) (Standard Proctor).*
ASTM D1556	*Standard Method of Test for Density of Soil in Place by the Sand-Cone Method*
ASTM D1557	*Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3) (Modified Proctor).*
ASTM D1784	*Standard Classification System and Basis for Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds. [Active. 2020]*
ASTM D2122	*Standard Method of Determining Dimensions of Thermoplastic Pipe and Fittings.*
ASTM D2167	*Standard Method of Test for Density of Soil in Place by the Rubber-Balloon Method*
ASTM D2321	*Practice for Underground Installation of Thermoplastic Pipe for Sewer and Other Gravity-Flow Applications.*
ASTM D2487	*Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).*
ASTM D2665	*Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.*
ASTM D2937	*Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method*
ASTM D3034	*Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.*
ASTM D3139	*Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.*

ASTM D3212	*Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.*
ASTM D4253	*Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.*
ASTM D4254	*Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.*
ASTM D4318	*Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.*
ASTM D6938	*Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).*
ASTM F477	*Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.*
ASTM F679	*Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.*
ASTM F794	*Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.*
ASTM F1336	*Standard Specification for Poly(Vinyl Chloride) (PVC) Gasketed Sewer Fittings.*
ASTM F1417	*Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air.*

American Association of State Highway & Transportation Officials

AASHTO T99	*Standard Method of Test for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop.*
AASHTO M145	*Standard Specification for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.*
AASHTO T180	*Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop*
AASHTO T191	*Density of Soil In-Place by the Sand-Cone Method*
AASHTO T204	*Density of Soil In-Place by the Drive Cylinder Method*
AASHTO T205	Density of Soil in Place by the Rubber-Balloon Method

American Water Works Association

AWWA C600	*Installation of Ductile-Iron Mains and Their Appurtenances*

AWWA C605 *Standard for Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings*

AWWA C800 *Underground Service Line Valves and Fittings*

AWWA M23 *PVC Pipe Design and Installation*

Uni-Bell PVC Pipe Assoc.

UNI-B-6 *Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe*

UNI-PUB-6 *Installation Guide for PVC Solid Wall Sewer Pipe (4-48 in.)*

UNI-TR-3 *Maintenance of PVC Sewer Pipe*

Handbook of PVC Pipe Design and Construction

Also (https://www.uni-bell.org/Portals/0/ResourceFile/installation-guide-for-solid-wall-pvc-sewer-pipe.pdf)

Other

ANSI American National Standards Institute

ARMEA American Railway Engineering and Maintenance-Of-Way Assoc.

DIPRA Ductile Iron Pipe Association

NCDWR North Carolina Division of Water Resources

NCDEQ NC Department of Environmental Quality

NCDOT North Carolina Department of Transportation

NPDES National Pollutant Discharge Elimination System

OSHA Occupational Safety and Health Administration

SDS Safety Data Sheet

1.8 TESTING SERVICES

A. TESTING LABORATORY

The Testing Laboratory (selected by the Contractor) shall be approved by OWASA's Engineer and will be responsible for conducting and interpreting tests. The Testing Laboratory shall state in each report whether or not the test specimens conform to all requirement of the Contract Documents and specifically note any deviation there from.

B. TEST AND INSPECTION REQUIREMENTS

Specific test and inspection requirements shall be as specified herein.

1.9 PROJECT CONDITIONS

A. DEMOLITION

Demolish and completely remove from the site existing underground utilities indicated on the plans to be removed.

B. ENVIRONMENTAL – WETLANDS

Before crossing or entering into any jurisdictional wetlands, contractor shall verify whether or not a wetlands permit has been obtained for the encroachment and whether special restrictions have been imposed. Care shall be taken to prevent draining or otherwise destroying non-permitted wetlands. Restore as stated on either the project drawings, the contract documents, and/or as noted in the permit.

C. ENVIRONMENTAL - BUFFER CROSSING REQUIREMENTS

Before crossing streams or ditches or working within 50 feet of ponds, lakes, or rivers, the Contractor shall verify whether either the line is exempt or a permit has been obtained to encroach into a nutrient sensitive river basin buffer and if so, to what extent work is permitted to occur. Unless otherwise permitted, shown on the contract drawings, or exempted, water and sewer crossing stream, river, pond, or lake buffers are to be as near perpendicular as possible (the crossing is considered to be perpendicular if it intersects the stream or surface water between an angle of 75 and 105 degrees). Do not disturb more than 40 linear feet (longitudinal) of riparian buffer. When permitted to encroach into zone 1 (the lower 30 feet beside the stream or water), adhere to all of the following Best Management Practices in during construction.

1) Woody vegetation is cleared by hand. No grading allowed.
2) Stumps to remain except in trench where trees are cut. Minimize disturbance to roots in buffer zone.
3) Backfill trench with the excavated soil immediately following installation.
4) Do not use fertilizer except for the one-time application to reestablish vegetation.
5) Minimize removal of woody vegetation, the amount of disturbed area, and the time the disturbed area remains disturbed.
6) Take measures to ensure diffuse flow of water through the buffer after construction.
7) In wetland areas, use mats to minimize soil disturbance.

D. SAFETY

The Contractor shall keep the surface over and along the trenches and other excavation in a safe a satisfactory condition during the progress of the work.

1.10 LOCATING SERVICES

Contact OWASA Distribution and Collection Systems Division to coordinate interruption of service, operation of valves, line cut-ins, or placement of a tapping sleeve and valve. If interruption is necessary, the interruption shall be arranged to occur at such a time to cause the least disruption and minimize loss of service. At the direction of OWASA's Engineer, temporary service may be required to be provided. Provide a minimum of 10 working days' notice of the proposed utility interruption or necessary operation of valves.

1.11 COORDINATION

A. OWASA OPERATES VALES AND HYDRANTS
Coordinate tie-in to municipal water mains with OWASA's Engineer. OWASA will be the sole operator of all valves and hydrants on the OWASA water distribution system. Do not interrupt existing utilities or shut off valves of active lines unless approved by OWASA's Engineer. If interruption is necessary, the interruption shall be arranged to occur at such a time to cause the least disruption and minimize loss of service.

B. TIE-IN TO SEWER MAIN AND MANHOLES

Coordinate tie-in to sewer mains and manholes with OWASA's Engineer.

C. BYPASS PUMPING

At the direction of OWASA's Engineer, temporary pumping/bypass of sewerage flow may be required to be provided. See Section 02530 - *Sanitary Sewer*, *Bypass Pumping* for bypass pumping requirements and procedure.

D. TRAFFIC SIGNALS

When traffic signals, loops, or their appurtenances are likely to be damaged or interfere as a result of the construction, coordinate temporary operation with the applicable agency having jurisdiction of the signals. Provide a minimum of 48-hour notice prior to anticipated disturbance or interruption.

E. CALL BEFORE YOU DIG

Contact ***"NC One Call"*** 1-800-632.4949 or The National "Call Before You Dig" 811 before digging.

1.12 PUBLIC CONVENIENCE

The Contractor shall at all times so conduct their work as to ensure the least possible inconvenience to the general public and the residents in the vicinity of the work. Fire hydrants on or adjacent to the work shall be kept accessible to firefighting equipment at all times. Temporary provisions shall be made by the Contractor to ensure the proper functioning of all gutters, sewer inlets, drainage ditches, and irrigation ditches, which shall not be obstructed except as approved by OWASA's Engineer.

1.13 EROSION AND SEDIMENTATION CONTROL AND NPDES MONITORING, CONTROLS, AND LIMITATIONS FOR PERMITTED DISCHARGES

The Project Engineer shall submit a sedimentation and erosion control plan to the appropriate authority and obtain all necessary construction permits. The Contractor shall follow all local and state requirements regarding sedimentation and erosion control. Construction methods shall minimize sedimentation and erosion.

It is the Contractor's responsibility to periodically monitor the Stormwater Discharge Outfall points at the specified frequency and maintain reports as outlined in these specifications.

A. FINAL LIMITATIONS AND CONTROLS FOR STORMWATER DISCHARGES

During the period beginning on the effective date of the permit and lasting until expiration, the Owner (Permittee) is allowed and authorized to discharge stormwater associated with construction activity. Such discharges shall be controlled, limited, and monitored as specified below.

1) The Contractor shall implement the Erosion & Sedimentation Control plan, which has been approved by the approval authority. The approved plan is considered a requirement or condition of the general NPDES permit. Deviation from the approved plan, or approved amendment to the plan, shall constitute a violation of the terms and conditions of this general permit except that deviation from the approved plan will be allowed:

    a. To correct an emergency situation where sediments are being discharged off the site, or

    b. When minor modifications have been made for the purpose of improving the performance of the erosion and sedimentation control measures and notification of the minor modification has been made to the Division of Energy, Minerals, and Land Resources (or approved local program).

2) Such a deviation from the approved plan shall be noted on the approved plan maintained at the job site. During active construction, a copy of the approved plan shall be maintained on the site.

3) Equipment utilized during the construction activity on a site must be operated and maintained in such a manner as to prevent the potential or actual pollution of the surface or ground waters of the state. Fuels, lubricants, coolants, and hydraulic fluids, or any other petroleum products, shall not be discharged onto the ground or into surface waters. Spent fluids shall be disposed of in a manner so as not to enter the waters, surface, or ground, of the state and in accordance with applicable state and federal disposal regulations. Any spilled fluids shall be cleaned up to the extent practicable and disposed of in a manner so as not to allow their entry into the waters, surface or ground, of the state.

4) Herbicide, pesticide, and fertilizer usage during the construction activity shall be consistent with the Federal Insecticide, Fungicide, and Rodenticide Act and shall be in accordance with label restrictions.

5) All wastes composed of building materials shall be disposed of in accordance with North Carolina General Statutes, Chapter 130A, Article 9 – Solid Waste Management, and rules governing the disposal of solid waste (North Carolina Administrative Code Section 15A NCAC 13B).

6) The Contractor, for the Permittee, shall control the management and disposal of litter and sanitary waste from the site such that no adverse impacts to water quality occur.

B. MINIMUM MONITORING AND REPORTING REQUIREMENTS

Minimum monitoring and reporting requirements are as follows unless otherwise approved in writing by the Director of the Division of Water Resources.

1) All erosion and sedimentation control facilities shall be inspected by or under the direction of the permittee (the Owner). However, the responsibility for inspection is herein delegated by the Owner to the Contractor as part of this project. Inspections shall be made:

   a. At least once every seven calendar days (at least twice every seven days for those facilities discharging to waters of the State listed on the latest EPA approved 303(d) list[1] for construction related indicators of impairment such as turbidity or sedimentation), and

   b. Within 24 hours after any storm event of greater than 0.5 inches of rain per 24-hour period.

   A rain gauge shall be maintained on the site by the Contractor and a record of the rainfall amounts and dates shall be kept by the Contractor.

2) Once land disturbance has begun on the site, stormwater runoff discharges shall be inspected by observation for stormwater discharge characteristics as defined below at the frequency in stated above to evaluate the effectiveness of the pollution control facilities or practices. If any visible sedimentation is leaving the disturbed limits of the site, corrective action shall be taken immediately to control the discharge of sediments outside the disturbed limits.

Stormwater Discharge Characteristics	Monitoring Type[1]	Monitoring Location[2]
Clarity	By observation	SDO
Floating Solids	By observation	SDO
Suspended Solids	By observation	SDO
Oil Sheen	By observation	SDO
Other obvious indicators of stormwater pollution	By observation	SDO

Footnotes:
[1] Monitoring Type: The monitoring requires a qualitative observation of each stormwater outfall. **No analytical testing or sampling is required**.
[2] Sample (observation) location: **SDO**= **S**tormwater **D**ischarge **O**utfall

3) The operator (Contractor) shall keep a record of inspections and forward copies of these reports to OWASA's Engineer. Visible sedimentation found outside of the disturbed limits shall be recorded and a brief explanation kept with the records as to the measures taken to control future releases. Any measures taken to clean up

[1] *The latest approved list may be obtained from the Division of Water Resources, or from the following website location:* https://deq.nc.gov/about/divisions/water-resources/planning/modeling-assessment/water-quality-data-assessment/integrated-report-files.

the sediment that has left the disturbed limits shall also be recorded. These records shall also be made available to NCDWR or an authorized agent upon request. If OWASA's Engineer discovers sedimentation outside the limits of disturbance, the Contractor will be notified in writing and requested to remediate the situation.

4) All records of monitoring shall be turned over to OWASA along with the "red lined" record water and/or sewer drawings.

C. SCHEDULE OF COMPLIANCE

1) The Contractor shall comply with Final Limitations and Controls specified for stormwater discharges once disturbance has begun on the site and until completion of construction or development and the establishment of a permanent ground cover.

2) During construction and until the completion of a construction or development and the establishment of a permanent ground cover, the Contractor shall provide the operation and maintenance necessary to operate the stormwater controls at optimum efficiency.

PART 2 – PRODUCTS

2.1 SOIL, BEDDING AND BACKFILL

A. MATERIAL CLASSIFICATION

1) **Bedding Material**: #57 or #67 stone (NCDOT Standard Specifications for Roads and Structures, Table 1005-1). In poor soils, or when the foundation is determined by OWASA to be unsuitable, improve foundation in accordance with Paragraph 3.2 F.

2) **Excavation**: All excavation material shall be classified as either Rock or Unclassified Earth Excavation.

3) **Flowable Fill Concrete Backfill**

a. Non-excavatable flowable fill concrete shall have a minimum 28-day compressive strength of 125 psi but no more than 200 psi (to be excavatable by machine equipment). Materials shall comply with the recommendations within ACI 229, latest revision, which include cement, aggregates, fly ash, water, admixtures, slag and other non-standard materials).

Excavatable is an application where it may be necessary to remove the flowable fill at a later date. Non-excavatable is an application where it is not necessary to remove or otherwise excavate the flowable fill at a later date.

b. Flowable Fill Concrete for Pipe Abandonment Controlled Low Strength Material. Concrete strength shall be liquid enough to flow, be self-leveling, excavatable, and have a minimum 56-day compressive strength of 50 psi but not more than 150 psi.

4) **Foundation Stone**: Foundation/Trench Stabilization Material: #57 or #67 stone.

5) **Select Earth Backfill** shall be free of debris, roots, frozen materials, organic matter, rock, or gravel larger than 1 inch in any dimension, or other harmful matter and shall generally meet NCDOT *Standard Specifications for Roads and Structures*, Section 1016 – Select Material for properties and gradation. The suitability of material shall be determined by a geotechnical engineer and approved by OWASA's Engineer, however at its sole discretion, OWASA may require select, import fill to be used, such as when DI pipe is installed in corrosive soils.

6) **Common Trench Backfill**: Suitable material from the specific excavation may be used for final backfill provided the material meets the following criteria. The suitability of material for specific purposes shall be determined by a geotechnical engineer and approved by OWASA's Engineer.

   a. **Satisfactory Soils**: ASTM D2487 (Unified Soil Classification System)(USCS), soil classification groups GW, GP, GM, SW, SM, SC, ML, and CL; or a combination of these group symbols; free of rock or gravel larger than 3 inches in any dimension, debris, waste frozen materials, vegetation, and other deleterious matter.

   b. **Unsatisfactory Soils**: ASTM D2487 USCS soil classification groups GC, CH, MH, OH, OL and PT; soils which contain rock, gravel, or clumps of clay larger than 3 inches in any dimension, debris, waste frozen materials, vegetation, perishable and objectionable materials (organic), and other deleterious matter. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction, unless otherwise approved by either OWASA's Engineer or a Geotechnical Engineer.

7) **Structures, Backfill Around**: Backfill shall be approved by OWASA's Engineer and shall be free from large or frozen lumps, wood, or rocks more than 3 inches in their greatest dimension or other extraneous material. Porous backfill shall be either #67 or #57 clean stone.

8) **Topsoil**: Topsoil shall consist of friable clayey or silty loam, free from roots, stones, and other undesirable material and shall be capable of supporting a good growth of grass. Topsoil shall be free of material greater than 1-inch in any dimension.

2.2 MISCELLANEOUS

A. GEOTEXTILE FABRIC

Geotextile fabric shall be protected from mud, dirt, dust, sunlight, and debris during transport and storage. Material shall be inert to commonly encountered chemicals; resistant to mildew, rot, insects, and rodents; and biologically and thermally stable. Geotextile fabric for subsurface installation shall not be exposed to direct sunlight for more than 24 hours before or during installation.

Nonwoven geotextile, specifically manufactured as a drainage fabric; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to ASTM D4759 and referenced test methods:

1) **Drainage Fabric**

Physical Property	Test Method	Requirements
Apparent opening size	ASTM D4751	Equal to or greater than No. 30 sieve
Permittivity	ASTM D4491	Minimum 0.51 sec.
Tensile strength @ 20% (max) elongation	VT<52	Minimum 25 in-lbs/lin

2) **Geotextile for use with Rip-Rap**

Physical Property	Test Method	Requirements
Apparent opening size	ASTM D4751	Equal to or greater than No. 50 sieve
Puncture Strength	ASTM D751	Minimum 80 lb.
Tensile strength @ 20% (max) elongation	VT<52	Minimum 30 in-lbs/lin

Seams shall be equal in strength to the basic material.

Additional fabric material or noncorrosive steel wire may be incorporated into fabric to increase overall strength.

3) **Separation Fabric**

Physical Property	Test Method	Requirements
Apparent opening size	ASTM D4751	Equal to or greater than No. 30 sieve
Puncture Strength	ASTM D 4833	90 lbf
Grab Tensile strength	ASTM D 4632	Minimum 200 lbf
Water Flow Rate	ASTM D 4491	4 gpm per sq. ft.

4) **Stabilization Fabric**

Provide fabric meeting Geotechnical Engineer's recommendations for the application intended.

B. DEFORMED REINFORCING STEEL

Reinforcing Steel bars shall meet ASTM A615, grade 60, latest revision.

C. WELDED WIRE FABRIC

Welded wire fabric shall meet ASTM A1064, latest revision.

D. TRACER TAPE AND TRACER WIRE

a) **Metallic Underground Warning Tape**: Metallic detectable underground warning tape shall consist of a solid aluminum foil core, 35 gauge minimum, encased on each side with plastic (minimum overall thickness 5.0 mils) and be 3 inches wide with black lettering imprinted on a color-coded background that conforms to APWA uniform color code specification (BLUE for water, GREEN for sewer and PURPLE for reclaimed water) and silver with black ink letters. Minimum tensile strength shall be 22 lbs/inch. Soil tolerance range to be pH 2.5 to pH 11.0. On one side of the tape, the text shall include the wording “WATER LINE BELOW,” “SEWER LINE BELOW,” or “RECLAIMED WATER LINE BELOW” as appropriate, repeated along the length of the tape.

b) **Tracer Wire**: Tracer wire shall be as manufactured by Copperhead Industries, LLC. 12 AWG Superflex expanded wire or approved equal for open cut and SoloShot Extra-High Strength CCS or approved equal for directional bores and shall be installed above all mains and services. The wire color shall be appropriate for the utility being installed. Blue for potable water, green for sewer, and purple for reclaimed water. Water and corrosion proof connectors, such as 3M direct bury splice kits, Copperhead Snakebite Locking Connectors, or approved equal, shall be used when splicing wire together.

Placement of tracer tape and tracer wire shall be installed per Paragraph 3.16B, *Identification of New Water or Sewer Lines* of this Section.

PART 3 – EXECUTION

3.1 PREPARATION

A. GENERAL REQUIREMENTS APPLYING TO ALL AREAS

1) Contractor shall plan construction to minimize disturbance to properties adjacent to the water or sewer lines.

2) OWASA’s Engineer reserves the right to limit the width of land to be disturbed and to designate on the drawings or in the field certain areas or items within this width to be protected from damage.

3) **Access and/or Haul Roads**: Any grading or excavation required for equipment travel during the course of construction as well as erosion control, access or haul road removal, restoration, seeding and ground cover shall be provided by the Contractor.

4) The contractor shall be responsible for damage to areas or items designated by OWASA's Engineer or outside of the construction limits to be protected. Repairs to, replacement of, or reparations for areas or items damaged shall be made to the satisfaction of OWASA's Engineer before acceptance of the completed project.

5) The Contractor shall protect all buildings or structures located along the utility line. Hand trenching, shoring, or other methods may be required.

6) Any fences disturbed by the Contractor shall be repaired with new materials to a condition equal to or better than their original condition or to the satisfaction of OWASA's Engineer.

7) Contractor shall limit width of disturbed area through garden areas to a width absolutely necessary for construction of utility line.

8) Contractor shall obtain written permission from property owners for use of any access other than ones located within public rights-of-way or easements. Written permission shall contain conditions for use and restoration agreements between property owner and Contractor.

9) All areas disturbed shall be restored to a condition equal to or better than their original condition and shall be graded to drain.

10) The Contractor shall replace or repair all damaged or destroyed hedgerows and property corners using the services of a licensed Professional Surveyor.

B. CONSTRUCTION LIMITS

1) Contractor shall not disturb any areas outside the limits contained in this section without express written permission from OWASA's Engineer.

2) Except as indicated on the plans, no "clear cutting" of timber shall be permitted within the construction limits. Contractor shall make select cutting of trees, taking smallest trees first, that are mandatory for the construction of the utility line. The decision of OWASA's Engineer shall be final on the determination of which trees are to be cut.

3) The widths measured from the centerline of the water or sewer lines shall be as shown on the contract drawings. The Contractor shall protect all areas outside these construction limits unless written variations are granted by OWASA's Engineer.

4) **Specific Requirements Applying to Developed Subdivision/Lots**

   a. All trees located beyond 15 feet of the centerline of water or sewer line shall be protected by the Contractor. OWASA's Engineer reserves the right to designate other trees located closer to the centerline for protection where possible.

   b. All shrubs, hedges, or other ornamental plantings located along the line shall be protected or removed and replanted by the Contractor.

c. The Contractor shall protect septic systems or springs located beyond 15 feet from the centerline of the line.

d. Contractor shall grub only brush, roots, and stumps of removed trees. Damage to lawns shall be kept to an absolute minimum necessary for construction.

e. Excavated or blasted rock shall be removed from the site unless otherwise ordered by OWASA's Engineer.

f. Restoration and fine grading shall follow within 15 calendar days from the time an area is disturbed or within 1000 feet from the immediate work site, whichever occurs first. Seeding shall follow as ordered by OWASA's Engineer.

5) **Specific Requirements Applying to Undeveloped Areas**

a. In wooded areas, the clearing shall be 15 feet on each side of pipe, unless indicated differently on the OWASA approved construction drawings, in which case, the work shall be confined to the limits defined on the plans. All permanent easements shall be fully cleared. All trees 12 inches in diameter or larger located beyond 15 feet of the centerline of the water or sewer line shall be protected unless Contractor obtains written authorization from OWASA's Engineer to remove them. OWASA's Engineer reserves the right to designate select trees located closer to the centerline for protection where possible.

b. In areas where livestock is kept, the Contractor shall notify property owner prior to commencing work and keep owner advised of progress of work. Fences shall be kept secure at all times and livestock protected from open ditches, machinery, blasting, and other hazards.

c. Restoration, fine grading, and permanent seeding shall follow within 15 working days or 30 calendar days, whichever is shorter, from the time an area is disturbed or within 1000 feet from the immediate work site, whichever occurs first. See paragraph 3.15 – *Seeding and Groundcover*.

C. CLEARING AND GRUBBING

1) **Description**: This work shall consist of clearing, grubbing, removing, and disposing of all vegetation and debris within the limits of construction, as designated on the plans or as required by OWASA's Engineer. The work shall also include the preservation from injury or defacement of all vegetation or objects designated to remain. Clearing shall consist of cutting, removal, and satisfactory disposal of all trees, down timber, brush, rocks, projected roots, stumps, rubbish, laps, and other material within easement.

2) A preconstruction meeting shall be held with appropriate urban forestry personnel from the Town of Chapel Hill or Town of Carrboro prior to any clearing. Tree protection fencing shall be installed, and all tree ordinances shall be followed.

3) The Contractor shall provide barricades, fences, coverings, or other types of protection necessary to prevent damage to existing improvements, not indicated to be removed, and improvements on adjoining property. All improvements damaged by this work shall be restored to their original condition to a condition acceptable to the owner or other parties or authorities having jurisdiction. Trees

and shrubs that are to remain within the construction limits will be indicated on the drawings or conspicuously marked on site. Unless otherwise noted, trees within the construction limits shall become the property of the Contractor and shall be removed from the site.

4) Contractor shall protect existing tress and other vegetation indicated by OWASA's Engineer to remain in place against limb, bark or root damage such as cutting, breaking, or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. When such damage does occur, all rough edges of scarred areas shall be removed in accordance with accepted horticultural practices.

5) Carefully and cleanly cut roots and branches of trees indicated to remain where the roots and branches obstruct construction of the utility line. If directed by OWASA's Engineer, the Contractor shall provide protection for roots and branches over 1 ½ inches diameter that are cut during construction operations. Coat the cut faces with emulsified asphalt, or other coating especially formulated for horticultural use on cut or damaged plant tissues. Temporarily cover all exposed roots with wet burlap to prevent roots from drying out. Provide earth cover as soon as possible.

6) Trees and vegetation designated to remain shall be repaired or replaced at Contractor's expense in a manner acceptable to OWASA's Engineer if they are damaged by construction operations. Repair tree damage as directed by a qualified tree surgeon.

7) Debris from the site shall be removed in such a manner as to prevent spillage. Keep pavement and area adjacent to site clean and free from mud, dirt, dust, and debris at all times.

8) The method of stripping, clearing, and grubbing the site shall be at the discretion of the Contractor. However, all stumps, roots and other debris protruding through the ground surface or in excavated areas shall be completely removed and disposed of off the site by the Contractor.

9) **Stripping of Topsoil**: Remove the existing topsoil to a depth of 6 inches or to the depth encountered from all areas in which excavation will occur. The topsoil shall either be stored in stockpiles separate from the excavated trench material if the topsoil is to be re-spread or otherwise disposed of off-site. Topsoil stockpiles shall be graded to freely drain surface water and shall have a silt fence placed around the base of the stockpile.

10) **Disposal**: All brush, tree tops, stumps, and debris shall be hauled away from site or otherwise disposed of in a manner acceptable to OWASA's Engineer. The Contactor shall clean up debris resulting from clearing operations continuously with the progress of the work and remove promptly all salvageable material that becomes their property and is not to be reused in construction. Sale of material on the site is prohibited.

Disposal of cleared material shall be in accordance with all local and state laws. Trees cut down on the construction site will be hauled away from the site for proper disposal unless instructed otherwise by OWASA. Stumps of trees cut down outside of the excavation area will be removed. Perishable material shall not be disposed of at the construction site. Brush, laps, roots, and stumps from trees shall be disposed of in an NCDEQ approved and permitted land clearing and inert debris type landfill. The Contractor will be responsible for obtaining all applicable permits and paying all fees for the disposal of excess material.

D. PROTECTION OF EXISTING UTILITIES AND STRUCTURES

1) **Subsurface Obstructions**

a. **Subsurface Obstructions**: Take necessary precautions to protect existing utilities from damage due to any construction activity. The contractor shall locate existing utilities, culverts, and structures (above or below ground), before any excavation starts and coordinate work with utility companies. The Contractor shall be responsible for notifying utility companies when working within the vicinity of the existing utilities. Omission from or inclusion of located utility items on plans do not constitute non-existent or definite location. Even though for convenience, the utility may be shown on the plans, the Contractor is responsible for and shall call for utility location a minimum of 3 business days prior to excavations. Contact underground damage protection services NC One Call at 1.800.632.4949. Secure and examine local utility surveyor records for available location data including building service lines.

b. Unless shown to be removed, protect active utility lines shown on the drawings or otherwise made known to the Contractor prior to trenching. In excavating, care must be taken not to remove or injure any subsurface structure. All existing gas pipes, water pipes, steam pipes, telephone lines, cable TV lines, electrical conduits, sewers, drains, fire hydrants, and other structures which, in the opinion of the utility company, do not require relocation shall be carefully supported, shored up, the flow maintained, if applicable, and the line/main protected from damage by the Contractor. If damaged, the contractor shall give immediate notice to the proper authorities. The utility shall be restored, at the Contractor’s expense, by the appropriate utility to original or better condition. Where pipes, conduits, or sewers are removed from the trench leaving dead ends in the ground, such ends shall be carefully plugged or bulkheaded by the Contractor at the Contractor’s expense. The Contractor shall be responsible for any damage to persons or property caused by such breaks.

c. The Contractor shall be responsible for anticipating and locating underground utilities and obstructions. When construction appears to be in close proximity to existing utilities, the trench(es) shall be opened a sufficient distance ahead of the work or test pits made to verify the exact locations and inverts of the utility to allow for changes in line and grade.

d. If active utility lines are encountered and are not shown on the Drawings or otherwise known to the Contractor, promptly take necessary steps to assure that service is not interrupted.

e. If permanent facilities being constructed under this Section are found to interfere with or encroach on the existing utilities, immediately notify OWASA’s Engineer and secure their instructions.

f. Do not proceed with permanent relocation of utilities until written instructions are received from OWASA's Engineer.

2) **Protection of Surface Features**

a. Whenever the utility line is to be placed in or near a paved street, the Contractor shall provide pads or take necessary precautions to protect the pavement from damage by the construction equipment. Pavement damaged by cleated or tracked equipment, or by any other means, shall be repaired by the Contractor at their expense.

b. Where a utility line is in an existing paved area, the Contractor shall use care to cut in sharp, neat lines ahead of the excavating/ditching equipment and parallel to the pipe on each side as may be applicable. If the existing road to be cut is located within either the Town of Carrboro or Town of Chapel Hill's corporate limits, the Contractor is responsible for contacting the Town Engineer or representative about pavement repair/replacement.

c. Avoid overloading or surcharge a sufficient distance back from edge of excavation to prevent slides or caving. Maintain and trim excavated materials in such manner to be as little inconvenience as possible to public and adjoining property.

d. Provide full access to public and private premises, to fire hydrants, at street crossings, sidewalks and other points as designated by OWASA's Engineer to prevent serious interruption of travel.

e. Protect and maintain benchmarks, monuments, or other established points and reference points and if disturbed or destroyed, replace items to full satisfaction of OWASA's Engineer and the jurisdictional agency.

3) **Procedures for Repairing Damaged Utility Services**

a. If a located service is interrupted as a result of work under this Section, immediately restore service by repairing the damaged utility at no additional cost to OWASA.

b. **House Services**: If a service pipe supplying water or gas to an adjoining house is broken, the Contractor shall repair same at once and at their expense. OWASA may, at the Contractor's expense, repair any such service without prior notice to the Contractor.

E. PROTECTION OF PERSONS AND PROPERTY

1) Barricade open holes and depressions occurring as part of the work, and post warning lights on property adjacent to or part of public access.

2) Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, washout, and other hazards created by operations under this or other related sections.

F. TRAFFIC CONTROL

1) When working within the OWASA service area, conform to the *Manual on Uniform Traffic Control Devices*, latest revision (MUTCD) as well as the NCDOT Standard Specifications for Roads and Structures, latest revision.

2) Traffic Maintenance shall comply with the latest revision of the NCDOT Standard Specifications for Roads and Structures, Division 9 – *Signing* and Division 11 – *Work Zone Traffic Control*, as well as other applicable sections.

3) When traffic signals or their appurtenances are likely to be damaged or interfere as a result of the construction, coordinate temporary operation with the NCDOT or the applicable Town's Traffic or Town Engineer. Provide 48-hour notice prior to anticipated disturbance or interruption.

4) Whenever it becomes necessary to leave a section of trench open after completion of the day's work, the Contractor shall provide barricades and lights to protect the public. Operate warning lights during hours from dusk to dawn each day and as otherwise required for inclement weather and visibility.

G. DEWATERING

1) **Water in Trenches**: When ground water that would affect the construction of the lines or their appurtenances is encountered, the contractor shall remove the water that accumulates in the trenches or pits by pumping, bailing, well-pointing, or other approved dewatering method and shall perform all work necessary to keep the trenches or pits entirely clear from water while bedding is being placed, the pipe is being laid, masonry units are being placed, and structures are either being set or constructed. All water removed from the trench shall be conveyed in a proper manner to a suitable point of discharge and shall comply with applicable erosion and sediment control laws.

2) No pipe shall be constructed in water and water shall not be allowed to drain through the pipe. The open end of the pipe shall be kept closed with a tight-fitting plug to prevent washing of any foreign matter into the line.

3) No structure shall be constructed in water and water shall not be allowed to flow over or rise upon any concrete masonry structure until the work has been accepted.

4) The Contractor shall dispose of water from the trenches in such a manner to cause no injury to public health, public or private property, work completed or in progress, street surfaces, or which may cause any interference with the use of the streets. Water, if odorless and stable, may be discharged into an existing storm drain, channel, or street gutter in a manner approved by OWASA's Engineer. When required by OWASA's Engineer, a means shall be provided for desilting (filtering) the water before discharge. Under no circumstances shall water be discharged to the sanitary sewer.

5) Prevent surface water from ponding on prepared subgrades and from flooding project site and the surrounding area. Reroute surface water runoff away from or around excavated areas.

6) Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

7) Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

8) Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation. Include cost of de-watering in bid for water or sewer lines. No additional remuneration for this item is permitted.

9) Where underground streams or springs are encountered, provide temporary drainage or bailing. Notify OWASA's Engineer of such conditions.

3.2 TRENCH EXCAVATION

A. GENERAL

1) **Classification of Excavated Material**: All excavated material shall be classified as either earth or rock. Prices bid for the various sizes of pipe shall include excavation and backfilling; such excavation shall be classified as earth.

2) Remove all material of whatever nature, including but not limited to clay, silt, and gravel. Material, of a compactable nature that can be re-used as trench backfill shall be replaced and re-compacted to the requirements set forth in these specifications.

3) **Unsuitable Material and Wasting**: When directed by the Owner's Engineer or OWASA's Engineer, unsuitable material in the trench shall be removed to an appropriate depth and width. At the Contractor's expense, dispose of all unsuitable material, of whatever nature, to a site which legally can accept such material as fill. Adhere to all applicable laws and ordnances regarding permitting of waste site, erosion control, zoning, etc. as may be applicable.

4) Excavation shall be performed in accordance with OSHA Standard 29 CFR Part 1926, OSHA Subpart P "Excavation and Trenching."

5) **Sewer Alignment and Grade**: Offset stakes set at each manhole shall indicate the line and grade of the sewer. Alignment and grade of the pipe by the Contractor shall be established by laser beam. The Contractor shall employ personnel experienced in the use of laser beams. The alignment and grade of the sewer shall be constructed as indicated on the approved plans. Prior to making changes in the field, OWASA's Engineer shall approve any change in grade or alignment which deviates from the approved plans.

6) Concrete collars shall be installed on lines with slopes 20% or greater. See Standard Detail 536.01.

B. PIPE COVER

1) **General**: Where lines transverse public property or are subject to other governmental or utility company jurisdiction, provide depth, bedding, cover, and other requirements as set forth by legally constituted authority having jurisdiction, but in no case less than the depth shown in the Contract Documents.

2) **Minimum and Maximum Cover**: Unless shown otherwise on the construction documents, provide minimum trench depth indicated below to maintain a minimum cover over the top of the installed item. Minimum and maximum cover on pipe are measured perpendicular from top of pipe or fittings to original ground or proposed finished grade as applicable and shall be per Table 02275.1, below. Where the minimum cover is not provided, either use Ductile Iron Pipe or encase the pipe(s) in concrete as indicated. Provide concrete with a minimum 28-day compressive strength of 3000 psi.

3) **Water mains**: Under conditions which otherwise prevent 42-inch bury, such as at crossings above shallow buried structures or rock, the minimum cover shall be 30 inches, as approved by OWASA's Engineer. Lines which have no more than 18 inches of cover at ditch or culvert crossings may be required by OWASA's Engineer to be encased in concrete for a length of 5 feet on each side the ditch or culvert or utilize a higher pressure class. Such encasements shall require approval of the OWASA Engineer.

Table 02275.1

Minimum and Maximum Cover Above Top of Water and Sewer Pipes[a]

Utility	**Condition**			
	Minimum Cover **Subject to Vehicular Traffic?**		**Maximum Cover**	**Minimum Cover With Concrete Encasement**
	Yes	**No**		
Sanitary Sewer/ Ductile Iron	36 inches	24 inches	18 feet	Case specific
Sanitary Sewer/ C900 PVC	36 inches	36 inches	12 feet	NA
Sewer Services	30 inches	12 inches	For gravity flow to main	Case specific
Water Distribution	42 inches	42 inches	72 inches	18 inches (encasement, if required, shall extend to at least 5 feet beyond each side of a ditch or culvert crossing)
Water Services	30 inches	30 inches	72 inches	As Designed

[a]OWASA's Engineer must approve installation of all pipes that do not meet these requirements.

C. TRENCHING

1) **General**: The trench for gravity pipe shall be excavated to conform to Standard Detail 531.01*, Standard Sewer Bedding Detail.* Where it is necessary to remove existing pavements, prepared road surfaces, sidewalks and curbs, these structures/surfaces must be replaced by the Contractor. When making a pavement cut, the Contractor shall use care to saw cut in sharp, neat lines ahead of the excavating/ditching equipment and parallel to the pipe on each side as may be applicable.

   All trenching shall be open cut from the surface. No tunneling or boring will be allowed without the consent of OWASA's Engineer. All trenches shall be excavated to the lines and grades as shown on the plans. Where utility lines are in an existing paved area, the edges of the pavement for the utility line shall be cut in a straight line, parallel to the pipe.

   Trenches shall be excavated in straight lines, in general, following the contour of the ground, and shall be accurately graded in order to establish a true elevation of the invert of the pipe. Trenches for water lines may be curved within the limits of curvature of the pipe as allowed by AWWA C600. In no case shall the trench alignment exceed the allowable vertical or horizontal pipe deflection of offset recommended by the pipe manufacturer.

2) **Trench Width**: The sides of trench shall be uniform and vertical. The width of the trench at the top of the pipe shall be a width that will permit the proper construction of joints and compaction of backfill around the pipe and shall be equal to the largest outside diameter of the pipe plus 12 inches on each side of the pipe, measured at the top of the pipe. The sides of the trenches shall be vertical unless otherwise approved by OWASA's Engineer. Vertical walls should project at least 2 feet above the top of the pipeline laid to existing construction grade unless the finished grade fill depth is less than 2 feet. Lowering trench wall height may necessitate a change in either pipe or bury classification. Notwithstanding, this section is subject to OSHA guidelines and regulations regarding trench protection and shoring.

   Every effort shall be made to maintain the width of the pipe plus 24 inches, but trench width must also be wide enough to provide adequate space for laying and connecting pipe and appurtenances, and for compaction. Sufficient space shall be allowed at the joints for the free use of wrenches for tightening of bolts.

   The minimum trench width should generally be no less than 36 inches in order to accommodate a "Rammax" tamp.

   In excavating for the trench, it is essential that the trench bottom be uniform in grade and remain static during backfilling and under all subsequent trench conditions. To ensure a uniform depth of stone, the grade of the bottom of the trench shall be graded to within 0.04 foot (1/2-inch) of the plan specified grade. The stone shall be graded to the same tolerance.

   Care shall be taken not to over excavate the trench. All trenches excavated below grade (over excavated) shall be refilled to grade with clean #57 stone.

3) **Trench Depth**:

   a. **General**: All trenches shall be excavated to accommodate the bedding and backfill as shown in Standard Detail 531.01

   b. **Water**: Trench depth shall generally conform to that shown on the plans and in conformity to the requirements of Table 02275.1, *Minimum and Maximum Cover Above Top of Main Pipe Lines*.

   c. **Gravity Sewer**: Excavate to the depth and grades shown on the plans. Trench depth shall generally conform to the requirements of Table 02275.1, *Minimum and Maximum Cover Above Top of Main Pipe Lines*.

   d. **Shaping Subgrade**: In excavating for the trench, it is essential that the trench bottom be uniform in grade and remains static during backfilling and under all subsequent trench conditions. To ensure a uniform depth of stone, the grade of the bottom of the trench shall be graded to within 0.04 foot (1/2-inch) of the plan specified grade. The stone shall be graded to the same tolerance.

   e. **Zone of Influence for Building Foundations and Retaining Walls**

      i. The outside bottom of a trench shall not pass through the zone of influence of a building foundation or retaining wall. Unless otherwise indicated by OWASA, the zone of influence is defined as a line extending down and out from the outside edge of a building or retaining wall footing at a 45-degree angle. For walls greater than 8 feet tall or with a surcharge load behind them, OWASA may require a Structural or Geotechnical Engineer review and approve any trench constructed within a horizontal distance of two times the trench depth from the face of the surcharge load. If either of these situations arise, contact the OWASA Engineer for direction before proceeding with trench excavation into these zones.

      ii. Where shoring systems are proposed to be placed within the zone of influence, the surcharge loads imposed by the building or structure shall be taken into consideration by the shoring system designer.

4) **Open Trench Exposure**: Once trench is opened, proceed immediately and with dispatch to place specified materials in trench, or to otherwise utilize trench for intended purpose. Long stretches of open trench ahead of pipe laying shall be avoided. Excavating, pipe laying, and backfilling must move forward at approximately equal rates of progress. The Contractor shall only open as much ditch as they can completely install pipe, backfill, compact, and cleanup within that working day. The Contractor shall string out the pipe that can be installed in one day, and no more than 300 feet of trench shall be open in advance of the completed work in any section. There shall be no trenches left open without proper supervision during working hours or after work has been completed for day. Any exception to this construction practice must be approved, in writing, by OWASA's Engineer. Schedule work and order materials so that trenches are not left open for a longer period than is reasonably necessary. For OWASA contracts, if the Contractor should fail to heed the aforementioned requirement, OWASA's Engineer may refuse payment until these conditions are complied with.

5) **Containment of Sediment (solids and mud)**: The Contractor shall at all times so conduct their work to ensure that all solids and mud are contained within the trench. This containment shall be by the employment of a brick or block weir at the junction of new construction and the existing OWASA system in order to trap material for the Contractor's removal and OWASA's inspection prior to acceptance. The installation and removal of this dam shall be at the Contractor's expense and shall be removed before the line is televised.

A. SHEETING AND BRACING, TRENCH BOXES

Trench walls may have vertical sides up to a maximum depth of 5 feet above subgrade elevation. Above this depth the entire side must be laid back or either shoring or a trench box, certified for the depths being used, must be used. The contractor shall be required to furnish, put in place, and maintain such sheeting, bracing, etc. as may be required to support the sides of the trenches. Brace and sheet trenches must be in full compliance with OSHA requirements.

Brace trenches running near walls or columns, to prevent any settlement or other disturbance of walls or columns.

Do not remove sheeting until backfilling has progressed to stage that no damage to piping, utility service, or conduit will result due to removal. All shoring and form material shall be removed before backfilling. For OWASA contracts, when sheeting, bracing, or trench boxes are required, in order to prevent damage to existing facilities or structures, or as a matter of safety, or as directed by OWASA's Engineer, the costs are to be included in the unit prices as bid for sanitary sewers, storm drains, water lines or structures as applicable and there shall be no additional cost for these items.

Sloping Trench Walls: If trench walls are to be sloped or benched, contractor is responsible for determining the proper and applicable slope based on soil type in order to meet OSHA requirements. Laying back slopes also applies for areas where the top of the trench box is lower than the top of the bank. Contractor shall employ the services of a Geotechnical Engineer for direction and guidance if unstable or difficult soils are encountered. In any event, the Contractor shall hold OWASA harmless for injuries and/or damages resulting from failure to properly adhere to trench protection regulations/requirements in force at the time of a failure or mishap including, but not limited to, damage to utilities, equipment, structures, paving, etc.

B. ROCK

1) **Rock Excavation/Definition**: Rock excavation shall consist of the removal and satisfactory disposal of all materials, which in the opinion of OWASA's Engineer, cannot be excavated except by drilling, blasting, "jack hammering or hoe ramming" (reasonable production for rock excavation by "jack hammering or hoe ramming" will be defined as 5 or more cubic yards per hour). Rock shall consist of undecomposed stone, hard enough to ring under hammer. All boulders containing a volume of more than one-half cubic yard will be classified as rock. When rock is encountered in the trench, OWASA's Engineer must be notified before any rock has been blasted or removed. OWASA's Engineer will measure the rock, after which, the rock shall be excavated to a depth 6 inches below the grade of pipe and the bottom of trench brought back to grade by using an approved fill material. See paragraph 3.8, *Blasting* for other requirements regarding rock excavation.

2) **Cushioning Pipe in Rock**: Special precautions shall be exercised to prevent any pipe from resting on rock or any other hard projection that might cause breakage of pipe. At no time shall the pipe bell or the pipe barrel rest on rock. A minimum of 6 inches of stone cushioning is required between the barrel of the pipe and rock. A minimum of 12 inches of clearance is required between the sides of the pipe and the rock. See Standard Detail 511.01. Thicker cushioning may be required for deeper pipe on a case-by-case basis.

3) **Disposal of Rock**: Rock excavated from the trench shall be hauled off the site at the Contractor's expense. Borrow required to replace excavated rock shall be provided by the Contractor and for OWASA contracts, shall be included in the unit price bid for rock excavation. No rocks or boulders shall be used as backfill in any part of the trench. Where rock has scattered over adjoining property as a result of blasting, the Contractor shall remove the rock and restore the area to its original condition at no cost to OWASA.

C. PREPARATION OF FOUNDATION FOR PIPE LAYING

1) Excavation of trenches for all pipelines shall be done to line and grade as established by the Engineer. The bedding surface shall provide a firm, stable, and uniform support through the entire length of the pipe. Recesses shall be excavated to accommodate bells and joints. When bedded firmly on the subgrade, the pipe shall be on the exact grade of the completed water or sewer line.

2) **Unsuitable Trench Subgrade/Foundation Improvement**: If the trench subgrade is found to be soft, spongy, excessively wet, unstable or in any other way unfit such that there is inadequate pipe support, when directed by OWASA's Engineer, the material shall be removed for the full width of the trench, and the excavated area shall be strengthened for foundation purposes by furnishing and placing either approved clean stone, a concrete cradle, concrete mud mat, concrete encasement or a combination of these materials. Whenever the bottom of the trench is such that it cannot be reasonably stabilized, OWASA's Engineer may require the sewer to be laid in cradles or in cradles supported on piles. These foundations shall be placed as directed by the OWASA's Engineer.

   Observe the following requirements when unstable trench bottom materials are encountered:

   a. Notify OWASA when unstable materials are encountered and define by drawing station locations and limits when encountered.

   b. Remove unstable trench bottom materials as directed and replace with subgrade stabilization material specified.

3) **Over-Excavation**: Unauthorized over-excavation consists of removal of material beyond indicated subgrade elevations or side dimensions, without specific approval of OWASA's Engineer. Exercise care to avoid excavations below established grade where firm earth conditions exist. Where unauthorized excavations have been carried beyond points required, restore these areas to the elevations and dimensions shown on the drawings with approved fill material and compact as specified (as noted in the preceding paragraph). In no case shall the pipe be brought to grade by blocking under the barrel of the pipe. A uniform

support shall be provided for the entire length of the pipe. Unauthorized excavation shall be replaced at Contractor's expense.

D. TRENCH PREPARATION FOR PIPE

In all installations, the pipe trench needs to be excavated deep enough to accommodate the required depth of bedding and backfill, including recesses for pipe bells, as well as for the minimum and maximum cover depth per Table 02275.1.

1) **Preparation of Trenches for Gravity Sewer Pipelines**

The bottom of the pipe trench for gravity pipes shall be excavated to a minimum over depth as shown on Standard Detail 531.01 to provide for improved pipe bedding material for the entire length of the gravity pipeline, including sewer lateral connections, except in rock where bedding shall be a minimum of 6 inches deep for DI pipe and 8 inches deep for PVC pipe (see Standard Detail 511.01 and paragraph 3.2.E.2, above). The bedding shall be Table 02275.3.

2) **Preparation of Trenches for Water Mains and Sewer Force Mains**

The trenches for water lines and sewage force mains shall be graded to avoid local high points. Trenches shall be graded either level or on a continuous upslope to the high points designated on the drawings. Trenches shall be of such depth as to provide a minimum cover over the top of the pipe as noted in Table 02275.1. The trenches shall have 4 inches of loose soil in the bottom before pipe is placed, so pipe is firmly and continuous in contact with the soil. Pipe shall not bridge any areas. Rock larger than 2 inches shall be removed from the trench bottom and any voids filled with soil or clean stone. Bell holes shall be provided at each joint to permit proper joint assembly and proper pipe support. Rock shall be removed in accordance with Paragraph E. See Standard Detail 511.01.

Bedding for DIP water mains and sewer force mains shall conform to Standard Detail 511.01 (See also Paragraph 2.1 B- Bedding Definitions) for mains 12 inches and smaller with a maximum depth of cover of 10 feet. The design engineer shall consider laying conditions other than Type 1 for pipe 14 inches and larger or greater than 10 feet deep, consistent with DIPRA Design of Ductile Iron Pipe, to be approved by the OWASA engineer.

3) **Surface or Ground Water in Trenches/Pipe**

When ground water is encountered, the Contractor shall pump, or otherwise remove any water that accumulates in the trenches and shall perform all work necessary to keep the trenches clear from water while pipe is being laid. No pipe shall be laid in water and the pipe shall not be used as a means of draining ground water from the trench. The open end of the pipe shall be kept closed with a watertight plug to prevent washing of any foreign matter into the line. At the conclusion of the workday, or at any other time when pipe laying is not in progress, a watertight plug shall be placed in the bell of the last joint of pipe laid. All water removed from the trench shall be conveyed in a proper manner to a suitable point of discharge and shall comply with the applicable erosion and sedimentation laws. See paragraph 3.1.G – *Dewatering*, of this specification.

E. TRENCHING IN FILLS

In areas where trenching for pipes will be in fills, the fills shall be brought to an elevation of at least 12 inches above the top of the pipe, and then the trench excavated in the compacted fill, as herein specified for trench excavation.

F. EXCAVATION FOR STRUCTURES

1) Excavate to provide a minimum of 12 inches of horizontal clearance between outer surface of structure and trench wall.

2) Where rock is encountered so that a built-in-place manhole, precast structure (such as a manhole or vault), or other structure will bear over rock, remove the rock to a minimum of 8 inches below the foundation or footing of the structure and place an 8-inch cushion of clean #57 stone over the rock.

G. WATER MAIN BEND BLOCKING INSTALLATION

1) Excavate area to receive poured in place concrete blocking to exact dimensions shown in Standard Detail 512.02. Blocking is to be placed in undisturbed residual soils. If blocking is to be placed in areas where boulders or stumps have been removed or in areas of loosely compacted fills, such as in landscaped areas (outside of pavements or parking lots), contact OWASA's Engineer for directions.

2) Concrete shall be plain concrete with a minimum compressive strength of 3000 psi at 28 days.

3) Wrap bolts in plastic or provide other acceptable means of protection, approved by OWASA's Engineer before pouring concrete blocking.

4) Concrete thrust blocking and rodding is not required for installation of restrained joint piping unless directed and at the discretion of the OWASA Representative.

H. DEPOSITION OF EXCAVATED MATERIAL

1) All excavated material shall be placed on one side of the trench away from the roadway unless permission is given by OWASA's representative to place it on both sides. Excavated materials shall be so placed as not to endanger the work and so that free access may be had at all times to all parts of the trench and to all fire alarm boxes, fire hydrants and gate valves on water pipes, which are located in the vicinity. Excavated material shall be placed so as to inconvenience the public as little as possible. All fences and walls shall be protected and, if damaged, shall be repaired or replaced in as good condition as before it was disturbed. Protect shade trees from stockpiling of material.

2) Exercise care when stockpiling excavated material on the bank in order to prevent surcharging the bank of the trench and potentially rendering the excavation unstable.

3) **Wasting of Unsuitable Material**: All surplus or unsuitable excavated materials are designated as waste and shall include, but are not limited to, material of an uncompactable nature, material unsatisfactory for backfill, trash and excess material shall be removed from project site and disposed at the Contractor's

expense. For OWASA contracts, where removal of unsatisfactory material is due to negligence on the part of the contractor (i.e., resulting from inadequate shoring or bracing, failure to dewater, improper material storage exposing it to rain or flooding, or other failure to meet specified requirements), work shall be performed at no additional cost to OWASA. If additional material is required, the Contractor shall supply same from an approved borrow pit at no additional cost to OWASA. Rock excavated from the trench shall be hauled off the site at the Contactor's expense.

3.3 BEDDING

A. BEDDING DEFINITIONS

See paragraph 2.1 B, *Pipe Bedding Definitions.*

B. MINIMUM BEDDING REQUIREMENTS BY TYPE OF PIPE

1) **General**

a. In no case shall the #57 or #67 stone bedding be less than the minimum bedding shown in Standard Detail 531.01, unless specifically exempted in writing by OWASA's Engineer.

b. Ductile Iron Pipe: Laying Condition and Pipe Bedding Definitions for ductile iron pipe are based on AWWA C150 and DIPRA's Design of Ductile Iron Pipe. Refer to Standard Detail 531.01 Sheet 1.

c. Polyvinyl Chloride (PVC) Pipe: Laying Condition and Pipe Bedding Definitions are based on Unibell PVC Pipe Association Installation Guide for Solid-Wall PVC Sewer Pipe. Refer to Standard Detail 531.01 Sheet 2.

2) **Sewer Mains and Sewer Laterals**: Provide #57 or #67 stone trench bedding material.

a. **DIP Gravity Pipe**: Pipe shall be bedded in carefully compacted sand, gravel, or crushed stone to a depth of 1/8 pipe diameter with a minimum of 4 inches of granular material between the pipe and pipe bells and the trench bottom and covering the full width of the trench. The bedding shall be shaped so that the bottom of the pipe rests on the bed. Bell holes and depressions as required of the joint shall be dug after the bedding has been graded and shaped, and shall only be of such length, depth, and width as required for properly making the particular type of joint. Provide an additional 1-inch depth of cushioning material for each additional 2 feet of depth in excess of 16 feet up to a maximum of 12 inches of cushioning material. See Section 3.2.E, paragraph 2, and Standard Detail 511.01. When the foundation is determined by OWASA to be unsuitable, improve foundation in accordance with Paragraph 3.2 F.

b. **DIP Force Mains** (Flat Bottom): The ditch is excavated slightly above grade by excavation equipment and cut to finish grade by hand to undisturbed earth creating a flat bottom. Bell holes are dug, to prevent point loading the pipe bells, so that pipe bears uniformly upon the trench bottom between bell holes. Existing soil shall be shovel sliced or otherwise compacted under the haunching of the pipe to provide uniform support. Do not bed sewage force mains in stone except as indicated for rock areas. For pipe 14 inches or greater in diameter or installed greater than 10 feet deep, the design engineer shall determine appropriate trench type for the depth of cover in accordance with DIPRA's Design of Ductile Iron Pipe, latest edition and the manufacturers recommendations, as approved by the OWASA engineer.

c. **PVC C900 Gravity Pipe**: Pipe shall be bedded in sand, gravel, or crushed stone with a minimum compacted depth of 8 inches with an additional 1-inch depth of cushioning material for each additional 2 feet of depth in excess of 16 feet up to a maximum of 12 inches of cushioning material. See Standard Detail 531.01 for bedding, haunching, and backfill.

Blocking is required for the sewer lateral at the wye or tap to the main to prevent rotation.

3) **Water Pipe and Water Service Pipe, and Sewer Force Mains**: Do not bed water pipe and water service pipe in stone, unless as indicated for rock areas or as otherwise directed by the OWASA Engineer. The trenches shall have 4 inches of loose soil in the bottom before pipe is placed, so pipe is firmly and continuous in contact with the soil. Bell holes are dug to prevent point loading the pipe bells, such that pipe bears uniformly upon the trench bottom between bell holes. Existing soil shall be shovel sliced or otherwise compacted under the haunching of the pipe to provide uniform support. In poor soils, improve foundation in accordance with Paragraph 3.2 F.

4) **Bedding for Structures**: The bottom of manhole bases and other precast structures and appurtenances shall be excavated to minimum over depth of 12 inches below the bottom of the structure. The structures shall be placed on a minimum of 12 inches of clean stone bedding that has been firmly consolidated. Bedding material shall be shaped, graded, and compacted so that the entire bottom of the structure rests level on the material for its entire area.

C. BEDDING MATERIAL PLACEMENT

Unless otherwise specified, the bottom of the pipe trench for sanitary sewer shall be excavated to a minimum over depth of 6 inches below the bottom of the pipe, to provide for the compacted bedding materials, except as specified in rock. Rock larger than 3 inches shall be removed from the trench bottom and any voids filled with soil or clean stone. Bedding material shall be placed, shaped, and compacted so that at least the bottom half of the pipe rests uniformly upon the material for the entire length of the pipe: pipe shall not bridge any areas. Bell holes and depressions required for the jointing of pipe shall be dug after the compacted bedding material has been graded and shaped and shall be only of the length, depth, and width required to make the joint properly. **Care shall be taken to make sure bedding fills the voids beneath the pipe haunches, by poking with a shovel or tamper.**

3.4 HAUNCHING AND BACKFILLING (MATERIALS AND METHODS)

A. HAUNCHING AND BACKFILLING

1) **General**:

a. Pipe and fittings shall be inspected before backfilling. Before placing any backfill, all rubbish, forms, blocks, wires, and other unsuitable material shall be removed from excavation.

b. After the pipe has been brought to grade on a proper foundation, earth fill shall be placed carefully and equally on both sides of pipe and structures to avoid displacement of the pipe or structure. Exercise **extreme care** in backfilling operations to avoid displacing joints and appurtenances or causing any horizontal or vertical misalignment, separation, or distortion. The pipe shall be tamped properly to hold the pipe or structure in position. Repair damages, distortions, or misalignments to full satisfaction of OWASA's Engineer. Pipe and structures shall be removed if broken or damaged during installation.

c. Backfill shall closely follow the pipe installation. Unless otherwise directed or permitted by OWASA's Engineer, all pipe laid shall be backfilled during the same day, and prior to the completion of the day's work, to provide a firm continuous support and covering for the pipe.

d. Reopen trenches that have been improperly backfilled, to a depth as required for proper compaction. Refill and compact as specified, or otherwise correct to the approval of OWASA's Engineer.

e. Do not allow or cause any of the work performed or installed to be covered up or enclosed by work prior to required inspections, tests, and approvals. Should any of the work be so enclosed or covered up before it has been approved, uncover all such work and, after approvals have been made, refill and compact as specified, all at no cost to OWASA.

f. Observe specific pipe manufacturer's recommendations regarding methods of backfilling and compaction.

g. Ensure compaction of each lift to requirements stated in these specifications. Place backfill in lifts not exceeding 6 inches (loose thickness) in areas to be paved and 12 inches for unpaved areas. See Table 02275.4.

h. All pipe areas shall be graded and maintained in such a condition that erosion or saturation will not damage the pipe bed or backfill.

i. Heavy equipment shall not be operated over any pipe until it has been properly backfilled and compacted with a vibratory compaction device and has a minimum cover as required by the plans. Pipe that is misaligned, shows excessive settlement, or has been otherwise damaged by the Contractor's operations, shall be removed and replaced at no cost to OWASA.

j. Metallic underground warning tape shall be installed directly over water or sewer main pipe in accordance with Paragraph 2.2D of this Section. See Section 02520 for additional Reclaimed Water installation requirements.

k. Care shall be taken to prevent any disturbance to the pipe or damage to newly made joints. The filling of the trench shall be carried on simultaneously on both sides of the pipe in such a manner that injurious side pressures do not occur such that the pipe could be displaced or dislodged. Do not backfill on muddy or frozen soil.

l. Sheeting and shoring generally should be removed only when the trench below it has become substantially filled, and every precaution shall be taken to prevent any slides of material from the sides of the trench onto or against the pipe.

2) **Ductile Iron Pipe**

a. **Materials**: See paragraph 2.1.A – *Material Classification* for Select Earth Backfill and Common Trench Backfill classification. Except as otherwise specified or directed for special conditions, backfill trenches to the ground surface with unfrozen Common Trench Backfill material approved by OWASA's Engineer. In areas of extensive rock excavation, where there is a shortage of suitable backfill, the Contractor shall, at their own expense, haul suitable material in to be placed over the pipe.

b. **Haunching and Backfill for DIP Gravity Pipe:**

i. **Carefully Compacted Select Earth Backfill**: Furnish carefully compacted select earth backfill where indicated on drawings and specified for compacted backfill conditions up to 12 inches above top of pipe. See paragraph 2.1 *Soil, Bedding, and Backfill* for definition of Select Earth.

ii. **Haunching**: The haunch area of the sewer pipe must be fully supported to the springline of the pipe with the bedding material; therefore, the granular material should be hand-placed, shovel sliced, and hand tamped or otherwise consolidated under the pipe haunch to the springline of the pipe.

iii. **Backfill**: The initial backfill from the pipe bedding to the top of the pipe shall consist of carefully placed select earth trench backfill; compacting to no less than 80% of the Standard Proctor maximum dry density. Carefully place backfill tamped around the pipe to the top of the pipe, bringing fill up both sides at the same time to avoid uneven pressures and pipe misalignment. Only hand tamping shall be used to compact earth around the pipe line. The remainder of the soil to the ground surface is to be common trench backfill compacted to the density specified in Table 3. When the backfill has been brought to 12 inches above the top of the barrel, pneumatic tampers may be used to compact the remained of the soil. For lines placed in roadways or in corrosive soils, at the OWASA's Engineer's discretion and where conditions warrant, the Contractor may be required to backfill with select earth trench backfill in lieu of common trench backfill.

3) PVC C900 Pipe

a. **Materials:** See paragraph 2.1.A – *Material Classification* for Select Earth Backfill and Common Trench Backfill classification. Except as otherwise specified or directed for special conditions, backfill trenches from the stone backfill to the ground surface with unfrozen Common Trench Backfill material approved by OWASA's Engineer. In areas of extensive rock excavation, where there is a shortage of suitable backfill, the Contractor shall, at their own expense, haul suitable material in to be placed over the pipe.

b. **Haunching and Backfill for PVC C900 Pipe**

i. **Haunching**: **Proper placement and compaction of the haunching material are the most important factors critical for proper pipe performance and deflection.** The haunch area of the sewer pipe must be fully supported to the springline of the pipe with the bedding material; therefore, the granular material shall be shovel-sliced or otherwise consolidated under the pipe haunch to the springline of the pipe carefully, bringing up both sides at the same time to avoid uneven pressures and pipe misalignment, and then carefully compacting. Side support is accomplished by tamping the soil firmly under the haunches of the pipe out to the trench walls. Tamping should be done in layers no greater than 6 inches. DO NOT DISTURB SIDE SUPPORT WHEN MOVING SHEETING OR TRENCH BOX.

ii. **Backfill**: The initial backfill from the springline of the pipe to a minimum 12 inches above the pipe shall consist of carefully placed #57 or #67 stone. Stone shall be covered with a non-woven geotextile separation fabric in accordance with Paragraph 2.2 A to prevent soil migration unless a geotechnical engineer has presented and OWASA has accepted analysis that the soil is not prone to migration. The remainder of the fill to the ground surface is to be common trench backfill compacted to the density specified in Table 3. Do not use machine compaction or rolling equipment until a minimum of 18 inches of backfill material has been placed over the top of the pipe. Pneumatic tampers may be used to compact the remained of the soil. If a hydro hammer is to be used to compact the backfill, a minimum of 3 feet of cover is required. Final backfill shall be tamped with a vibratory compaction device. See Table 02275.3 below for specific density requirements. For lines placed in roadways, at the OWASA's Engineer's discretion and where conditions warrant, the Contractor may be required to backfill with select earth trench backfill in lieu of common trench backfill.

4) **Methods**

a. **Tolerances:** All areas within the limits designated on the drawings, including adjacent transition areas, shall be uniformly graded. The Contractor shall finish surfaces within the specified tolerances with uniform levels or slopes between points where elevations or existing grades are shown.

i. Finish subgrade areas that are to receive topsoil. Bring such areas to within 0.10 foot of required subgrade elevations.

ii. Under Sidewalks: Shape subgrade under sidewalks to line, grade, and cross-section. Subgrade is to be brought to within plus or minus0.10 foot of required subgrade elevations.

iii. Under Pavement: Shape subgrade under pavement to line, grade, and cross-section. Bring to within ½ inch of required subgrade elevations.

c. **Surface Protection – Traffic**: The Contractor shall protect newly graded areas from traffic and erosion, and repair and re-establish grade in settled, eroded, or rutted areas. Where compacted areas are disturbed by subsequent construction or adverse weather, the Contractor shall scarify the surface, reshape, and re-compact to the required density. If the Contractor shall fail to maintain any trench within 2 days after receipt of written notice from OWASA's Engineer, OWASA may refill said depressions and invoice the cost of such work to the Contractor, or for OWASA contracts, cost may be retained from monies due. In case of emergency, OWASA's Engineer may refill any dangerous depressions without prior notice to the Contractor.

d. **Structures**

Structure Backfill: Backfill placed within 2 feet of manholes and other special structures shall be of the same quality as that specified for backfill around water or sewer lines. Take care to prevent wedging action of the backfill against structure by carrying the material uniformly around the structure so approximately the same elevation is maintained in each lift. If necessary to prevent damage to the structure, provide temporary bracing of structure walls. Material shall be solidly tamped with a mechanical or pneumatic tamper in such a way as to avoid damaging the structures or producing unequal pressures. The Contractor shall refill all excavations as rapidly as practical after completion of the structural work therein, or after the excavations have served their purpose.

3.5 COMPACTION/DENSITY

Soil shall be compacted using equipment suitable for the material and the work area location. There are two types of testing discussed in Section 3.5, Quality Control (QC) and Quality Assurance (QA).

A. TESTING

1) Testing of backfill shall be performed by an independent laboratory approved by OWASA and the Contractor. The Contractor shall be responsible for excavation of both types (QC and/or QA) of testing at no cost to OWASA.

2) **Quality Control (QC) vs. Quality Assurance (QA)**:

QC testing is required testing that shall be performed by the Contractor to assure compliance with the requirements of these specifications. The associated cost for QC testing is the Contractor's responsibility. The contractor is also responsible for "re-testing" costs incurred by OWASA when OWASA's test results (tests for QA) results in a "failure."

QA testing, and associated costs will be paid for by OWASA. OWASA will contract with a separate testing firm for QA testing. QA testing may be conducted to ensure Contractor compliance with these specifications.

B. QUALITY ASSURANCE (QA)

In the course of backfilling trenches for utility installations, OWASA's Engineer may require "Field Density Determinations" or compaction tests in addition to those required for Quality Control. OWASA's Engineer will determine the location of the tests and OWASA shall engage a qualified testing firm to perform the test. The Contractor shall perform the excavation during normal working hours at no additional cost to OWASA. Field density determinations shall be performed in accordance with AASHTO T191, T204, and T205 modified to include material sizes used in the laboratory determination of density with nuclear field density testing device or by other approved methods. A representative of OWASA will observe tests and a copy of the test results and inspection report will be submitted by the testing firm directly to the OWASA's Engineer. When the average of 3 test results, with no one test failing by more than 3 percentage points, indicate that the density is less than the percent specified, the Contractor shall excavate and re-compact the areas that have failed at no expense to OWASA. Payment for a failed compaction test shall be made by the Contractor.

C. QUALITY CONTROL (QC)

The Contractor is required to perform Quality Control testing. Field density or compaction tests determinations shall be performed in accordance with AASHTO T191, T204, and T205 modified to include material sizes used in the laboratory determination of density with nuclear field density testing device or by other approved methods. A representative of OWASA will observe tests and a copy of the test results and inspection report will be submitted by the testing firm directly to the OWASA's Engineer. The Contractor shall pay for all costs associated with testing.

Table 02275.2	
Testing Frequency[a]	
Location	**Frequency**
Trench areas in road crossings	1 per road crossing, and/or
Trench areas in road intersections	1 per road intersection, and/or
Trench areas	1 per 200 linear feet per two feet of fill thickness
Exception: Where additional tests are required to determine the extent of unacceptable compaction. In this case, the costs for these additional tests are the responsibility of the Contractor.	

[a]**Each test consists of a compaction test on each layer of backfill material in the trench segment.**

D. SITE ACCESS FOR TESTING:

Ensure OWASA, at all times, has immediate access to the site for the testing of all soils related work. Ensure excavations are in a safe condition for testing personnel.

E. MINIMUM COMPACTION REQUIREMENTS

Unless noted otherwise on drawings or more stringently by other sections of these specifications, place and ensure backfill and fill materials achieve an equal or "higher" degree of compaction than undisturbed materials adjacent to the work; however, in no case shall degree of compaction fall below the following percentages of the maximum density at optimum moisture content. Tolerance is to be within +/- 2 percentage points of the optimum moisture content.

Table 02275.3		
Minimum Compaction Limits (Cohesive Soils)		
Location	**Density**	
Beneath and within 5 feet of buildings	100% of the maximum dry density by ASTM D698 (Standard Proctor), AASHTO T99.	
Areas under roadway pavement surfaces, curb and gutter, paved easements, and sidewalks	Top 12 inches	100% of the maximum dry density by ASTM D698 (Standard Proctor), AASHTO T99.
	Up to within 12 inches	95% of the maximum dry density by ASTM D698 (Standard Proctor), AASHTO T99.
Roadway shoulders	95% of the maximum dry density by ASTM D698 (Standard Proctor), AASHTO T99.	
Under turf, sodded, planted, or seeded non-traffic areas	90% of the maximum dry density by ASTM D698 (Standard Proctor), AASHTO T99.	

F. PASSING TEST

When the average of 3 test results, with no one test failing by more than 3 percentage points, indicate that the density is less than the percent specified, the Contractor shall excavate and re-compact the areas that have failed at no expense to OWASA. However, where backfill compaction is suspect and questionable, the material shall be removed as directed by OWASA's Engineer and the area tested. If a suspect area fails to meet the prescribed minimum moisture density test requirements, the soil shall be removed, replaced, compacted, and re-tested, as directed by OWASA's Engineer, until the backfill meets or exceeds the minimum density requirements.

G. COMPACTION LIFTS

Table 02275.4	
Compaction Lift Thickness	
Lift Thickness (inches)	**Location**
6	Inside street rights-of-way and paved easements
12	Outside street rights-of-way

H. REFERENCE STANDARDS FOR IN-PLACE TESTING OF SOILS

Table 02275.5	
In-Place Density Tests	
Soil Type/Classification	**Reference Standard**
Crushed Rock	ASTM D4253 by percentage of relative density ASTM D1557 or D698 (Standard Proctor)
GW, GP, SW and SP	ASTM D4253 by percentage of relative density ASTM D1557 or D698 (Standard Proctor)
GM, GC, SM, SC, ML, CL	ASTM D2167, D1556, D6938, or D2937 by percentage of Standard Proctor Density according to ASTM D698 or AASHTO T99

3.6 SERVICE CUTS, DIRECTIONAL BORED OR PUNCHED SERVICES

A. OPEN TRENCHES

Sewer lateral and water service connections that cross paved streets shall be installed by saw cutting the pavement and opening the trench. The open trench width shall be no wider than 12 inches.

Lateral connection trenches in non-paved areas shall be buried as specified for gravity sewers and for water lines, as applicable. See Table 02275.1.

Bed and backfill water or sewer service pipes as outlined in Sections 3.3 and 3.4.

B. DIRECTIONAL BORING OR PUNCHING

At the direction of OWASA's Engineer, service pipes may be required to be "punched" or "directional bored" beneath the pavement.

3.7 PAVEMENT REPAIR AND REPLACEMENT

A. PAVED STREET REPAIR

This work shall consist of replacing sub base stone, and bituminous material in the street in areas where it becomes necessary to remove the original pavement for sewer and water main trenches. Pavement repair shall be the type to match the existing street pavement, as shown on the drawings, or as determined by OWASA's Engineer. The pavement patch shall provide a uniform and smooth driving surface free of humps or depressions.

B. CONSTRUCTION IN PUBLIC RIGHTS OF WAY

Water and sewer lines installed in or across NCDOT roads shall be installed in accordance with the requirements stipulated in the approved encroachment permit, if applicable, and the latest requirements of both the NCDOT *Standard Specifications for Roads and Structures* and the *Roadway Standard Drawings*. All water and sewer lines installed in or across Town of Carrboro or Town of Chapel Hill roads shall be in accordance with the respective town's standards.

When it is necessary to remove the existing pavements, prepared road surfaces, sidewalks, or curbing, it shall be the responsibility of the Contractor to replace these surfaces to original or better condition. The Contractor shall be responsible for contacting NCDOT, the Town of Carrboro, or the Town of Chapel Hill regarding pavement replacement, as applicable. Unless specified more stringently by the owner of the right-of-way, the backfill shall be compacted in accordance with Table 02275.3.

Contractor shall replace pavement base with a minimum of 10 inches of ABC compacted to 100% of the Modified Proctor (ASTM D1557) maximum dry density prior to pavement overlay.

C. CROSSING GRAVEL OR MACADAMIZED ROADWAY

When water and/or sewer lines are installed in or across roadways that have been macadamized or graveled, the Contractor shall save the gravel or stone and refill the upper 12 inches of the trench with the material and supply sufficient new stone or gravel to return the roadway to the original grade. It shall be the Contractor's responsibility to maintain the original grade by adding gravel or ABC until the ditch is stable and the pipeline accepted by OWASA. Maintain area as outlined in paragraph *3.4.A.2.b.iii- Surface Protection – Traffic*.

D. CUTTING PAVEMENT

See also paragraph 3.1.D.2 – *Protection of Surface Features*. Perform cutting operations prior to commencing excavation operations to avoid excessive removal of asphalt / damage to roadway.

E. PROTECTION OF PAVEMENT

See paragraph 3.1.D.2 – *Protection of Surface Features*.

3.8 BLASTING

A. GENERAL

1) Blasting procedures shall conform to all applicable local, state, and federal laws and ordinances and shall be performed in accordance with OSHA *Standard 29 CFR part 1910.109*, *Explosives and Blasting Agents*; NCDOT Rules for Transporting Explosives; and local Fire Department Regulations. Prior to any blasting, a blasting permit shall be obtained. The approval of the OWASA's Engineer shall be obtained before any blasting takes place and OWASA's Engineer may fix the hours of blasting if they deem it to be necessary. The use of explosives shall be in accordance with approved methods that safeguard lives and property. Explosives shall only be handled, placed, and detonated by persons licensed in this work. It is the responsibility of the Contractor to provide proper notification to appropriate parties.

2) **Rock Excavation**: See *paragraphs 3.2.E. – Rock and 3.8.B.2* for the definition of rock.

3) The minimum insurance coverage for blasting shall be as annotated in the OWASA contract documents. The coverage shall include explosion and collapse. If blasting occurs within 200 feet of any underground structure or utility, underground coverage will be required. The owner and the property owners shall be named as "additional insured."

4) **Storage**: Store explosives in accordance with the Occupational Safety and Health Act and with other Federal, State and Local ordinances and regulations. The Contractor shall keep explosive materials that are on the job site in special constructed boxes provided with locks. These boxes shall be plainly identified as to their contents. Failure to comply with this specification shall be grounds for suspension of blasting operations until full compliance is made. No blasting shall be allowed unless a galvanometer is employed to check cap circuits.

5) OWASA may prohibit blasting when the method of detonation or the means of protection provided is inadequate. Blasting conducted with or without direct supervision of OWASA will not relieve the Contractor of the responsibilities stipulated herein.

6) Blasters shall not explode or attempt to explode blasting powder or high explosives unless it is performed with a suitable electric blasting machine. Electric current from batteries, telephone, or power lines shall not be used for detonation.

7) A minimum of 3 minutes prior to the detonation, the blaster shall inform competent flagmen, equipped with red flags, stationed at reasonable distances from the blast area at every avenue of approach, to warn all persons.

8) Immediately after the loading and tamping of the drill hole and before fixing the blast, the material to be blasted shall be covered on all exposed sides with blasting mats, or other approved protective material. After the protection has been applied, the blast shall be fired without unnecessary delay.

B. BLASTING PROCEDURE

1) The Contractor shall provide a blast warning signal system. The blast warning signal system shall consist of one or more air horns located at the blast site. The air horn(s) shall be audible a minimum of 1 mile from the blast site. The signals shall be one long horn 5 minutes prior to the blast, one short horn 1 minute prior to the blast, and one long horn after the blast to signal all clear. The Contractor shall erect two clear and legible blast warning signal signs at locations determined by OWASA's Engineer. The signs shall list the blast warning signal system, the Contractor Superintendent's name and telephone number, and the OWASA representative's name and telephone number.

2) The Contractor shall establish test pits at up to two representative locations along the alignment and up to three locations adjacent to the site proposed to be blasted to determine if the rock is "rippable" with a track backhoe caterpillar 225 or equivalent and the feasibility of rock excavation by "hoe ramming." If these procedures do not offer reasonable production for rock excavation, then blasting will be allowed unless otherwise indicated.

3) The Contractor shall notify in writing all property Owners within 300 feet of the proposed blast at least 1 week prior to the proposed blast and verbally on the day of the scheduled blast.

4) Blasting shall be limited to mid-morning hours on days of clear-to-partly cloudy skies with increasing surface temperature and light wind. The Contractor shall provide monitoring equipment to monitor all blasting. A copy of monitor record shall be given to OWASA daily.

5) The use of unconfined explosives shall be prohibited.

6) Unless otherwise stipulated in Title 13 of the NC Administrative Code, Chapter 7, the maximum allowable peak particle velocity shall be 1.25 inches per second for all structures located 0 to 300 feet from the blasting site. The maximum allowable peak particle velocity shall be 1.00 inch per second for all structures located 301 to 5,000 feet from the blasting site. The maximum allowable peak particle velocity shall be 0.75 inch per second for all structures located 5,001 feet and beyond from the blasting site.

7) To minimize vibration, minimum scaled distance (SD) of 50 shall be used to determine maximum explosive weight per delay. A test blast shall be conducted to verify the scaled distance. The maximum explosive weight per delay shall not exceed the distance from the blast to the nearest structure divided by 50 squared. Maximum explosive weight per delay may be revised pending outcome of test blast. The recommendations indicated for blasting criteria in no way relieves the Contractor of their liability.

8) The peak overpressure of air blast shall not exceed 0.015 pound per square inch or 138 decibels.

9) Pre-blast meetings may be scheduled with OWASA's Engineer to document hole depths and spacing, charge weight per delay, shot scheduling, and weather conditions. The Contractor shall obtain accurate measured distances from

structures to center of blast area prior to determining the safe maximum charge-weight per delay and loading blast holes.

10) Pre-blast and post blast surveys will be obtained by the Contractor using an "Independent Blasting Firm". The pre-blast and post blast surveys will include all occupied and vacant buildings and other Structures within 250 feet of the blasting area. Any pre-blast and post blast surveys performed by OWASA or the property owner in no way relieve the Contractor of their liability. The firm selected by the Contractor will be evaluated by the Engineer and Owner for approval. The "Independent Blasting Firm" shall obtain written permission from the property owners and submit a copy or copies to the engineer and owner prior to entering upon private property.

C. BLASTING MONITORING REQUIREMENTS

1) **Monitoring of Blast-Related Vibrations**

Pre-Construction Condition Assessment: The geotechnical engineering firm shall perform a pre-construction condition assessment to document the conditions of the nearby buildings and other sensitive nearby structures prior to the beginning of construction. The assessment shall be performed on all properties adjacent to the project site and any other properties as directed by the engineer or owner. The assessment shall include full color video and photographic documentation of all exteriors including building foundations and installation of crack monitors on façade cracks that might propagate due to blasting vibrations. All documentation of existing building conditions and information concerning the type and location of crack monitors shall be presented to the engineer and owner in a report prior to construction.

2) **Crack Monitoring During Blasting**

During blasting operations, the geotechnical firm shall perform periodic readings of sufficient frequency of the crack monitors that were installed during the pre-construction condition assessment to assess/monitor the effects of the blasting operations. All readings shall be provided to the Engineer and Owner within 48 hours of taking the reading. If the crack readings suggest that blasting vibrations are contributing to crack width, then the geotechnical firm shall immediately notify the Engineer and Owner and review the blasting operations. The geotechnical firm and the contractor shall then submit a detailed plan for repair, the contractor shall perform the repair at no cost to the Owner and develop and submit for review a revised blasting plan to address the vibration problems and minimize further damage and complaints.

3) **Vibration Monitoring During Blasting**

a. **Procedure:** The geotechnical firm shall monitor vibrations at no less than two locations at the closest structures to the project during all blasting activities. The locations shall be selected by the geotechnical firm based on the location of the blasting activities and their relative position to nearby structures. Prior to blasting, a plan of the monitoring locations shall be submitted to the Engineer and Owner for approval. The location of the vibration monitors shall be adjusted during construction with approval by Engineer and Owner. The vibration monitors shall be established at the site so that background vibrations may be determined prior to beginning construction and blasting. The sensitivity range of the seismograph shall be selected so that the recording is initiated below the maximum allowable particle velocity and extends above the highest excepted intensity. Specific activities of the vibration source shall be indexed in time to allow correlation with the arrivals on the vibration.

b. **Project Vibration Criteria:** The maximum allowable particle velocity is as indicated in Section 3.8.B.6. If the data from the monitors indicate that vibrations are exceeding the established criteria, then the geotechnical firm shall immediately notify the Engineer and Owner and suspend the blasting operations which are generating the vibrations, until the geotechnical firm and Contractor have developed a revised blasting plan to resolve the problem. The problem shall be resolved by the Contractor at no additional cost to the Owner.

c. **Instrumentation:** The vibration monitors shall consist of digital seismographs that display the particle velocities and associated frequencies plotted against the criteria for this project. Each seismograph shall contain geophones with response capability in three mutually perpendicular axes or components; one vertical and two horizontal (radial and transverse). The frequency response of the geophones shall be linear from at least 4 Hz to more than 200 Hz. The sensitivity shall range from less than 0.02 in/sec to more than 5.0 in/sec. The Blastmate III by Instantel is one type of seismograph that is suitable for this project.

d. **Calibration and Instrument Use:** The geotechnical firm shall field calibrate the vibration monitors before the start of each recoding period. The transducer shall be positioned with the longitudinal axis toward the vibration source. Transducers must be adequately coupled with the ground. Operation of all vibration monitors shall be in accordance with the instrument manufacturer’s instructions and recommendations. Vibration records shall be collected in waveform plot or strip chart plot. The peak vector sum of the particle velocity in longitudinal, transverse, and vertical planes shall be shown along with the respective dominant or principal frequencies. The highest recorded particle velocity (i.e., the vector sum of the three orthogonal directions), when indexed to a particle vibration event, shall be reported as the peak particle velocity. The recorded peak particle velocity shall be compared to criteria appropriate for the subject of concern.

e. **Complaints:** In the event of a complaint, the geotechnical firm shall immediately contact the Engineer and Owner and review those blasting activities that are introducing vibrations. The geotechnical firm shall prepare a report documenting all relevant data such as the time and date presented in the complaint, a description of the blasting activities during the subject time/date, data from the monitoring instruments for the subject time/date, complaint information and a description (including photographs, if possible) of the alleged damage. The geotechnical firm and Contractor shall then submit for review a detailed plan for repair, and revised blasting plan to address the complaints. The Contractor will be required to perform the necessary repairs at no cost to the owner.

f. **Additional Requirements:** In addition to the pre-construction condition assessment report, the geotechnical firm shall also provide monthly reports, as required, containing the results of the crack monitors and vibration monitors during the blasting procedures. The reports shall document that the geotechnical firm is providing the work described by this specification.

The geotechnical firm shall submit a final report after the completion of the blasting operation that contains all previous reports in one document. The final report shall contain an “executive” summary of the various reports.

3.9 HIGHWAY CROSSING

A. BORE AND JACK

Pipeline crossing shall be installed in a steel casing pipe installed by the “dry bore and jacking” method. Length of steel pipe shall be welded to the preceding length installed. The carrier pipe shall be protected by spiders/skids constructed as shown on Standard Detail 517.01. The ductile iron carrier pipe shall be as specified for sewer and water pipe and shall be slip joint ductile iron pipe. If, in the opinion of the Contractor, boring and jacking of the highway crossing is not possible due to rock, they shall test drill, in the presence of OWASA’s Engineer at the proposed crossing locations, at least 3 evenly spaced points in the placement along the crossing alignment. Upon verifying the presence of rock at a depth that would conflict with the boring and jacking operation, the Contractor shall make application to the applicable Town or the NCDOT, as applicable, to allow open cutting of the crossing. The Contractor shall be responsible for providing all data and shall pay any fees required for this application. If the trench is allowed to be open cut, casing pipe shall be provided and the trench shall be backfilled entirely with #57 stone to the bottom of the pavement base course and the pavement restored within one day of placing the pipe. Non-woven fabric separation fabric is to be provided between the stone and the pavement.

B. STEEL CASING PIPE

The steel casing pipe shall be of the thickness as specified in Standard Detail 517.01. Refer to specification Section 02530, *Sanitary Sewer* and Section 02510, *Water Distribution* for casing pipe specifications.

C. AREMA

Installation shall be in accordance with the American Railway Engineering and Maintenance-Of-Way Assoc.

D. NO PIPE SETTLEMENT

The jacking operation shall be carried on in such a manner that settlement of the ground or the highway above the pipeline will not occur. The use of water or other fluids in connection with the boring and jacking operation shall not be allowed. Excavation shall be made by auger or manual methods, at the Contractor’s option, to suit the conditions encountered. The Contractor shall repair or replace, as directed by OWASA’s Engineer, at their own expense, casing pipe damaged during the jacking operation.

E. CARRIER PIPE

After installation of the casing pipe, the carrier pipe, if required, shall be installed. The ends of the casing shall be plugged in accordance with Standard Detail 517.01. Place a ¾-inch diameter steel drain line at downstream end of casing and drain either to daylight or a blind French drain consisting of 1/4 cubic yard of #57 stone.

F. SAFETY TO TRAFFIC

All operations of the Contractor shall be subordinate to the free and unobstructed use of the highway right of way for passage of traffic without delay or danger to life, equipment, or property. The Contractor shall provide all necessary bracing, bulkheads, and shields to ensure complete safety to all traffic at all times.

3.10 RAILROAD CROSSING/TRACKS

Crossing of railroad tracks with water or sewer lines shall be by the method shown on the contract drawings and approved by the applicable Railroad Company. It is the responsibility of the Project Engineer and Contractor to contact the Railroad Company and to comply with all Railroad Company requirements for specifications, drawings, permits, etc. All water and sewer lines installed beneath railroad tracks shall be in accordance with the Railroad Company's policies, procedures, and permits requirements. The railroad right of way and track structure shall be fully restored to its original pre-existing condition and to the full satisfaction of the Railroad Company. The work shall not interrupt the use of the railroad tracks or in any way endanger the traffic on them.

3.11 UNDERGROUND RIVER OR CREEK CROSSINGS

Underground river or creek crossings shall be made either by horizontal directional drilling (HDD) with HDPE pipe or constructed in the dry by providing a temporary cofferdam or bulkhead. River or creek crossings shall be in accordance with OWASA's "Policy on Extension of Sewer Mains and Sewer Laterals," this Manual, NCDEQ, the US Army Corps of Engineers, and all other agencies having jurisdiction. Unless horizontal directional drilling is specified in the OWASA contract documents, river or creek crossings shall be made by providing a temporary cofferdam or bulkhead using ductile iron pipe for the crossing.

River or creek crossings shall be as near to perpendicular as possible to the stream.

A. COFFERDAM METHOD

The Contractor shall construct the river crossing in the "dry" by providing a temporary cofferdam or bulkhead of non-erodible material. The cofferdam shall not obstruct more than one-half of the water surface at any time and shall not extend more than 3 feet above the normal water surface. The Contractor shall not be allowed to operate construction equipment on the native steam bottom, except during removal of the cofferdam. The Contractor shall be advised that the level in any river can fluctuate rapidly.

1) Non-erodible material shall be defined as heavy coarse aggregate as specified on the plans. An earth core for the cofferdam may be constructed over the proposed excavations; however, the non-erodible materials shall be in place prior to the

placement of the earth, so that the erodible earth does not come in contact with the flowing water.

2) A bulkhead may be constructed in lieu of the cofferdam. The bulkhead shall be made of wood, steel or some like material suitable to withstand the hydraulic forces to permit construction in a dry trench.

3) Construct the crossings as indicated. The Contractor shall then remove the cofferdam, bulkhead, or whatever equipment or material that was used to construct the crossing. The bottom of the river in the construction area shall be restored to its original cross section. All disturbed areas on the banks of the river shall be seeded and mulched in accordance with paragraph 3.15 **–** *Seeding and Groundcover*.

4) Comply with all terms and conditions of all permits issued by the US Army Corps of Engineers and/or NCDEQ for this work.

5) The pipe and joints of water or sewer main entering or crossing streams shall be tested in place and shall exhibit zero infiltration. This testing shall be done prior to encasing in concrete.

B. HORIZONTAL DIRECTIONAL DRILLING (HDD) METHOD

HDPE pipe shall be installed by horizontal directional drilling using a surface mounted rig, first to drill a guided hole along a bore path consisting of a shall arc and then to pull a string of pipe into the hole. Pull back is facilitated by a back-reamer, which enlarges the hole to approximately one and a half times the pipe diameter. Drilling fluids are injected into the bore hole to stabilize the hole and lubricate the pipe and drilling string. Tracking equipment is used to guide and direct the drilling. See Section 02510, *Water Distribution* for installation, testing and other requirements for horizontal directional drilling.

3.12 SURFACE WATER CROSSINGS

Surface water crossings, with pipe above the water, shall be adequately supported by casing pipe or beams as shown on **Standard Details** 536.03, 536.04, and 536.06**.** Surface water crossings with pipe under streambed shall have the pipe encased in concrete in accordance with Standard Detail 536.08.

3.13 CONCRETE COLLARS ON SEWER MAINS

Concrete collars shall be used on sewer lines with slopes 20% or greater. At least one concrete collar shall be placed before the bell of each joint of pipe (see Standard Detail 536.01). Additional collars may be required by OWASA.

3.14 CLEANUP AND RESTORATION OF SITE

A. DEBRIS

During the progress of the work, the Contractor shall keep the premises and the vicinity of the work clear from unsightly and disorderly piles of debris. Suitable locations shall be specified for the various construction materials and for debris. The materials shall be kept in their storage locations, except as needed for the work and debris shall be promptly and regularly collected and deposited in the specified location.

B. GRADING

Upon completion of section of pipeline and appurtenances, the Contractor shall fine grade the ground adjacent thereto, removing all surplus excavated material, leaving the area free from surface irregularities. They shall dispose of all surplus material, dirt, and rubbish from the site; and shall keep the site free of mud and dust to the satisfaction of OWASA's Engineer. The contractor may be required to flush or sprinkle the street to prevent dust nuisance.

C. SHOULDERS

When working on the shoulders of paved roads, the Contractor shall keep the pavement clean of all loose earth, dust, mud, grave, etc., and shall restore road surfaces, shoulders, and ditches as required by either the NCDOT or the right-of-way owner.

D. GRADING EASEMENTS

Easements shall be graded to have cross slopes of 4% or less. The ground surfaces of easements shall be graded and cleared in such a way to promote proper drainage and allow mowing by vehicular equipment without damage to equipment from rocks and other debris.

E. CLEANUP

After all work is completed, the Contractor shall remove all tools and other equipment, leaving the site free, clean, and in good condition.

F. ONE-YEAR RESPONSIBILITY

The Contractor shall keep the surface over and along the trenches and other excavation in a safe and satisfactory condition during the progress of the work and for a period of one year after the work has been completed. They shall be held responsible for any accidents that may occur on the account of the defective condition of such surface.

3.15 SEEDING & GROUNDCOVER

Seeding and groundcover includes seedbed preparation, liming, fertilizing, seeding, and mulching of all disturbed areas. Areas inside or outside the limits of construction that are disturbed by the Contractor's operation and activity shall be seeded and mulched.

A. SEED

Unless called for otherwise on the Erosion and Sedimentation Control Plan, in areas where natural sod or vegetation has been disturbed, the area shall be seeded with the following:

Fertilizer:	10-10-10	**Rate**:	500 lbs. per Acre
Seed:	Kentucky 31 Fescue	**Rate**:	80 lbs. per Acre

If the line is installed through a landscaped lawn, the seeding shall be modified to restore ground cover comparable to the existing lawn.

B. ESTABLISHING VEGETATION

Seeding shall be carried out as soon as practical after the construction in any one area and shall be maintained against erosion through the completion of the project. Seeding shall be accomplished as work progresses.

The Contractor shall be responsible for proper care of the seeded area during the period that vegetation is being established. In the event of an erosive rain before an adequate stand of vegetation has been established, damaged areas shall be repaired, fertilized, seeded, and mulched at the Contractor's expense.

Seeding on rights of way of NCDOT maintained roads shall be in accordance with NCDOT specifications and the requirements of the approved encroachment permit.

C. TEMPORARY SEEDING

Denuded areas to be graded during the construction phases that are not to be brought to final grade within 30 days shall receive temporary seeding within 15 days of completing initial earthwork. Note that the time for establishment of permanent ground cover is 15 working days or 30 calendar days, whichever is shorter. Temporary seeding shall also be used to stabilize finished grade areas if the time of year is outside the specified permanent seeding periods.

D. STOCKPILE AREA

The Contractor is responsible for securing a material lay down and stockpile storage area. As such, the Contractor is responsible for the necessary erosion control measures, including but not necessarily limited to, a construction entrance, silt fence, protection of streams/buffers, clean up and restoration of site to the satisfaction of both OWASA and the NCDEQ, Division of Land, Minerals, and Energy. Stockpile and/or waste areas must be maintained within the limits of the areas protected by the proposed measures and otherwise temporarily seeded if to be left stockpiled over 30 days.

3.16 MISCELLANEOUS

A. DUST CONTROL

The Contractor shall be required to sprinkle with water or to apply dust allaying materials in the vicinity of dwellings, schools, churches, stores, or other places, where in the opinion of OWASA's Engineer, it is necessary to ensure that dust is held to an absolute minimum. For OWASA contracts, dust control is considered incidental and shall be carried out at the Contractor's expense.

B. IDENTIFICATION OF NEW WATER OR SEWER LINES

Underground Warning Tape and Tracing Wire: Placement of underground warning tape and Tracing Wire during backfill operations shall be required on all newly installed mains and service laterals.

1) Underground warning tape is to be placed 18-24 inches below the finished grade directly above the line. Underground tracing wire shall be attached to the top of the main with zip ties, electrical tape, or duct tape every 5 feet. Water and corrosion proof connectors shall be used when splicing wire together, and electrical conductivity along the pipe shall be continuous and uninterrupted between main and valve and meter vault/boxes or terminal access point. A sufficient excess length of wire shall be left in each box or terminal access point to provide at least a 12- to 24-inch length of wire above finished grade, coiled and carefully fastened within the box to prevent loose wire. Installation shall be per Standard Details 513.01 and 531.01. Testing of tracing wire shall be witnessed by OWASA after backfilling is completed, with any untraceable wire replaced by the contractor. For reclaimed water mains see Section 02520.

Materials shall be per paragraph 2.2.D, *Tracer Tape and Tracer Wire* of this Section.

C. FLOWABLE FILL CONCRETE BACKFILL

When directed by OWASA's Engineer, the Contractor shall backfill trenches or undercut areas with flowable fill concrete plant mix. To allow for future re-excavation of filled area, concrete strength shall be liquid enough to flow, be self-leveling, and have an ultimate minimum strength 225 psi (this product is a combination of sand and Portland cement). Except for structural applications, traffic can be placed on mixture within an hour or two after placement. Final surfacing of pavements; however, should be delayed if possible, at least 24 hours to allow for shrinkage and hydration of concrete. Settlement of 2" to 3" is to be expected.

The option to use flowable fill is open to the Contractor to reduce delay and inconvenience to traffic. However, for OWASA contracts, payment for flowable fill backfill is considered incidental to the cost of construction unless a pay item has been provided in the proposal, a change order has been approved, or the Contractor is ordered by the OWASA's Engineer to place flowable fill concrete as an emergency measure.

D. SALVAGE OF USEABLE MATERIALS

All materials such as paving blocks, brick, castings, and pipe etc., removed during excavation that is useable on this project shall be used after approval of its use by OWASA's Engineer or the applicable owner of the street right-of-way. Such material shall be stockpiled on site. Unnecessary abuse and damage to these items shall be the Contractor's responsibility and the cost of replacement may be deducted from the retainage.

END OF SECTION 02275

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02510 - WATER DISTRIBUTION

(Last revised 01/01/2025)

SUGGESTED SEARCH WORDS FOR THIS SECTION

Part 1 – General	Hydrant Bagging	Steel Encasement Pipe-Install
Part 2 – Products	Fire Hydrant-Spec	Steel Encasement Pipe-Spec
Part 3 – Execution	Fire Hydrants-Setting	Sterilization
Air Release Valve-Spec	Gate Valves-Spec	Small Service Connections-Spec
Backflow Preventers	1 ½" & 2" Service-Spec	Tape, Detector
Butterfly Valve-Spec	Meter Boxes, Small-Spec	Tunneling Method
Check Valve-Spec	Meters	Tunnel Liner - Spec
Ductile Iron Pipe - Spec	Parallel Pipe-Clearances	Tapping Sleeve & Valve-Spec
DIP-Installation	Pipe Crossing Clearances	Vault Access Frames-Spec
DIP Fittings	Pipe Separation Req'ts	Valve Boxes-Spec
DIP Joints	Pressure Test & Leakage	Valves-Settings
Fire Hydrant Painting	PVC Pipe Spec	

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the OWASA Contract, including the General Requirements and Supplementary Conditions, apply to this specification.

Section 02275 – TRENCHING, BACKFILLING AND COMPACTION OF UTILITIES.

1.2 SUMMARY

This section includes all equipment, labor, material, and services required for complete installation of water distribution piping and specialties for municipal water and fire-service mains and services.

1.3 DEFINITIONS

For the purposes of this specification, the following definitions refer to water distribution systems that come under the authority of OWASA as specified within this and other sections of this manual.

Combined Domestic and Fire Protection Service: Service supplying a residential dwelling that includes an integrated fire suppression system.

Fire Service: Exterior firefighting/suppression water piping.

Water Main: Exterior water systems for both domestic water and fire suppression needs.

Water Service: Exterior water piping used to provide water for domestic purposes.

The following are industry abbreviation for various pipe materials:

AC: Asbestos Cement Pipe
CI: Cast Iron Pipe
DIP: Ductile Iron Pipe
PVC: Polyvinyl Chloride Pipe
RCP: Reinforced Concrete Pipe

1.4 SUBMITTALS

A. PRODUCT DATA

Submit product data for the following:

1) Pipe and fittings,
2) Valves and accessories,
3) Water meters and accessories,
4) Detector check valves,
5) Backflow preventers and assemblies,
6) Fire hydrants, and
7) Fire department connections.

B. SHOP DRAWINGS

Submit shop drawings for the following:

1) Precast concrete vaults including frames and covers,
2) Drains,
3) Access hatches,
4) Wall sleeves,
5) Valve support stands,
6) Prefabricated above ground vaults, and
7) Backflow prevention devices.

1.5 QUALITY ASSURANCE

A. LATEST CODES AND STANDARDS

Materials and operations shall comply with the latest revision of all applicable Codes and Standards.

B. PIPE MARKINGS

Piping materials shall be marked clearly and legibly.

1) Ductile Iron Pipe shall show identification marks on or near bell as follows:

a. Weight,
b. Class or nominal thickness,
c. The letters “DI” or “Ductile,”
d. Manufacturer’s identifying mark,
e. Year in which pipe was made, and
f. Casting period.

2) Steel pipe shall be marked as follows. Each length of pipe and each special section shall be legibly marked by paint stenciling, die stamping, or hot-roll marking to show the following:

   a. Manufacturer's name or mark,
   b. Size and weight of the pipe or special section,
   c. The type of steel from which the pipe or special section was made.

3) PVC Pipe shall show proper marking of pipe as required in the applicable product specification AWWA C900 or ASTM D2241 (2-inch) pipe and shall remain legible during normal handling, storage, and installation. The manufacture date of the pipe must be within 1 year of the date of installation. Marking of PVC pipe shall be applied at a maximum of 5-foot intervals and should include:

   a. Manufacturer's name or trademark,
   b. Nominal pipe size and outside diameter base,
   c. PVC cell classification or material code (2 inch),
   d. Dimension ratio or standard dimension ratio,
   e. Product type (PVC), pressure class or pressure rating,
   f. Standard specification designation (AWWA C900 or ASTM 2241), and
   g. production run record or lot code.

C. ADDITIONAL STANDARDS

1) Comply with Factory Mutual's *"Approval Guide"* and Underwriters Laboratories, Inc. "*Fire Protection Equipment Directory*" for fire-service main products.

2) NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, and flushing and valve and hydrant supervision for fire mains.

3) Comply with NSF Standard 61 for materials for water service piping and specialties for domestic water.

4) Comply with all applicable AWWA and ANSI standards.

1.6 QUALITY STANDARDS

Materials and operations shall comply with the latest revision of the Codes and Standards listed below. The use of standard specification references without a year designation implies the most current applicable specification. Additional Reference Standards are listed in Section Introduction 1.5.

AASHTO American Association of State Highway Transportation Officials.

ANSI American National Standards Institute

AREMA American Railway Engineering and Maintenance-Of-Way Association

ASSE American Society of Sanitary Engineers

ASTM American Society for Testing and Materials

AWWA	American Water Works Association
DIPRA	Ductile Iron Pipe Association
FM	Factory Mutual System
FS	Federal Specifications
NCDEQ	North Carolina Department of Environmental Quality
NCDOT	North Carolina Department of Transportation
NSF	National Sanitation Federation International
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Administration
SDS	Safety Data Sheet
UL	Underwriters Laboratories, Inc.
Uni-Bell	PVC Pipe Association

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

A. APPROVAL OF MATERIALS

Materials used for the construction of water mains and appurtenances in OWASA's water distribution system shall be new, free of defects, and meet the highest standards set forth. An authorized OWASA representative must inspect, review, and approve all materials to be used for water lines and appurtenances prior to installation. At the option of OWASA, any material installed without inspection will have to be sufficiently removed for inspection and review. Any additions, deletions, or changes from the OWASA approved plan set must be submitted to OWASA's Engineer for approval, prior to making changes in the field.

B. PIPE CONDITION/PIPE EXAMINATION

1) **New Pipe Inspection**: Inspect each truckload of materials thoroughly upon arrival at the site. Examine material for damage and to ensure that the right pipe has been delivered to the site. Pipe shall be protected during handling against impact shocks and free fall. Care shall be taken when unloading pipe to avoid damaging the pipe lining. Pipe that has been damaged either in transit or during unloading shall be plainly marked and shall not be used in the construction of the utility. Pipe shall be kept clean at all times, shall be stored on racks so that pipe is not on the ground, and no pipe shall be used in the work that does not conform to the appropriate ASTM specifications. PVC pipe stored onsite shall be covered if not installed within 180 days.

2) **Pre-Installation Inspection**: Prior to being installed, each section of the pipe shall be carefully examined for damage and conformity with these specifications. All pipe in which spigots and bells cannot be made to fit properly, or pipe, which has

chipped bells or spigots, will be rejected. PVC pipe which has discolored shall not be installed. All pipes damaged or deemed not to conform to these specifications, shall be plainly marked and shall not be used in the construction of the utility. The faces of all spigot ends and all shoulders on the bells must be true, without lumps or rough edges, and be brought in fair contact. Examine bell and spigot for uniformity and smoothness of liner and barrel.

3) Inspect fittings and structures thoroughly upon arrival for damage. Remove damaged or rejected materials from site.

C. STORAGE AND HANDLING

1) Observe manufacturer's directions for handling, delivery, and storage of materials and accessories.

2) Protect pipe coating during handling using methods recommended by the manufacturer. Use of bare cables, chains, hooks, metal bars or narrow skids in contact with coated pipe is not permitted.

3) Protect stored piping from entry of water or dirt into pipe. Store pipe on shoulders and not in ditch lines. String out no more pipe than can be installed in a day. Also, protect bells and flanges of special fittings from entry of moisture and dirt. If pipe is provided with end protectors, do not remove protectors until ready for installation or for inspection. Once inspected, replace protectors.

4) Support pipe to prevent sagging or bending.

5) Use slings to handle valves and fire hydrants if size requires handling by crane or other type of lift. Do not use handwheels or stems to lift or for rigging points.

6) Store fire hydrants and valves in such a way as to prevent entry of water and dirt into openings. Support on skids or pallets off the ground or pavement. If fire hydrants or valves are provided with end protectors, do not remove protectors until ready for installation or for inspection. Once inspected, replace protectors. Protect valves against damage to threaded ends or flanges.

1.8 PRODUCT SUBSTITUTIONS

OWASA's Engineer will approve materials not specified but deemed equal, on a case-by-case basis. OWASA's Product and Design Review Committee (PDRC) meets on an "as-needed" basis to evaluate new products for incorporation into these specifications. If submitting new products, submit in writing 60 days prior to meeting date. Documentation and samples of materials must be submitted to OWASA. New materials approved for the water distribution system will be incorporated into these specifications after approval by the PDRC.

1.9 PROJECT CONDITIONS – SEPARATION OF WATER AND APPURTENANCES FROM SANITARY SEWERS AND OTHER STRUCTURES

Follow the NCDEQ and OWASA standards, whichever is more stringent, for separation of water mains and sanitary sewers lines.

A. PARALLEL INSTALLATIONS

1) **Preferred/Normal Condition** – water lines shall be constructed at least 10 feet horizontally from an existing or proposed sewer or sewer manhole whenever possible. The distance shall be measured edge-to-edge.

2) **Unusual Conditions** – when preexisting local conditions prevent a horizontal separation of at least 10 feet, OWASA may approve the water line to be laid closer to a sewer or sanitary sewer manhole , provided that:

   a. The water main shall be placed in a separate trench, with elevation of the bottom of the water line at least 18 inches above the top of the sewer; or

   b. The water main shall be placed in the same trench as the sewer, and located to one side, on a bench of undisturbed earth, and the elevation of the bottom of the water main shall be at least 18 inches above the top of the sewer; or

   c. Where this vertical separation cannot be obtained, the sewer shall be constructed of AWWA-approved Ductile Iron Pipe pressure tested in place to 150 psi without leakage prior to backfilling. The sewer manhole shall be of watertight construction and tested in place.

B. WATER MAINS CROSSING ABOVE SEWERS

1) **Preferred/Normal Condition:** Water lines shall be constructed to cross over sewers whenever possible and shall be laid to provide a vertical separation of at least 18 inches between the bottom elevation of the water line and the top of the sewer.

2) **Unusual Conditions:** When preexisting local conditions prevent an 18-inch vertical separation as described in *Water Mains Crossing Above Sewers, Preferred/Normal Condition* (paragraph above), the following construction shall be used:

   Both the sewer and water line itself shall be constructed of AWWA- approved Ductile Iron Pipe with joints that are equivalent to water main standards for a distance of 10 feet on each side of the point of crossing.

C. WATER MAINS CROSSING BELOW SEWERS

Unusual Conditions: When preexisting local conditions prevent an 18-inch vertical separation, as described in paragraph B, *Water Mains Crossing Above Sewers, Preferred/Normal Conditions*, above, with OWASA approval, the following construction shall apply:

1) That the section of the water pipe is centered at the point of the sewer crossing so that water pipe joints shall be equal distant and as far as possible from the sewer such that, for a 90-degree crossing, the water main joints are a minimum of 10 feet on each side of the point of crossing.

2) Provide adequate structural support for the sewers to prevent excessive deflection of the joints, which can result in settling on and/or breaking the water line.

3) The sewer main shall be designed and constructed of ferrous pipe designed to water main standards, centered on the crossing, and pressure tested at 150 psi (reference minimum design criteria for the permitting of gravity sewers) to assure water tightness prior to backfilling, or either the water main or sewer main be encased in a water-tight carrier pipe which extends 10 LF beyond both sides of the crossing. These options shall comply with 15A NCAC 2T regulations Section .0305.

D. WATER MAINS AND APPURTENANCES FROM OTHER UTILITIES OR STRUCTURES

1) **Horizontal Separation – Preferred/Normal Condition:** Water lines shall be constructed to provide at least 3 feet of horizontal separation from other utilities whenever possible. The distance shall be measured edge-to-edge along the vertical plane. For Asbestos Cement, gas mains, and reclaimed water lines, provide a minimum 5 feet of clear horizontal separation.

For buildings or other permanent structures, a minimum of 15 feet of clear horizontal separation, including roofs and building foundations, shall be provided for mains up to 15 feet deep. Separations for water mains greater than 15 feet deep, larger than 12-inch diameter, or where incapable of meeting separation requirements due to preexisting site constraints will be evaluated on a case-by-case basis.

Other Separations

Meter vaults	10 feet
Fire hydrants	10 feet
Air release valve	10 feet
Underground Stormwater Control Measures	10 feet*
Permeable pavers	5 feet*
Meter boxes	5 feet
Blowoff assembly	5 feet
Other appurtenances	5 feet

*Note: If separations from underwater stormwater control measures and permeable pavers cannot be maintained, OWASA may consider allowing construction in accordance with creek crossings as an alternative.

2) **Vertical Separation – Preferred/Normal Condition:** whenever it is necessary for another utility to cross a water main, a 12-inch vertical separation shall be maintained between the lines. Separation of 18 inches is required for reclaimed water lines. When preexisting local conditions prevent a 12-inch vertical separation, the following construction shall apply:

Provide adequate structural support for the utility to prevent excessive deflection of the joints, which can result in settling on and/or breaking the water line.

E. SANITARY SEWER MANHOLES

No water mains shall pass through or come in contact with any part of a sewer manhole. A minimum of 10 feet of horizontal separation shall be maintained between water mains and sanitary or combined sewer manholes provided that the applicable provisions of Paragraph A, *Parallel Installations, Unusual Conditions*, above, are also met.

F. NEW UTILITIES AND EXISTING WATER MAINS

When installing a new utility adjacent to or in close proximity to an *existing* water main, the new utility line shall be installed to provide the minimum horizontal and vertical clearances specified in paragraph D, *Water Mains and Appurtenances Other Utilities or Structures*.

1.10 LOCATING SERVICES

Contact ***"NC One Call"*** 1-800-632-4949 or the National Three Digit "Call Before You Dig" 811 three days, excluding weekends and holidays, before digging.

1.11 COORDINATION

A. Coordinate tie-in to all water mains with OWASA's Engineer. OWASA will be the sole operator of all valves and hydrants on the OWASA water distribution system.

B. Contact OWASA Construction Inspector, Distribution and Collection Systems Division, or OWASA Project Manager to coordinate interruption of service, operation of valves, line cut-ins, or placement of a tapping sleeve and valve. If interruption is necessary, the interruption shall be arranged to occur at such a time to cause the least disruption and minimize loss of service. At the direction of OWASA's Engineer, temporary service may be required to be provided. Provide a minimum of 10 working day notice of the proposed utility interruption for necessary operation of valves.

PART 2 – PRODUCTS

2.1 PIPE AND FITTINGS

NOTICE: The use of STANDARD GASKETS WITH PUSH-ON PIPE IS NO LONGER PERMITTED for sizes less than 16 inches.

The following references provide the minimum standards as they apply to the specific item listed. In all cases, the latest revision shall apply.

A. DUCTILE IRON PIPE

Ductile iron pipe shall be manufactured in accordance with all applicable requirements of AWWA C151/ ANSI A21.51 for 4-inch and larger diameter pipe; pressure class rated, Class 350, minimum (see **Section 3** – *Water & Sewer Design*); and shall be in 18 or 20-foot lengths; unless otherwise approved. The thickness of Ductile Iron Pipe shall be determined by considering trench load and internal pressure *(the pressure zone and variances in which the pipe will be used)* separately in accordance with AWWA C150/ANSI A21.50.

The ductile iron pipe shall be cement-mortar lined with a seal coat in accordance with AWWA C104/ANSI A21.4. Outside coat shall be a minimum of 1-mil bituminous paint according to AWWA C151/ANSI A21.51.

Each joint of ductile iron pipe shall be hydrostatically tested before the outside coating and inside lining are applied at the point of manufacturer to 500 psi. Testing may be performed prior to machining bell and spigot. Failure of ductile iron pipe shall be defined as any rupture or leakage of the pipe wall.

All materials used in production of the pipe are to be tested in accordance with AWWA C151 for their adequacy within the design of the pipe, and certified test results are to be provided to OWASA upon request. All certified tests, hydrostatic and material are to be performed by an independent testing laboratory at the expense of the pipe manufacturer.

1) Push-on and mechanical joint pipe shall be as manufactured by the American Cast Iron Pipe Company, United States Pipe and Foundry Company, McWane Ductile, or approved equivalent.

2) **Ductile Iron Joints**

   Pipe joints shall be restrained by either mechanical joint or manufactured restrained joint system, as outlined in (c) below. The use of restraining gaskets shall be permitted. This applies to all pipe sizes 4 inch through 12 inch. Pipe 16 inch and larger shall be as approved by the OWASA Engineer. Acceptable types of pipe joints are as follows:

   a. **Push-on Joint, Ductile Iron Pipe THE USE OF STANDARD PUSH-ON GASKETS IS NOT PERMITTED!** The pipe shall conform to AWWA C151/ANSI A21.51 (such as "Fastite" or "Tyton"). The dimensions of the bell, socket, and plain end shall be in accordance with the manufacturer's standard design dimensions and tolerances. The gasket shall be of such size and shape to provide an adequate compressive force against the plain end and socket after assembly to affect a positive seal. Gaskets shall be manufactured of an acceptable elastomeric material, and comply with AWWA C111/ANSI A21.11 and shall be **as manufactured by American Pipe (Fast-Grip), US Pipe (Field Lok 350), or McWane Ductile (Sure Stop 350).**

   b. **Mechanical Joint, Ductile Iron Pipe, and Tee Bolts**

      i. The mechanical joint shall consist of:

         a) A bell cast integrally with the pipe or fitting and provided with an exterior flange having cored or drilled bolt holes and interior annular recesses for the sealing gasket and the spigot of the pipe or fitting;

         b) A pipe or fitting spigot;

         c) Rubber EPDM material and comply with AWWA C110/ANSI A21.11 sealing gasket;

         d) Separate ductile iron follower gland having cored or drilled bolt holes; as outlined in d. below.

         e) Stainless steel Tee Head bolts and hexagon nuts. All threads are Coarse-Thread Series Class 2A, External and Class 2B, Internal, per ANSI B1.1. Nuts to be furnished in accordance with ASTM F594. Use of a stainless steel anti-seize compound is required or specially coated nuts to prevent galling.

ii. The joint shall be designed to permit normal expansion, contraction, and deflection of the pipe or fitting while maintaining a leak proof joint connection. The mechanical joint shall conform to the requirements of Federal Specification WW-P-421, AWWA C111/ANSI A21.11, and ASTM A536.

iii. **Tee Bolts and Nuts:** All tee bolts shall be 304 or 316 stainless steel with either a coated heavy hex nut, or the use of stainless steel anti-seize compound, to prevent galling. Bolts shall conform to AWWA C111/ANSI A21.11. This requirement supersedes all other bolt references in the standard. Only bolts and nuts that are 304, or 316, stainless steel shall be permitted for use in the OWASA jurisdiction.

iv. **Mechanical Joint Bolt Torque**: See Section 3.1.A, paragraph 2, item a, *Installing Mechanical Joint Pipe*, below.

c. **Mechanical Joint Restraint**: Acceptable types of joint restraints shall be:

i. Restrained Joints shall consist of the use of a wedge action joint restraint system, using: Megalug series 1100 mechanical joint restraint by EBAA Iron Sales, Inc.; Ford wedge action restrainer gland UFR Series 1400; Sigma One-Lok; Tyler Union TUFGrip; Star Grip 3000; SIP EZ Grip; or approved equal. Bolt heads are to be “auto-torque” twist off. Auto-torque twist off bolts are exempt from the stainless steel requirement. See Standard Detail 512.08, sheet 2 of 2 for figure.

ii. Restrained Joint Pipe shall be TR Flex or Lok Tyte as manufactured by United States Pipe and Foundry Company, Flex-Ring or Lok-Ring as manufactured by American Cast Iron Pipe Company, or approved equal.

iii. Concrete thrust blocking and rodding is required for connection to all existing water mains or as shown on plans.

d. **Flanged Joints** shall be firmly bolted with machine bolts; however, where valves or special fittings are attached to a flange pipe, stud or tap bolts may be used, providing the number used and diameter for each joint is the same for each respective size of pipe, specialty, or valve, as recommended by the latest AWWA Standard for flanged drilling. Bolts are specified in ANSI B18.2.1 and nuts are specified in ANSI B18.2.2. Bolts and nuts are to be cold worked 304 stainless steel meeting ASTM F593 for sizes up to 1.5 inches. Use of a stainless steel anti-seize compound is required or specially coated nuts to prevent galling. Stainless steel bolts and nuts shall have a minimum yield strength of 50,000 psi. For high strength applications, use 304L stainless steel bolts. Bolts shall be of sufficient length to pass through two flanges and the nut threads shall be accurately cut, close fitting, and the prevailing standard. Bolt heads shall be cut square and nuts hexagon in shape, both the heads and nuts being chamfered. Gaskets to be of 1/8-inch thick rubber (EPDM or approved elastomer) per AWWA C110/ANSI A21.10 or equal as approved by OWASA’s Engineer.

3) DUCTILE IRON FITTINGS

Fittings shall be ductile iron, grade 70-50-05, and shall conform to AWWA C110/ANSI A21.10 or AWWA C153/ANSI A21.53 for compact fittings, pipe sizes 4 inches through 48 inches with the exception of manufacturer's proprietary design dimensions and thicknesses for iron, in accordance with AWWA C110/ANSI A21.10. All ductile iron fittings shall have a minimum working pressure rating of 350 psi and shall be cement-mortar lined and bituminous coated (minimum 1-millimeter), in accordance with AWWA C104/ANSI A21.4. The fittings shall be tested and the manufacturer shall provide certified test results when requested by OWASA. This testing shall include hydrostatic proof testing of fittings. Glands, gaskets, and bolts shall conform to AWWA C111/ANSI A21.11. <u>The use of push on fittings is not permitted</u>. Acceptable manufacturers are: American Cast Iron Pipe Company, Union/Tyler Pipe Company, or U. S. Pipe & Foundry Company, Star Pipe Products, or SIP Industries. Acceptable types of fittings are:

a. **Full Body Mechanical Joint Fittings:** Full body ductile iron mechanical joint fittings shall be class 250 minimum and shall conform to AWWA C110/ANSI A21.10. Glands, Gaskets and Bolts shall conform to AWWA C111/ANSI A21.11.

b. **Mechanical Joint Fittings – Compact:** Compact fittings shall be minimum class 350 and shall comply with AWWA C153/ANSI A21.53, pipe sizes 4 inches through 48 inches. Glands, Gaskets and Bolts shall conform to AWWA C111/ANSI A21.11.

c. **Mechanical Joint Restraints:** Joint restraints shall consist of the use of a wedge action joint restraint system using: Megalug series 1100 mechanical joint restraint by EBAA Iron Sales, Inc.; Ford wedge action restrainer gland UFR Series 1400; Sigma One-Lok; Tyler Union TUFGrip; Star Grip 3000; SIP EX Grip; or approved equal. Bolt heads are to be "auto-torque" twist off. Auto-torque twist off bolts are exempt from the stainless steel requirement. See Standard Detail 512.08, sheet 2 of 2 for figure.

B. COPPER TUBE

Copper pipe shall meet ASTM B88.

¾" and 1" copper pipe shall be Type "K" soft drawn copper pipe with brass AWWA C800 flare as manufactured by Ford or Mueller, or equivalent. See Standard Detail 515.01 and 515.02, sheets 1 and 2.

2" copper pipe shall be Type "K" hard drawn copper.

Connections and fittings shall be brazed with Silvalloy, Excel, SilFos, or approved equal comprised of 15% silver. Brazing temperature shall be between 1,300- and 1,500-degrees Fahrenheit.

C. PVC PIPE

<u>PVC pipe larger than 2 inches or smaller than 2 inches in diameter is not permitted for use in the OWASA service area</u>. Pipe older than one (1) year is not permitted for use. Joints in 2-inch pipe shall be bell-end with gasket. PVC water pipe meeting ASTM D2241, SDR 21, class 200 minimum for pipe 2-inches in diameter. Pipe design shall also meet AWWA M23, latest revision.

D. STEEL CASING PIPE

1) **Steel Casing Pipe**: Pipe shall be high strength steel, spiral welded or smooth-wall seamless manufactured in accordance with ASTM A139 and ASTM A283 and consisting of grade “B” steel with a minimum yield strength of 35,000 psi. All encasement pipes shall meet the applicable NCDOT, Municipal, or AREMA specifications but shall be no less than 6 inches larger than the outside diameter of the carrier pipe bell. The steel pipe shall be capable of withstanding the design load. No interior lining and exterior coating shall be required except that all exposed metal is to be coated with epoxy or asphaltic material. Casing pipe shall include pipe carriers (Spiders) to support carrier pipe. The steel encasement pipe shall be of leak-proof construction and shall include end caps.

2) **Spiders/Skids for Encasement Pipes**: Spiders shall be placed at the bell of each carrier pipe within a steel encasement. Bare, coated, or stainless steel Spiders/Skids with EPDM skids or skids of the same material as the spiders with a nylon shoe shall be as manufactured by ITT Grinnell, Charlotte, NC; Spider Manufacturing, Durham, NC; Advanced Products & Systems (APS) model SSI with EPDM skids, Lafayette, LA, or approved equal. See Standard Detail 517.01. For bolted connections, bolts shall be 304 ASTM F593 stainless steel. Use of a stainless steel anti-seize compound is required or specially coated nuts to prevent galling.

3) **Steel Casing End Seals**: Casing end seals shall be 1/8” thick synthetic rubber seamless pull-on end seals with T-304 stainless steel banding with 100% non-magnetic worm gear mechanism. End seals shall permit pipe movement while maintaining a seal. Acceptable manufacturers are: Advance Products & Systems, Inc., Lafayette, LA, or equal.

E. TUNNEL LINERS AND APPURTENANCES

1) Grout mix for filling voids in between carrier pipe and tunnel shall consist of the following materials properly mixed in proportions by weight.

   a. 1.0 Part Cement.
   b. 3.0 Parts Fine Sand, 100 Percent Shall Pass No. 16 Sieve.
   c. 0.5 to 0.6 Part Water.

2) Tunnel lining construction shall comply with the “Specification for Steel Tunnel Liner Plates” in the AREMA *Manual for Railway Engineering*. The design and shape of the liner plates shall be such that erection and assembly of the liner plate structure can be completely and readily effected from inside the tunnel. Plates shall be accurately curved to suit the tunnel cross section, and all dimensions shall be of the size and accuracy that plates of similar curvature shall be interchangeable. All plates shall be connected by bolts on both longitudinal and circumferential joints.

3) The steel lining shall consist of plates 16, 18, or 24 inches wide. Each circumferential ring shall be composed of the number and length plates necessary to complete the required shape shown on the drawings. The nominal tunnel diameter shall be of sufficient size to install the carrier pipe.

4) Plates shall be one-piece steel meeting the requirements of ASTM A1011 or ASTM A1008. Plates shall have an ultimate tensile strength of at least 42,000 psi and yield strength of 28,000 psi. Gage thickness shall be a minimum of 8 gauge. The liner plate and bolts shall be galvanized in accordance with ASTM A153. In addition, the liner plates shall be asphalt coated to meet AREMA *Manual for Railway Engineering*. For two flange plates, the minimum thickness shall be 0.135 inches. Plates shall be manufactured by Armco Steel Corporation, Commercial Shearing, Incorporated, Republic Steel Corporation, or equal.

5) Grout holes 1½ inches or 2 inches (or larger) in diameter shall be provided in each ring to permit grouting as the erection of the tunnel liner plates progresses. Grout hole screw plugs shall be provided in plates.

6) Steel bolts shall meet requirements of ASTM A449 for plate thickness equal to or greater than 0.209 inch and ASTM A307 for plate thickness less than 0.209 inch. The nut shall meet requirements of ASTM A307, Grade A.

7) Steel bolts shall meet requirements of ASTM A449 for plate thickness equal to or greater than 0.209 inch and ASTM A307 for plate thickness less than 0.209 inch. The nut shall meet requirements of ASTM A307, Grade A.

F. CARRIER PIPE FOR CASINGS AND TUNNELS

Carrier pipe shall be ductile iron restrained joint pipe of the class indicated on the drawings, unless otherwise approved by the OWASA engineer.

G. POLYETHYLENE PIPE

1) **USED ONLY AT THE DIRECTION OF THE OWASA REPRESENTATIVE.** All polyethylene pipe, tubing, and fittings shall conform to all applicable provisions and requirements of the latest revision of AWWA C901, AWWA C906, or CSA B137.1 and, by inclusion, all appropriate standard references therein. Polyethylene compounds utilized in the manufacture of products furnished under this specification shall have a grade of PE24 with a minimum cell classification of PE 234343(C, D, or E) for PE2406 materials, or a grade of PE34 with a minimum cell classification of PE 345444(C, D, or E) for PE3408 materials, as defined in ASTM D3350. In conformance with AWWA C901, AWWA C906, or CSA B137.1, they shall have a PPI recommended Hydrostatic Design Basis (HDB) of 1250 psi (PE2406) or 1600 psi (PE3408) at a temperature of 73.4°F (23°C).

All materials that come in contact with water, including lubricants, shall be evaluated, tested, and certified for conformance with ANSI/NSF Standard 61.

Clean re-work material of the same type grade, and cell classification generated from the manufacturer’s own pipe and fitting production may be used by the same manufacturer as long as the pipe, tubing, and fittings produced meet the requirements of AWWA C901, AWWA C906, or CSA B137.1.

2) **Reference Standards**

AWWA C515: *Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service*

AWWA C901: Polyethylene (PE) Pressure Pipe and Tubing, 1/2-inch through 3-inch for Water Service.

AWWA C906: Polyethylene (PE) Pressure Pipe and Tubing, 4-inch through 63-inch for Water Service.

ASTM D2657: Standard Practice for Heat Joining Polyolefin Pipe and Fittings.

ASTM D2683: Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.

ASTM D2837: Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products

ASTM D3261: Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.

ASTM D3350: Standard Specification for Polyethylene Plastic Pipe and Fittings Materials.

ASTM F1055: Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.

PPI TR-3: Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials.

PPI TR-4: Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Pipe and Fitting Compounds.

ANSI/NSF: Standard 61 for Drinking Water Systems Components – Health Effects.

NSF Standard #14: Plastic Piping Components and Related Materials.

CSA B137.1: Polyethylene Pipe, Tubing, and Fittings for Cold Water Pressure Services.

3) **Qualification Of Manufacturers:** The manufacturer shall have manufacturing and quality control facilities capable of producing and assuring the quality of the pipe and fittings required by these specifications. Given reasonable notice, the manufacturer's production facilities shall be open for inspection by OWASA or their representative. Qualified manufacturers shall be approved by the Project Engineer. Approved manufacturers include Plexco Performance Pipe Division-Chevron Chemical Company.

4) **Manufacturer's Quality Control:** The manufacturer of the Polyethylene pipe and fittings shall have an established quality control program responsible for inspecting incoming and outgoing materials. Incoming polyethylene materials shall be inspected for density, melt flow rate, and contamination. The cell classification properties of the material shall be certified by the supplier. Incoming materials shall be approved by Quality Control before processing into finished goods. Outgoing products shall be tested as required in AWWA C901 or AWWA C906, as applicable.

5) **Pipe And Tubing:** Pipe and tubing furnished under this specification shall be manufactured using compounds complying with the requirements of paragraph A

above. Dimensional performance characteristics shall conform to the requirements of AWWA C901, C906, or CSA B137.1. The pipe's DR (Dimension Ratio) and Working Pressure (WPR) shall be as specified or shown on the drawings.

6) **Fittings:** Polyethylene fittings furnished under this specification shall be manufactured using compounds complying with the requirements of paragraph A above and all appropriate requirements of AWWA C901, C906, or CSA B137.1. Socket type fittings shall comply with ASTM D2683. Butt fusion fittings shall comply with ASTM D3261. Electrofusion fittings shall comply with ASTM F1055. Mechanical fittings produced from material not listed in paragraph A, above, shall be approved only after submission of appropriate test data and service histories indicating their acceptability for the intended service. In all cases, the specifications and requirements of the fittings supplied shall comply with the appropriate section of AWWA C901, C906, or CSA B137.1.

7) **Pressure Class:** The Pressure Class of the Polyethylene pipe and fittings shall be specified on the basis of the Working Pressure Rating of the water system as defined in AWWA C906. Recurring positive pressure surges of up to one half of the pipe's nominal pressure class and occasional pressure surges of up to 100% of the pipe's nominal pressure class may be ignored due to the fatigue endurance of the polyethylene materials. Non-polyethylene fittings shall be specified and used in accordance with the surge tolerance of the particular appurtenance in use.

8) **Marking:** Pipe and tubing shall be marked in accordance with either of AWWA C901, AWWA C906, or CSA B137.1, whichever applies. Marking shall be legible and shall remain legible under normal handling and installation practices. Indent marking may be utilized provided; 1) the marking does not reduce the wall thickness to less than the minimum value for the pipe or tubing, 2) it has been demonstrated that these marks have no effect on the long-term strength of the pipe or tubing and, 3) the marks do not provide leakage channels when elastomeric gasket compression fittings are used to make the joints.

   Fittings shall be marked on the body or hub. Marking shall be in accordance with either ASTM D2683, ASTM D3261, AWWA C906, or ASTM F1055, depending on fitting type and the standard that applies. Mechanical fittings shall be marked with size, body material designation code, pressure rating, and manufacturer's name or trademark.

9) **Workmanship:** Pipe, tubing, and fittings shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, blisters, dents, or other injurious defects. The pipe, tubing, and fittings shall be as uniform as commercially practicable in color, opacity, density, and other physical prosperities.

2.2 VALVES AND FIRE HYDRANTS

A. GATE VALVES

1) **Gate Valves, Resilient Wedge (2 inches through 12 inches)**: All gate valves shall be iron body of the resilient wedge type complying with AWWA C509 or AWWA C515 and shall be UL listed and FM approved for a working pressure of 200 psi. All internal parts shall be accessible without removing the body from the line. The wedge shall be of cast iron completely encapsulated with resilient

material. The resilient sealing material shall be permanently bonded to the cast iron wedge with a rubber-tearing bond to meet ASTM D429 and AWWA C550.

Non-Rising Stems (NRS) shall be cast bronze with internal collars in compliance with AWWA. OS&Y stems shall be bronze. The NRS stuffing box shall have two "O"-Ring seals above the thrust collar. These rings shall be field replaceable without removing the valve from service.

Each valve shall be hydrostatically tested at 400 psi to the requirements of both AWWA and UL/FM.

All gate valves 4 through 12 inches shall be of the mechanical joint type. 2-inch gate valves shall be iron pipe threads.

All bolts and nuts shall be stainless steel. Use of a stainless steel anti-seize compound is required or specially coated nuts to prevent galling.

Valves shall open counter-clockwise (left) and shall be equipped with a 2-inch square AWWA operating nut.

The valve body and bonnet shall be coated interior and exterior with fusion bonded thermosetting plastic or epoxy. **ALL RUBBER GASKETS AND O-RINGS SHALL BE MANUFACTURED WITH AN APPROVED ELASTOMER.**

Acceptable gate valves, sizes 4-inch through 12 inches, shall be:

Manufacturer	Model
American Flow Control	**Series 2500SS**
Clow (M&H)	**F-6100**
Mueller	**A-2360-20**

All resilient seat gate valves furnished for a project shall be from the same manufacturer.

2) **Gate Valves, Resilient Wedge (16 inches and larger)**: Valves shall be iron body of the resilient wedge type complying with AWWA C509 and shall be UL listed and FM approved for a working pressure of 250 psi. Valves shall meet or exceed the requirements of AWWA C515. Valve body, bonnet, wedge, and operating nut shall be constructed of ductile iron. The exterior of the ductile iron wedge shall be fully encapsulated with rubber. The resilient sealing material shall be permanently bonded to the ductile iron wedge with a rubber-tearing bond to meet ASTM D429 and AWWA C550. Buried and non-buried valves shall have all internal and external surfaces of the valve body and bonnet shall have a fusion-bonded epoxy coating complying with AWWA C550, applied electrostatically prior to assembly.

Non-Rising Stems (NRS) shall be cast bronze with internal collars in compliance with AWWA. Stem and stem nut shall be high-strength bronze. Stem shall be sealed by three O-rings. The NRS stuffing box shall have the top two O-ring seals shall be replaceable with valve fully open and while subject to full rated working pressure. O-rings set in a cartridge shall not be allowed. Valve shall have thrust washers located with 1 above and 1 below the thrust collar to ensure trouble-free operation of the valve.

Each valve shall be hydrostatically tested at 500 psi to the requirements of both AWWA and UL/FM.

All gate valves (16” and larger) shall be of the flanged joint type.

Valves 16” and larger of the MJ type will require written approval from the OWASA engineer.

All bolts and nuts shall be stainless steel. Use of a stainless steel anti-seize compound is required or specially coated nuts to prevent galling.

Valves shall open counter-clockwise (left), be equipped with operational assist with a 2-inch square AWWA operating nut. This can be in the form of a Spur or Bevel gear. Bevel gear will require additional engineering for detail. Or can come in the form of a bypass assembly. Bypass assembly will require additional engineering for detail. All rubber gaskets and O-rings shall be manufactured with an approved elastomer**.**

Gate valves 16” and larger and installed at standard depths shall be installed with a valve box to access the valve nut. See Standard Detail 513.01. Gate valves at excessive depth, as determined by OWASA, shall be installed in a manhole. See detail **513.08**.

Acceptable gate valves, sizes 16 inches and larger, shall be:

Manufacturer	Model
American Flow Control	**Series 2500 w/options**
Mueller	**A-2361 w/options**
Clow (M&H)	**F-6100**

All resilient seat gate valves furnished for a project shall be from the same manufacturer.

3) **Insertion Valves**: Insertion valves shall meet requirements of gate valves specified above for valve mechanism and AWWA C110/ANSI A21.10 for the sleeve for pressure ratings shown on the drawings.

4) **Gate Valves Smaller Than 3 Inches** shall be resilient seat, solid wedge, inside screw, non-rising stem, bolted bonnet, stainless steel bolts, and threaded ends. All valves shall be furnished with a 2-inch operator nut and open left. ALL RUBBER GASKETS AND O-RINGS SHALL BE MANUFACTURED WITH AN APPROVED ELASTOMER. Acceptable gate valves are:

Manufacturer	Model
American Flow Control	**2502SS Series**
Clow (M&H)	**F-6103**
Mueller	**H-2360-8**

B. COMBINATION AIR VACUUM VALVE

Automatic Air and Vacuum Valves shall be infinitely variable automatic air and vacuum valves designed to allow escape of air, close watertight when liquid enters the valve and allow air to enter in the event of a vacuum. The valve shall be an NPT threaded Stainless Steel body. The valve outlet is to be protected from debris entering the outlet of the valve. Valves shall be all brass. Valves shall be designed for a maximum cold water pressure of 200 psig. Combination air and vacuum release valves shall be located as shown on the drawings or as otherwise directed by OWASA's Engineer. The valve shall be housed in a precast concrete eccentric manhole and shall be installed in accordance with Standard Detail 538.01. Acceptable Models are, X-Series (1- or 2-inch outlet) by Crispin-Multiplex Manufacturing Co. and 986 Stainless Steel by H-Tec Inc.

Size	Manufacturer	Model
2-inch	Crispin	Type X Series
2-inch	H-Tec	986 Stainless Steel

Manhole units shall consist of standard modular precast riser sections, modular riser sections, and a doghouse base. Where conditions do not favorably accommodate the use of an eccentric cone, eccentric precast reinforced concrete flat tops are to be used. See Standard Details 513.04 and 513.05.

C. BUTTERFLY VALVES

Butterfly valve applications 16 inches and larger, shall meet AWWA C504. See Standard Detail 513.06. OWASA's Engineer must approve the installation of 16-inch and larger butterfly valves. Valves shall be short body and rated at no less than 250 psi.

Valves shall be flanged joint in accordance with AWWA C111. Accessories (bolts, glands, and gaskets) shall be supplied by the valve manufacturer.

All bolts shall be stainless steel. Use of a stainless steel anti-seize compound is required or specially coated nuts to prevent galling.

Valve operators shall meet the requirements of AWWA C504 and shall be of the traveling-nut type, sealed, gasketed, and lubricated for direct-bury underground service. Valve operators shall be sized for the pressure indicated on the drawings. Operator shall be capable of withstanding an input torque of 450 ft-lbs at full open or closed position, without damage to the valve or valve operators.

Valves shall be factory tested in accordance with Section 5 of AWWA C504 specification. Upon request the manufacturer shall furnish certified copies of test reports.

Valves shall open counter-clockwise (left) and shall be equipped with a 2-inch square AWWA operating nut and have a 4 to 1 gear ratio.

Valves shall be coated interior with fusion bonded thermosetting plastic, rubber, or epoxy. The exterior of buried valves shall be epoxy coated per AWWA C550 standard. ALL RUBBER GASKETS AND O-RINGS SHALL BE MANUFACTURED WITH AN APPROVED ELASTOMER.

Acceptable butterfly valve manufacturers are:

Manufacturer	Model
Clow (M&H)	4500-02(250 psi) FLG by FLG
Mueller / Pratt	Linseal XP 250B FLG by FLG / Triton HP250 FLG by FLG
DeZurik	BAW/EPDM (250 psi) FLG by FLG

All Butterfly valves furnished for a project shall be from the same manufacturer.

Butterfly valves 16 inches and larger and installed at standard depth shall be installed with a valve box to access the valve nut. See Standard Detail 513.01. Butterfly valves that are at excessive depth, as determined by OWASA, shall be placed in a precast concrete manhole. See Standard Detail 513.06.

D. CHECK VALVES

All swing check valves used for pressure zone separation shall be iron body, with a disc of extra heavy cast iron, ASTM A126 construction, bronze mounted with either mechanical joint or flanged ends as noted on the drawings. Standard mechanical joint ends shall be furnished with bolts, glands, and rubber gaskets. ALL RUBBER GASKETS AND O-RINGS SHALL BE MANUFACTURED WITH AN APPROVED ELASTOMER. Flanged ends shall be provided with bolts and gaskets. The shaft shall be of 304 stainless steel and the seat ring shall be of bronze with an easily replaceable resilient disc seat. The valve shall be tight seating.

Check valves shall be non-slamming (such as shock absorber) type. All valves shall have a minimum non-shock cold-water pressure rating of 250 psi.

Flanged check valves shall meet the dimensional requirement of ANSI B16.1 and meet or exceed the requirements of ANSI/AWWA C508.

When more positive control is needed a lever-and-spring may be specified.

When check valves are used in vault applications, a ball drip valve is to be provided.

All check valves shall be furnished with an arrow cast into the body indicating the direction of flow during system operation.

Acceptable manufacturers are:

Manufacturer	Model
G.A. Industries	Model 250-U
American Flow Control	Series 2100

E. CROSS-CONNECTION CONTROL

Refer to OWASA Cross-Connection Control Ordinance, and Manual, latest revisions as applicable.

F. TAPPING SLEEVES AND VALVES

The tapping sleeve and valve shall be suitable for wet installation without interrupting water service.

1) **Iron Body Tapping Sleeve**: The sleeve body shall be of split type, full body ductile iron construction with mechanical joint ends and epoxy coating (10 mil minimum) for AC sleeves. The sleeve shall be suitable to fit the type and class of pipe being tapped. The mechanical joint type shall have longitudinal compound (EPDM) rubber gaskets that fit against the rubber end gaskets effecting a totally enclosed rubber, watertight seal. Side and end bolts shall be stainless steel. Tapping sleeve shall meet the requirements of AWWA C110/ANSI A21.10. For asbestos cement pipe, the Contractor shall measure the diameter of the pipe prior to selecting a tapping sleeve to ensure the sleeve will fit the pipe (this information shall be provided to OWASA on the as-built drawings). See Standard Detail 512.04.

Acceptable tapping sleeves are listed below:

Manufacturer	Model
American Flow Control	2800-C for CI to PVC 2800-A for AC
Mueller	H-615 for CI to PVC H-619 for AC
Tyler/Union	For CIP/DIP to DIP

2) **Tapping Valves**: Resilient seat tapping valves shall be epoxy coated (minimum 10 mil thickness) and otherwise meet the requirements of Section 2.2.A, *Gate Valves*, except that the seat openings shall be larger than nominal size with a raised alignment ring on the flange. Valve ends shall be mechanical joint by flange. Valves shall open counter-clockwise (left) and shall have a 2-inch operator nut. See Standard Detail 512.04.

   All bolts and nuts are to be stainless steel.

   Tapping valves shall be an "O" ring type mechanical joint end conforming to AWWA non-rising stem construction. Inlet flange end shall be Class 125 (ANSI B16.1). ALL RUBBER GASKETS AND O-RINGS SHALL BE MANUFACTURED WITH AN APPROVED ELASTOMER. Acceptable resilient seat tapping valves are listed below:

Manufacturer	Model
American Flow Control	2500 TM
Clow	F-6114
Mueller	T-2360

G. FIRE HYDRANTS

1) See **Standard Details** 514.02 and 514.03. ALL RUBBER GASKETS AND O-RINGS SHALL BE MANUFACTURED WITH AN APPROVED ELASTOMER. ALL BRASS PRODUCTS SHALL BE LEAD FREE AND CONFORM TO NSF STANDARD 61-ANNEX G IN CONJUNCTION WITH NSF372 REQUIREMENTS. Fire hydrants shall comply with ANSI/AWWA C502, latest revision, UL 246 and FM1510. Hydrants shall be hub end, triple nozzle, improved AWWA type. Interior coating to be in accordance with AWWA C550. Minimum working pressure shall be 250 PSI working pressure in all pressure zones. Hydrants shall consist of the following:

a. Two 2½-inch fire nozzles and one 5-inch Storz connection nozzle (or OWASA-approved equivalent) with National Standard hose threads. The nozzle shall be an integral part of the fire hydrant and must be furnished by the manufacturer or authorized distributor designated by the manufacturer. Storz connector shall have the following characteristics: brass hydrant nozzle connection; have hard anodized aluminum Storz ramps and lugs (hydrant and cap side); and require a high-torque Storz spanner wrench in order for the cap to be removed.
b. All nozzles shall be provided with caps and chains.
c. The hydrant valve opening shall be 5¼ inches.
d. Bronze to bronze threads shall be provided between the hydrant seat or seat ring and the seating attaching assembly.
e. All hydrants must include cast or ductile epoxy lined shoe (minimum 4 mils), rubber drain seals and positive protective valve stop device.
f. Hydrants shall open left and shall have a National Standard pentagon-type operating nut (1 ½" point to flat). The operating nut shall be of one-piece bronze construction. A thrust washer shall be supplied between the operating nut and stem lock nut. The valve stem shall have a safety flange and a safety coupling.
g. Hydrants shall have a 6-inch hub-end or mechanical joint elbow.
h. The hydrant barrel shall be of sufficient length to provide a minimum bury of 4 feet.
i. Hydrants shall be of the compression type closing with line pressure and shall be of the traffic model breakaway type.
j. Hydrant cap and stuffing box shall be of unitized, one-piece design creating a watertight cavity without the use of gaskets. The combination of O-Rings to a crimped brass ferrule around the stem shall seal the cavity from contact with water. Hydrant caps shall have a means for providing periodic lubrication of the operating threads.
k. The main valve shall be of synthetic rubber reinforced with steel. The seat shall be of a bronze ring threaded to a bronze insert in the hydrant shoe, with O-Rings to seal the drain way and barrel from leakage of water in the shoe.
l. The hydrant drain hole shall momentarily force flush with each operation.
m. All hydrant extension kits, flange kits, stems, couplings or other repair parts must be of the original hydrant manufacturer. Only one 24-inch extension kit is allowed.
n. Hydrants are to be painted in accordance with Standard Detail 514.01. Barrels are to be painted red with the caps and bonnet painted reflective

silver. Private hydrants are to be clearly distinguishable from OWASA hydrants by painting with distinctly different paint colors, as prescribed by the local fire authority.

o. If line is to be pressurized within 7 days of setting hydrant, then 4000-psi high early strength concrete shall be used.

Approved fire hydrants including model and manufacturer are listed below:

Manufacturer	Model
Clow (M&H)	F-2545 Medallion
Mueller	A-423 Super Centurion 250
American Flow Control	B62B Traffic Model (Long Barrel)

All hydrants furnished for a project shall be from the same manufacturer.

See Section 3.2.F, *Fire Hydrants* for installation requirements.

H. BLOW OFFS

1) **Blow-Off Assembly for Future Extension**: Blow-off assemblies for future extensions shall consist of two standard valve boxes, one for a NRS gate valve and one for a 2-inch brass pipe riser (see Standard Detail 514.05), thrust collar, a push-in plug tapped for 2-inches, a 2-inch brass pipe riser with a 2-inch threaded male threaded plug.

2) **Permanent Blow-Off Assembly**: Permanent blow-off assemblies shall consist of a standard valve box (see Standard Detail 514.06) with a concrete stabilizing pad, an NRS gate valve, a mechanical joint reducer as applicable, thrust collar, a riser with elbow and blocking, and if applicable, a flange 90-degree elbow placed above grade. See Standard Details 514.04 and 514.06.

I. CORPORATION STOPS

ALL BRASS PRODUCTS SHALL BE LEAD FREE AND CONFORM TO NSF STANDARD 61-ANNEX G IN CONJUNCTION WITH NSF372 REQUIREMENTS. ALL RUBBER GASKETS AND O-RINGS SHALL BE MANUFACTURED WITH AN APPROVED ELASTOMER. Corporation stops for ¾-inch and 1-inch taps only shall be all bronze CC tapered threaded inlet by flare copper as manufactured by Ford or Mueller. Acceptable corporation stops shall be the Ford FB600-(3 OR 34)-NL Series or the Mueller B25000N Series. 2-inch corporation or ball stops are not permitted. See Standard Detail 512.06.

2.3 MISCELLANEOUS APPURTENANCES

A. DETECTABLE WARNING TAPE AND TRACER WIRE

Tracer tape and tracer wire shall be installed per Section 02275.

B. DUCTILE IRON TRANSITION COUPLINGS

Transition couplings shall be ANSI/NSF Standard 61 Certified, fusion bonded powder epoxy coating and constructed of ASTM A536 grade 65-45-12 ductile iron flanges and middle ring. Coupling to be rated at a minimum of 200 psi working pressure per AWWA C219, and -20ºF to 212º F. Gaskets shall be suitable for use on water and sewage. Bolts are to be stainless steel 18-8 Type 304. Transition couplings are to accommodate IPS PVC, C-900 PVC, Ductile Iron Pipe, Cast Iron, and Asbestos Cement Classes 100/150/200. Acceptable couplings are Smith-Blair Type 441 and 461, JCM 240 for line sizes 3-inch through 12-inch and the Dresser Style 253 Modular Cast Coupling (2-inch through 16-inch), Ford Style FC2W Ultra-Flex Ductile Iron Wide Range Coupling (4-inch through 12-inch), Hymax (Standard or Long body) coupling, Romac (Macro HP) coupling with EPDM gaskets. ALL RUBBER GASKETS AND O-RINGS SHALL BE MANUFACTURED WITH AN APPROVED ELASTOMER.

C. MISCELLANEOUS CONCRETE WORK

Concrete classes (NCDOT) to Design Compressive Strength at 28 days (f'c):

Concrete shall be constructed of a minimum of 3000 psi concrete at 28 days. Ready mixed concrete shall comply with ASTM C94. This applies to concrete blocking, valve box stabilizing pads, thrust collars, concrete encasement, and Fire Hydrant setting and thrust pads. All exposed concrete shall be air entrained.

D. BEDDING

Bedding material, when specified, shall be clean coarse aggregate No. 57, and shall meet the requirements of Section 1016-3, *Classifications* of the NCDOT *Standard Specifications for Roads and Structures*, latest revision for class VI stone.

E. PRECAST CONCRETE MANHOLE STRUCTURES

Structures of precast reinforced concrete manholes shall be designed and manufactured in accordance with ASTM C478, latest revision ("O" ring joints), or AASHTO M199 (gasketed joints). The standard joint shall be sealed with plastic cement putty meeting Federal Specification SS-C-153. An "O" ring or "mastic" joint seal may be used. The "O" ring joint shall conform to the requirements of ASTM C443. Type Concrete used in the construction of the manholes shall have a minimum 28-day compressive strength of 4000-psi air entrained (with 4 to 6 percent air) conforming to ASTM C33 and ASTM C94. Manholes shall have monolithic base and eccentric cone flat top as applicable. See Standard Details 513.04, 513.05, and 513.06. Structures are not permitted to have steps. Acceptable manufacturers are: Oldcastle Precast/N. C. Products Concrete Corporation, Stay-Right Tank, Lindsey Precast, Concrete Pipe and Precast, LLC (Hanson), Precast Solutions, Mack Industries or Tindall Precast Concrete Products, Inc.

Manhole Size Determination:

1) Unless shown otherwise, the minimum diameter of manholes shall be 5 feet.

2) Manholes with 16-inch diameter or larger pipe shall be a minimum of 6-foot diameter.

F. PRECAST UNDERGROUND CONCRETE UTILITY STRUCTURES

Structures of precast reinforced concrete shall be designed and manufactured in accordance with ASTM C858, latest revision with preformed butyl rubber joint sealant meeting ASTM C990, latest revision. Type Concrete used in the construction of the Utility Structures shall have a minimum 28-day compressive strength of 4000-psi air entrained (with 4 to 6 percent air) conforming to ASTM C33 and ASTM C94. Unless shown otherwise on the drawings, structures are not to have steps. Steel reinforcing shall conform to the requirements of ASTM C857, latest revision. Structures shall be designed for an H20-44 loading in traffic areas. Acceptable manufacturers are: Oldcastle Precast/N. C. Products Concrete Corporation, Lindsey Precast, Concrete Pipe and Precast, LLC (Hanson), Precast Solutions, Mack Industries, Tindall Precast Concrete Products, Inc. or M.C. Precast Concrete.

G. MANHOLE FRAME AND COVERS

Manhole frames and covers shall be meet ASTM, Class 30, traffic frame and cover as manufactured by Capitol Foundry, US foundry or East Jordan Iron Works. Cover shall read OWASA, “WATER” in the center and “DANGER ENTRY PERMIT REQUIRED” around the circumference. See Standard Detail 516.01. Provide four 1-inch diameter holes in the top at each compass point.

Weights shall not vary more than 5% +/- of the weight shown on Standard Detail 516 .01.

Acceptable Manufacturers and models are:

Manufacturer	Model
Capitol Foundry	MH-2001
US Foundry	USF-669
East Jordan Iron Works	V-1384

H. PIPE SADDLE SUPPORT - ADJUSTABLE

Adjustable Pipe Saddle Support: For Dry Conditions 2½-inch through 36-inch pipe: Material to be cast iron saddle formed to ductile iron pipe, with lock nut, and special cast iron reducer. Vertical adjustment range to be from 0 up to 4½ inches. Adjustable pipe saddle supports shall comply with Federal Specification WW-H-171E (Type 39). Pipe saddle supports shall equal or exceed the *Standon* Model S92, as manufactured by Material Resources, Inc., Hillsboro, OR., or Grinnell Figure 259.

Adjustable Pipe Saddle Support For Wet or Harsh Corrosive Conditions 2-inch Through 24-inch Pipe: Material to be steel saddle formed to ductile iron pipe, lock nut, and special steel reducer. Vertical adjustment range to be from 0 up to 4½ inches. Material to be 100% 304 stainless steel with saddles formed of ductile iron pipe. Saddle strap to meet ASTM A36. Collar and base cups ASTM A53 D.O.M. tubing. Thread Stud to meet ASTM A36, rolled thread, grade ASTM A307. Base Plate to meet ASTM A36 sheet steel, 0.25-inch. Pipe saddle support shall equal or exceed the *Standon* Model S92, as manufactured by Material Resources, Inc., Hillsboro, OR., or approved equal.

I. SERVICES

1) **SMALL SERVICES: 3/4-INCH AND 1-INCH WATER SERVICES**

Type K Copper, soft drawn; comply with ASTM B88. Services shall be ¾-inch to 1-inch and shall be one continuous run from main to meter with no joints or couplings in between. On these water services, the fittings shall be brass AWWA C800, or copper type fittings. See Standard Detail 515.01 and 515.02.

Service saddles shall be used on all service connections. Direct service taps are not permitted. See Standard Detail 512.06.

Service Saddles: Saddles shall be all bronze saddle with either a single or double bronze strap and a grade 60 neoprene "O" ring gasket attached to the body. The saddle casting, straps, and nuts shall be water works bronze 85-5-5-5. ALL RUBBER GASKETS AND O-RINGS SHALL BE MANUFACTURED WITH AN APPROVED ELASTOMER. The saddle shall have CC flared corporation stop threads. See Standard Detail 515.01 and 515.02.

Acceptable service saddles are:

Manufacturer	Model
Ford	101B Series
Mueller	BR1B

Water Service 5/8 x 3/4-inch and 1-inch meter setter/yoke: ALL BRASS PRODUCTS SHALL BE LEAD FREE AND CONFORM TO NSF STANDARD 61-ANNEX G IN CONJUNCTION WITH NSF372 REQUIREMENTS. ALL RUBBER GASKETS AND O-RINGS SHALL BE MANUFACTURED WITH AN APPROVED ELASTOMER. 5/8-inch x ¾-inch and 1-inch meter setters/yokes shall conform to AWWA C800 and be factory tested for water-tightness before shipping. Setters shall be comprised of all brass and copper padlock wing stop inlet ball valve (lockable cut-off), angle double check outlet valve, with inlet and outlet copper connections, and a 12-inch rise. See Standard Detail 515.01.

Acceptable meter setters/yokes are:

Size	Manufacturer	Model
5/8-inch x ¾-inch	Ford	VBHH72-12W-11-33-NL
1-inch	Ford	VBHH74-12W-11-44-NL
Both 5/8-inch x ¾-inch and 1-inch	Mueller	B-2404N-2A & two H-14222N couplings

Combined Domestic and Fire Protection SERVICE 3/4 x 3/4-inch and 1-inch meter setter/yoke: 3/4-inch x 3/4-inch and 1-inch meter setters/yokes shall conform to AWWA C800 and be factory tested for water-tightness before shipping. Setters shall be comprised of all brass and copper padlock wing stop inlet ball valve (lockable cut-off), angle double check outlet valve, with inlet and outlet copper connections, and a 12-inch rise. See Standard Detail 515.02. Acceptable meter setters/yokes are:

Size	Manufacturer	Model
3/4-inch x ¾-inch	Ford	VBHH73-12W-11-33-NL
1-inch	Ford	VBHH74-12W-11-44-NL
Both 3/4-inch x ¾-inch and 1-inch	Mueller	B-2404N-2A & two H-14222N couplings[a]

Notes:
[a] Specify size of yoke when ordering Mueller setter

Meter Boxes: Meter boxes shall be 12-inch deep lightweight boxes with heavy duty polymer lid/cover capable of transmitting the AMI signal and marked with the OWASA logo. The box shall be ultraviolet light and chemical resistant as well as unaffected by freezing and moisture. Boxes shall equal or exceed Model 118-12 BCFXL by Oldcastle Enclosure Solutions, Madera, CA. Lids shall equal or exceed Model B12 by Nicor, Inc., Dripping Springs, TX. See Standard Detail 515.01 and 515.02.

2) **2-INCH WATER SERVICES**

a. **Service Pipe**: Type K Copper, hard drawn; comply with ASTM B88. Water service pipe for 2-inch connections shall be type "K" hard drawn copper with silver-brazed joints with brass fittings or restrained joint Viega ProPress with EPDM gaskets or equivalent fitting pressure rated to 300 psi. On these water services, the fittings shall be threaded type brass fittings. 1½" copper tubing is not permitted.

   The service line for a 2-inch meter shall consist of a 2-inch tap, 2-inch type K hard drawn copper service line, a 2-inch Clow F6103, AFC series 2500SS, or Mueller H-2360-8 threaded Iron Body Gate Valve and a 2-inch x 4-inch long threaded (iron pipe thread) brass nipple. See Standard Detail 515.04.

b. **Service Saddles**: Service saddles shall be 2-inch all bronze or brass saddle with double bronze straps and with a grade 60 neoprene "O" ring gasket attached to the body. All rubber gaskets and O-rings shall be manufactured with an approved elastomer. The saddle casting, straps, and nuts shall be water works bronze 85-5-5-5. The saddle shall have 2-inch iron pipe threads.

Acceptable service saddles are:

Manufacturer	Model
Ford	202B Series
Mueller	BR2B

c. **2-inch meter setter/yoke**: all brass products shall be lead free and conform to NSF Standard 61-Annex G in conjunction with NSF 372 requirements. All rubber gaskets and O-rings shall be manufactured with an approved elastomer. Meter Setters shall be constructed from 85-5-5-5 Brass (AWWA C800) and copper tubing, and factory tested for water-tightness before shipping. 2-inch meter setter/yoke shall be comprised of all brass and copper padlock wing inlet ball valve (lockable cut-off), angled double check outlet ball valve, 1 ¼-inch by-pass line with a 1 ¼-inch stop ball valve, in-line double check valve, and brace pipe eyelets for 1-inch pipe. Outlet connections are to be threaded. See Standard Detail 515.04. Acceptable meter setters/yokes are:

Size	Manufacturer	Model
2-inch	Ford	VBHH77-18BHC-11-77 (standard 18-inch rise) Ford Drawing No. B-95270-02
2-inch.	Mueller	Mueller Drawing No. B2423-2 (must specify 2-inch meter with 15-inch rise)

d. **Meter Setter Idlers**: all brass products shall be lead free and conform to NSF STANDARD 61-ANNEX G in conjunction with NSF 372 requirements. Meter idlers shall be provided for the 2-inch setter. The idler is used to maintain proper spacing until a system is ready for a meter to be set. The meter idler for a 2-inch setter is manufactured by Ford and is designated as No. 7 Idler.

e. **Small Meter Vaults**: Small meter vaults shall be constructed of precast concrete See Section 02510-2.3.E. The size and shape shall be as shown on Standard Detail 515.04. The cover shall have a minimum opening dimension of 30 inches x 36 inches. The access hatch shall be constructed with an aluminum tread plate cover, extruded aluminum frame with concealed hinges, hatch drain, and stainless steel hardware. The hatch shall have a slam lock and shall have an H-20 load rating. Vaults located within vehicular travel lanes shall meet the minimum AASHTO guideline H-20 traffic loads for full H20 loads. See specification Section 2.3.L, *Vault Access Hatch*, below.

Acceptable hatches are:

Manufacturer	Model
Bilco	J-3AL-H20
Halliday Products	H1R3036
US Foundry & Manufacturing Corporation	THS 30x36 W/OP

3) **LARGE METER SERVICES (3-INCH AND LARGER):**

i. **Piping**: For services greater than 2 inches, the water service pipe shall be 4, 6, 8, 10, or 12 inches in diameter and shall be constructed of ductile iron pipe. 3-inch meters shall be served by a 4-inch tap and 4-inch service line. Ductile iron fittings shall be used on these services. 3-inch diameter pipe is not allowed in the OWASA distribution system. All taps will be made by using the appropriate size tapping sleeve and valve. On a dry line, the connection may be made with a tee and valve.

ii. **Large Meter Vaults**: Meter vaults for 3-inch and larger meters shall be constructed of precast concrete with a floor drain with a connection that is compatible with 4-inch diameter ductile iron pipe. Meter vault floors shall be sloped toward the drain. Sump pumps are not permitted. Meter vaults shall have aluminum, cast-in-place double leaf, and spring-loaded doors with slam locks. Doors shall be rated H-20 in All areas. Vaults located within vehicular travel lanes shall meet the minimum AASHTO guideline H-20 traffic loads for full H20 loads. The vault doors shall be located over the water meter. See specification Section 2.3.L, *Vault Access Hatch*, below. Acceptable manufacturers for large meter vault access doors are Halliday Products, Inc., The Bilco Company, or an approved equal. Door sizes vary according to water main size. See Standard Details 515.13, 515.14, and 515.15.

Manufacturer	H-20 Model No.
Bilco	JD-2AL H20
Halliday Products	H2W4848
US Foundry & Manufacturing Corporation	Type THD 48x48 W/OP

Precast meter vault manufacturers are listed in Section 02510-2.3.E. See Section 02275 – *Trenching, Backfilling and Compaction of Utilities*, Section 3.3.B, paragraph 3 for bedding requirements for Structures.

Minimum meter vault dimensions shall be as follows below.

Meter Size	Minimum Vault Size
3- and 4-inch	10’-0” L x 8’-0” W x 6’-6” H
6- and 8-inch	12’-0” L x 10’-0” W x 6’-6” H

iii. **Combinations Vaults**: Combination vaults shall be designed and constructed to provide the following minimum clearances between the pipe, fittings or vault walls:

Conflict	Minimum Clearance
Vault side wall to meter	24”
Vault side wall to side of pipe or valve	6”
Vault end wall to nearest bolted connection	6”
Pipe to pipe, fitting or valve	6”
Top of OS&Y valve stem (fully opened) to vault ceiling	6”

4) **Low Profile Vaults**: Some areas may require the use of a shallow vault. Detail 515.14 provides the minimum depth permitted.

5) **Meters**: All water meters are to be purchased from OWASA. Meters that are 2-inches and smaller shall be delivered and set by OWASA. For meters 3-inches and larger, Contractor shall pick up and install under supervision of OWASA. Appropriate lead-time for supplying meters shall be given to OWASA by the Contractor or Owner requesting the water meter. No meters will be installed until “Tentative Acceptance” of the lines has been granted and the appropriate fees paid.

Meters larger than 2-inches are to be provided with remote read out meter reading capabilities (see Standard Detail 515.13 for detail of remote readout in relation to vault).

J. TIE-RODS

Tie rods shall be 304 or 316 stainless steel, and of size and number as shown on Standard Detail 512.09. No duck lugs shall be allowed. All eyebolts shall be 304 or 316 stainless steel. All nuts and rod couplings shall be stainless steel, and be coated to prevent galling, or the use of stainless steel anti-seize compound used.

K. VALVE BOXES

Adjustable valve boxes shall be US made gray cast iron of the dimensions shown in Standard Detail 513.01 *(2-Piece Adjustable Screw Valve Box and Cover* Detail*)* of these specifications. Lids shall be heavy-duty traffic weight with the word “WATER” cast into the lid. Provide cast-iron telescoping top section of length required for depth of burial of valve and bottom section with base of size to fit over valve. Acceptable valve boxes are: Charlotte Pipe and Foundry Company Figure UTL 273 or Tyler Pipe Company 6850 Series or approved equal.

L. VAULT ACCESS HATCH

1) **All Areas** shall be Low Density Traffic H-20 Loading (incidental) – of 16,000 lb. wheel load on a 10-inch x 20-inch wheel area:

2) **Streets, Parking Decks, Etc.**: Vaults access Hatches located within vehicular travel lanes shall meet the minimum AASHTO guideline H-20 traffic loads for continuous vehicular traffic.

3) The aluminum access frames and covers are provided with a 1/4-inch thick structural grade aluminum channel frame with the flanges acting as a continuous concrete anchor. The inside of the frame has a continuous door support angle that must have a full bed of Class "A" concrete under both the frame and support angle. Door leaves shall be a minimum of 1/4-inch thick aluminum diamond plate with structural grade aluminum. Door reinforcing shall withstand an H-20 live load designation. The doors also have lifting aids of aluminum tubular construction with compression springs to assist in opening and closing of the doors. The doors are provided with heavy-duty stainless steel hinges with tamper-proof fasteners. All hardware is to be stainless steel. The doors open to 90 degrees and lock automatically in that position with a steel positive locking arm and a stainless steel release handle. Doors are provided with a stainless steel lifting handle, stainless steel snap-lock with removable key handle. Two key handles shall be provided with each door. The door leaves extend to the outside perimeter of the frame for added support.

4) **Guarantee and Manufacturer**: The aluminum access frames and covers shall carry a 10-year guarantee against defects in materials and workmanship. The frame and cover shall equal or exceed the units manufactured by Halliday Products, Inc. or The Bilco Company.

PART 3 – EXECUTION

INSTALLATION – PIPE AND FITTINGS

3.1 PIPE AND FITTINGS

Refer to Section 02275 – trenching, backfilling and compaction of utilities.

A. DUCTILE IRON PIPE

1) **DIP Installation**

a. **Trenching & Bedding**: Refer to Section 02275 – *Trenching, Backfilling, and Compaction of Utilities*.

b. **Installation of DIP Water Mains**: Comply with AWWA C600.

c. **Pipe Laying - Separation**: The contractor shall comply with the NCDWR standards for separation of water mains from sanitary sewers or storm drainage lines. See Part 1 – GENERAL, Section 1.9, *Project Conditions* of this specification.

d. **Materials, Storage, and Handling**: See Section 1.7, *Product Delivery, Storage and Handling*.

2) **Construction**

a. **Construction**: Water mains and fittings shall be installed with approved tools in accordance with the requirements of ANSI/AWWA Standard Specification C600, which is herein made part of the specification by reference.

Construct piping to accurate lines and grades avoiding localized high points and support as required on drawings or described in specifications. When temporary supports are used, ensure that sufficient rigidity is provided to prevent shifting or distortion of pipe.

Pipe shall be laid with bell ends upgrade and facing the direction of laying.

Due care shall be taken in the storing and handling of pipes, fittings and valves to avoid contamination with the ground and prevent foreign matter from entering pipe and fittings. String out no more pipe than can be installed in a day. Gaskets shall be lubricated as per manufacturer's recommendations.

Pipe, fittings, and valves shall be carefully handled and lowered into the trench. Under no circumstances shall any pipe or fitting be dumped or rolled into the trench or be allowed to drop against the pipe or fitting already in the trench. Great care shall be taken to prevent the pipe lining and coating from being damaged, and the Contractor shall not install any damaged pipe. The Contractor shall be responsible for removal and disposal of damaged pipe.

Prior to being lowered in to the trench, all pipes shall be carefully inspected to see that each pipe is clean. If necessary, pipes shall be fitted together to ensure sufficient opening for the gasket or joint compound and smooth inside flow line.

Special care shall be taken to ensure that the pipe is well bedded on a solid foundation, and any defects due to settlement shall be made good by the Contractor at their own expense. Bell holes shall be dug sufficiently large to ensure the making of proper joints. Special precautions shall be exercised to prevent any pipe barrel or bell from resting on rock. A minimum of 6 inches is required between rock and the bottom of pipe (see Standard Detail 511.01 and Section 3.2.E, paragraph 2, *Cushioning Pipe in Rock*, of Section 02275 – *Trenching, Backfilling, and Compaction of Utilities*). If the bed formed in the bottom of the trench is too low, the pipe shall be removed, clean stone placed in the bottom, and a new bed prepared for the pipe. In no case shall the pipe be brought to grade by blocking under the barrel of the pipe. A uniform support shall be provided for the entire length of the pipe.

Whenever a pipe requires cutting, to fit in the line or to bring it to the required location, the work shall be done in a satisfactory manner with an approved cutting tool or tools which will leave a smooth end at right angles to the axis of the pipe, and not otherwise damage the pipe or liner. When the cut end is to be assembled in a *Fastite* bell, an adequately smooth (without sharp edges) bevel should be ground or filed on the cut edge to prevent damage to or dislodgement of the gasket during assembly. Generous bevels are advantageous in the assembly of field prepared ends. The approved methods of cutting pipe are: rotary type, abrasive wheel, and snap cutter on DIP. No welding, flame cutting, or flame tapping will be allowed.

Mains shall be installed to the depth as directed by OWASA's Engineer, but in no case with a cover of less than 42 inches below finished grade. In the event site conditions prevent adherence to minimum cover requirements, approval of an alternate design by OWASA's Engineer is required. See Table 02275.1 of Section 02275 – *Trenching, Backfilling, and Compaction of Utilities*.

The Contractor shall be required at the end of the day's work to keep the end of the line, under construction, plugged to prevent foreign matter from entering pipe and fittings. A watertight plug shall be placed in the bell of the last joint of pipe laid. The pipe shall not be used as a means of draining ground water from the area.

Maximum horizontal deflections for ductile iron pipe shall meet AWWA C600, latest revision.

Allowable Joint Deflection			
Size (inches)	Nominal Laying Length (feet)	Maximum Allowable Deflection	
		Offset per Length (inches)	Deflection Angle (degrees/radius, ft)
4	18	19	5°/205
6	18	19	5°/205
8	18	19	5°/205
12	18	19	5°/205
16	18	11	3°/340
20	18	11	3°/340
24	18	11	3°/340
30	18	11	3°/340
36	18	11	3°/340
42	18	11	3°/340
48	20	12	3°/380

i. **Installing Mechanical Joint Pipe**:

a) Gaskets shall not be exposed to oil, grease, ozone, extensive heat, sunlight, or other elements that would degrade the gasket. Store gasket in a cool dark place until installation in accordance with manufacturer's recommendations.

b) Clean socket and plain end thoroughly, removing mud, oil, gravel, or any other foreign matter. Gaskets shall be lubricated. Paint the bell and the spigot with soap solution (half cup granulated soap dissolved in 1 gallon of water). Slip ductile iron gland on spigot end with the lip extension of the gland toward the end of the pipe. Paint rubber gasket with or dip into the soap solution and place on the spigot end with thick edge toward the gland.

c) Push the spigot end forward to seat in the bell. Then, press the gasket into the bell so that it is located evenly around the joint. Move the gland into position, insert bolts, and screw nuts up finger tight. Then tighten all nuts to torque listed below (excerpted from AWWA C600):

Bolt Size (Inches)	Torque (Ft. – Lbs)
5/8	45-60
3/4	75-90
1	100-120
1 3/4	120-150

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

d) **Permissible deflection** in mechanical joint pipe shall not be greater than listed in AWWA C600.

Allowable Joint Deflection			
Size (inches)	Nominal Laying Length (feet)	Maximum Allowable Deflection	
		Offset per Length (inches)	Deflection Angle (degrees/radius, ft)
4	18	31.0	8°-18’/125
6	18	27.0	7°-07’/145
8	18	20.0	5°-21’/195
12	18	20.0	5°-21’/195
16	18	13.5	3°-35’/285
20	18	11.0	3°-00’/340
24	18	9.0	2°-23’/450

ii. **Installing Push on Pipe**: Standard PUSH-ON GASKETS ARE NOT PERMITTED FOR USE IN OWASA SERVICE AREA!

a) Gaskets shall not be exposed to oil, grease, ozone, extensive heat, sunlight, or other elements that would degrade the gasket. Store gasket in a cool dark place until installation in accordance with manufacturer’s recommendations.

b) Clean the socket and 8 inches of the outside of the plain end thoroughly, removing mud, gravel, or any other matter that might cause the front of the gasket to protrude into the path of the entering spigot. Flex rubber gasket and apply lubricant supplied with the pipe to the plain end and to the inside surface of the gasket before assembly. Start the spigot end of the pipe in to the socket with care. The circumferential stripe on the plain end provides a visual indication for checking the proper insertion of the joint. Insert gasket fully in the gasket recess of the socket, large end of the gasket entering first. For assurance of proper gasket positioning, a thin automotive, blade-type feeler gauge can be used for quick and easy probing to confirm a properly installed gasket position around the joint. Then complete the joint by forcing the plain end to the bottom of the socket with a forked tool or jack-type device.

b. **Cutting Pavement/Driveways:** Where the water line is in an existing paved area, the edges of the pavement for the water line shall be cut in a straight line, parallel to the pipe on each side. Perform cutting operations prior to installation of water line to avoid excessive removal of asphalt. Care shall also be taken during installation of pipe to avoid damage to adjoining paved surfaces. Refer to the applicable Municipal or NCDOT standard pavement repair details pavement width and patching requirements. Driveway crossings shall be completed within 48 hours after the initial cutting of the pavement.

c. **Protection of Pavement:** Whenever the water line is to be placed in or near a paved street, the Contractor shall provide pads or take necessary precautions to protect the pavement from damage by construction equipment. Pavement damage by cleats or tracked equipment, or by any other means, shall be repaired by the Contractor.

3) **Connections To Existing Mains**

The Contractor shall furnish all materials for connection to existing water mains. THIS INCLUDES ALL RODDING, BLOCKING AND BRACING NECESSARY TO PLACE WATER MAIN INTO SERVICE AS SOON AS TIE-IN IS COMPLETE. OWASA shall be the sole operator of all EXISTING valves and fire hydrants.

In making connections to the existing distribution system, valves shall be set as shown on the plans.

Before shutting off any main, residents are to be notified by an OWASA representative in writing 48 hours in advance of cut off. The Contractor shall provide assistance to OWASA in notification distribution.

If connection to an existing main requires a wet tap, such tap shall be performed by OWASA. Fees must be paid 48 hours in advance of tapping the main. Contactor is responsible for traffic control, excavating, dewatering, and safe access in the trench at the time of tap. The contractor is to provide taping sleeve and valve. Contractor must have approved traffic control plan.

Work shall be scheduled at least one week in advance through OWASA's inspector. A crewman from the OWASA Distribution and Collection Systems Division shall be present during the operation. After installation of the tapping sleeve and valve and prior to performing the tap, the assembly shall be air tested at 100 psi. Such pressure shall be maintained with no loss for a minimum time of 5 minutes.

4) **Removal Of Asbestos Cement Pipe**

The Contractor is hereby advised that some of the pipe within the OWASA distribution system may contain asbestos. Removal, handling, and disposal of asbestos cement pipe shall be performed in accordance with applicable EPA and

OSHA regulations and applicable Federal, State and local regulations. Documentation and paperwork as well as a chain of custody are to be provided to OWASA.

5) **Utility Protection**

Take necessary precautions to protect existing utilities from damage due to any construction activity. The Contractor shall locate existing utilities, culverts, and structures (above or below ground), before any excavation starts and coordinate work with utility companies. Protect, maintain in service, and prevent damage to utilities not designated to be removed. Omission from or inclusion of located utility items on plans does not constitute non-existent or definite location. Secure and examine local utility surveyor records for available location data including building service lines. Contact underground damage protection services by contacting “National Cal Before You Dig” at 811/NC One Call Center at 1-800-632-4949l 48 hours before you dig.

The Contractor shall protect, maintain in service, and prevent damage to utilities not designated to be removed. When utilities are encountered and are not shown on drawings or when locations differ from those shown on drawings, notify Project Engineer for instruction before proceeding. In the event that a gas line, water line, power cable or conduit, or telephone cable or conduit is broken or damaged, the Contractor shall give immediate notice to the proper authorities and shall be responsible for any damage to persons or property caused by such breaks. If a service pipe supplying water to an adjoining house is broken, the Contractor shall repair same at once. OWASA may, at the Contractor’s expense, repair any such service without prior notice to Contractor.

Should it become necessary to move the position of any underground structure, the Contractor may be required to do such work.

The Contractor shall be responsible for protecting all existing utilities that could be damaged by excavation near the proposed line. Trench boxes may be necessary to prevent sloughing, etc., as well as to protect workmen, the motoring public, and the pavement. Failure to use a box, which subsequently results in damage to an existing line or other public improvements, shall be cause for liability against the Contractor for the repair costs.

6) **Surface Or Ground Water In Trenches/Pipe**:

When ground water is encountered, the Contractor shall pump, or otherwise remove any water that accumulates in the trenches and shall perform all work necessary to keep the trenches clear from water while pipe is being laid. No pipe shall be constructed in water and water shall not be allowed to drain through the pipe. At the end of the day, the open end of the pipe shall be kept closed by placing a watertight fitting plug into the bell end to prevent washing of any foreign matter into the line. All water removed from the trench shall be conveyed in a proper manner to a suitable point of discharge and shall comply with the applicable erosion and sedimentation laws. See also Section 3.1.G, *Dewatering* of Section 02275 – *Trenching, Backfilling, and Compaction of Utilities*.

7) **Abandoning Of An Existing Water Mains/Services/Lines**:

Services: When abandoning services 2-inch in diameter, the valve shall be closed and the pipe cut and removed from the valve, a threaded plug shall be installed into the valve body. On lines smaller than 2" in diameter, the corporation stop shall be turned to the off position, a flair cap placed on the corporation stop and the line shall be cut as close to the main as possible and a one-foot segment of the line removed. A galvanized saddle shall be removed and replaced with a repair clamp or brass saddle with brass plugs, as directed by OWASA. For larger services, the service shall be removed and straight-piped, capped, or a blow off added, as directed by OWASA. Leaded tees/ connections shall be replaced and straight piped.

Mains: When an existing water main is replaced with a new water main, abandonment of the existing line is required once it is no longer in service. The line shall be abandoned as shown in Standard Detail 512.05 or as directed in the plans and Specifications. Additionally, the following water pipes shall be abandoned by removal or by filling with grout / flowable fill concrete (50 psi minimum/ 150 psi maximum) in accordance with the following criteria:

a. Pipes larger than 24-inches diameter

b. Pipes located within roadway section and meeting one of the following conditions:

   i. pipes that are 12-inches diameter up to and including pipes that are 24-inches diameter and are buried less than 20 feet below finished grade

   ii. pipes that are 6-inches diameter up to 12-inches diameter that are not cast iron, ductile iron, PVC, or HDPE and are buried less than 12 feet below finished grade

c. Pipes located below groundwater table that could become a conduit for water movement:

Optionally, pipe may be excavated and removed subject to Engineer's approval and approval of controlling agency of Right-of-Way. Additionally, if a valve is not located at the source, plugging of the branch at the source will be required. Location of abandonment shall be approved by an OWASA representative.

B. STEEL ENCASEMENT PIPE – DRY BORING & JACKING OR OPEN CUT

1) **General**: Where required, steel encasement pipe shall meet the length as shown on the plans and the thickness and diameter as shown on Standard Detail 517.01. Boring across roads and railways shall be performed by dry boring and jacking a steel encasement pipe under the pavement or rail. The encasement shall be located in an area that is relatively free from material such as rock and stone that may hamper the boring operation.

Construction shall be executed in such a manner as to prevent settlement of the ground surface above the pipeline. The installation of the pipeline shall follow the heading or tunneling excavation as closely as possible.

All operations of the Contractor shall be subordinate to the free and unobstructed use of the right of way of the passage of traffic without delay or danger to life, equipment, or property. Installation shall be in accordance with of the NCDOT *Standard Specifications for Roads and Bridges,* latest revision or AREMA *Manual for Railway Engineering*, as applicable.

The pipe shall be beveled and prepared for field welding at the circumferential joints. Joining of steel casing pipe shall meet the requirements of AWWA C206. Casing shall be installed either by dry boring and jacking or open cut, as indicated on the drawings.

Encasement ends shall be enclosed as shown on Standard Detail 517.01. All exposed metal is to be coated with epoxy, asphaltic material or be stainless steel.

All carrier piping shall be ductile iron pipe supported by spiders.

2) **Manufactured Spiders**: The spiders necessary to support the carrier pipe inside of the steel encasement pipe shall conform to both the shape and dimensions of Standard Detail 517.01 and shall be in accordance with Section 2.1.D, paragraph 2, *Spiders/Skids for Encasement Pipes*. Unless otherwise shown on the drawings, one spider shall be placed at each bell as well as at each end of the encasement pipe (see Standard Detail 517.01 for location of spiders).

C. TUNNELING METHODS

1) **General**

a. The Contractor shall submit shop drawings to OWASA's Engineer for approval prior to construction. All liner plates and ribs used in the tunnel shall be of one type. All material removed shall be disposed of off the site by the Contractor.

b. All operations of the Contractor shall be subordinate to the free and unobstructed use of the rights of way for passage of traffic without delay or danger to life, equipment, or property. The Contractor shall provide all necessary bracing, bulkheads, and shields to ensure complete safety to all traffic at all times. The Contractor shall provide all traffic control devices as necessary and as shown on the approved traffic control plan at no additional cost.

2) **Tunneling (Boring Method)**

a. Commence boring operation from a pit, with the bottom excavated to grade, and sheeted or shored if necessary. Boring through soil shall have a steel pipe jacked in place as a casing pipe. Boring through rock shall be oversized to allow installation of carrier pipe but no casing pipe shall be required unless liner plate is necessary for safety reasons.

b. Smoothly pave the bottom of the tunnel with concrete. Pull the carrier pipe in place a joint at a time. Securely block each section in place.

3) **Tunneling (Hand Mining)**

a. Commence tunneling operation from a pit, with the bottom excavated to plan grade, and sheeted or shored if necessary.

b. Trim the periphery of the tunnel smoothly to fit the outside of the steel liner plate as nearly as practical. All blasting shall conform to requirements for blasting in Section 02275 – Trenching, Backfilling and Compaction of Utilities.

c. Install the steel liner plates immediately after the excavated material has been removed and remove the material not more than 24 inches ahead of the installed liner plates.

d. Grout all voids between the soil and tunnel liner plates. The maximum grouting pressure shall be 30 psi. Start grouting at the bottom of the tunnel liner plates and proceed upward progressively and simultaneously on both sides of the tunnel. Install liner plates no more than 6 feet ahead of grout section. Prohibit traffic over ungrouted sections of tunnel unless this section is in solid rock. Thoroughly dry-mix grout ingredients before adding water. After adding water, mix the batch for 3 minutes. Batches shall be of size to allow continuous placement of freshly mixed grout. Grout not used within 30 minutes after mixing shall be discarded. Placing shall be quick and continuous. Placement shall be under pressure with a grout pump. The period between installation of the tunnel liner plate and the placing of grout shall not exceed 7 hours, without the approval of OWASA's Engineer. Upon completion of grouting, fill grout plugs with provided grout hole plugs.

e. Smoothly pave the bottom of the tunnel with concrete: After installation of the tunnel liner plates, the Contractor shall pour concrete pavement on the bottom quadrant (invert) of the tunnel, the surface of the pavement being parallel to the liner plate, with screed rails embedded in it, on line and grade for the installation of pipe in the tunnel.

f. The periphery of the tunnel shall be trimmed smooth to fit the outside of the steel liner plate as nearly as is practical, so that the void outside the plates is a minimum.

g. After installation of the casing pipe or the tunnel liner, pull the carrier pipe in place a joint at a time. Securely block each section in place. Each joint of the carrier pipe shall be supported at two points by steel saddles or by pressure treated wood skids, strapped to the carrier pipe with steel straps. The carrier pipe shall be blocked, in place to the prevent flotation.

h. Close tunnel liner ends to protect against entrance or foreign matter. The open ends of the casing pipe or tunnel shall be closed off by an 8-inch grout or masonry block wall prior to backfilling. A steel drain line to a 1 cubic yard French drain shall be provided.

i. If installation is under railway tracks, all permits shall be obtained and Railway Company shall be notified prior to such installation. The same shall apply to contacting applicable Municipality or NCDOT if installation is under roadway.

4) See also PART 2 – PRODUCTS, Section 2.1.E, *Tunnel Liners and Appurtenances.*

D. HORIZONTAL DIRECTIONAL DRILLING OF HDPE WATER PIPE

1) HDPE pipe shall be installed by Horizontal Directional Drilling (HDD) using a surface mounted rig, first to drill a guided hole along a bore path consisting of a shallow arc and then to pull a string of pipe into the hole. Pull back is facilitated by a back-reamer, which enlarges the hole to approximately one and a half times the pipe diameter. Drilling fluids are injected into the bore hole to stabilize the hole and lubricate the pipe and drill-string. Tracking equipment is used to guide and direct the drilling.

a. **Mechanical Restraint:** When Polyethylene pipe is pressurized, it expands slightly and shortens slightly. Shortening may be enough to disjoin unrestrained mechanical joints that are in line with PE pipe. Disjoining can be prevented by installing external joint restraints at mechanical connections, by installing line anchors, or by a combination of both. Contractor shall install mechanical connections with joint restrain at connection to mechanical joint pipe.

Note: Poisson Effect pipe shortening must be taken into account whenever the pipe is pressurized, both during the pressure testing, and when it is placed in service. Because pressures are usually higher during pressure testing (up to 150% of the system pressure rating), pipe expansion and Poisson Effect pipe shortening may be slightly greater during pressure testing. Before pressure testing, all mechanical joint restraints must be completely installed and secured per manufacturer's instructions. Concrete in-line anchors and thrust blocking (if used) must be fully cured (minimum of 21 days for 3,000 psi or 7 days for 4,500 psi concrete) and properly backfilled before testing. Restraint is not required at PE to PE butt fusion joints. Restraint is not required at bolted flanged joints.

b. **Mechanical coupling**: Stainless steel internal stiffeners shall be used on all couplings to increase the seal. All couplings shall have restraint devices per the manufacturer's recommendation and installed per the Manufacturer's direction.

2) **Installation And Testing**

The Manufacturer shall supply an Installation Manual to OWASA's Engineer, which outlines guidelines for handling, joining, installing, embedding, and testing of the Polyethylene Pipeline. These guidelines shall be used as reference material by OWASA's Engineer in their determination of the required procedures.

Joints between plain ends of Polyethylene pipe shall be made by butt fusion when possible. The pipe manufacturer's fusion procedures shall be followed at all times as well as the recommendations of the fusion machine manufacturer. The wall thicknesses of the adjoining pipes and fittings shall have the same DR at the point of fusion.

When saddle connections are fusion welded, the Manufacturer's recommended saddle fusion procedures shall be used.

If mechanical fittings (which are designed for, or tested and found acceptable for use with Polyethylene pipe) are utilized for transitions between pipe materials, repairs, joining pipe sections, saddle connections, or at other locations; the recommendation of the Mechanical Fitting manufacturer must be followed. These procedures may differ from other pipe materials.

On each day butt fusions are to be made, the first fusion of the day shall be a trial fusion. The trial fusion shall be allowed to cool completely, and then fusion test straps shall be cut out. The test strap shall be 12 inches long or 30 times the wall thickness in length (minimum) and 1 inch or 1.5 times the wall thickness in width (minimum). Bend the test strap until the ends of the strap touch. If the fusion fails at the joint, a new trail fusion shall be made, cooled completely, and tested. Butt fusion of pipe to be installed shall not commence until a trail fusion has passed the bent strap test.

Socket and Straddle fusions shall be tested by a bent strap test as described by the Pipe manufacturer. The pipe manufacturer shall provide visual guidelines for inspecting the butt, saddle, and socket fusion joints.

Pressure testing shall be conducted in accordance with manufacturer's recommended procedure. Pressure testing shall use water as the test media. Pneumatic testing is prohibited.

3) **Shop Drawings**

Contractor shall submit shop drawings and details on the proposed HDPE pipe, fittings, bore methods, etc., for review and approval of OWASA's Engineer before ordering material or beginning installation of the HDPE. Contractor shall also submit to OWASA's Engineer proposed subcontractor's name as well as references on who they plan to use on this project. All subcontractors/installers must be approved by OWASA's Engineer.

E. PVC PIPE

1) PVC pipe shall only be used with written approval from OWASA's Engineer.

2) If PVC pipe must pass through an area contaminated with or subject to contamination with low-molecular-weight organic solvents or petroleum products, the design engineer shall provide a determination regarding the suitability of PVC

pipe for the installation, including documentation from the manufacturer regarding permeation.

3) Pipe bundles shall be stored on flat surfaces with uniform support, be protected from prolonged exposure (six months or more for all pipe) to sunlight with a suitable covering (canvas or other opaque material), and air circulation shall be provided under any covering.

3.2 VALVES AND FIRE HYDRANTS

A. VALVE APPLICATIONS

1) **Valves – Vault/Above Ground Applications**

a. Plumbing Gate Valves:	Brass non-rising stem type (for air release valve manholes)
b. Gate Valves 2-inch & smaller:	Bronze ¼ turn ball type
c. Gate valves 4-inch & larger:	OS & Y
d. Relief Valves:	Air/Vacuum Release Valves
e. Water-Regulating Valves:	Pressure-regulating valves Flow-regulating valves
f. Detection of unauthorized water:	Detector Check Valves
g. Backflow prevention:	Reduced Pressure Zone Backflow Preventers – USC approved

2) **Valves – below ground applications**: Non-rising stem.

B. GATE VALVES

1) **Setting of valves and valve boxes**: Valves shall be installed with stems in a vertical plane through the pipe axis and perpendicular to the pipe axis. The Contractor shall clean the valves before installation and check for satisfactory operation. All valves adjacent to tees or bends shall be tied to the fitting with A restraint flange joint restraint system OR APPROVED RESTRAINT METHOD. Valve nut extensions shall not be installed unless approved by OWASA's Engineer.

   Nipples for 4-inch through 12-inch valves shall be cut so that the valves are installed 30 inches from the fitting (centerline to centerline). 2-inch valves shall be installed with a 4-inch long brass nipple.

2) All underground valves without gearing or operators shall be equipped with a 2-piece valve box with lid (see Standard Detail 513.01). Valve boxes shall be set on concrete brick placed beneath the bottom outstanding flange of the valve box. Place a minimum of 1 inch of earth cushion beneath the concrete brick and the

valve and the valve box set in alignment with the valve stem centered on the valve nut, set in a manner to prevent transmitting shock or stress to the valve. Place #57 stone around pipe and under valve box. Valve box cover must be set flush with the finished ground surface or pavement. The Contractor shall be responsible for keeping valve boxes clean and free of any foreign matter until acceptance of the project.

3) Valve boxes shall be set to grade and a concrete stabilizing pad placed around the valve box. Valve boxes in easements are to be provided with a valve box marker post. See Standard Detail 513.02.

4) When valve box tops project more than 1 inch above the unfinished road surface, a temporary layer of asphaltic concrete feathering shall be required to provide a smooth transition from 1 inch below the edge of the rim and cover to the unfinished road surface. The exposed sides of the valve box shall be painted bright orange. See Standard Detail 532.07.

5) Valves at intersections shall be restrained with restraint flange system.

C. VALVES 16 INCHES AND LARGER (GATE OR BUTTERFLY VALVES)

Valves at standard depths (See Table 02275.1) shall be installed with a valve box. Valves with gearing or operators or those installed at excessive depths as determined by OWASA shall be installed in a manhole. The manhole or valve box shall be constructed/set in such a way as to prevent transmitting any load or shock to the valve. It is also to be set in such a way that the packing, operator, and other parts of valve are readily accessible for minor repairs. The valve is to be provided with a flanged coupling adapter to permit valve removal for maintenance. Manholes shall be constructed in accordance with the Standard Details 513.06 and 513.08. Manhole or valve box opening shall be positioned over the operating nut. Either a gate valve or a butterfly valve may be used.

D. TAPPING SLEEVES AND VALVES

Tapping sleeves and valves shall be installed in accordance with the manufacturer's recommendations at locations shown on the plans. With prior approval, when taps are made on asbestos cement pipe, the Contractor shall excavate at the location of the tap and measure the diameter of the pipe prior to selecting a tapping sleeve to ensure the sleeve will fit the pipe (this information shall be provided to OWASA on the as-built drawings). See Standard Detail 512.04. Taps shall be performed by OWASA. Fees must be paid 48 hours in advance of tapping the main. Contactor is responsible for traffic control, excavating, dewatering, and safe access in the trench at the time of tap. The contractor is to provide taping sleeve and valve. Contractor must have approved traffic control plan.

Work shall be scheduled at least one week in advance through OWASA’s inspector. A crewman from the OWASA Distribution and Collections Division shall be present during the operation. After installation of the tapping sleeve and valve and prior to performing the tap, the assembly shall be air tested at 100 psi. Such pressure shall be maintained with no loss for a minimum time of 5 minutes.

E. AIR RELEASE VALVES

Air release valves are to be used to bleed air during filling of a water line and to automatically vent air that collects in the water lines. Pressure air release valves shall be located as shown on the drawings. The valve shall be housed in a precast concrete eccentric manhole and shall be installed in accordance with Standard Details 513.04 and 513.05. All pipe and fittings are to be brass including the plumbing gate valve. Air release valve locations shall be as shown on the plans and or as otherwise directed by OWASA's Engineer.

F. FIRE HYDRANTS

1) **Construction**: Fire hydrants shall be installed where shown upon the plans UNLESS the Fire Marshall of the governing municipal REPRESENTATIVE HAVING jurisdiction CHANGES THE LOCATION. Hydrants shall be set upon a concrete setting slab in such manner as to preclude the possibility of settlement of hydrants. Place loose #57 stone around the hydrant elbow. See Standard Detail 514.03.

   Hydrants are to be located at a distance from the curb or edge of pavement to provide ready access and minimize the possibility of damage from vehicle and set to the height prescribed by Standard Detail 514.03 with the pumper nozzle facing or pointing to the street or fire access lane. Care shall be taken to keep concrete away from bolts and weep holes. Hydrants must be set with the stem vertical/plumb and the flange above grade. The Contractor is responsible for determining barrel length and ordering to meet conditions. Where adjustments in height are needed, provide extension kits at no additional cost. However, only one 24-inch riser extension is allowed per hydrant. Where hydrants are set behind guardrails, the pumper nozzle shall be set with its centerline a minimum of 12 inches and a maximum of 18 inches above the top of the guardrail.

   An OWASA representative must inspect fire hydrants prior to backfilling.

2) **Operation and Painting**: Hydrants, upon installation and prior to acceptance of the project, shall be painted and greased, the caps are to be greased with a food grade anti-seize lubricant after installation, and individually operated in front of an OWASA representative to verify the hydrant is greased and in working condition. Paint is to be Sherwin Williams Industrial Enamel or equal. The hydrant barrel is to be painted red with the caps and bonnet painted reflective silver. See Standard Detail 514.01. Do not remove chains.

3) **Hydrant Bagging**

   a. **New Hydrants**: Place a heavy-duty orange plastic bag over newly installed fire hydrant until hydrant is placed in service and accepted by OWASA.

   b. **Out of Service Hydrants**: During times when a fire hydrant is taken out of service, such as when it has been replaced with a new hydrant, or when it is abandoned, place a heavy-duty orange bag on hydrant.

4) **Valving of Main**: A resilient seat gate valve shall be installed 30 inches from the fitting of the main and properly restrained. Provide a concrete stabilizing pad in accordance with Standard Detail 513.02.

5) Fire hydrants are to be pressure tested with the main.

G. BACKFLOW PREVENTERS

See OWASA Cross-Connection Control Ordinance and Manual, latest revision as applicable.

3.3 MISCELLANEOUS APPURTENANCES

A. SERVICES

1) **General**: Taps into existing (in-service) water mains shall be made by OWASA personnel only. All fees must be paid and work scheduled with OWASA Operations Department before OWASA will make the tap. All materials must be on-site, trenches open, and shoring and traffic control devices in-place before OWASA will perform the tap. Contractor may be required to provide approved traffic control plan if required by inspector.

a. **Allowable Tapping Methods**

i. ¾ or 1-inch taps are to be made using an all bronze single or double strap tapping saddle. See Standard Detail 512.06.
ii. 1½-inch and 3-inch taps are not permitted.
iii. 2-inch taps shall be made using a 2-inch all bronze double strap tapping saddle.
iv. Taps 4-inches and larger are to be made using an iron body tapping sleeve. Steel sleeves are not permitted.

Service Connections on "In-Service" water mains.	
Size Connection	Responsibility
¾-inch and 1-inch services	OWASA makes tap and runs service
2-inch and larger services	Contractor digs hole at main, runs line, and furnishes all material. OWASA makes tap.

b. **Tap Location**: Taps 2-inches and smaller shall be made no closer than 18 inches apart from the next tap, and a minimum of 3 feet from a bell, repair clamp, or fitting (see Standard Detail 512.06). Taps shall be made in line with the meter box. Copper service lines shall be installed in a straight line from the tap to the box. Services shall be perpendicular to the main.

c. **Three-Quarter (¾) and 1-inch Taps**: All ¾-inch and 1-inch taps into water mains shall be made using an all bronze tapping saddle. Corporation stops shall have AWWA Standard CC tapered threads. Taps shall be made at a 45° angle above the horizontal on the upper half of the pipe. A bend or "gooseneck" in the service line shall be provided to ensure flexibility. A double strap saddle shall be used on both PVC and AC pipe. Multiple taps in the same section of the pipe shall be staggered (see Standard Detail 512.06). Two ¾-inch services in the same location may be served by a single 1-inch tap (see Standard Detail 515.01 and 515.02). On these water services, the fittings shall be flared type brass. (ALL BRASS PRODUCTS SHALL BE LEAD FREE AND CONFORM TO NSF STANDARD 61-ANNEX G IN CONJUNCTION WITH NSF372 REQUIREMENTS. (Saddles are exempt from the no lead requirement.) ALL RUBBER GASKETS AND O-RINGS SHALL BE MANUFACTURED WITH AN APPROVED ELASTOMER.) Corporation stops shall be placed in clean #57. Stone is to be carried under and around the pipe to protect the corporation stop. Service saddles are also to be embedded in 1 cubic foot of #57 stone.

d. **2-inch Taps**: All 2-inch taps shall be made using a 2-inch all bronze double strap saddle, a 2-inch diameter x 4-inch long brass threaded nipple, and a 2-inch threaded Iron body gate valve. Water service pipe for 2-inch connections shall be type K hard drawn copper pipe with silver brazed joints. For short distances between the main and the meter, threaded brass pipe may be used. See Standard Detail 515.04 and Section 2.3.J.

e. **Large Taps**: Taps 4-inch and larger shall be made using iron body tapping sleeves and tapping valves. Only one 4-inch or larger tap or repair clamp shall be made per joint of pipe on AC and/or pit cast (gray iron) pipe. The outside diameter of the pipe must be measured at the location of the tap to determine the appropriately sized tapping saddle.

f. An **OWASA representative** must inspect all service connections prior to backfilling.

g. **Tapping Sleeve Support:** AC Pipe: A concrete pad shall be poured under tapping sleeves placed on AC pipe to support the weight of the tapping sleeve and valve. Wrap sleeve with plastic to protect bolts and nuts. Care shall be taken to ensure that bolts and nuts are free of concrete and debris to allow accessibility for future repairs. An OWASA representative must inspect all blocking prior to backfilling.

2) **Small Meter Boxes and Setters:** Installation: Meter boxes for ¾-inch x 5/8-inch and 1-inch meters shall be installed within the utility strip behind the curb, or within the right of way at the back of the sidewalk. Meter boxes shall be set on four 4-inch x 8-inch concrete bricks, one on each corner. All meter boxes shall be set so that there is a minimum of 8-inch clearance between the top of the box and the cut-off nut on the meter setter. The meter setter shall be straight, level and centered in the box. Meter boxes shall be set to avoid inflow of surface water into the box. See Standard Detail 515.01 and 515.02.

3) **Three-quarter (¾)-inch and 1-inch Copper Service Lines**: Copper service lines shall have a minimum of 30 inches of cover from the water line to the top of the back of curb or centerline of the drainage ditch. Service lines shall run perpendicular from the water main to the property served. Water service pipe

shall be one continuous run, from main to meter setter, of type K soft copper with no joints or couplings in between.

4) **2-inch Meters**: Meter boxes for 2-inch meters shall be placed on a 6-inch bed of clean #57 stone. Meter boxes shall be set so that there is a minimum 12 inches of clearance between the top of the box and the cut-off nut on the meter setter. The meter setter shall be straight, level, and centered in the box. Meter boxes shall be set to avoid inflow of surface water. Drains for 2-inch meter vaults shall be installed if grade allows.

   Meter setters 2-inch meters shall be provided with a section of copper pipe extending horizontally 24 inches out the back of the meter box. The outlet connection on 2-inch meter setters shall be plugged with a pipe plug until pressure testing has been completed on the section of main to which it is connected. Setters are to be perpendicular to meter and vertical. For 2-inch setter, use a 17-inch long idler bar with two 1/8 rubber gaskets. The idler is used to maintain proper spacing until a system is ready for a meter to be set. The setter should have an opening of 17 ¼ inch.

5) **Meter Vaults**: Meter vaults for 3-inch and larger meters shall be placed level on a 6-inch bed of #57 stone that has been thoroughly and firmly consolidated. The vault floor shall have a floor drain with the floor sloped toward the floor drain. A minimum 4-inch diameter drain on negative grade to daylight shall be provided. Sump pumps are not permitted. Meters and fittings shall be supported by mortared concrete masonry units. Vault doors shall be centered over the meter and otherwise located as shown. See meter vault Standard Details 515.13, 515.14, and 515.15.

6) **Grounding to Water Services**: Grounding shall not be allowed to be connected to meter boxes or vaults. As a minimum, place meter boxes/vaults no closer than 10 feet from a building. If unavoidable, place a grounding jumper around meter box/vault.

7) **Abandoning Water Services**: Water services shall be abandoned by closing the corporation stop at the main and cutting out a section of the water service, 1 foot from the corporation stop. A galvanized saddle shall be removed and replaced with a repair clamp or brass saddle with brass plus, as directed by OWASA.

8) **Testing**: All taps and services shall be pressure tested with the main.

B. RESTRAINTS/CONCRETE THRUST BLOCKING

1) **Thrust Blocking**: Thrust Blocking SHALL be installed at the direction of the OWASA Representative or as shown on the plans. Thrust blocks shall be constructed from 3000 psi concrete (at 28 days) and poured against an undisturbed earth trench wall. Concrete thrust blocking shall be constructed in accordance with Standard Detail 512.02. Sacrete is not permitted. Concrete anchors may be unformed but minimum dimensions must be maintained. All fittings and pipe shall be wrapped in plastic prior to installation of concrete to ensure that bolts and nuts are free of concrete and debris to allow accessibility for future repairs. When soft, mucky, unsuitable, or unstable soils are

encountered, thrust shall be resisted by running tie rods to solid foundations by removing the soft materials and replacing it with ballast of sufficient size and weight to resist thrust.

Vertical upward thrust at fittings or vertically deflected joints shall be resisted with thrust collars of adequate size and weight to resist thrust. See Standard Detail 512.01.

Pipe manufacturer's installation manuals shall be followed for the anchoring of valves and fittings in difficult locations unless superseded by the requirements of these specifications.

Concrete thrust blocking is not recommended where the blocking may bear on other utilities or where the area behind the block may be excavated in the future.

An OWASA representative must inspect all blocking and anchoring prior to backfilling.

2) **Rodding**: 4-inch and larger valves and assemblies of fittings shall be secured to a blocked fitting by threaded rods with eyebolts. Refer to Standard Detail 512.09 for the minimum size and number of rods needed for various test pressures. No more than one coupling shall be allowed between rods. Rodding length between fittings shall not exceed 20 feet. When the length between fittings exceeds 20 feet, place a thrust collar on the line and rod to the thrust collar.

   All eyebolts, nuts and threaded steel rods shall be 304 or 316 stainless steel.

3) **Thrust Collars**: Thrust collars shall be constructed as shown in Standard Detail 512.08 for pipes up through and including 36 inches in diameter. The thrust collar shall consist of a wedge action restrainer gland (see Section 2.1.A, paragraph 2, item c., *Mechanical Joint Restraints*, of this specification for manufacturer and model number of approved restrainer gland) placed around a joint of ductile iron pipe encased in a reinforced 3000 psi concrete block. Where the blocking provides thrust resistance for fittings, threaded rods shall be connected to the restraint flange fitting secured to a full joint of ductile iron pipe. On dead end lines, the thrust collars must be placed on a full joint of ductile iron pipe just after the terminal end line valve.

C. MANHOLE INSTALLATIONS

Manhole bases shall be placed on a level 12-inch bed of #57 stone that has been thoroughly and firmly consolidated. Voids around the pipe, joints, grade rings, and other openings in the manhole shall be thoroughly and neatly grouted inside and outside with a non-shrink gout to prevent infiltration. A maximum of 2 grade rings or one grade ring and one course of concrete bricks will be allowed to bring the rim and cover to finished grade (see Standard Detail 532.06). If additional height is required, a riser must be installed.

Manhole rings and covers shall be installed a minimum of 12 inches above grade in easements and cemented to the cone section. In paved areas, an 8-inch thick by 18-inch wide annular concrete pad is to be placed around the manhole iron casting (see

Standard Detail 532.06) beginning 2 inches from the top of the manhole ring. In other areas, the ring is to be placed beginning ½ inch below the top of the ring. For air release manholes, flat tops shall be used. When a manhole rim projects more than 1 inch above the unfinished road surface, a temporary layer of asphaltic concrete feathering shall be required to provide a smooth transition from 1 inch below the edge of the rim and cover to the unfinished road surface. The exposed sides of the manhole shall be painted bright orange. See Standard Detail 532.07. To protect a manhole, the contractor shall set the concrete pad to final grade and feather asphalt from the concrete pad to the existing grade for a smooth surface prior to OWASA accepting the manhole for operation.

3.4 TESTING, DISINFECTION AND SAMPLING

A. GENERAL

Pipelines shall be hydrostatically pressure tested, in sections between valves, as soon as the installation is completed. Disinfection shall occur after hydrostatic test has passed, then sampling may begin. Testing, disinfection, and sampling shall be as follows:

1) Pipelines and appurtenances have been laid and the trench backfilled. Pipe subjected to contaminating materials (any type) shall be removed from the project site immediately. OWASA shall bear no portion of any cost sustained by the Contractor in meeting the specification.

2) Hydrants shall be properly located, operable and plumb, and at correct elevation.

3) Valves shall be properly located, operable, and at correct elevation. Valve boxes or manholes shall be centered over operating nuts and the top of the box or manhole shall be at proper elevation.

4) All services shall be installed complete with setters (Contractor shall provide a meter, approved by OWASA, for pressure testing). There shall be no bypass around the meter used for pressure testing.

5) All reaction anchors (if any) have had sufficient set of 7 days or high early strength concrete may be used to reduce the curing time to 3 days. For high early concrete mix, use 4,500 psi or greater concrete. Temporary bracing may be allowed at the discretion of the OWASA Representative.

6) Lines shall be properly vented where entrapped air is a consideration.

7) All visible leaks, broken or cracked pipe, valves, hydrants, etc. shall be repaired.

8) Air release valves shall be installed complete and in place after pressure test.

9) All construction activities on the project, that requires trenching or excavation within the limits of the water location shall be completed. Pavement base course and curb and gutter shall be in place before sampling, if applicable. Pressure testing is to be performed before pavement is put down.

10) Pigging. All new mains which cannot meet 3.0 fps flushing velocity as calculated by the Engineer of Record shall be pigged with a polyethylene "pig", 5# per cubic foot density, at minimum, that is the size as specified by the manufacturer for the interior diameter of the main, upon the conclusion of installation. The contractor installing the line shall write the name of the company and street name in which the work is taking place on the pig in a way it will not rub off.

11) Line shall be disinfected and samples collected.

12) Approval from OWASA's Representative on section of line to be sampled.

B. ORDER OF OPERATIONS

1) **Fill Line**: Fill the system slowly with water, at a velocity of approximately 1 foot per second, while necessary measures are taken to eliminate all air at the highest points of the system where air may collect in pockets. After filling, shut off system in order to prevent contaminated water from flowing back in the line supplying the water.

2) **Flushing**: Allow filled system to set undisturbed for a minimum of 24 hours, then begin flushing operations. Flushing shall be a velocity of not less than 3.0 feet per second to remove sediment and other foreign matter until the water runs clear. For lines larger than 12 inches, follow AWWA guidelines. The Contractor shall be responsible for making adequate provisions for drainage of large volume of flushing water, including proper de-chlorination/disposal of chlorinated water. All water shall be chemically de-chlorinated. Any damages that may occur from this operation shall be the sole responsibility of the Contractor.

3) **Pressure Test**: A pressure test shall be scheduled with an OWASA representative in advance of chlorination of the main. Testing shall be in accordance with Section 3.4.C, *Pressure Tests & Leakage*.

4) **Chlorination of Line**: Chlorination of the line shall be performed by one of the methods described in Section 3.4.D.1. An OWASA representative will perform a high range chlorine concentration test. Chlorine concentration of 100 mg/l minimum must be provided. Allow chlorinated water to set in the test section for 48 hours. The chlorine concentration shall not drop below 20 ppm within a minimum period of 48 hours. See Section 3.4.D, *Disinfection and Bacteriological Testing*.

5) **Sampling – Day 1**: Check chlorine and turbidity. Once the control valve has been opened a continuous flow of water shall be maintained until all samples have been collected. After allowing the system to flush so that at least two volumes of water pass through the main, the first bacteria sample shall be collected at regular intervals not exceeding 1,200 feet and tested for bacteriological quality. The contractor shall be responsible for making adequate provisions for drainage of large volume of flushing water, including proper de-chlorination/disposal of heavily chlorinated water. See Section 3.4.D, *Disinfection and Bacteriological Testing*.

Note: Services shall be included in the main line disinfection process. The Contractor shall have the same responsibility for laterals as for the mains in regard to bearing full cost of any corrective measures needed to comply with either the bacteriological test or other such requirements.

6) **Sampling – Day 2**: The water main shall not be flushed for more than 5 minutes before the first sample is collected. OWASA's Representative will check both chlorine concentration and turbidity. If within the acceptable limits, a second bacteriological test will be performed collecting from the same discharge points as on day one. If the second bacteria sample has passed, the system may be left in service if NCDWR PWS Section final approval has been granted.

7) **Final**: After Final Approval by NCDEQ PWS Section is granted, confirm all valves are fully open and flow all fire hydrants.

C. PRESSURE TESTS & LEAKAGE

The Contractor shall hydrostatically test completed sections of water line, including service lines, fire hydrants, and fittings with water. OWASA reserves the right to test all lines connected to the OWASA system. This testing, however, does not relieve the Contractor of their responsibility to repair or replace all workmanship and defective pipe. All work necessary to secure a tight line shall be done at the Contractor's expense. Testing shall be performed in the presence of OWASA's Representative.

All additions or replacements to water system, including water services, fire lines and backflow prevention devices, shall be tested. Such work must take place under the supervision of OWASA's Representative.

The newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for two hours to a leakage test with a beginning test pressure of 150% of design working pressure, but no less than 200 psi. The test pressure shall be slowly brought to the designated pressure by use of a hand pump or power pump. Only OWASA personnel shall operate water valves on OWASA's existing water system. Extreme care shall be used to prevent backflow into the potable water supply. The lines should be allowed to stand under pressure for a period of 24 hours prior to the test. Air should be vented from all high points just prior to the test. Only clean water, free of dirt and other debris, from a clean container shall be used for testing. The Contractor shall notify OWASA's Inspector a minimum of 5 business days in advance of any expected test. The Contractor shall pretest all mains for a period of 2 hours before notifying OWASA for a final pressure test. No final pressure test will begin after 2:00 PM. The maximum allowable leakage shall be no greater than allowances shown in Section 5.2, Table 5A - Hydrostatic Testing of AWWA C600 (excerpt at the end of this Section). No leakage shall be allowed for services.

OWASA's Representative will verify 1 pressure test – the final observation of the test section. A fee will be charged if the OWASA Representative is required to make more than 1 trip to verify a pressure test on the same section of main being tested.

1) **Acceptance Tests**

a. **Pressure Test**: Subject the pipe system to a hydrostatic pressure test. Raise the pressure by pump to 200 psi, 150% of system design working pressure, or test pressure as shown on the drawings, whichever is greater. Measure pressure at the high point on the system compensating for gauge elevation. A pressure loss greater than 5 psi over a 2-hour period results in an automatic failure of test. Pressure loss less than 5 psi (between 200 and 195 psi) is acceptable if the allowable leakage permitted (shown in table 5A AWWA C600) is not exceeded. All water used to determine the amount of leakage shall be measured thru a water meter (measuring in tenths of a gallon) approved by the OWASA Representative. Tests that exceed the allowable leakage are deemed failed and the Contractor shall determine cause, repair, and repeat the test until successful. Contactor shall be responsible for all labor, materials, and equipment to perform the testing.

b. **Leakage Test**: Leakage shall be defined as the quantity of water that must be supplied into the pipe to attain the initial test pressure, after all air in the pipeline has been expelled and the pipe has been tested for duration of 2 hours. Leakage shall not exceed the quantity determined by AWWA C600.

If leakage exceeds allowances, the Contractor shall be responsible for locating and repairing leaks and retesting of line until successful.

No leakage will be allowed for 2-inch mains regardless of material.

D. DISINFECTION AND BACTERIOLOGICAL TESTING

Pipe Disinfection: Comply with ANSI/AWWA C651. The Contractor shall disinfect water mains and accessories in accordance with the procedures listed in AWWA C651 and meet the requirements of OWASA, whichever is more stringent.

1) **Forms of Chlorine For Disinfecting**

a. **Calcium Hypochlorite:** Two forms are available – granular and tablets (both with 65% available chlorine). It will normally require 6.5 lbs. of Calcium Hypochlorite to produce a concentration of 50mg/L of available chlorine in 10,000 gallons of water. (Warning Note: *This chemical must not be used on solvent-welded or on screwed-joint steel pipe because of the danger of fire or explosion from the reaction of the joint compounds with the calcium hypochlorite*!)

b. **Sodium Hypochlorite** is supplied in strengths of 5.25% to 16% available chlorine. The required amount of sodium hypochlorite to produce a 50mg/L concentration of available chlorine in 10,000 gallons of water can be calculated from the following formula:

Gallons of Sodium Hypochlorite needed = 50 ÷ % of available chlorine

2) **Methods Of Chlorine Application**

The Contractor will inject a chlorine solution as specified in AWWA Standard C651, latest revision, into the water main.

Chlorination shall be in accordance with the following guidelines for calcium hypochlorite granules:

Pounds of Calcium Hypochlorite Granules per 1000 feet of pipe to provide 100 ppm	
6-inch diameter pipe	1.9 lbs.
8-inch diameter pipe	3.33 lbs.
12-inch diameter pipe	7.5 lbs.
16-inch diameter pipe	13.4 lbs.
24-inch diameter pipe	30.1 lbs.

a. The chlorine solution shall be injected in the section of the main nearest an existing main. The chlorine solution shall result in a chlorination concentration of 100 ppm or greater. Chlorine injected on Friday yielding a 48-hour contact time of 20 ppm must be achieved or samples cannot be collected, on a case-by-case basis, 50 ppm chlorine concentration with a 24-hour contact time yielding 20 ppm may be accepted. Manually operated pumps shall not be used to inject the solution into the main.

b. **Application for Continuous Feed and Slug Method**

Taps will be made at the control valve at the upstream end of the line and at all extremities of the line including valves. These taps shall be located in such a manner as to allow chlorine solution to be fed into all parts of the line.

The chlorine solution shall be circulated in the main opening of the control valve while systematically manipulating hydrants and taps at the line extremities. The chlorine solution must be pumped in at a constant rate for each discharge rate in order that a uniform concentration will be produced in the lines.

c. **Continuous Feed Method**

Potable water shall be introduced into the pipe main at a constant flow rate. Chlorine shall be added at a constant rate to this flow so that the chlorine concentration in the water in the pipe is a minimum of 100mg/L. The chlorinated water shall remain in the main at 48 hours, after which, the chlorine concentration in the water shall be at least 20mg/L. All valves and appurtenances shall be operated while the chlorinated water remains in the main.

d. **Slug Method**

The slug method shall be as described in AWWA C651 and the following requirement. The water shall receive a chlorine dosage, which will result in a chlorine concentration of 100mg/L in a “slug” of the water.

3) **Bacteriologic Tests-General**

Before the water main is placed in service, all samples shall be collected at regular intervals not exceeding 1,200 feet and tested for bacteriologic quality and shall show the absence of both background growth (gram positives) and coliform organisms.

a. Bacteriological testing shall comply with AWWA C651. All samples shall be tested for bacteriological (chemical and physical) quality in accordance the Standard Methods for the Examination of Water and Wastewater and shall show the absence of coliform organisms and the presence of chlorine residual.

b. Purity Testing includes a series of tests that must be taken on two consecutive days. Samples cannot be collected if any type of precipitation is falling unless, an acceptable protective covering (approved by the OWASA Representative) is constructed suitable to prevent contamination.

c. All sampling pipe shall be either brass or PVC and as shown in Standard Details 514.07, 514.08 and 514.09.

d. The Contractor is responsible for furnishing all material, construction of sampling points and performing all labor associated with collecting samples. Temporary pipes used for sampling shall be composed of sections of vertical pipe terminating into a 90-degree horizontal bend and nipple at least 18 inches above ground level. Copper tubing used for sampling shall terminate horizontally with the ground, at least 18 inches above ground level. Samples will not be taken from a hose.

e. **Sampling Log**: OWASA’s representative will prepare a Sampling Log, including a sketch of the sampling points, as specified by OWASA’s chemist. An OWASA Representative will collect the samples and deliver them to the OWASA Laboratory. Day 1 samples can be taken on Monday or Tuesday during regular business hours. Day 1 samples cannot be collected on Wednesday. Day 2 samples collected on Wednesday must be received in the laboratory by 3:00 p.m. The normal turnaround time for OWASA’s laboratory to acquire results is 3 working days.

f. **Sampling Costs**: Samples will be taken at each discharge point for Day 1 and Day 2 sampling free of charge. If purity testing fails on either Day 1 or Day 2, OWASA’s Inspector will resample each discharge point at no cost. However, a charge will be assessed after the second set of samples has failed. Cost will be based on time, travel, equipment and material used/expended to collect and obtain results.

Samples for bacteriological analysis shall be collected in sterile bottles treated with sodium thiosulfate. Day 1 results will not be available until 24 hours after sample has been run by lab. If laboratory results indicate the presence of coliform bacteria, the samples are unsatisfactory. If laboratory results indicate background growth masking the detection of coliform bacteria, the sample will be considered unsatisfactory. If the line fails either Day 1 or day 2 sampling, the main shall be re-chlorinated by the Contractor and new tests performed prior to moving to the next section of main. OWASA will furnish water and operate the control valves for these operations. The Contractor shall be responsible for loading, removal, hauling, and discharging of water.

Samples for bacteriological analysis shall be collected for each section of pipe between main line valves after flushing is completed.

Primary sampling points are blow-offs, 2-inch setters and all fire lines. Sampling will be allowed at hydrants only if no other acceptable sampling point is available. All work required shall be at the Contractor's expense.

4) **New Water Main Disinfection And Purity Testing – Procedure**

STEP 1: Disinfection

The Contractor is responsible for furnishing all taps and materials required to satisfactorily disinfect the water system. All sample points shall be setup as shown in Standard Detail 514.07, 514.08 or 514.09 as applicable. The following steps will be completed by OWASA and the Contractor cooperatively.

a. OWASA's representative will witness the flushing of the section of main to be disinfected until turbidity readings indicate 1.0 or less NTU.

Minimum blow-off sizes:	
2" – 8" lines	2" blow-offs
12" lines	4" blow-offs
16" & larger lines	6" blow-offs

The Contractor is responsible for adequate disposal of the large volumes of water generated from flushing and de-chlorinating.

b. The Contractor will inject a chlorine solution as specified in Section 3.4 of this 02510, into the water main.

   i. Do not use manually operated pumps to inject the solution into the main.
   ii. The chlorine solution shall result in a chlorine concentration of 100 ppm or greater.
   iii. The chlorine solution should be injected in the section of main nearest an existing water main.

c. OWASA's representative will witness water being drawn from the following areas until 100 ppm chlorine concentration has been measured at all points of discharge at which time each point will be closed:

- End of the main,
- Hydrants,
- Lateral lines, and
- Other connections as necessary.

i. OWASA's representative will witness the closing of all control valves feeding water into the main.
ii. The chlorine concentration shall not drop below 20 ppm within a minimum period of 48 hours.
iii. After the 48-hour period expires, OWASA's representative with the assistance of the Contractor will check the chlorine concentration to confirm that it has not dropped below 20 ppm. Day 1 samples will not be collected if the concentration is below 20 ppm after contact time has ended.

STEP 2: Preparing for Purity Testing

The Contractor is responsible for furnishing all material and constructing sample points. (See Standard Detail 514.07, 514.08, 514.09) For Blow off 4" and larger consult OWASA Representative.

a. OWASA's representative is responsible for preparing a Sampling Log that includes a sketch of sampling points, which is specified by OWASA's Chemist.

b. The Contractor must ensure that each sample point terminates horizontally 18" or greater above ground level, but no more than 36".

c. **SAMPLES WILL NOT BE TAKEN FROM A HOSE.**

Now the water main is ready for purity testing which includes a series of tests that must be taken on two consecutive days. The normal turnaround time for OWASA's Laboratory to acquire results is about three working days. Day 1 samples can only be taken during normal business hours on Monday or Tuesday. Day 2 samples may be collected on Wednesday, but must be received in the OWASA Laboratory by 3:00 p.m. Samples collected but not received in the Laboratory by 3:00 p.m. on Wednesday will be considered failing and re-chlorination must be completed.

STEP 3: Purity Testing

OWASA is responsible for collecting and approving samples. ONCE THE CONTROL VALVE HAS BEEN OPENED AND WATER FLOW HAS BEGUN THROUGH THE NEW WATER MAIN THE FLOW SHALL NOT BE STOPPED, THE BLOWOFF/DISCHARGE POINT SHALL NOT BE CLOSED

UNTIL ALL SAMPLES HAVE COLLECTED. THE BLOWOFF/DISCHARGE POINT SHALL NOT BE CLOSED, EITHER UNTIL THE CONTROL VALVE(S) HAVE BEEN CLOSED OR SIMULTANEOUSLY.

SAMPLING – DAY 1

a. OWASA's Representative with assistance from the contractor will check both chlorine concentration and turbidity.

b. If the chlorine concentration and turbidity are within limits, OWASA's inspector will collect samples from the new main and from an approved/control water main in the distribution system.

   Obtaining a control sample allows the laboratory to compare the water quality in the distribution system with that in the new water main.

c. On the day of collection, OWASA's Representative will deliver the collected sample to OWASA's Laboratory either on Monday or Tuesday before 5:00 p.m.

d. OWASA's Laboratory personnel will conduct a Colilert® bacteriological test. This test requires 24 hours of incubation before the result is obtained. The Laboratory begins these tests around 3:30 p.m. on Monday, Tuesday and Wednesday. Samples delivered on Monday and Tuesday after 3:00 p.m. will be refrigerated and Colilert test run the following day.

e. The Colilert® results must be negative for coliform and E. Coli bacteria.

   i. If the samples from the water main are positive (fail), the main must be disinfected again which means Step 1 must be repeated in its entirety.
   ii. In the rare event that the samples from the control main are positive (fail), the new main must be disinfected again which means Step 1 must be repeated in its entirety.

   Laboratory personnel will also conduct a Heterotrophic Plate Count (HPC) bacteriological test. This test required 48 hours incubation before the result is obtained.

   The HPC result must be less than or equal to 500 CFU (colony forming units/ml.

   If the results from the control main are greater than 500 CFU, the control main must be flushed and re-sampled at a later date. This is not a responsibility of the contractor to perform.

SAMPLING – **DAY 2**

a. The water main shall not be flushed again.

b. OWASA's Inspector will check both chlorine concentration and turbidity.

If the chlorine concentration and turbidity are within the limits, OWASA's Representative will collect samples from the new main and from an approved/control water main in the distribution system. Samples will be collected from the same discharge points as in Day 1.

c. Laboratory personnel will conduct a Colilert® bacteriological test. **This test required 24 hours of incubation before the result is obtained**. (If results are positive, step 1 must be repeated).

d. In the rare event that the samples from the control main are positive (fail). The new main must be disinfected again which means Step 1 must be repeated in its entirety.

5) **Dechlorination**: Water containing even very small concentrations of chlorine or chloramines is harmful to aquatic life in the receiving streams. The state standard for water entering surface waters should be below 17 ppb for total residual chlorine (NCDEQ- Division of Water Resources' "Red Book" Surface Water and Wetland Standards NC Administrative Code 15A NCAC 02B.0100 and .022). Therefore, no discharge of chlorinated water into a storm sewer or a stream will be permitted unless the discharge is first treated by a neutralizing chemical applied to the water to be wasted to neutralize thoroughly the residual chlorine. A de-chlorinating device is required. The use of tankers or pools to hold chlorinated water will not be permitted. Disposal of chlorinated water shall be by as outlined in the following: 1. For water with chlorine residuals between .1 and 4.0 ppm a tablet form (sodium sulfite 81.3%) of de-chlorination shall be used thru an acceptable de-fuser approved by the OWASA Representative. 2. ONLY APPLIES TO DIRECT STREAM DISCHARGE. For water with chlorine residuals between .1 and 4.0 ppm only Vita-D-Chlor or Enviro-C tablets (ascorbic acid) shall be used if the discharged water goes directly into the stream. The appropriate de-fuser with tablet screen is required 3. For water with chlorine residuals above 4 ppm a liquid form (Calcium thiosulfate 20-30%) of de-chlorination shall be used. This chemical shall be run thru an acceptable de-fuser which allows the chemical to be gravity feed (at the appropriate rate) or siphoned (at the appropriate rate) directly into the water flow. And meet the applicable sections of AWWA C651, latest revision. See Standard Detail 514.07, *Purity Sampling Connection Detail for 2" Blow Off Line*, Standard Detail 514.08, *Purity Sampling Connection Detail on Fire Hydrant*, and Standard Detail 514.09, *Purity Sampling Connection Detail at Backflow Preventer*.

3.5 FINAL ACCEPTANCE

Upon completion of water main installations and prior to acceptance, the Contractor shall provide adequate and competent personnel to conduct, in conjunction with the OWASA Representative, an inspection of each valve and hydrant on the newly completed main. The purpose of this inspection shall be to ensure the operability and location of each valve and to further ensure that all valves are left in the open position.

Fire hydrants shall be greased and painted.

Flow tests are to be performed on each hydrant to verify both that flows are in line with the design flows and that all line and leg valves are open.

AWWA C600 TABLE 5A
HYDROSTATIC TESTING ALLOWANCE PER 1,000 FT OF Pipeline - gph
(Allowable Leakage per 1000 ft. of Pipeline * in gph)
(This table is excerpted from AWWA C600, Section 5.2 Table 5A)

AVERAGE TEST PRESSURE PSI	NOMINAL PIPE DIAMETER-IN.								
	4	6	8	12	16	24	30	36	42
450	0.57	0.86	1.15	1.72	2.29	3.44	4.30	5.16	6.02
400	0.54	0.81	1.08	1.62	2.16	3.24	4.05	4.86	5.68
350	0.51	0.76	1.01	1.52	2.02	3.03	3.79	4.55	5.31
300	0.47	0.70	0.94	1.40	1.87	2.81	3.51	4.21	4.92
275	0.45	0.67	0.90	1.34	1.79	2.69	3.36	4.03	4.71
250	0.43	0.64	0.85	1.28	1.71	2.56	3.21	3.85	4.49
225	0.41	0.61	0.81	1.22	1.62	2.43	3.04	3.65	4.26
200	0.38	0.57	0.76	1.15	1.53	2.29	2.87	3.44	4.01
175	0.36	0.54	0.72	1.07	1.43	2.15	2.68	3.22	3.75
150	0.33	0.50	0.66	0.99	1.32	1.99	2.48	2.98	3.48
125	0.30	0.45	0.60	0.91	1.21	1.81	2.27	2.72	3.17
100	0.27	0.41	0.54	0.81	1.08	1.62	2.03	2.43	2.84

If the pipeline under test contains sections of various diameters, the testing allowance will be the sum of the testing allowance for each size.

Orange Water and Sewer Authority
Water Pressure Test Report

Location: ______________________________

Test Made by: __________ Time: ____________ Date: _______________
Test Requested by: __________

Make of Hydrant: __________________
Nozzle Size: __________________
Static Pressure: __________ Psi
Residual Pressure: __________ Psi

	Hydrant #1	Hydrant #2	Hydrant #3
Pitot Reading:	____________	____________	____________
Flow (GPM):	____________	____________	____________

Sketch:

END OF SECTION 02510

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02520 – RECLAIMED WATER DISTRIBUTION

(Last revised 01/01/2025)

SUGGESTED SEARCH WORDS FOR THIS SECTION

Part 1 – General		Steel Encasement Pipe-Install
Part 2 – Products		Steel Encasement Pipe-Spec
Part 3 – Execution		
Part 4 - Testing		
Air Release Valve-Spec	Gate Valves-Spec	Small Service Connections-Spec
Backflow Preventers	1 ½” & 2” Service-Spec	Tape, Detector
Butterfly Valve-Spec	Meter Boxes, Small-Spec	Tunneling Method
Check Valve-Spec	Meters	Tunnel Liner - Spec
Ductile Iron Pipe – Spec	Parallel Pipe-Clearances	Tapping Sleeve & Valve-Spec
DIP-Installation	Pipe Crossing Clearances	Vault Access Frames-Spec
DIP Fittings	Pipe Separation Req’ts	Valve Boxes-Spec
DIP Joints	Pressure Test & Leakage	Valves-Settings
	PVC Pipe Spec	

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

Refer to Section 2510.

1.2 SUMMARY

Refer to Section 2510.

1.3 DEFINITIONS

A. GENERAL

For the purposes of this specification, the following definitions refer to reclaimed water transmission and distribution systems that come under the authority of OWASA as specified within this and other sections of this manual.

1. **Reclai**med **Water Main**: Exterior reclaimed water systems for approved uses.

2. **Reclaimed Water Service**: Exterior reclaimed water service piping used to provide water for domestic purposes.

B. INDUSTRY ABBREVIATION FOR VARIOUS PIPE MATERIALS

AC Asbestos Cement Pipe
CIP: Cast Iron Pipe
DIP: Ductile Iron Pipe
PVC: Polyvinyl Chloride
RCP: Reinforced Concrete Pipe
Cu: Copper

1.4 SUBMITTALS

Refer to Section 2510.

1.5 QUALITY ASSURANCE

Refer to Section 2510.

1.6 QUALITY STANDARDS

Refer to Section 2510.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

Refer to Section 2510.

1.8 PRODUCT SUBSTITUTIONS

Refer to Section 2510.

1.9 PROJECT CONDITIONS

Refer to Section 2510.

1.10 SEPARATION OF RECLAIMED WATER FROM SANITARY SEWERS AND POTABLE WATER MAINS

Follow the NCDEQ and OWASA standards, whichever is more stringent, for separation of reclaimed water mains, sanitary sewers lines, and potable water mains.

Reclaimed water distribution lines shall be located at least 5 feet horizontally from and 18 inches below any water line. If these separation distances cannot be met, OWASA may consider allowing piping and integrity testing procedures which shall meet water main standards.

Reclaimed water distribution lines shall meet the separation distances to sewer lines in accordance with 15A NCAC 02T .0305. [15A NCAC 02U .0403(g), 02U .0403(j)].

1.11 COORDINATION

Refer to Section 2510.

1.12 CROSS-CONNECTION CONTROL

Refer to Section 2510

PART 2 – PRODUCTS

2.1 PIPE, FITTINGS AND IDENTIFICATION

Refer to Section 2510.

A. DUCTILE IRON PIPE

Refer to Section 2510.

B. DUCTILE IRON PIPE JOINTS

All pipe joints shall be restrained joint as manufactured by its respective pipe manufacturer in sizes 4 inches through 48 inches. Acceptable types of pipe joints are as follows:

1) **Mechanical Joint Restraint**: Acceptable types of joint restraints shall be:

Restrained Joint Pipe shall be TR Flex as manufactured by United States Pipe and Foundry Company, or Flex-Ring as manufactured by American Cast Iron Pipe Company, Snap-lok as manufactured by Griffin Pipe Products Company.

2) **Flanged Joints**

Refer to Section 2510.

C. DUCTILE IRON FITTINGS

Refer to Section 2510.

All retainer glands shall be as manufactured by; Ebba Iron (Mega- Lug), Ford (Uni-Flange), Sigma (One-Lok) or approved equal.

D. POLYETHYLENE WRAP

All pipe and fittings shall be wrapped with a polyethylene wrap, unless otherwise indicated on the Drawings. The polyethylene wrap shall be purple (Pantone 522C) as required for reclaimed water. Polyethylene wrap shall conform to ANSI A21.5 and installation shall be in accordance with AWWA C105. Polyethylene wrap shall be provided in tube rolls, accordion bundles or sheets, and shall be manufactured of virgin polyethylene material conforming to ANSI/ASTM D1248. The specified nominal thickness for low-density polyethylene film is 0.008 in. (8 mils). The specified nominal thickness for high-density cross-laminated polyethylene film is 0.004 in. (4 mils). The minus thickness tolerance shall not exceed 10% of the nominal thickness on both material types. Joints in the polyethylene wrap shall be taped. Installation of polyethylene wrap shall conform to ANSI/AWWA C105/A21.5 and DIPRA's "Polyethylene Wrap" brochure.

E. DETECTABLE WARNING TAPE AND TRACER WIRE

Tracer tape and tracer wire shall be installed per Section 02275.

On one side of the tape, the text shall include the wording “CAUTION - RECLAIMED WATER – DO NOT DRINK” repeated along the length of the tape. Underground warning tape is to be below grade and affixed directly to the pipe.

F. COPPER TUBE

Refer to Section 2510

G. PVC PIPE

Refer to Section 2510 except as noted below:

All PVC reclaimed piping shall be either colored Pantone 522C (Purple) or bagged in poly wrap as specified in the ductile iron pipe section of this standard.

H. STEEL CASING PIPE

1) **Steel Casing Pipe**: Refer to Section 2510
2) **Spiders/Skids for Encasement Pipes**: Refer to Section 2510
3) **Steel Casing End Seals**: Refer to Section 2510

I. CARRIER PIPE FOR CASINGS

Refer to Section 2510

J. TUNNEL LINERS

Refer to Section 2510.

2.2 VALVES AND VALVE BOXES

A. GATE VALVES

Refer to Section 2510

B. VALVE BOXES

Refer to Section 2510 and the following requirements.

Valve box covers shall be square in shape (NOT round) and shall be designed for AASHTO H-20 truck loadings. All valve box covers shall be of non-interchangeable shape with potable water covers and cast on the top surface with a recognizable inscription indicating “Reclaimed Water”. All valve box covers shall be painted purple, Pantone 522. All top sections of reclaimed the reclaimed system shall be square

C. AIR RELEASE VALVE

Refer to Section 2510

D. BUTTERFLY VALVES

Refer to Section 2510

E. CHECK VALVES

Refer to Section 2510

F. TAPPING SLEEVES AND VALVES

Refer to Section 2510

G. BLOW OFFS

Refer to Section 2510

H. CORPORATION STOPS

Refer to Section 2510

I. MANHOLE FRAME AND COVERS

Manhole frames and covers shall be meet ASTM A48, Class 30, traffic frame and cover as manufactured by Capitol Foundry, US Foundry or East Jordan Iron Works. Cover shall read “CAUTION - RECLAIMED WATER – DO NOT DRINK” in the center and “DANGER ENTRY PERMIT REQUIRED” around the circumference. See Standard Detail 516.01. Provide four 1-inch diameter holes in the top at each compass point.

Weights shall not vary more than 5% +/- of the weight shown on Standard Detail 516.01.

Acceptable Manufacturers and models are:

Manufacturer	**Model**
Capitol Foundry	**MH-2001**
US Foundry	**USF-669**
East Jordan Iron Works	**V-1384**

2.3 MISCELLANEOUS APPURTENANCES

A. CAST STRAIGHT AND TRANSITION COUPLINGS

Refer to Section 2510

B. DUCTILE IRON TRANSITION COUPLINGS

Refer to Section 2510

C. MISCELLANEOUS CONCRETE

Refer to Section 2510

D. BEDDING

Refer to Section 2510

E. PRECAST CONCRETE MANHOLE STRUCTURES

Refer to Section 2510

F. MANHOLE SIZE DETERMINATION:

Refer to Section 2510

G. PIPE SADDLE SUPPORT - ADJUSTABLE

Refer to Section 2510

H. SERVICES, VAULTS AND BOXES

Refer to Section 2510 and the following requirements.

1) All exposed (visible piping) shall be pantone 522C in color. This can be achieved by poly wrap taped to piping or paint.

2) **RECLAIMED WATER METER BOXES AND PRECAST CONCRETE VAULTS:** All covers shall be color coded purple, Pantone 522C, with words “Reclaimed Water – Do Not Drink” cast into the lid.

I. VAULT ACCESS HATCH

Refer to Section 2510 and the following requirements.

All covers shall be color coded purple, Pantone 522C, with the words “Reclaimed Water – Do Not Drink” cast into the lid.

PART 3 – EXECUTION (INSTALLATION)

3.1 PIPE AND FITTINGS

Refer to Section 02275 – trenching, backfilling and compaction of utilities.

A. DUCTILE IRON PIPE

DIP INSTALLATION:

Refer to Section 2510.

B. CONSTRUCTION

Refer to Section 2510 and the following requirements.

Polyethylene Wrap Application: The pipe, including mains and service lines, shall be slid into the poly bag and cut in a manner to allow for a minimum of 1-foot overlap on each section, this requirement applies to both horizontal and vertical applications. Prior to being lowered into the trench, all pipes shall be carefully inspected to see that each pipe is clean inside and on the outside. Joints in the polyethylene wrap shall be taped to ensure complete coverage of the piping with sufficient slack to allow for stretching of poly bag/wrap. In addition, joints in the polyethylene wrap shall also be taped every two (2') foot along the length of the pipe. Installation of polyethylene wrap shall conform to ANSI/AWWA C105/A21.5 and DIPRA's "Polyethylene Wrap" brochure.

1) **Cutting Pavement/Driveways**

Refer to Section 2510.

2) **Protection of Pavement**

Refer to Section 2510.

3.2 UTILITY PROTECTION

Refer to Section 2510.

3.3 SURFACE OR GROUND WATER IN TRENCHES/PIPE

Refer to Section 2510.

3.4 ABANDONING OF AN EXISTING WATER SERVICE/LINE

Refer to Section 2510.

3.5 STEEL ENCASEMENT PIPE – DRY BORING AND JACKING OR OPEN CUT

Refer to Section 2510.

A. TUNNELING METHOD

Refer to Section 2510.

B. TUNNELING (BORING METHOD)

Refer to Section 2510.

C. TUNNELING (HAND-MINING)

Refer to Section 2510.

3.6 HORIZONTAL DIRECTIONAL DRILLING OF HDPE WATER PIPE

Refer to Section 2510 and the following requirements.

All HDPE pipe shall be purple in color and properly identified as being reclaimed water line or wrapped in polyethylene as previously described and properly identified.

INSTALLATION AND TESTING

Refer to Section 2510.

3.7 PVC PIPE FOR RECLAIMED WATER MAIN

Refer to Section 2510 and the following requirements.

All PVC pipe shall be purple in color and properly identified as being reclaimed water line or wrapped in polyethylene as previously described and properly identified.

3.8 RECLAIMED GATE VALVES

Refer to Section 2510.

3.9 VALVES 16 INCHES AND LARGER (GATE OR BUTTERFLY VALVES)

Refer to Section 2510.

3.10 TAPPING SLEEVES AND VALVES

Refer to Section 2510.

3.11 AIR / VACUUM RELEASE VALVES

Refer to Section 2510.

3.12 MISCELLANEOUS APPURTENANCES - SERVICES

Refer to Section 2510 and the following requirements.

A. GENERAL

Taps into in-service reclaimed water mains shall be made by OWASA personnel only. All fees must be paid and work scheduled with OWASA Operations Department before OWASA will make the tap. All materials must be on-site, trenches open, and shoring and traffic control devices in-place before OWASA will perform the tap. Contractor may be required to provide approved traffic control plan if required by inspector.

B. ALLOWABLE TAPPING METHODS

Refer to Section 2510.

C. TAP LOCATION SIZES AND SUPPORT

Refer to Section 2510.

D. SMALL METER BOXES AND SETTERS

Refer to Section 2510.

E. ¾-INCH AND 1-INCH COPPER SERVICE LINES

Refer to Section 2510.

F. 1 1/2-INCH AND 2-INCH METERS

Refer to Section 2510.

G. METER VAULTS

Refer to Section 2510.

H. GROUNDING TO WATER SERVICES

Refer to Section 2510.

3.13 RESTRAINTS

Refer to Section 2510 and the following requirements.

THRUST COLLARS: Refer to Section 2510.

3.14 VAULT CONSTRUCTION

Refer to Section 2510.

3.15 MANHOLE INSTALLATIONS

Refer to Section 2510.

3.16 CONNECTIONS TO EXISTING RECLAIMED MAINS:

The Contractor shall furnish all materials for connection to existing reclaimed water mains. OWASA shall be the sole operator of all valves and fire hydrants.

In making connections to the existing reclaimed water distribution system, valves shall be set as shown on the plans.

Before shutting off any reclaimed water main, customers are to be notified by an OWASA representative in writing at least 24 hours in advance of cut off. The Contractor shall provide assistance to OWASA in notification distribution. OWASA shall be notified at least 10 days in advance of request for operation of valves and making either a wet tap or cut-in.

If the connection to the existing reclaimed mains requires a wet tap, such tap shall be done by a firm experienced and equipped to do this type of work. All materials and labor shall be provided by the Contractor to include, but not necessarily limited to the sleeve, valve, tapping machine, accessories, installation, and testing of such materials to complete the work. OWASA shall have the right to approve the firm or crew performing the work.

Work shall be scheduled at least 10 working days in advance through OWASA's inspector. A crewman from the OWASA Distribution and Collections Division shall be present during the operation. After installation of the tapping sleeve and valve and prior to performing the tap, the assembly shall be hydrostatically tested at a pressure equal to the test pressure of the new line installed. Such pressure shall be maintained with no loss for a minimum time of 15 minutes.

PART 4 - TESTING

4.1 TESTING

A. TIMING

Pipelines shall be tested, in sections between valves, as soon as the installation is completed. Using this method, errors in workmanship can be identified immediately and leaks can be fixed quickly and with minimum expense.

B. PREREQUISITE CONDITIONS FOR TESTING

Prerequisite conditions for Testing and Disinfection shall be as follows:

1) Pipelines and appurtenances have been laid and the trench backfilled.

2) Valves shall be properly located, operable, and at correct elevation. Valve boxes or manholes shall be centered over operating nuts and the top of the box or manhole shall be at proper elevation.

3) All services shall be installed complete with setters (Contractor shall provide a meter, approved by OWASA, for pressure testing). There shall be no bypass around the meter used for pressure testing.

4) All reaction anchors (if necessary) have had sufficient set of 7 days or high early strength concrete may be used to reduce the curing time to 3 days. For high early concrete mix, use 4,500 psi or greater concrete. Temporary bracing shall not be allowed.

5) Lines shall be properly vented where entrapped air is a consideration.

6) All visible leaks, broken or cracked pipe, valves, etc. shall be repaired.

7) Air release valves shall be installed complete and in place after pressure test.

8) All construction activities on the project, that requires trenching or excavation within the limits of the water location shall be completed. Pavement base course and curb and gutter shall be in place before sampling. Pressure testing is to be performed before pavement is put down.

9) Approval from OWASA's Inspector on section of line to be tested.

10) The Contractor shall provide all materials, equipment, taps, and accessories required for filling, testing, and flushing.

4.2 ORDER OF OPERATIONS

A. FILL LINE

Refer to Section 2510.

B. PRESSURE TEST

Refer to Section 2510.

C. FLUSHING

System shall be filled and left undisturbed for a minimum of 24 hours prior to beginning flushing operations. Flushing shall be a velocity of not less than 3.0 feet per second to remove sediment and other foreign matter until the water runs clear. The flushing will be considered complete when the turbidity of a water sample taken after flushing does not exceed 3.0 NTU. The turbidity analysis will be completed by the OWASA Inspector. The Contractor shall be responsible for making adequate provisions for drainage of large volume of flushing water. Any damages that may occur from this operation shall be the sole responsibility of the Contractor.

D. FINAL

After final flushing, flow all blow-offs to confirm the valves are open.

4.3 FINAL ACCEPTANCE

Refer to Section 2510.

END OF SECTION 02520

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02530 – SANITARY SEWER

(Last revised 01/01/2025)

SUGGESTED SEARCH WORDS FOR THIS SECTION

Part 1 – General	Line Air Pressure Test - Table	Pump Station & Force Mains
Part 2 – Products	Low Press Air Test Gravity Lines	PVC Pipe
Part 3 – Execution	Manhole Corrosion Protection	Service Connections
Bypass Pumping	Manhole Plugs	Steel Encasement Pipe
Concrete Encasements	Manholes Precast - Spec	Testing
Ductile Iron Pipe - spec	Manhole Vent Pipes	Tunneling
DIP Fittings	Manhole Vacuum Test	Tunnel Liners
Iron Castings	Pipe Laying	UV Damage Protection
KOR-N-SEAL	Pipe Separation Requirements	

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this specification.

Section 02275 – TRENCHING, BACKFILLING AND COMPACTION OF UTILITIES.

1.2 SUMMARY

This section includes sanitary sewer piping and specialties for municipal sewer and services outside of building structures. All discharges to sanitary sewer shall conform to OWASA's Sewer Use Ordinance.

1.3 DEFINITIONS

A. GENERAL

For the purposes of this specification, the following definitions refer to sanitary sewer collection and pressure systems that come under the authority of OWASA as specified within this section and other sections of this manual.

1) **Cleanouts**: A riser pipe off of a service line that provides access to the line for the purpose of line cleaning.

2) **Easement**: An instrument that depicts/describes and conveys rights and privileges to OWASA for the placement, access to and maintenance of a utility line across and/or on the property of a second party. Ownership of the land remains with the second party.

3) **Sanitary Sewer**: Exterior gravity or pressure public sanitary sewer systems.

4) **Force Main:** Pressure sanitary sewer systems.

5) **Lift/Pump Station:** A combination wetwell/pump station and appurtenances.

6) **Sewer Service**: Exterior domestic sewer piping which connects to the public sewer system.

B. INDUSTRY ABBREVIATION FOR VARIOUS PIPE MATERIALS
The following are industry abbreviation for various pipe materials:

AC: Asbestos Cement Pipe
CI: Cast Iron Pipe
DIP: Ductile Iron Pipe
RCP: Reinforced Concrete Pipe
PVC: Polyvinyl Chloride

1.4 PERFORMANCE

A. GRAVITY FLOW, NON-PRESSURE PIPING PRESSURE RATINGS

At least equal to the system test pressure.

B. FORCE MAIN PRESSURE RATINGS

Shall be equal to the system operating pressure PLUS 50 PSI, but no less than 200 psi.

1.5 SUBMITTALS

A. PRODUCT DATA SUBMITTAL

Submit product data for the following. For third party projects, the Developer/Project Engineer shall perform all product review and make a submittal at the end of the project to OWASA.

1) Piping specialties.
2) Air & vacuum release valves and accessories.
3) Autodialers.
4) Sewage pumps and appurtenances, operating manuals.
5) Auxiliary generators.
6) Alarm devices.
7) Precast concrete manhole castings.
8) Piping paint.

B. SHOP DRAWING SUBMITTAL

Submit shop drawings for precast concrete vaults and wetwells, including frames and covers, ladders, drains, access hatches, wall sleeves, valve support stands, pumps, and motors.

C. COORDINATION DRAWINGS

Show manholes and other structures in vicinity, pipe sizes and elevations, elevations of lift station elements such as influent lines, floats, etc.

D. COMPUTATIONS

1) Buoyancy calculations for wetwells, manholes, interceptor/outfalls, and mains with shallow cover.

2) Provide structural calculations for any elevated main and pier system where span of the main exceeds the joint length. Provide calculations for all aerial mains, and their supporting structures that are subject to hydrodynamic forces.

E. BYPASS PUMPING

Bypass pumping operations must be approved by OWASA before starting. Provide a detailed written plan of how the bypass pumping operation shall be performed two weeks prior to the operation. See Section 3.5 of this specification.

F. PROJECT CLOSEOUT

Submit 3 copies of manufacturer's maintenance and operation manuals on all sewage pumps and/or package lift stations and appurtenant devices.

1.6 QUALITY ASSURANCE

A. COMPLIANCE WITH CODES AND STANDARDS

Materials and operations shall comply with the latest revision of the Codes and Standards listed in Section 1.7, below.

B. PIPING MATERIAL MARKINGS

Piping materials shall be marked clearly and legibly.

1) **Ductile Iron Pipe Markings**

Ductile Iron Pipe shall show on or near bell:

a. Weight,
b. Class or nominal thickness,
c. The letters "DI" or "Ductile,"
d. Manufacturer's identifying mark,
e. Year in which pipe was made, and
f. Casting period.

2) **Steel Pipe Markings**

Each length of steel pipe and each special section shall be legibly marked by paint stenciling, die stamping or hot-roll marking to show the following:

a. Manufacturer's name or mark,
b. Size and weight of the pipe or special section,
c. The type of steel from which the pipe or special section was made.

3) **PVC Pipe Markings**

PVC pipe shall be marked at a maximum of every 5 feet in accordance with AWWA C900 as follows:

a. nominal size in inches and outside diameter base;
b. PVC;
c. dimension ratio;
d. Pressure class in pounds per square inch;
e. the hydrostatic integrity test pressure;
f. AWWA designation (ANSI/AWWA C900);
g. manufacturers name or trademark and production run record or lot code;
h. NSF 61, or if not intended for potable water “NOT FOR POTABLE USE”; and
i. for deflectable joints, the maximum allowable axial joint defection in degrees.

C. DESIGN STANDARDS

1) *“Gravity Sanitary Sewer Design and Construction*,” ASCE Manuals and Reports on Engineering Practice – NO. 60, WEF Manual of Practice NO. FD-5.
2) ASTM D1784 – *Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds*
3) ASTM D2321 – *Practice for Underground Installation of Thermoplastic Pipe for Sewer and Other Gravity-Flow Applications*
4) ASTM D3034 – *Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and* Fittings
5) ASTM D3212 – *Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals*
6) ASTM F477 – *Elastomeric Seals (Gaskets) for Joining Plastic Pipe*
7) ASTM F679 – *Polyvinyl Chloride (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings*
8) ASTM F1417 – *Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air*
9) AWWA C600: *Installation of Ductile-Iron Mains and Appurtenances.*
10) AWWA C900. *AWWA Standard for Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings*
11) AWWA M23: *PVC Pipe – Design and Installation*
12) DIPRA *Design of Ductile Iron Pipe*
13) NC Department of Environmental Quality, Division of Water Resources, *NCAC Title 15A 02T Regulations*, latest revision.
14) UNI-B-6 – *Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe*
15) UNI-PUB-6 – *Installation Guide for PVC Solid-Wall Sewer Pipe (4 - 48 in.)*
16) UNI-TR-3 – *Maintenance of PVC Sewer Pipe*
17) Uni-Bell PVC Pipe Association: *Handbook of PVC Pipe Design and Construction*

1.7 QUALITY STANDARDS

Materials and operations shall comply with the latest revision of the Codes and Standards listed below. Additional references are listed in Section Introduction 1.5.

AASHTO	American Association of State Highway Transportation Officials.
ACI	American Concrete Institute
ANSI	American National Standards Institute
AREMA	American Railway Engineering and Maintenance-Of-Way Association
ASCE	American Society of Civil Engineers
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
CISPI	Cast Iron Soil Pipe Institute
CRSI	Concrete Reinforcing Steel Institute
DIPRA	Ductile Iron Pipe Association
FS	Federal Specifications
NCDEQ	North Carolina Department of Environmental Quality
NCDOT	North Carolina Department of Transportation
NCMA	National Concrete Masonry Association
NPCA	National Precast Concrete Association
NSF	National Sanitation Federation International
OSHA	Occupational Safety and Health Administration
SDS	Safety Data Sheet
UL	Underwriters Laboratories, Inc.
Uni-Bell	PVC Pipe Association
WEF	Water Environment Federation

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

Materials used for the construction of gravity sewer, pressure mains and appurtenances in OWASA's sewer collection system shall be new, free of defects, and meet the highest standards set forth. An authorized OWASA representative must inspect, review, and approve all materials to be used for sewer main and appurtenances prior to installation. At the option of OWASA, any material installed without inspection will have to be sufficiently removed for inspection and review.

A. PIPE CONDITION/PIPE EXAMINATION

1) **New Pipe Inspection**: Inspect materials thoroughly, including the interior, upon arrival. Examine materials for damage and to ensure that the right pipe has been delivered to the site. Remove damaged or rejected materials from site. Pipe shall be protected during handling against impact shocks and free fall. Pipe shall be kept clean at all times, and no pipe shall be used in the work that does not conform to the appropriate ASTM Specifications.

2) **Pre-Installation Inspection**: Prior to being installed, each section of the pipe shall be carefully examined for damage and conformity with these specifications. All pipe damaged or deemed not to conform to these specifications shall be rejected and removed from site. All pipe in which the spigots and bells cannot be made to fit properly, or pipe, which has chipped bells or spigots, will be rejected. The faces of all spigots ends and of all shoulders on the bells must be true. Examine bell and spigot for uniformity and smoothness of liner and barrel.

B. PIPE PROTECTION AND SUPPORT

1) Protect pipe coating during handling using methods recommended by the manufacturer. Use of bare cables, chains, hooks, metal bars, or narrow skids in contact with coated pipe is not permitted.

2) Prevent damage to pipe during transit. Repair abrasions, scars, and blemishes to the satisfaction of OWASA. If repair of satisfactory quality cannot be achieved, replace damaged material immediately.

3) Observe manufacturer's directions for delivery and storage of materials and accessories.

4) Protect stored piping from entry of water or dirt into pipe. Protect bells and flanges of special fittings from entry of moisture and dirt.

5) Support stored pipe to prevent sagging or bending. Pipe bundles shall be stored on flat surfaces with uniform support, be protected from prolonged exposure (six months or more for all pipe) to sunlight with a suitable covering (canvas or other opaque material), and air circulation shall be provided under any covering. Plastic pipe, structures, and fittings shall not be stored in direct sunlight.

6) Handle precast concrete manholes and other structures according to manufacturer's written rigging instructions.

7) Construct piping to accurate lines and grades and support as shown in drawings or prescribed in specifications. When temporary supports are used, ensure that sufficient rigidity is provided to prevent shifting or distortion of pipe.

1.9 PRODUCT SUBSTITUTIONS

OWASA's Engineer will approve materials not specified but deemed equal, on a case-by-case basis. OWASA's Product and Design Review Committee (PDRC) meets on an "as-needed" basis to evaluate new products for incorporation into these specifications. If submitting new products, submit in writing 60 days prior to meeting date. Documentation and samples of materials must be submitted to OWASA. New materials approved for the sewer collection system will be incorporated into these specifications after approval by the PDRC.

1.10 PROJECT CONDITIONS – SEPARATION OF SANITARY SEWER AND APPURTENANCES FROM WATER MAINS AND OTHER STRUCTURES

Follow the NCDEQ and OWASA standards, whichever is more stringent, for separation of water mains and sanitary sewers lines.

A. PARALLEL INSTALLATIONS

1) **Preferred/Normal Conditions:** Sewer mains or sewer manholes shall be constructed at least 10 feet horizontally from water lines whenever possible. The distance shall be measured edge-to-edge.

2) **Unusual Conditions:** When preexisting local conditions prevent a horizontal separation of at least 10 feet, OWASA may approve the sewer main or sanitary sewer manhole to be laid closer to a water line provided that:

a. The sewer line shall be placed in a separate trench, with elevation of the top of the sewer line at least 18 inches below the bottom of the water line; or

b. The sewer line shall be placed in the same trench as the water, and located to one side, on a bench of undisturbed earth, and the elevation of the top of the sewer line at least 18 inches below the bottom of the water main; or

c. Where this vertical separation cannot be obtained, the sewer shall be constructed of AWWA-approved Ductile Iron Pipe pressure-tested in place to 150 psi without leakage prior to backfilling. The sewer manhole shall be of watertight construction and tested in place.

B. SEWER MAINS CROSSING BELOW WATER MAINS

1) **Preferred/Normal Condition:** Sewer lines shall be constructed to cross below water lines whenever possible and shall be laid to provide a vertical separation of at least 18 inches between the bottom elevation of the water line and the top of the sewer.

2) **Unusual Conditions:** When preexisting local conditions prevent an 18-inch vertical separation as described in *Sewer Mains Crossing Below Water Mains, Preferred/Normal Conditions* (paragraph above), the following construction shall be used:

Both the sewer crossing above water line and the water line itself shall be constructed of AWWA-approved Ductile Iron Pipe with joints that are equivalent to water main standards for a distance of 10 feet on each side of the point of crossing.

C. SEWER MAINS CROSSING ABOVE WATER MAINS

Unusual Conditions: When preexisting local conditions prevent an 18-inch vertical separation, as described in paragraph B, *Sewer Mains Crossing Below Water Mains*, *Preferred/Normal Condition*, above, the following construction shall apply:

1) That a section of DIP sewer pipe, with water main type pipe joints, is centered at the point of the water crossing so that the joints are equal distant and as far as possible from the water main such that, for a 90- degree crossing, the water main type joints are a minimum of 10 feet on each side of the point of crossing.

2) Provide adequate structural support for the sewers to prevent excessive deflection of the joints, which can result in settling on and/or breaking the water line.

3) THE SEWER MAIN SHALL BE CONSTRUCTED OF FERROUS MATERIAL AND TESTED TO 150 PSI.

D. SEWER MAINS AND APPURTENANCES FROM OTHER UTILITIES AND STRUCTURES

1) **Horizontal Separation – Preferred/Normal Condition:** Sewer lines shall be constructed to provide at least 3 feet of horizontal separation from other utilities whenever possible. The distance shall be measured edge-to-edge along the vertical plane. For asbestos cement water lines and gas lines provide a minimum 5 feet of clear horizontal separation.

   For buildings or other permanent structures, a minimum of 15 feet of clear horizontal separation, including roofs and building foundations, shall be provided for mains up to 15 feet deep. Separations for sewer mains greater than 15 feet deep, larger than 12-inch diameter, or where incapable of meeting separation requirements due to preexisting site constraints will be determined on a case-by-case basis.

   Other Separations

Manholes	10 feet
Air Release Valves	10 feet
Vaults	10 feet
Underground Stormwater Control Measures	10 feet*
Permeable pavers	5 feet*
Other Appurtenances	5 feet

   *Note: If separations from underground stormwater control measures and permeable pavers cannot be maintained, OWASA may consider allowing construction in accordance with creek crossings as an alternative.

2) **Vertical Separation – Preferred/Normal Condition:** Whenever it is necessary for another utility to cross a sewer main, a 12-inch vertical separation shall be maintained between the lines. When local conditions prevent a 12-inch vertical separation, the following construction shall apply:

a. Provide adequate structural support for the utility to prevent excessive deflection of the joints, which can result in settling on and/or breaking the sewer line.

b. A 24” VERTICAL SEPARATION SHALL BE PROVIDED BETWEEN STORM SEWER AND SANITARY SEWER LINES OR FERROUS PIPE SPECIFIED.

E. SANITARY SEWER MANHOLES

No water main shall be allowed to pass through or come in contact with any part of a sewer manhole. A minimum of 10 feet of horizontal separation shall be maintained between water mains and sanitary sewer manholes provided that the applicable provisions of paragraph A, *Parallel Installations, Unusual Conditions*, above, are also met.

F. STORM DRAINAGE SYSTEM

No gravity sewer or sewer lateral shall pass through a storm drain pipe or manhole system.

G. NEW UTILITIES AND EXISTING SEWER MAINS

When installing a new utility adjacent to or in close proximity to an *existing* sewer main, the new utility line shall be installed to provide the minimum horizontal and vertical clearances specified in paragraph D, *Sewer Mains and Appurtenances From Other Utilities and Structures*.

H. PROTECTION OF WELLS

No gravity sewer, force main, or manhole structure shall pass or be placed within 25 ft of a private well or 50 feet of a public water supply well, source or structure. This offset distance assumes that the sewer is constructed of materials and joints equivalent to state water main standards. If not, the minimum separation is 100 feet.

1.11 COORDINATION OF SERVICE INTERRUPTIONS

Contact OWASA Construction Inspector to coordinate interruption of services. If interruption is necessary, the interruption shall be arranged to occur at such a time to cause the least disruption and minimize loss of service. At the direction of OWASA’s Engineer, temporary service may be required to be provided. Provide a minimum of 10 working days’ notice of the proposed utility interruption.

1.12 LOCATE SERVICES

Contact ***“NC One Call”*** 1-800-632-4949 or “National Call Before You Dig” at 811 before digging.

PART 2 – PRODUCTS

2.1 PIPE & FITTINGS

The following references provide the minimum standards as they apply to the specific item listed. In all cases, the latest revision shall apply. The pipe material selected shall be adapted to local conditions, such as: soil characteristics, exceptionally heavy external loadings, abrasion, corrosion, and similar problems. Consideration shall also be given to pipes and compression joint materials subjected to corrosive or solvent wastes. The pipe interior, sealing surfaces, fittings, and other accessories shall be kept clean.

A. ACCEPTABLE PIPE MATERIAL

1) Refer to Section 3 Water and Sewer Design for additional design information. Use pipe, fittings, and joining methods according to the application indicated.
2) RCP and VCP gravity pipe are not permitted.

B. DUCTILE IRON PIPE

Ductile iron pipe shall be manufactured in accordance with all applicable requirements of AWWA C151/ANSI A21.51 and ASTM A746, pressure class rated, class 350, unless otherwise approved by the OWASA Engineer. The thickness of Ductile Iron Pipe shall be determined by considering trench load in accordance with ANSI/AWWA C150/A21.50 (Public Sewers shall be no less than 8-inch diameter).

All pipe and fittings 6 inches and larger shall be lined with a calcium aluminate mortar made of fused calcium aluminate cement and fused calcium aluminate aggregates. The thickness of the lining shall be the thickness identified on AWWA C104, latest revision but no less than 1/16 inch for 6-inch through 12-inch and 3/32 inch for 14-inch through 24-inch pipe. The lining thickness may taper to less than the specified at the ends of the pipe. Cracks, other than closed hairline cracks and/or fine crazing shall not be acceptable. Loose areas of cement lining are not allowable. A seal coat shall be applied to the lining as identified on AWWA C104.

Epoxy Liners: Protecto 401 and Novocoat SP-2000W are acceptable linings when pipe is to be used for sewer only.

Outside coat shall be a minimum of 1 mil bituminous paint according to ANSI/AWWA C151/A21.51.

Each joint of ductile iron pipe shall be hydrostatically tested before the outside coating and inside lining are applied at the point of manufacturer to 500 psi. Testing may be performed prior to machining bell and spigot. Failure of ductile iron pipe shall be defined as any rupture or leakage of the pipe wall.

All materials used in production of the pipe are to be tested in accordance with AWWA C151 for their adequacy within the design of the pipe, and certified test results are to be provided to OWASA upon request. All certified tests, hydrostatic and material are to be performed by an independent testing laboratory at the expense of the pipe manufacturer.

Push-on and mechanical joint pipe shall be as manufactured by the American Cast Iron Pipe Company, McWane Ductile, or United States Pipe and Foundry Company.

1) **Ductile Iron Joints**

Pipe joints may be either push-on or mechanical joint pipe sizes 4 inches through 48 inches in diameter. Rubber Gasket Joints and Mechanical Joints shall comply with AWWA C111/ANSI A21.11, ASTM A536. Acceptable pipe joints are as follows:

a. **Gravity Main Push-on Joint, Ductile Iron Pipe** shall conform to AWWA C151/ANSI A21.51 (such as *"Fastite" or "Tyton"*). The dimensions of the bell, socket, and plain end shall be in accordance with the manufacturer's standard design dimensions and tolerances. The gasket shall be of such size and shape to provide an adequate compressive force against the plain end and socket after assembly to affect a positive seal. Gaskets shall be manufactured with an approved elastomeric material and comply with AWWAC111/ANSI A21.11.

b. **FORCE MAIN Push-on Joint Ductile Iron Pipe**: Gaskets shall be manufactured with an approved elastomeric material, and comply with AWWA C111/ANSI A21.11. and shall be as manufactured by American Pipe (Fast-Grip), US Pipe (Field Lok 350), or McWane Ductile (Sure Stop 350). The pipe shall conform to AWWA C151/ANSI A21.51 (such as *"Fastite" or "Tyton"*). The dimensions of the bell, socket, and plain end shall be in accordance with the manufacturer's standard design dimensions and tolerances. The gasket shall be of such size and shape to provide an adequate compressive force against the plain end and socket after assembly to affect a positive seal.

c. **Mechanical Joint, Ductile Iron Pipe** shall be used only at the specific locations indicated on the drawings or as approved by OWASA's Engineer.

i. The mechanical joint shall consist of:

a) A bell cast integrally with the pipe or fitting and provided with an exterior flange having cored or drilled bolt holes and interior annular recesses for the sealing gasket and the spigot of the pipe or fitting;

b) A pipe or fitting spigot;

c) A sealing gasket;

d) Separate ductile iron follower gland having cored or drilled bolt holes; and

e) Ductile iron tee head bolts and hexagon nuts.

ii. The joint shall be designed to permit normal expansion, contraction, and deflection of the pipe or fitting while maintaining a leak proof joint connection. The mechanical joint shall conform to the requirements of Federal Specification WW-P-421, AWWA C111/ANSI A21.11, and ASTM A536.

iii. **Mechanical Joint Bolt Torque**: See Section 3.1.B, paragraph 2, *Mechanical Joint Bolt Torque*, below.

2) **DUCTILE IRON FITTINGS**

Fittings shall be ductile iron at least class 54 thickness and shall conform to AWWA C110/ANSI A21.10 or AWWA C153/ANSI A21.53 for compact fittings. All ductile iron fittings shall have a minimum working pressure rating of 250 psi and minimum iron strength of 25,000 psi. All fittings shall be high alumina cement mortar lined in accordance with ANSI/AWWA C104/A21.4, fittings 6" and larger shall be lined with Protecto 401 or Novocoat SP-2000W and the outside shall be bituminous coated. The fittings shall be tested and the manufacturer shall provide certified test results when requested by OWASA. This testing shall include hydrostatic proof testing of fittings. Acceptable types of fittings shall be Mechanical Joint.

Mechanical Joint Fittings: Restraint shall be Megalug series 1100 mechanical joint restraint by EBAA Iron Sales, Inc., Ford wedge action restrainer gland UFR Series 1400, Sigma "One-Lok", Star Products-StarGrip 3000, SIP-EZ Grip, or approved equal. Ductile Iron fittings shall conform to AWWA C110/ANSI A21.10 or AWWA C153/ANSI A21.53 (compact). Glands, Gaskets and Bolts shall conform to AWWA C111/ANSI A21.11.

C. PVC PIPE

1) **General**: C900 PVC gravity and pressure pipe shall comply at a minimum with AWWA C900, Pressure Class 235, DR 18, unless otherwise approved by the OWASA Engineer, and shall be green for sewer applications. PVC may be used for 2-inch through 16-inch mains, supplied in 12.5-foot lengths with bell end with gasket and spigot end joints, and for 4-, 6-, and 8-inch laterals. Pipe shall also meet all applicable ASTM Standards, including ASTM D2122, ASTM 3034, and ASTM D3139, and certified test results are to be provided to OWASA upon request. Pipe shall have a bell with an integral wall section with a factory installed, solid cross section elastomeric ring meeting ASTM F1336 and in accordance with ASTM F477. All certified tests, hydrostatic and material are to be performed by an independent testing laboratory at the expense of the pipe manufacturer.

Public Sewers shall be no less than 8-inch diameter. The minimum thickness of PVC Pipe shall be determined by considering trench load and maximum depth in accordance with ANSI/AWWA C150/A21.50.

If pipe must pass through an area contaminated with or subject to contamination with low-molecular-weight organic solvents or petroleum products, documentation from the manufacturer regarding permeation and the suitability of PVC pipe in the installation must be provided.

2) **PVC Joints**

PVC pipe shall be IB gasketed integral bell with spigot end.

3) **PVC Fittings**

PVC fittings shall be made for use with AWWA C900 pipe made from virgin PVC satisfying the manufacturing and long-term performance requirements of AWWA C907 and be classified in accordance with ASTM D1784.

4) **PVC Pipe for Sewer Force Mains (other than 2 inch)**

PVC pressure pipe with bell end with gasket and spigot end shall comply with AWWA C900, Pressure Class 235, DR 18, or as directed by OWASA for the specific installation. C900 pipe shall be used with ductile iron or PVC fittings (restrained joint). PVC pipe for public sewer force mains shall require approval of the OWASA Engineer.

5) **PVC Pipe for Sewer Force Mains (2 inch)**

2-inch PVC pressure pipe, bell end with gasket and spigot end shall comply with ASTM D2241.

D. STEEL PIPE (Use of Steel Pipe – Approved on a Case-by-Case Basis)

1) **Steel Pipe For Sewer Mains, Aerial Creek Crossings, Encasement, Boring Applications, And Vent Pipes**

Steel pipe for gravity sewer mains and aerial crossings shall meet the requirements of AWWA C200. Nominal pipe diameter and wall thickness shall be as indicated on the drawings. Pipe shall be high strength steel, spiral welded or smooth-wall seamless manufactured in accordance with ASTM A139, and ASTM A283/A283M, Grade "B" steel with a minimum yield strength of 35,000 psi. The interior lining shall be a coal-tar enamel coating as specified under AWWA C203.

a. **Steel Pipe for Gravity Sewer Mains**: Pipe shall be seamless and either furnace-welded or electrically welded pipe, Grade A. The exterior coating shall be coal-tar enamel in accordance with AWWA C203.

b. **Steel Pipe for Aerial Creek Crossings** (*without encasement and carrier pipe*): The outside of the pipe shall have one coat of zinc chromate primer conforming to Federal Specification TT-86-a and afterwards painted with coal-tar enamel.

c. **Steel Encasement Pipe for Boring Applications:** Encasement pipe shall meet applicable NCDOT and AREMA specifications. For 24" and larger pipe, grouting in the annular space between carrier and casing pipe and certification of durability with a design life of 100 years is required by NCDOT. Casing pipe shall include pipe carriers (spiders) to support carrier pipe.

d. The spiders necessary to support the carrier pipe inside of the steel encasement pipe shall conform to Standard Detail 517.01. Refer to **Standard Detail 517.01** for spider spacing.

e. **Steel Vent Pipes for Manholes**: The vent pipe shall be made from 4-inch Schedule 40. The pipe shall be coated inside and out in accordance with AWWA C203 and a finish coat of paint (Hunter Green) applied to the exposed portion of the vent once installed on the manhole casting. See Standard Detail 532.05.

E. TUNNEL LINERS

1) Carrier pipe shall be restrained mechanical joint or other approved restrained joint ductile iron pipe with a minimum pressure class 350 rating.

2) Grout mix for filling voids in between carrier pipe and tunnel shall consist of the following materials properly mixed in proportions by weight.

   a. Part Cement.

   b. 3.0 Parts Fine Sand, 100 Percent Shall Pass No. 16 Sieve.

   c. 0.5 to 0.6 Part Water.

3) Tunnel lining construction shall comply with the "*Specification for Steel Tunnel Liner Plates"* in the AREMA *Manual for Railway Engineering*. The design and shape of the liner plates shall be such that erection and assembly of the liner plate structure can be completely and readily effected from inside the tunnel. Plates shall be accurately curved to suit the tunnel cross section, and all dimensions shall be of the size and accuracy such that plates of similar curvature shall be interchangeable. All plates shall be connected by bolts on both longitudinal and circumferential joints.

4) The steel lining shall consist of plates 16, 18, or 24 inches wide. Each circumferential ring shall be composed of the number and length plates necessary to complete the required shape shown on the drawings. The nominal tunnel diameter shall be of sufficient size to install the carrier pipe.

5) Plates shall be one-piece steel meeting the requirements of ASTM A1011, or ASTM A1008. Plates shall have an ultimate tensile strength of at least 42,000 psi and yield strength of 28,000 psi. Gage thickness shall be a minimum of 8 gage. The liner plate and bolts shall be galvanized in accordance with ASTM A153. In addition, the liner plates shall be asphalt coated to meet AREMA *Manual for Railway Engineering*. For two flange plates, the minimum thickness shall be 0.135 inches. Plates shall be manufactured by Armco Steel Corporation, Commercial Shearing, Incorporated, Republic Steel Corporation, or equal.

6) Grout holes 1½ inches or 2 inches (or larger) in diameter shall be provided in each ring to permit grouting as the erection of the tunnel liner plates progresses. Grout hole screw plugs shall be provided in plates.

7) Steel bolts shall meet requirements of ASTM A449 for plate thickness equal to or greater than 0.209 inch and ASTM A307 for plate thickness less than 0.209 inch. The nut shall meet requirements of ASTM A 307, Grade A.

F. CARRIER PIPE FOR CASINGS AND TUNNELS

Carrier pipe shall be restrained mechanical joint or other approved restrained joint type of ductile iron pipe, and of the class indicated on the drawings.

2.2 MISCELLANEOUS APPURTENANCES AND MATERIAL

A. AIR AND VACUUM RELEASE VALVES

Combination Air Valves shall conform to the following:
Automatic Air and Vacuum Valves shall be infinitely variable automatic air and vacuum valves designed to allow escape of air, close watertight when liquid enters the valve and allow air to enter in the event of a vacuum. The valve shall be an NPT threaded Stainless Steel body. The valve outlet is to be protected from debris entering the outlet of the valve. Valves shall be all brass. Valves shall be designed for a maximum cold water pressure of 200 psig. Combination air and vacuum release valves shall be located as shown on the drawings or as otherwise directed by OWASA's Engineer. The valve shall be housed in a precast concrete eccentric manhole and shall be installed in accordance with Standard Detail 538.01. Acceptable Models are, X-Series (2-inch outlet) by Crispin-Multiplex Manufacturing Co. and 986 Stainless Steel by H-Tec Inc.

B. BEDDING

Bedding, backfill, and compaction shall be in accordance with Section 02275.

C. SOLID BRICK (FOR MODIFICATIONS TO MANHOLES)

Sold brick shall be hard clay, grade SM, in accordance with ASTM C32.

D. CONCRETE

Concrete classes (NCDOT) to Design Compressive Strength at 28 days (f'c):

Class	28-day Compressive Strength (f'c)
AA	4500 psi
A	3000 psi
B	2500 psi

Ready mixed concrete shall comply with ASTM C94. All exposed concrete shall be air entrained. Concrete strength shall be as specified on the standard details and drawings. Unless otherwise specified, all concrete shall be minimum Class A.

E. CONCRETE BLOCK (FOR MANHOLES)

Concrete block shall conform to the requirements of ASTM C139.

F. DETECTABLE WARNING TAPE AND TRACER WIRE

Tracer tape and tracer wire shall be installed per Section 02275.

G. MORTAR FOR CONCRETE BLOCK & CLAY BRICK

Mortar shall be type S, ASTM C 270 and ASTM C-144. Mortar shall be prepared from cement in perfect condition and shall be prepared in boxes for that purpose. No mortar that has stood beyond forty-five minutes shall be used. Proportion by volume for the different types of application shall be as follows:

Brick masonry = 1 part cement to 2 parts sand

Pointing = 1 part cement to 1 part sand

H. IRON CASTINGS: MANHOLE FRAMES AND COVERS

1) **General**: Manhole frames and covers shall be manufactured from Class 35B gray iron, meeting the requirements of ASTM A48 as noted in of AASHTO M306. Standard manhole frames and covers shall be built to the dimensions and configurations shown on Standard Details 533.01 and 533.02. Minimum inside diameter of the opening shall be 23 ½ inches. Manholes castings are to be uncoated. The bearing surface of the frames and covers shall be machined and the cover shall seat firmly into the frame without rocking. Covers are to be embossed along the perimeter with the name “OWASA” and with the words “Sanitary Sewer” and “Entry Permit Required.” See Standard Details 533.01 and 533.02.

   Watertight Frames and Covers: Watertight bolt-down frames and covers shall have 4 stainless steel bolts at 90 degrees and one polyvinyl gasket between cover and frame seat. Frame is to have four 1-inch diameter holes in flange at 90 degrees. Watertight frames and covers are to be utilized whenever a manhole top is set lower than 2-foot above the 100-year base flood elevation.

2) **Approved castings** are:

Manufacturer	East Jordan Iron Works	US Foundry	Capitol Foundry
Standard Model	V-1384	USF-669	MH -2001
Watertight Model (Bolt-Down)	Bolt-down V-2384	669-KL-BWT	MH-2001-WT
Cover Weight	135	125	120
Frame Weight	180	190	190

   Note: Weights shall not deviate by – 5% from that shown in the above table.

   An East Jordan Iron Works V-1883 or US Foundry 1261-KL is to be used with flat top manholes unless the top of the manhole is less than 2-foot above the 100-year base flood elevation. In that case a bolt-down watertight frame and cover is to be used.

3) Frame weights shall not vary more than 5%+/- from that shown on the standard details.

I. IRON CASTINGS: SEWER CLEANOUT BOX

General: Sewer cleanout frames and covers shall be manufactured from Class 30 gray iron, meeting the requirements of ASTM A48. Standard sewer cleanout frame and covers shall be built to the dimensions and configurations shown on Standard Detail 534.01. Approved casting is Capitol Foundry model VB-9 By-Pass Valve Box and the US Foundry 7610 FC.

J. MANHOLE EXTERIOR JOINT SEALANT

Manhole castings shall be sealed to the structure with an “O” ring or “ram neck” joint seal and an external sealing system such as Infi-Shield® Uniband as manufactured by Sealing Systems, Inc. The seal shall be continuous bands, made of high-quality EPDM (Ethylene Propylene Diene Monomer) rubber with a minimum thickness of 60 mils. Each unit shall have a 2-inch wide mastic strip on the top and bottom of the band. The mastic shall be non-hardening butyl rubber sealant, with a minimum thickness of 3/16-inch, and shall seal to the cone/top of the manhole and over the lip of the casting.

The seams on each manhole joint section shall be sealed with a minimum of one layer of “ram neck” or O ring made of nonhardening butyl rubber and an external sealing wrap. Acceptable manufacturers of “ram neck” or O-ring are Conseal Concrete Sealants, Inc. item CS-202. The wrap shall be a minimum of 6” wide. Acceptable products are Gator Wrap as manufactured by sealing systems, Inc.
See Standard Details 532.09 and 532.01.

K. MANHOLE FLEXIBLE INTERIOR COATING SEALANT

THIS PRODUCT IS TO BE USED ON ALL REHABILITATED MANHOLES LOCATED WITHIN THE PAVED ROADWAYS. Internal sealant system (see Standard Detail 532.06) shall prevent leakage of water into the manhole though the frame joint area and the area above the manhole cone including all extensions to the chimney area. The seal shall remain flexible allowing for repeated vertical or horizontal movements of the frame due to frost lift, ground movement, or the thermal movement of pavement. The product shall have a minimum elongation of 800% and a Durometer hardness of 75. The manhole sealant shall conform to the physical requirements of ASTM D412. Sealant shall equal or exceed “Flex-Seal” as manufactured by Sealing Systems, Inc., Loretto, MN.

L. MANHOLE PLUGS

Manhole plugs shall be of the mechanical type and shall not rely upon air pressure to secure the plug to the inside of the pipe. The plug shall be of cast iron construction with a Neoprene rubber “O” ring. The plug shall be secured to the inside of the pipe by means of a large wing nut that, when tightened, compresses the Neoprene rubber “O” ring against the inside of the pipe. The plug shall include a minimum ½ inch diameter NPT by-pass. Backpressure on the plug shall not exceed the manufacturers recommended pressure ratings. Approved manhole plugs shall be Cherne Iron-Grip by-pass style mechanical plug or approved equal. See Standard Detail 532.04.

M. PORTLAND CEMENT

Type I, CSA normal, ASTM C150.

N. PRECAST REINFORCED CONCRETE STRUCTURES

1) General

Manholes of precast reinforced concrete shall be designed and manufactured in accordance with ASTM C478, latest revision. Manhole diameters shall be 4-ft. minimum. The wall shall be a minimum of 5 inches thick and have a 6-inch minimum base. Either an “O” ring or “ram neck” joint seal shall be used. The “O” ring joint shall conform to the requirements of ASTM C443, latest revision. The gasketed joint shall conform to ASTM C990 (or AASHTO M199), latest revision. Rubber boot and stainless steel clamps, meeting the requirements of ASTM C923 shall be supplied with the manhole bases to tie the pipe to the base section of the manhole. Concrete used in the construction of the manholes shall have a minimum 28-day strength of 4000-psi air entrained (with 4 to 6 percent air) conforming to ASTM C33 and ASTM C94/C94M. Manhole units shall consist of standard modular precast riser sections, modular riser sections, and a monolithic base (except doghouse bases are to be used when placing manholes over existing mains). Where conditions do not favorably accommodate the use of an eccentric cone, eccentric precast reinforced concrete flat tops are to be used. In areas of high H_2S concentration, provide protection of manhole by providing linings or coatings on the interior of the manhole such as Polyurethane (Sherflex by Sherwin Williams) PVC, Reinforced Thermosetting Resin (RTR), Strong-Seal Epoxy, or coal-tar epoxy. Manufacturer products shall be approved for use by NCDOT and be NPCA certified.

Manhole steps are not permitted.

Refer to the Standard Detail 532.01 for boot to pipe connection detail.

2) **Extended Bases**: Manholes over 12 feet in depth, as measured from top of casting to effluent invert, shall have extended bases with appropriate reinforcing.

3) **Drop Manholes**: Unless otherwise allowed by OWASA’s Engineer, manholes will be precast reinforced concrete. New drop manholes shall be a minimum of 4 feet in diameter and shall be constructed in accordance with Standard Detail 532.03.

4) **Joint Seal**: The standard joint shall be sealed/parged inside and out with plastic cement putty meeting Federal Specification SS-C-153. All buried joints shall also have an Infi-Shield® Gator Wrap external sealing system, as manufactured by Sealing Systems, Inc., are to be placed on the perimeter of the manhole joint. Infi-Shield® Uniband shall be placed at the top of manholes where the iron casting mates with the precast concrete cone section and/or grade rings. See Infi-Shield® specification elsewhere in this specification. See also Standard Details 532.01, 532.06, and 532.09

5) **Flexible Pipe-to-Manhole Connector**: A flexible Pipe-to-Manhole connector shall be employed in the connection of the sanitary sewer to precast manholes. The connector shall be *KOR-N-SEAL*, as manufactured by NPC, Inc., Milford, New Hampshire, *PSX*, or equal.

The connector shall be the sole element relied on to assure a flexible watertight seal of the pipe to the manhole. No adhesives or lubricants shall be employed in the installation of the connector into the manhole. The rubber for the connector shall comply with ASTM C923 and consist of EPDM and elastomers designed to be resistant to ozone, weather elements, chemicals, including acids, alkalis, animal and vegetable fats, oils and petroleum products from spills.

All stainless steel elements of the connector shall be totally non-magnetic Series 304 Stainless, excluding the worm screw for tightening the steel bands around the pipe, which shall be Series 305 Stainless. The worm screw for tightening the steel band shall be torqued by a breakaway torque wrench available from the precast manhole supplier, and set for 60-70 inch/lbs.

The connector shall be of a size specifically designed for the pipe material and size being utilized on the project.

O. SERVICES

1) **Pipe**

a. **Ductile Iron** Services: DI pipe for sewer services shall be minimum class 350 slip joint pipe with mechanical joint fittings. The service shall include the clean-out stack provided with a cast iron ferrule with brass clean-out plug. See Standard Detail 534.01.

b. **PVC Services: PVC** pipe for sewer services shall use a push on AWWA C900 DR 21, 200 psi in-line monolithic wye gasketed fitting and shall be constructed as shown on Standard Detail 534.01. The wye shall be supported with a concrete block to keep it from rotating under load. The service shall include the clean-out stack provided with a cast iron ferrule with brass clean-out plug. See Standard Detail 534.01.

2) **Service Saddles**: Sewer pipe saddles shall be Romac Industries, Inc. CB-4.80 (6-inch through 12-inch) or CB4.80LS (14-inch through 24-inch). See Standard Detail 534.01.

Service saddles may be used only on existing sewer mains. Tee/wyes shall be used for new construction.

3) **Inline Fittings**: Fittings for services on new main installation shall be inline Class 350 DI, AWWA C900 DR 21 Pressure Class 200 psi PVC, or stainless-steel wyes.

P. WETWELL/VALVE VAULT ACCESS HATCHES

1) **All Areas** (Low Density Traffic (incidental) H-20 Loading – 16,000 lb. wheel load on an 8 ½-inch x 20 ½-inch wheel area): The aluminum access frames and covers are provided with a ¼-inch thick structural grade aluminum channel frame with the flanges acting as a continuous concrete anchor. The inside of the frame has a continuous door support angle that must have a full bed of Class “A” concrete under both the frame and support angle. Door leaves shall be a minimum of ¼-inch thick aluminum diamond plate with structural grade aluminum. Door reinforcing shall withstand an H-20 live load designation. The doors also have lifting aids of aluminum tubular construction with compression springs to assist in opening and closing of the doors. The doors are provided with heavy-duty stainless steel hinges with tamper-proof fasteners. All hardware is to be stainless steel. The doors open to 90 degrees and lock automatically in that position with a

stainless steel positive locking arm and a stainless steel release handle. Doors are provided with a stainless steel lifting handle, stainless steel snap-lock with removable key handle. Two key handles shall be provided with each door. The door leaves extend to the outside perimeter of the frame for added support. Provide padlock hasp for doors on wetwells and valve vaults.

2) **Guarantee and Manufacturer**: The aluminum access frames and covers shall carry a 10-year guarantee against defects in materials and workmanship. The frame and cover shall equal or exceed the units manufactured by Halliday Products, Inc. or The Bilco Company.

Q. YARD HYDRANTS

Yard hydrants shall equal or exceed the Clayton Mark model 5451 Lever type Frostproof Yard Hydrant or the Woodford W-34 for ¾-inch and the Woodford Y-1 for 1-inch. See Standard Detail 539.04.

PART 3 – EXECUTION

INSTALLATION – PIPE AND FITTINGS

3.1 PIPE AND FITTINGS

A. CONSTRUCTION – ALL PIPE

1) **Traffic Control**: All operations of the Contractor shall be subordinate to the free and unobstructed use of the right of way of the passage of Pedestrians and traffic without delay or danger to life, equipment, or property.

2) **Trench width** shall be in accordance with OSHA regulations and as shown in detail 531.01.

3) **Protection of Existing Sewers**: Sewer lines under construction shall be plugged with a mechanical plug at the first manhole upstream from the point of connection. Plug shall be placed in the outlet connection and secured with a steel cable. Plug shall remain in place until acceptance of lines by OWASA. Water, stone, dirt, or any other debris shall not be allowed to enter the OWASA sanitary sewer system during flushing operations or at any other time. Construction taking place in the vicinity of any existing OWASA sewer lines or manholes shall not cause any inflow of surface water or debris to enter the OWASA sanitary sewer system. Existing OWASA manholes located in construction sites are to remain accessible at all times. The Owner and/or Contractor shall be responsible for any damages incurred to the OWASA sanitary sewer system and any fines imposed by the State of North Carolina Division of Water Resources due to sewer spills or overflows.

4) **Pipe Laying Direction**: Place piping beginning at low point and progress uphill. Place on grade, with unbroken continuity in invert, horizontally and vertically, and on alignment as indicated on plans. Place bell ends of piping facing upstream. Install gaskets, seals, sleeve, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

5) **Directional Changes in Gravity Lines**: Use manholes for changes in direction of gravity lines.

6) **Stringing Out Pipe**: Only the amount of pipe that will be used in one day may be strung out. When pipe is strung out, it shall be set on high ground and in a position to prevent silt deposits, storm water, or other matter from entering the pipe prior to its placement in the trench.

7) **Pipe Laying**: The foundation for gravity sewer pipe shall be in accordance with Section 02275. The pipe and fittings shall be laid in the trench so that its interior surface shall conform to the grade and alignment as shown on the plans. Pipe laying shall be done in such a way as to disturb as little as possible the pipe that has already been laid. The alignment and grade of the sewer main may be field adjusted whenever, in the opinion of OWASA's Engineer, it is necessary, so long as the adjustments are within that allowed by NCDEQ based on regulations in affect at the time of the change and so long as the changes are consistent with OWASA's policy in affect at the time of the change. Changes in either grade or alignment may only occur at manholes.

   Before laying, the bell and spigot will be wiped free from any dirt or other foreign matter. All surfaces of the portion of the pipe to be joined, and the factory-made jointing material, shall be clean and dry. Lubricants, primer, adhesives, etc., shall be used as recommended by the pipe or joint manufacturer's specifications. The jointing material or factory-fabricated joints shall then be placed, fitted, and adjusted in such workmanlike manner as to obtain the degrees of water tightness required.

   Trenches shall be kept as dry as possible during bedding, laying and jointing and for as long a period as required until the trench is backfilled. As soon as possible after the joint is made, sufficient bedding material shall be placed along each side of the pipe to offset conditions that might tend to move the pipe off line or grade. The greatest care shall be used to secure water tightness and to prevent damage to or disturbing of the joints during the backfilling process, or at any other time.

   All special fittings, such as wyes and other connections, shall be installed at the points indicated on the plans, in accordance with the standard detail drawings. Use appropriate adaptors to tie connection pipe to wyes or saddles. Plug end of connection with appropriate plug. See Standard Detail 534.01.

   After the trench foundation has been properly graded to receive the pipe, the pipe shall be carefully lowered into the trench with approved methods. Under no circumstances shall the pipe or accessories be dropped or dumped into the trench. All damaged pipe shall be replaced.

   Any defects due to settlement shall be corrected by the Contractor.

8) **Temporary Suspension of Work**: When the trench is left for the night or if pipe laying is suspended, the upper end of the pipe shall be plugged to keep out dirt, water, animals and other foreign matter or substances. This plug shall be kept in the end of the pipe line at all times when laying is not in actual progress.

9) **Cutting or Fitting Pipe**: Whenever a pipe requires cutting, to fit in the line or to bring it to the required location, the work shall be done in a satisfactory manner

with an approved cutting tool or tools which will leave a smooth end at right angles to the axis of the pipe and not otherwise damage the pipe or liner. When the cut end is to be assembled in a *Fastite* bell, an adequately smooth (without sharp edges) bevel should be ground or filed on the cut edge to prevent damage to or dislodgement of the gasket during assembly. The method of cutting pipe shall be in accordance with manufacturer's recommendations. No welding, flame cutting, or flame tapping will be allowed. Such cuts shall be made by the Contractor.

10) **Surface Water Crossings**: Surface water crossings with pipe under streambed shall have the pipe encased in either a concrete or steel casing. Concrete or steel casing shall extend from top of stream bank to top of stream bank. See Standard Detail 536.08.

11) **Ravine/Channel Crossings**: Surface water crossings with pipe above the water shall be adequately supported by pipe support piers or steel girders as shown on Standard Details 536.03, 536.04, and 536.06. Neoprene Rubber shall be placed between pipe and all points of contact with concrete and stainless steel straps. Disturbed banks are to be stabilized with rip rap placed over a non-woven fabric.

12) **Crossing Conflicts**: All drains, gutters, culverts, and sewers for surface drainage are to be kept open. If unavoidable, Interruptions shall be coordinated with the jurisdiction having authority. They shall approve the plans to interrupt service.

B. DUCTILE IRON PIPE

1) **Construction**:

Gravity DIP shall conform to the same foundation and backfill requirements as those prescribed for water mains. Minimum laying length shall be 18 feet except for Tee/Wye connections or tie-in at a structure. However, bury limitations shall be governed by Table 02275.1.

2) **Mechanical Joint Bolt Torque**:

Where mechanical joint fittings are required, unless otherwise advised by the manufacturer, the minimum bolt torque shall comply with Table 2 of AWWA C600 for mechanical joints, as follows:

Bolt Size (Inches)	Torque (Ft-Lbs)
5/8	45-60
3/4	75-90
1	100-120
1 3/4	120-150

3) See also Section 02275 – Trenching, Backfilling, and Compaction of Utilities.

4) Minimum cover shall not be less than 3 feet. IF 36" CANNOT BE OBTAINED AT FINAL GRADE THAN 15A NCAC 2T .0305 (g) (4) SHALL APPLY.

C. STEEL PIPE

1) **Aerial Pipe**

a. Where required, steel aerial pipe shall meet the length, thickness, and diameter shown on the plans.

b. Pipe is to be joined by welding. The pipe shall be beveled and prepared for field welding at the circumferential joints. Joining of steel pipe shall meet the requirements of AWWA C206.

c. Pipe support piers shall be constructed in accordance with Standard Detail 536.03, as applicable. Upon completion of installation, paint the exterior of the pipe with coal-tar enamel. See Section 2.1.C of this specification.

2) **Encasement Pipe**

Where required, steel encasement pipe shall meet the length as shown on the plans and the thickness and diameter as shown on Standard Detail 517.01 OR AS DIRECTED BY THE ENGINEER OF RECORD WHICHEVER IS MORE STRINGENT.

Construction shall be executed in such a manner as to prevent settlement of the ground surface above the pipeline. The installation of the pipeline shall follow the heading or tunneling excavation as closely as possible.

Installation shall be in accordance with AWWA.

The pipe shall be beveled and prepared for field welding at the circumferential joints. Joining of steel casing pipe shall meet the requirements of AWWAC206. Casing shall be installed by dry boring and jacking or open cut, as indicated on the drawings.

Encasement ends shall be enclosed as shown on Standard Detail 517.01.

Manufactured Spiders: Refer to Standard Detail 517.01 for spider spacing.

All carrier piping shall be restrained joint.

D. PVC PIPE

PVC pipe shall be installed in accordance with Section 02275 and all manufacturers' recommendations.

3.2 TUNNELING METHOD

A. GENERAL

All liner plates and ribs used in the tunnel shall be of one type.

All operations of the Contractor shall be subordinate to the free and unobstructed use of the rights of way for passage of traffic without delay or danger to life, equipment, or property. The Contractor shall provide all necessary bracing, bulkheads, and shields to ensure safety to traffic at all times. The Contractor shall provide all traffic control devices as necessary and as shown on the approved traffic control plan.

B. TUNNELING (BORING METHOD)

Commence boring operation from a pit, with the bottom excavated to grade, and sheeted or shored if necessary. A steel pipe shall be jacked in place as a casing pipe. Boring through rock shall be oversized to allow installation of carrier pipe but no casing pipe shall be required unless liner plate is necessary for safety reasons.

C. TUNNELING (HAND MINING)

1) Commence tunneling operation from a pit, with the bottom excavated to grade, and sheeted or shored if necessary.

2) Install the steel liner plates immediately after the excavated material has been removed and remove the material not more than 24 inches ahead of the installed liner plates.

3) Grout all voids between the soil and tunnel liner plates. The maximum grouting pressure shall be 30 psi. Start grouting at the bottom of the tunnel liner plates and proceed upward progressively and simultaneously on both sides of the tunnel. Install liner plates no more than 6 feet ahead of grout section. Prohibit traffic over ungrouted sections of tunnel unless this section is in solid rock. Thoroughly dry-mix grout ingredients before adding water. After adding water, mix the batch for 3 minutes. Batches shall be of size to allow continuous placement of freshly mixed grout. Grout not used within 30 minutes after mixing shall be discarded. Placing shall be quick and continuous. Placement shall be under pressure with a grout pump. The period between installation of the tunnel liner plate and the placing of grout shall not exceed 7 hours, without the approval of OWASA's Engineer. Upon completion of grouting, fill grout plugs with provided grout hole plugs.

4) Smoothly pave the bottom of the tunnel with concrete. After installation of the tunnel liner plates, the Contractor shall pour concrete pavement on the bottom quadrant (invert) of the tunnel, the surface of the pavement being parallel to the inner plate, with screed rails embedded in it, on line and grade for the installation of pipe in the tunnel.

5) The periphery of the tunnel shall be trimmed smooth to fit the outside of the steel liner plate as nearly as is practical, so that the void outside the plates is a minimum.

6) After installation of the tunnel liner, pull the carrier pipe in place a joint at a time. Each joint of the carrier pipe shall be supported by spiders strapped to the carrier pipe.

7) Close up tunnel liner ends to protect against entrance or foreign matter. The open ends of the casing pipe or tunnel shall be closed off by an 8-inch grout or masonry block wall prior to backfilling. A steel drain line to a 1 cubic yard French drain or to daylight shall be provided.

8) If installation is under railway tracks, all permits shall be obtained and Railway Company shall be notified prior to such installation. The same shall apply to contacting the applicable Municipality or NCDOT if installation is under a roadway.

3.3 MANHOLE CONSTRUCTION

A. STANDARD MANHOLES

1) Manholes shall be constructed in accordance with Standard Details 532.01 and 532.02. The Contractor shall exercise care in the ordering of manholes so that the use of grade rings for leveling and adjustments can be minimized. “O” Ring or Ram Neck shall be used along with Infi-Shield® Gator Wrap external sealing systems, as manufactured by Sealing Systems, Inc., are to be placed on the exterior joints of manholes. Infi-Shield® Uniband shall be placed at the top of manholes where the iron casting mates with the precast concrete cone section and/or grade rings. See Standard Details 532.01, 532.08, and 532.09.

   Non-shrink grout shall be placed around pipe where pipe meets invert in manhole to provide for a smooth transition for sewage flow.

   Manholes shall be installed plumb.

   When applicable, during installation of manhole, if frame and cover is near or within wheel path in roadway, turn cone to place out of wheel path.

2) In general, **inverts** shall be poured and shaped on site. Precast manholes where the inverts are included in a monolithic pour are permitted, however, no field adjustment or additional shaping shall be made to preformed inverts to address deviations during installation.

3) **Flow Channel**: The flow channel straight through the manhole shall be made to conform as closely as possible in shape and slope to that of the connecting sewers. The channel walls shall be formed or shaped to one full diameter width and three-quarters (3/4) of the height of the crown of the outlet sewer in such a manner to not obstruct maintenance, inspection, or flow in the sewers. When inlet pipes are above the invert, the invert shall be shaped up toward the inlet pipe to keep material from depositing. When curved flow channels are specified in manholes, including branch inlets, minimum slopes should be increased to maintain acceptable velocities. See Standard Details 532.01 and 532.02.

4) **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 shall be sloped no less than ½ inch per foot (4%). The invert elevation of any lateral sewer, service connection, or drop manhole pipe shall be above the bench surface elevation. No invert shall be located directly on the surface of the bench. See Standard Detail 532.02.

B. DROP MANHOLES

Invert elevations for drop connections in manhole shall be as shown on the plans. ALL INVERTS 18” OR MORE SHALL BE CONSTRUCTED AS AN OUTSIDE DROP.

OWASA may require an outside drop if necessary to prevent excessive sewer main depth.

Exterior drop connections shall consist of DIP and mechanical joint fittings. Exterior drop manholes shall be installed per Standard Detail 532.03. Manholes shall conform to PART 2 - PRODUCTS.

Interior drops are not permitted.

C. FLEXIBLE PIPE-TO-MANHOLE CONNECTOR

When it is necessary to field core a manhole and install a flexible Pipe-to-Manhole connector. This applies to Brick/Block and precast concrete sanitary sewer manholes; the connector shall be installed per the manufacturer's recommendations.

D. PRECAST CONCRETE DOGHOUSE MANHOLES

When it is necessary to install a manhole over an existing sewer main, a precast concrete doghouse manhole shall be installed over the main. A concrete base shall be poured and the doghouse manhole set over the existing sewer. The joint between the precast manhole and the base shall be sealed both inside and out with grout. The annular space of the precast manhole, around the main, shall be filled with grout and a shelf formed to the springline of the existing main. The crown/top of the main shall be removed once the shelf has been formed and has set sufficiently. See Standard Detail 532.08.

E. INSTALLATION OF MANHOLE FRAMES AND COVERS

Frames and covers shall be installed to manhole in accordance with Standard Details 532.01 and 532.06, as applicable. Frame and covers shall be installed to finished elevation. Adjustments shall be made as necessary to achieve finished elevation. On all manholes, ½-inch grout is to be placed between the frame and concrete casting or grade adjustment ring.

F. GRADE RINGS/ADJUSTMENTS

In street rehabilitation work, the combination of grade rings and/or brick shall not exceed 12 VERTICAL INCHES before removal of the cone is necessary to effect adjustment. When making adjustments to manhole frames, place a ½-inch parge coat on interior of manhole from half depth of the iron casting to a depth of 2 inches below the top of the precast cone. See Standard Detail 532.06.

G. REPLACEMENT/REHABILITATION OF EXISTING MANHOLES

Replacement of Manholes: OWASA reserves the right to require replacement of the existing manhole with a new manhole. OWASA will provide the manhole but the Contractor shall pick up and install it. When a new manhole is necessary, the old manhole must be completely removed and a new precast manhole constructed in its place.

Any tie-in's performed on sanitary sewer manholes must be machine-core drilled with a neoprene flexible boot and adjustable band, except brick manholes. The core shall be the size specified with a smooth finish. If connecting to existing brick manhole, seal penetration WITH HYDRAULIC CEMENT on perimeter of manhole. Coordinate with OWASA's Engineer.

H. TESTING OF MANHOLES

All Manholes are to be subjected to a vacuum test. This includes all doghouse and rehabbed manholes. Manholes shall be vacuum tested after construction in accordance with the manhole vacuum testing procedures outlined in Section 3.9, paragraph B, item 6. Service connections tied into manholes shall be tested in conjunction with the manhole.

3.4 ABANDONING SEWER LINES AND MANHOLES

A. SEWER LINES

The following sewer pipes shall be abandoned by removal or by filling with grout / flowable fill concrete (50 psi minimum/ 150 psi maximum) in accordance with the following criteria (see Standard Detail 536.05):

1) Pipes larger than 24-inches diameter

2) Pipes located within roadway section and meeting one of the following conditions:

   a. pipes that are 12-inches diameter up to and including pipes that are 24-inches diameter and are buried less than 20 feet below finished grade

   b. pipes that are 6-inches diameter up to 12-inches diameter that are not cast iron, ductile iron, PVC, or HDPE and are buried less than 12 feet below finished grade

3) Pipes located below groundwater table that could become a conduit for water movement

   Optionally, sewer pipe may be excavated and removed subject to Engineers approval and approval of controlling Right-of-Way agency.

B. MANHOLES

When an existing manhole, either partially or wholly, is designated to be abandoned and the sewer lines, either entering or exiting the manhole, have been abandoned according to the preceding paragraph, the upper portion of the manhole is to be removed to within 36 inches of the proposed finished grade, or as determined by OWASA's Engineer, #57 stone dumped into the manhole, the stone vibrated to consolidate the stone. The remainder of void or space between the top of the manhole and the finished subgrade is to be backfilled as follows. Backfill with #57 stone and consolidate. Outside roadway right of ways, filter fabric shall be placed over the stone and suitable material of a compactable nature shall be placed over the concrete manhole pad (see Standard Detail 536.05) and tamped.

I. SERVICES

Prior to abandonment of a sewer service connection, as directed by OWASA, the contractor shall be responsible for televising the sewer main where the service is to be abandoned, and providing CCTV video footage to OWASA. The OWASA Inspector shall determine the nature of the permanent repair required for the abandonment by considering the sewer main material, the nature of the connection to the main, and the condition of the main. The abandonment shall be witnessed by the OWASA Inspector.

3.5 BYPASS PUMPING

Contractor is required to furnish all materials, equipment, labor, power, and maintenance, etc. to affect a temporary pumping system for the purpose of diverting the existing flow around the work area. The design, installation, and operation of the temporary pumping system shall be the Contractor's responsibility.

A. LONG-TERM BYPASS PUMPING (GREATER THAN 24-HOUR DURATION)

This section addresses bypass pumping arrangements of greater than 24-hours duration.

1) Bypass pumping arrangements shall consist of two pumps of equal size at the diversion manhole. Each of the bypass pumps; that is, the primary and secondary (redundant) pumps, shall be sized to:

   a. Accommodate maximum flow possible through the approaching pipeline entering the manhole where the pump suction piping will be installed. This volume of flow shall be based upon full circular pipe flow. The minimum design criteria slope for the size pipe being replaced shall be used for calculation, including the appropriate roughness coefficient for the pipe material; and,

   b. Pump continuously without disruption or suspension of flow to the discharge manhole. This requires that each pump be designed taking into consideration the total dynamic head conditions of the pump system including discharge piping and fittings.

   c. The pump size for the redundant pump shall be the same as the primary pump. The redundant equipment shall be staged and configured in a fashion so that the redundant pump operates automatically in the event of a failure of the primary system. The primary pump will be capable of handling the flow completely without assistance from the secondary pump.

2) Contractor shall provide the necessary labor and supervision to set up and operate the pumping and bypassing system. Contactor shall comply with local Town sound ordinance. If pumping is required between the hours of 8:00 PM and 6:00 AM, engines shall be equipped as specified in item 6) below in order to keep noise to a minimum.

3) Overflows from bypass operations will not be permitted to enter into any streams or bodies of water. The Contractor will be solely responsible for any legal actions taken by the state regulatory agencies if such overflows occur.

4) Bypass pumping equipment shall include pumps, conduits, engines, and related equipment necessary to divert the flow or sewage around the section in which work is to be performed. In addition, the Contractor shall maintain at the same location and in operable condition, duplicate equipment to be used in case there is equipment failure. In the event of failure of any component of the primary or

secondary system, the Contractor shall promptly repair or replace the failed equipment to the satisfaction of OWASA's Engineer.

5) The contractor shall remain onsite during inspection and testing of the bypass system by the contractor for a minimum of 24 hours of trouble-free bypass during testing, regardless of the approval to use an autodialer for the actual bypass operation. The new sewer line may be used by the Contractor to carry the sanitary flows after the new pipe has passed inspection and testing. Any "temporary" connections to the new sewer line shall be approved by OWASA's Engineer.

6) Engine driven equipment for primary bypass pumping equipment shall have "critical grade mufflers." If equipment is operated between the hours of 8:00 PM and 6:00 AM, this equipment shall also be provided with sound attenuation enclosure. It is not necessary that the secondary (redundant) pump meet these requirements. The enclosure shall be portable in order to allow the enclosure to be moved when bypass pumping equipment is moved. These conditions are subject to any other additional stipulations that may be required by local Town sound ordinances.

7) Security fencing or other means shall be provided around manholes and pumping equipment to protect the manhole from accidental or unauthorized entry and tampering with the bypass equipment.

8) Continuous (24 hours/day) monitoring is required for all bypass pumping operations. "Continuous monitoring" in this instance shall be documented at least hourly on log sheets and submitted daily to the Owner or owner's representative, with copy to OWASA. Continuous manning of the operation by an individual that is trained and able to respond in the event of equipment failure is preferred. In those cases where OWASA determines that continuous manning is not feasible/required then arrangements will be made to continuously monitor the operations remotely. This remote monitoring will require that maintenance/repair personnel can be notified and respond on site within 45 minutes. OWASA and the responsible owner will be immediately contacted by telephone anytime an overflow condition may occur. In addition, the contractor shall visit every bypass daily, including weekends and holidays, for visual inspection and document the visit on the log sheets. OWASA may require continuous monitoring during major storms.

9) The Contractor shall submit to OWASA a detailed plan and description outlining all provisions and precautions to be taken by the Contractor regarding handling of existing wastewater flows. This plan must be specific and complete, including flow calculations, pump sizing calculations, method of continuous monitoring of pumps (telemetry or manned), schedule for entire duration of bypass pumping operations, contact name and telephone numbers of responsible personnel. No bypass pumping shall begin until all requirements have been reviewed and approved by OWASA.

10) The plan shall be sealed by a Professional Engineer licensed in North Carolina, and include but not be limited to the details of the following:

   a. Staging areas for the pumps.
   b. Sewer plug method and type of plugs or gates to be used.
   c. Number, size, material, locations, and method of installation of suction piping.

d. Bypass pump sizes, capacity, number of each size to be on site, and power requirements.
e. Calculations of static lift, friction loss, and flow velocity
f. Stand-by power.
g. Downstream discharge plan.
h. Method of noise control for each pump.
i. Temporary pipe supports and anchoring required.
j. Heavy equipment needed for installation of pumps and piping.
k. Stand-by/back-up pumpset for the bypass application.
l. Fueling of pumpsets on demand.
m. **Alarm systems**: An alarm system designed to alert of bypass pumping system failures shall be included. Alarms shall be included for high water and activation of the secondary pump, as well as the loss of power to a pump. The proper functioning of an alarm shall not be dependent on the power for the pump served.
n. **Stormwater Outfalls**: Analysis of the outfall locations for any stormwater inlets which would receive water from an overflow, their outfall location to the environment, and maps identifying the inlet and outfall locations.

11) **Testing and Call Sequence**. Prior to beginning of any and all sewer bypass pumping operations, a complete and through trial run-thru of the operation of the pumps and equipment and functionality of the autodialer with OWASA's Point of Contact (POC) shall be conducted. Typically, the POC will refer to either a Construction Inspector (System Development projects) or Project Manager (for CIP projects). The bypass provider (manufacturer/provider) and utility contractor must be present during this event. This test must mimic a sewer overflow condition and all phone numbers programmed into autodialer must be contacted in sequence. Any prerecorded message must be approved in advance by OWASA and must include the project name and location of the reporting bypass as well as the OWASA POC assigned to the project.

Generally, the **sequence of calls** shall follow the protocol below:

1. Pump Supplier
2. *Superintendent for Utility Contractor
3. Project Manager for General Contractor
4. OWASA Inspector
5. Water Treatment Plant Operator
6. Owner Representative

*Note: Superintendent for Utility Contractor will immediately call OWASA POC to advise of situation.

12) Bypass pump documentation manufacturer's "cut sheet" or specification along with the pump curve shall be posted at the location of each pump. This shall be covered/protected so that it is legible and easily accessible to OWASA personnel at all times.

13) Contractor shall be responsible for providing any and all protection of the entire pumping system against freezing temperatures. The Contractor shall be responsible and pay all civil penalties, fines, costs, assessments, etc., associated

with any discharge of raw or inadequately treated wastewater due resulting from inadequate freeze protection of any and all parts of the pumping system.

14) Contractor shall have adequate bypass piping system replacement and repair parts and supplies located and immediately available to him on the jobsite. The OWASA representative shall review and approve the adequacy of the replacement and repair parts and supplies on the jobsite prior to initiation of any sewer bypass operations.

15) In the event of any sewer overflow or spill where active cleanup operations must commence, OWASA shall immediately become the incident commander. All those present in response to the emergency shall follow the directive of the OWASA incident commander. This incident commander shall be the Distribution and Collections Manager or assistant manager or OWASA POC. Contractor shall provide spill containment in areas where fuel or sewage may otherwise reach the ground.

16) In the event that there is a sanitary sewer overflow of any volume, the contractor shall immediately notify both the OWASA Inspector assigned for the project and OWASA's Distribution and Collection Systems Manager and provide any and all requested information regarding the overflow. The Contractor shall be responsible and pay all civil penalties, fines, costs, assessments, etc., associated with any discharge of raw or inadequately treated wastewater associated with the Contractor's bypass pumping operations.

17) Once a bypass operation is underway, the contractor shall perform periodic testing of the entire backup system, equivalent to the initial testing done prior to implementing the bypass. These checks shall include turning off the main pumps and seeing the secondary system function as expected, as well as the testing of all alarms. The duration of each check shall be sufficient to fully assess the system and recharge backup batteries. The testing shall occur on a weekly schedule, unless otherwise approved by OWASA.

B. SHORT-TERM BYPASS PUMPING (24 HOURS OR LESS)

Bypass Operations for periods of 24 hours or less may be sized on the expected peak flows during this period or, if applicable, the 10-year storm frequency event. In all cases, of bypass operations of 24 hours or less, the contractor shall provide for a qualified and competent attendant who shall be onsite at all times during this period. Any bypass pumping arrangements for 24 hours or less must be approved in advance by OWASA personnel and shall be on a case-by-case basis. Contactor must have an equivalent or larger sized redundant pump onsite and in good working condition. This pump must be available and ready to install immediately should the primary pump fail. Requirement for noise attenuation will also be considered on a case-by-case basis but may be subject to local governing jurisdictions' ordinances and must be approved by those entities. Requirements for fencing will be determined by OWASA on a case-by-case basis.

3.6 SERVICE CONNECTIONS

A. NEW SERVICES

Unless otherwise permitted by OWASA's Engineer, all sewer services and cleanout stacks between the OWASA main and the edge of easement or road right-of-way shall be either Class 350 DIP slip joint pipe with mechanical joint fittings or AWWA C900 DR 20 Pressure Class 200 psi with AWWA C900 PVC DR 21, Pressure Class 200 psi gasketed fittings. See Standard Detail 534.01.

B. BORED SERVICES

Where laterals are bored, the face of the bore cut shall be a minimum distance of five feet from the edge of the pavement on either side unless OWASA's Engineer gives approval to the contrary.

C. SEWER LATERAL

The minimum diameter for a sewer lateral is 4 inches, and is typically 4 or 6 inches in diameter. 4-inch sewer laterals shall be connected to the main by means of an in-line monolithic wye or, if on an existing line, with a tap and saddle installed over a hole cut in the top quadrant of the main at an angle of forty-five degrees (see Standard Detail 534.01), with respect to flow direction. The hole shall be cut with a mechanical circular type saw cutter designed for the particular use and rendering a smooth uniform cut with no damage to the main and is one which retrieves the plug.

D. WYE AT PROPERTY LINE CLEANOUT

A wye is to be provided at the cleanout set at the property line. All laterals are to be left exposed until the inspectors can verify the installation of each service.

E. NO VERTICAL STACKS OR STANDPIPE SERVICES

Vertical stacks or standpipe services are not allowed.

F. LOCATION OF CLEANOUT

The first cleanout upstream of the main shall be located at the public road right-of-way or sewer easement boundary, straddling the easement boundary. Where no right-of-way or easement exists, the cleanout shall be located a minimum of 15 feet from the main. A cleanout box and lid shall be set over the cleanout. The cleanout is to be set between 4 and 6-inches from the top of the box.

G. GRADE

Minimum grade for services shall be ¼-inch per foot for 4-inch services. Minimum grade for 6-inch services are to be laid preferably at a 1/8-inch per foot, but no less than 0.6%.

H. SERVICE SADDLES

Service saddles shall be constructed using Romac Industries, Inc. sewer service saddles or approved equal, placed in the top quadrant of the pipe main. Backfill under and around saddle with #67 stone. See Standard Detail 534.01.

I. MAINTENANCE OF SERVICE

During service installation or line rehabilitation on existing mains, the Contractor shall be responsible for the maintenance of all sewer house connections and the proper treatment and/or by-pass of effluent sewer around work areas.

J. CONTRACTOR RESPONSIBLE FOR CAUSED DAMAGE

Any services or utilities damaged by the Contractor shall be properly repaired.

K. AIR TESTING NEW SERVICES

Sewer lines shall be **air tested** (low-pressure air test) after the complete installation of all sewer services. Laterals shall be tested with the main line. THIS APPLIES TO NEW SEWER SERVICES INSTALLED.

L. CONNECTION TO MAIN IN EASEMENT OR RIGHT OF WAY

Sewer laterals connect to the public sewer main in the public road right-of-way or within a sewer easement that has been dedicated and conveyed to OWASA.

3.7 CONCRETE ENCASEMENTS

All concrete encasements shown on the plans shall be constructed per the details on the plans.

The earth may be used for side and bottom forms provided such sides can be excavated uniformly smooth and to the size and shape specified. Care must be taken during the pouring operation to ensure that the pipe does not float or move from the buoyant effects of the concrete. Misalignments of the crossings shall be cause for total removal and replacement of the encasement by the Contractor.

Once the concrete is set, measures shall be taken to cure the concrete by covering it with plastic. Water shall not be allowed to run over the concrete for at least 48 hours.

Forms will be required if the subgrade and sides are not firm or will not hold shape.

Exercise care to avoid spilling concrete into creek.

3.8 USE OF SLOPE ANCHORS ON STEEP LINES

All lines with slopes from 15 to 20 percent shall have concrete anchors placed on the bell end of the sewer line. The anchors shall be spaced AS OUTLINED IN 15A NCAC 02T REGULATIONS, the NCDWR Minimum Design Criteria for the permitting of Gravity Sewers, OR as shown on the plans (WHICHEVER IS MOST STRINGENT) and constructed to the dimensions shown on Standard Detail 536.01. Anchors shall penetrate at least 6 inches into virgin soil. Concrete shall be 4000 psi concrete.

3.9 TESTING

A. TESTS BY PIPE MATERIAL

The following tests shall apply for the respective pipe materials as required by the following specifications.

Table 02530.2				
Table of Testing Applications				
Material	Air Test	Vacuum Test	**TV Inspection** (OWASA may require VISUAL INSPECTION ON a case-by-case basis)	**Mandrel Pull**
DIP	X		X	
PVC	X		X	X
Manholes		X		

B. TEST AND INSPECTION

All sanitary sewer pipe shall be tested after backfilling has been completed and before final acceptance by OWASA. Upon completion of entire pipe installation, OWASA's Engineer shall inspect the work in part or as a whole and make such tests as necessary to verify that the work has been carried out in accordance with the plans and specifications.

All manholes shall be of the specified size, shape, and material, and shall have their tops set to the grade as furnished by the Design Engineer.

The Contractor shall provide all equipment, material, water, labor, etc. needed to perform any and all tests in accordance with the procedures listed herein. All equipment, materials, etc. used shall be checked and approved by OWASA's Engineer prior to its use. It shall be the responsibility of the Contractor to ensure pipe to be tested is clean before any tests are made. Frame and covers shall be tested with manhole tests.

Test for leakage of gravity sewers shall be done as directed by OWASA's Engineer or as shown on the plans.

1) **General Requirements**: Testing and inspection shall promptly follow installation of wastewater pipe including services. Testing shall not be more than 1000 feet behind sewer pipe laying operation.

   Furnish all pumps, gauges, instruments, test equipment and personnel required for inspections and testing operations.

   Provide lights and mirrors and inspect lines in presence of OWASA's authorized representative.

   All final testing and inspections shall be performed in the presence of the OWASA's Engineer.

Flush all sand, dirt and debris from lines prior to inspection.

Clean and pretest prior to notifying the OWASA's Engineer and arranging for inspections and tests. FAILURE TO CLEAN AND PRE-TEST MAY RESULT IN RE-INSPECTION FEES.

Inspect the system for conformance with line and grade shown on the plans and provide record drawing measurements CERTIFIED BY PLS AND ENGINEER OF RECORD on Record Drawings. THESE MEASUREMENTS SHALL BE TIED TO NC PLANE COORDINATES in 88/83 datum.

2) **Flushing**: If during any of the inspections sewer lines and manholes are found to contain mud and other debris, the Contractor shall be required to flush or clean this material from the system by whatever means necessary. Mud and other debris shall not be allowed to enter the existing sanitary sewer system. The Contractor shall be responsible for the cost of water used to flush the system AND PAY A RE-INSPECTION FEE

3) **Backfill Testing**: Testing of backfill shall be performed in accordance with the requirements of Section 02275 – *Trenching, Backfilling, and Compaction of Utilities*.

4) **Visual Inspection**: Visual inspections may be required by OWASA on a case-by-case basis. When required, sewer lines shall be visually inspected from every manhole by use of mirrors. The lines shall exhibit a fully circular pattern when viewed from one manhole to the next. Lines, which do not exhibit a true line and grade, have obstruction or structural defects, shall be corrected to meet these specifications and the sewer barrel left clean for its entire length.

5) **Primary test method – Low Pressure Air Test**: Sewer lines shall be **air tested** after the complete installation of all sewer services. Sewer laterals are to be tested along with main. The Contractor shall be responsible for furnishing all equipment and labor for the low pressure air test at no additional cost to OWASA.

The portion of the line being tested shall be accepted if the portion under the test meets or exceeds the requirements of ASTM F1417. This requirement shall be accomplished by performing the test as follows: the time required in minutes for the pressure to decrease from 3.5 to 2.5 psig greater than the average back pressure of any groundwater that may be over the pipe shall not be less than the time shown for the given diameters in Table I *Line Pressure Air Test Table.* If the system does not meet the foregoing requirements, the Contractor will be required to locate and repair the leaks at no cost to OWASA and repeat the tests until the allowable leakage is obtained.

Procedure:

a. **Prerequisites**

i. It is imperative that proper plugs be installed on the laterals at the cleanout stack. All plugs should be properly installed to withstand the test pressures without requiring external bracing or blocking. Before tests are made, all wyes, tees, or end of side sewer stubs shall be plugged with flexible-joint caps, or acceptable alternate, securely fastened to withstand the internal test pressures. Such plugs or caps shall be readily removable, and their removal shall provide a socket suitable for making a flexible-jointed lateral connection or extension.

ii. Air leakage testing of installed system shall be performed with a continuous monitoring gauge no less than 4 inches in diameter with minimum divisions of 0.10 psi and an accuracy of plus or minus 0.04 psi. All air used shall pass through a single, above ground control panel visible to the OWASA's Engineer.

iii. Individual air hoses shall be used from control panel to pneumatic plugs, from control panel to sealed line for introducing low pressure air, and from sealed line to control panel for continually monitoring the air pressure rise in the sealed line. After all pipes are cleaned, air shall be slowly supplied to the plugged pipe installation until the internal air pressure reaches 4.0 psig (greater than average groundwater backpressure that may submerge the pipe). Throttle the air supply to maintain that constant pressure for at least 2 minutes. The air pressure supply shall then be disconnected from the system or shut-off. Do not enter manhole during test. Do not exceed 9.0 psig in the system.

b. **Conducting the Test**

i. Observe the continuous monitoring gauge while decreasing the pressure to no less than 3.5 psig (greater than groundwater pressure). At a reading of 3.5 (adjusted), or any convenient observed pressure reading between 3.5 and 4.0 psig (adjusted), timing shall commence with a stopwatch or other timing device that is at least 99.8% accurate. Regulate the pressure for at least 2 minutes to permit the air/ground temperature to reach equilibrium before commencing test.

ii. Measure the time interval for pressure to drop 1.0 psig.

iii. If the time, shown in Table I for the designated line size and length, elapses before the air pressure drops 1.0 psig, the section undergoing the test may be discontinued once the prescribed time has elapsed even though the 1.0-psig drop has not occurred. Record all readings.

iv. If the pressure drops 1.0 psig before the appropriate time shown in Table I has elapsed, the air loss rate shall be considered excessive, and the section of pipe has failed the test. Record all readings.

v. If service lateral sewers are included in the test section, their lengths may be ignored for computing the required test times. The test will be slightly more severe. In the event a test section, having a total surface area less than 625 square feet, fails to pass the air test when lateral sewers have been ignored, the test time shall be recomputed to include all lateral.

TABLE I
Line Pressure Air Test Using Low-Pressure Air
SPECIFICATION TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP
FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q = 0.0015
(Excerpted from ASTM F1417)

1 Pipe Diameter (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.
4	3:46	597	.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33

c. **After a Failing Test**

i. If the sections fail the air test, the Contractor shall determine the source or sources of leakage and shall repair or replace all defective material and workmanship.

ii. No sealant shall be used in the newly installed sewers to correct the leaks.

iii. The extent and type of repair that may be allowed shall be subject to the approval of OWASA's Engineer.

iv. The repaired pipe installation shall be retested and required to meet the requirements of this test.

d. **Safety Note**

The air pressure test may be dangerous if, because of ignorance or carelessness, a line is improperly prepared. It is extremely important that the various plugs be installed and braced in such a way as to prevent blowouts. A force of 250 lbs is exerted on an 8-inch plug by an internal pressure of 5 psi. It should therefore be realized that sudden expulsion of a poorly installed plug, or a plug that is partially deflated before the pressure is released, can be dangerous. As a safety precaution, pressurizing equipment should include a pressure regulator set at, for example, 5 psi to avoid over-pressurizing and damaging an otherwise acceptable line. **No one shall be permitted in the manholes during testing**.

6) **Manhole Vacuum Testing**

a. **Prerequisites**

i. Manholes shall be vacuum tested as indicated below unless otherwise allowed by OWASA's Engineer. Vacuum testing shall meet ASTM C1244. Only new manholes are to be vacuum tested. Vacuum testing of existing manholes is not required.

ii. The test shall be made using an inflatable compression band, vacuum pump, and appurtenances specifically designed for vacuum testing manholes. Equipment to be manufactured by Peter A Glazier & Associates, Worcester, MA or approved equal. The Contractor shall be responsible for furnishing all equipment and labor for the vacuum test at no additional cost to OWASA.

iii. Manholes may be tested by vacuum test immediately after assembly of the manhole, frames and connecting pipes, and before any backfill is placed around the manholes. However, the final test and acceptance shall be based only upon a test after the manhole is backfilled and the cover frame castings are grouted in place. Testing devices shall be installed on the iron manhole frame.

iv. All lift holes shall be plugged with nonshrink grout and all pipes shall be plugged, taking care to securely brace the plugs and pipe. Stubouts, manhole boots, and pipe plugs shall be secured to prevent movement while the vacuum is drawn.

b. **Conducting the Test**

i. Manholes shall be tested from the top of the casting, including the casting-to-cone joint (adjusting ring).

ii. Installation and operation of vacuum equipment and indicating devices shall be in accordance with manufacturer's recommendations.

iii. After the testing equipment is in place, a measured vacuum of 10 inches of mercury (Hg) shall be established in the manhole. The time for the vacuum to drop to 9 inches of mercury shall be recorded.

iv. Acceptance standards for leakage shall be established from the elapsed time for a negative pressure change from 10 inches to 9 inches of mercury. See Table II, *Vacuum Test Table for Manholes*.

v. If a manhole joint mastic material is completely pulled out during the vacuum test, the manhole shall be disassembled and the mastic replaced.

c. **After a Failing Test**

If the manhole fails the test, the Contractor shall locate the leakage, make the proper repairs, and the vacuum test shall be repeated until the manhole passes the test. After the manholes have been backfilled and the cover frame casting sealed in place, and prior to final acceptance of the project, any signs of leaks or weeping visible from the inside of the manhole shall be repaired and the manhole made watertight and tested. The extent and type of repairs that may be allowed shall be subject to the approval of OWASA's Engineer. Leaks shall be repaired on the outside of the manhole unless approved otherwise by OWASA.

7) **Televising of Sanitary Sewers**

CCTV inspections ARE required by OWASA ON EACH NEW SEWER MAIN INSTALLED. Following placement and compaction of backfill and completion of other required testing, but prior to placing of pavement, the Contractor shall televise all sewer lines for conformance to the project drawings and specifications. The sewer main shall be cleaned prior to the TV inspection. A tape and log of the televising and a report of deficiencies as identified by a NASSCO-certified individual shall be delivered to OWASA's Engineer within a week of televising. If defective pipe or conditions are discovered, they shall be corrected at no cost to OWASA.

The television camera used for the inspection shall be one specifically designed and constructed for such inspection. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe. The camera shall be operative in 100% humidity conditions. The camera, television monitor, and other components of the video system shall be capable of producing picture quality IN COLOR to the satisfaction of the OWASA's Engineer.

The camera shall be moved through the line in either direction at a moderate rate, stopping when necessary to permit proper documentation of the sewer's condition. In no case will the television camera be pulled at a speed greater than 30 feet per minute. Manual winches, power winches, TV cable, and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions shall be used to move the camera through the sewer line.

OWASA WILL televise sewer lines prior to the expiration of the one-year warranty. If a defective condition is found, it shall be, COMPARED TO THE ORIGINAL VIDEO. IF EVIDENCE OF NO DEFECT IS FOUND IN ORIGINAL VIDEO THEN IT WILL BE presumed to be caused by defective workmanship or materials. The Contractor shall be notified and shall correct the work in a manner approved by OWASA's Engineer.

8) **Deflection Testing of Sewer Pipes**

a. Deflection tests shall be performed on all pipe installations. The test shall be conducted after the final backfill has been in place at least 30 days to permit stabilization of the soil-pipe system. As an alternative to waiting 30 days to permit stabilization of the soil-pipe system, with prior approval, OWASA may accept certification from a soil testing firm verifying that the backfill of the trench has been compacted to at least 95% maximum density.

b. **PVC Sewer Pipe Mandrel Test**: For PVC pipe, perform vertical ring deflection of all semi-rigid and flexible sewer pipe 8 inches or larger after backfilling has been in pace for at least 30 days but not longer than 12 months. Deflection shall not exceed 5% (95% of the ASTM D3034 base inside diameter). Testing shall be conducted in the presence of OWASA's authorized representative and shall utilize a mandrel go, no-go gauge complete with proving ring. Mandrel shall be approved by OWASA for this test.

   i. The mandrel device shall be cylindrical in shape and constructed with a minimum of nine evenly spaced arms or prongs. Mandrels with fewer than nine arms will not be approved for use. The "D" mandrel dimension shall carry a tolerance of plus or minus 0.01 inch. Allowance for piping wall thickness tolerances or ovality (from heat, shipping, poor production, etc., shall not be deducted from the "D" dimension but shall be counted in as part of the 5% or less deflection allowance.

   ii. The mandrel shall be hand-pulled by the Contractor in the presence of the OWASA authorized representative. The mandrel must slide freely through the pipe with only a nominal hand force applied. Any sections of the sewer not passing the mandrel shall be uncovered and the Contractor shall re-round or replace the sewer to the satisfaction of OWASA's authorized representative.

   iii. Contact length shall be measured between points of contact of the mandrel arm.

   iv. The inspector shall be responsible for approving the mandrel. Proving rings may be used to assist with this. Drawings of the mandrel with complete dimensions shall be furnished by the Contractor to OWASA for each diameter and specification of pipe.

c. Perform the test without mechanical pulling devices.

d. Allowable maximum deflection for installed plastic sewer pipe is limited to 5 percent of the original vertical internal diameter.

e. Perform deflection testing using “Go/No-Go” mandrel.

f. Measure pipe in compliance with ASTM D2122.

g. Locate, excavate, replace, and retest pipe exceeding allowable deflection.

9) **Force Mains**

a. **Order of Operations**: Fill the system with water at a velocity of approximately 1 foot per second while necessary measures are taken to eliminate all air. Do not leave fill line connected to sewer line unless an RPZ backflow preventer is placed between the potable water supply and the line being filled. AS OUTLINED IN AWWA C651.

b. **Pressure Tests & Leakage**: The Contractor shall test completed sections of line, including fittings, with water. This testing, however, does not relieve the Contractor of their responsibility to repair or replace any cracked or defective pipe. All work necessary to secure a tight line shall be performed by the Contractor. Testing shall be performed in the presence of OWASA’s Engineer and the Contractor. Cost for testing shall be incidental to line construction.

Pressure Test: The newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for two hours to a leakage test. Raise the pressure by pump to 200 psi, 150% of design working pressure, or test pressure as shown on the drawings, whichever is greater. Measure the pressure at the low point on the system compensating for gauge elevation. Maintain this pressure (+ or – 5psi) for 2 hours. If pressure cannot be maintained, determine cause, repair, and repeat the test until successful. The allowable leakage shall be no greater than allowances shown in AWWA C600. An excerpt from this chart is located at the rear of OWASA specification Section 02510 – *Water Distribution*. Contactor shall be responsible for all costs, labor, materials, and equipment to perform the testing. All visible leaks, broken or cracked pipe, valves, etc. shall be repaired.

i. **Prerequisites**

a) All pipe has been laid and the trench backfilled.

b) Valves shall be properly located, operable and at correct elevation.

c) All reaction anchors have had sufficient set of 7 days. High early strength concrete, 4500 psi or greater, may be used to reduce number of days to 4.

d) Lines shall be properly vented where entrapped air is a consideration.

e) All construction activities on the project, that requires trenching or excavation within the limits of the line location, shall be completed prior to pressure testing of line.

3.10 PUMP STATIONS AND FORCE MAINS

A. PUMP STATIONS

Pump stations and force mains will be allowed only with the permission of OWASA's Executive Director. Pump stations shall be either self-priming or submersible pumps and designed in accordance with the requirements of the NC Department of Environmental Quality, Division of Water Resources, NCAC Title 15A 2T, latest revision. Typical Pump station site layout shall conform to Standard Details 539.01 through 539.05. Lift stations shall include the following as a minimum:

1) Service head, meter base, service connection, disconnect, and area light with switch.
2) Audible and visual high-water alarm and alarm silence. High water alarm circuitry. Provide dual high-water alarm floats. The first (lowest) high water alarm float is to activate the telemetry only (not the alarm and light) to allow maintenance personnel time to arrive at site and attempt to fix the problem. The second (higher) high water alarm float shall activate the alarm horn and light.
3) Auto-dialer (minimum 8 numbers, 4 channels). The automatic telephone dialer shall be a solid-state component capable of dialing up to 8 phone numbers, each up to 24 digits in length. The dialer shall have solid state voice message recording and playback, all implemented with permanent nonvolatile solid-state circuitry with no mechanical tape mechanism.
4) Automatic air release valves, as applicable.
5) For self-priming pumps, provide air bubbler type control system with hand-off-automatic (H-O-A) switches and an automatic alternator. For submersible pumps, provide mercury float switches for level control.
6) 3-phase voltage monitor, if applicable. Indication of 3-phase power fail.
7) Suction and/or discharge gauges, as applicable.
8) Elapsed time indicators.
9) High pump temperature protection.
10) Pump run lights.
11) Motor overload resetter.
12) Surge suppressor.
13) Duplex service receptacles on GFCI installed external to the NEMA 4X enclosure.
14) Surge relief valve and return piping to wetwell.
15) Start-up assistance and certification, including operational/witness/drawdown test. Certified pump curves shall be provided as part of the project closeout documents.
16) Dual power supply auto switch-over, etc.
17) Non-Freeze Yard Hydrant (Clayton Mark model 5451 Lever type frost proof yard hydrant).
18) For self-priming pump stations, provide heaters and fluorescent lighting.
19) Non-Freeze shower w/ eyewash and concrete pad.
20) 10 ft x 10 ft x 8-inch concrete pad for water tank with drain and valve.
21) Emergency pump connection w/ blind flange and gate valve.

22) The lift station is to include back-up alarm system that operates off a 12-volt battery connection in the event of power failure. The battery system is to include a trickle charger to ensure battery integrity.

23) Provide auxiliary propane, natural gas or diesel fired automatically activated stand-by power generator source with automatic reset, placed on site. Pump manufacturer to provide power demand/ratings to Contractor before ordering pump and the power demand appropriately marked on the pump shop drawings. Generator shall have the capacity sufficient to sequentially start and run all pumps in the pump station. The Contractor shall provide a complete engine driven generator set. The generator set shall consist of four-cycle, radiator-cooled, engine direct connected to an alternating current generator, a unit-mounted control panel, all mounted on a common sub-base. The control panel shall be complete with engine controls and instruments, safety controls and panel lights including the following:

a. The generation unit shall be capable of powering the pump motors starting current, electrical systems, instrumentation/controls and alarm systems, and other auxiliary equipment as may be necessary to provide for the safe and effective operation of the pump station. The generation unit shall have the appropriate power rating to start and continuously operate under all connected loads.
b. The generation unit shall be provided with special sequencing controls to delay lead and lag pump starts unless the generating unit has the capacity to start all pumps simultaneously while the auxiliary equipment is operating.
c. The generation unit shall be capable of shutting down and activating the audible and visual alarms and telemetry if a damaging operating condition develops.
d. The generation unit shall be protected from damage when restoration of power supply occurs.
e. The generator shall be equipped with an automatic transfer switch to start generator and transfer load to emergency in case of utility undervoltage, overvoltage, power loss, phase reversal, or phase loss.
f. The control panel shall be complete with run-stop-remote switch; remote start-stop terminals; cranking limit; battery charge rate ammeter, oil pressure gauge, temperature gauge; low oil pressure shutdown; high engine temperature shutdown; over speed shutdown; AC voltmeter; voltage adjustment; frequency meter; and running time meter. The controls must indicate engine run, common engine fail, transfer switch position, low fuel level, and fuel tank leak for remote telemetry purposes. The generator shall be equipped with an automatic transfer switch to start generator and transfer load to emergency in case of utility under voltage, over voltage, power loss, phase reversal, or phase loss.
g. Circuit breakers shall be provided with a built-in control panel.
h. The manufacturer of the unit shall completely assemble and test the unit before shipment. They shall be one who is regularly engaged in the production of such equipment, and who has spare parts and service facilities. They must also provide 1 complete set of filters.
i. The controls must indicate engine run, common engine fail, transfer switch position, low fuel level, and fuel tank leak for remote telemetry purposes.
j. The automatic transfer switches must have a disconnect on the utility service main side.
k. The generator shall comply with the following minimum requirements:

i. Engine: Four-cycle, 4 cylinder, radiator cooled, at 1800 RPM. Starting shall be from batteries, with capability to start the unit at 32 degrees temperature.
ii. Generator: Rating shall be continuous standby service at 0.8 power factor, at 1800 RPM.
iii. Voltage: Three-phase, 208. KW rating to match facility needs.
iv. Engine shall be equipped with an isochronous governor as manufactured by Woodall.
v. Frequency regulation shall be less than 3-cycles from no-load to full load.

l. All accessories needed for the proper installation of the system shall be furnished. Included should be batteries, battery cables, exhaust piping, mufflers, vibration mounting, and three bound sets of detailed operation and maintenance manuals with parts list. Batteries should be lead acid.
m. The generator set shall be enclosed with a factory-installed weather-protective housing (sound abating enclosure to 68db @ 23 ft.) Housing shall provide easy access to the engine-generator and instrument panel. Muffler to be designed so exhaust is not blown or sucked across the set by cooling air.
n. Included with the generator shall be a complete fuel system consisting of a fuel tank, fuel gauge, fuel lines, fuel pumps, valves and any and all other items incidental to a first-quality installation.
o. Provide integral sub-base double-walled diesel tank. The tank is to be UL approved closed-top dike type. The tank shall also be fitted with a leak sensor device. The tank must have a capacity to run the generator for a minimum of 48 hours at 100% load.
p. Fuel tank shall consist of the fuel tank separate and contained within the frame. No generator weight is to be supported by the tank. Provide a drain plug at one end of the rupture basin. Provide vibration isolators between generator set and tank assembly. Provide fuel low-level alarm remote mounted.
q. Provide manufacturer's recommended anti-freeze and engine block heater, per manufacturer's recommendations, with thermostatic controls to maintain engine coolant at proper temperature to fulfill start-up requirements, adjustable if possible. Provide suitable trickle battery charger. All accessories shall be engine-mounted and within the weatherproof sound attenuated housing.
r. Provide annunciator panels with visual and audible alarms to monitor and warn of emergency operation conditions affecting line and generator power sources.
s. Provide stainless steel super critical grade type exhaust silencer mounted inside of the generator enclosure for corrosion protection.
t. Provide amp meter, voltmeter, and frequency meters with phase switches.
u. Provide fuses or circuit breakers for battery charger and engine.
v. Provide an automatic battery charger, static type, magnetic amplifier control with DC voltmeter, DC ammeter and potentiometer for voltage adjustment. The charger is to be completely automatic and rated for the type of battery use. The charging rate is to be determined by the state of the battery and reducing to milliamp current on fully charged battery. The charger shall be 120 V., single-phase, 60 cycle, AC input with 6-amp maximum output.
w. Operation and Maintenance instructions. The Contractor shall provide a minimum of 4 continuous hours of operation and maintenance instructions for the Owner's personnel.
x. OWASA must be furnished with one complete set of air, oil, and fuel filters.

B. PUMP CERTIFICATION

Contractor to provide a certified shop test of pump from pump manufacturer. Manufacturer’s representative shall be present at pump start-up. See paragraph H, *Pump Station Operational/Witness Test/Start-up* requirements, below.

C. WETWELL COATING

Wetwell interiors shall be coated with a two-component elastomeric, hydrophobic, corrosion resistant polyurea coating where the primer can be applied to damp or dry surfaces. Primer coat film thickness shall be 1.5 to 3 mils. The top coat film range shall be from 8 to 12 mils. Shore hardness D shall be minimum 75. Coating shall equal or exceed Duramer K-2002 by Innovative Polymer Solutions, LLC. Contractor to follow all applicable safety measures for handling and application as recommended by the Manufacturer of the coating. Comply with applicable confined space safety requirements.

D. WETWELL/VALVE VAULT HATCHES

Provide access frames and covers meeting Section 2.2.P of this specification with padlocked hasps.

E. FORCE MAINS

Force mains shall be ductile iron pipe. PVC Force mains may be approved by OWASA’s Engineer on a case by case basis. Pipe joints may be push on (provided each joint is mechanically restrained), or mechanical joint type with the appropriate restraining gland. All Fittings shall be mechanical joint with appropriate blocking and/or rodding. Force mains shall be constructed in accordance with the plans and in accordance with the requirements applicable to OWASA water main construction.

F. MANUALS/PARTS

OWASA must be furnished with 3 copies of the Operation and Maintenance and Parts Manuals for the pumps/motors and/or station, pump controls, the generator unit, and the automatic transfer switch. Also, provide a spare impeller, key, nut, washer, and mechanical seal for each pump.

G. SAFETY PLACARDS

Provide safety placards as required for structure (e.g. confined access entry) and equipment as required by OSHA shall be posted and readily visible.

H. PUMP STATION OPERATIONAL/WITNESS TEST/START-UP

1) **Witnessed Testing**: Witnessed testing shall be performed in the presence of OWASA’s Engineer and the results of the testing maintained as part of the construction record documentation. Witnessed testing shall include start-up assistance by a qualified factory representative and certification. Prior to acceptance by OWASA, an operational test of all pumps, drive, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is

safe and in optimum working condition; and conforms to the specified operating characteristics.

2) After construction debris and foreign material has been removed from the wetwell, the Contractor shall supply an adequate amount of clear water volume to operate station through several pumping cycles. Observe and record operation of pumps, suction (if applicable) and discharge gage readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment, test manual control devices, and automatic control systems. Be alert to any undue noise, vibration, or other operational problems.

3) **Drawdown Test**: The Contractor shall conduct a drawdown test to confirm that the pump is operating at or near the required design operating point and to determine the actual pumping rate of each pump. This test shall be conducted in the presence of OWASA's Engineer, the Contractor and a representative of the pump manufacturer. The rate shall be determined by subtracting the starting static surface elevation of the water in the wetwell from the "off" elevation and multiplying the difference by the volume per vertical foot of wetwell. That number shall then be divided by the number of minutes of pump run time to affect the drop measured. This test shall be performed for each pump and the rates recorded for each pump and included as part of the record in the certified pump test.

4) **Manufacturers Start-up Services**: The manufacturer's representative shall be present at pump start up. Co-ordinate station start-up with manufacturer's technical representative. The representative or factory service technician shall inspect the completed installation. They shall calibrate and adjust instrumentation, correct or supervise correction of defects or malfunctions, and instruct operating personnel in proper operation and maintenance procedures.

3.11 PIPE DESIGN LIFE

In addition to the above noted specifications, the Contractor shall secure and the manufacturer shall furnish and warrant that sanitary sewer pipe is designed for a 50-year life.

3.12 CLEANUP AND RESTORATION OF SITE

After the backfill is completed, the contractor shall dispose of all surplus material, dirt and rubbish from the site, and shall keep the site free of mud and dust to the satisfaction of OWASA's Engineer. The Contractor may be required to flush or sprinkle the street to prevent dust nuisance. It is important that clean up and restoration of the site follows the work closely. The Contractor shall dispose of surplus material and clean the street at the end of each day for the portion of work completed that day unless additional cleaning is required. After all work is completed, the Contractor shall remove all tools and other equipment, leaving the site free, clean, and in good condition.

TABLE II VACUUM TEST TABLE FOR MANHOLES BASED ON ASTM C1244					
MINIMUM TEST TIMES FOR VARIOUS manhole DIAMETERS FOR PRESSURE DROP FROM 10 INCHES TO 9 INCHES HG.					
			DIAMETER (FEET)		
Depth (FT)	**4**	**4.5**	**5**	**5.5**	**6**
			TIME (SECONDS)		
6	15				
8	20	23	26	29	33
10	25	29	33	36	41
12	30	35	39	43	49
14	35	41	46	51	57
16	40	46	52	58	67
18	45	52	59	65	73
20	50	53	65	72	81
22	55	64	72	79	89
24	59	64	78	87	97
26	64	75	85	94	105
28	69	81	91	101	113
30	74	87	98	108	121

END OF SECTION 02530

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SECTION 3 – WATER & SEWER DESIGN

(Last revised 01/01/2025)

SUGGESTED SEARCH WORDS FOR THIS SECTION

Air Release Valves
Bury of Pipes – Sewer
Bury of Pipes - Water
Combination Vaults
Dead End Lines
Design - Manholes
Design – Sewer System
Design – Water System
Fire Hydrants
Permits
Piping Material - Sewer
Piping Material - Water
Pressure/Pressure Zones
Public Easements
Pump Stations
Sewer Service Connections
Slopes – Sewer Pipes
Stream Crossings - Sewer
Water Services
Water/Sewer Crossings

1.1 GENERAL

A. SPECIFICATION AND DESIGN MANUAL

1) All projects within the jurisdiction of the OWASA shall be designed and constructed in accordance with OWASA's Manual of Specifications and Standards, latest revision.

2) Public sanitary sewer gravity mains, force mains, and lift stations shall conform to the design and construction requirements of the NC Department of Environmental Quality, Division of Water Resources, NCAC Title 15A 2T *Waste not Discharged to Surface Waters*, latest revision.

3) Public water distribution systems shall conform to the design and construction requirements of the NC Department of Environmental Quality, NCAC Title 15A, Subchapter 18C, *Rules Governing Public Water Systems*, latest revision.

4) All paving approved within an OWASA easement, such as for a greenway trail, shall be constructed in accordance with town requirements for roadway construction.

5) OWASA must maintain infrastructure in perpetuity. OWASA may require redesign of proposed projects where, in the sole discretion of the OWASA Engineer, such designs are determined to be unmaintainable.

B. PROJECT OVERVIEW REPORT REQUIREMENTS

Prior to proceeding with design, the developer's Engineer shall be required to provide a brief Project Overview Report satisfactory to OWASA'S Engineer which shall include the information outlined in the *"Procedure for Approval of Water and/or Sewer Extension Projects"* (located in this manual).

C. PERMITS

1) **Plan Approvals, Water & Sewer Permits**: Prior to commencing construction, all plan approvals and water and/or sewer permits shall be obtained. A preconstruction conference with OWASA's Inspectors must also be held prior to commencing any construction.

2) **Encroachment Permits:** An encroachment permit will be required from any Contractor or Developer wishing to excavate or place utilities on either a NCDOT or Municipal public right-of-way.

3) **Pavement Cuts**: Pavement cuts in streets shall be repaired in accordance with the specific requirements of public agency on whose street or roadway the utility is being placed, as well as any other applicable requirements dictated in the approved encroachment permit. Open cut or bored crossings shall otherwise adhere, as applicable, to **Specification Section 02275** – *Trenching, Backfilling & Compaction of Utilities.*

4) Developer must obtain all other State and Local permits, as applicable (Noise, Erosion and Sedimentation Control, Zoning, etc.)

5) Certificate of Compliance.

D. PLAN REVIEW AND OBSERVATION FEES

All plan review and observation fees must be paid prior to approval of project.

1.2 WATER SYSTEM DESIGN STANDARDS

The purpose of this module is to establish standard design procedures and criteria for water system design on systems owned and maintained by OWASA.

A. DISTRIBUTION SYSTEM

1) **General:** Distribution systems shall meet the minimum requirements of the NC Department of Environmental Quality, NCAC Title 15A, Subchapter 18C, *Rules Governing Public Water Systems*, latest revision.

a. **Water Supply System**: The subdivider shall connect the subdivision or development with the water system at their expense and shall construct it in such a manner as to serve adequately for both domestic use and for fire protection.

b. **Individual Meter Services**

i. General

Building/structure plumbing shall typically be served through a single meter. Redundant meters for improved service reliability are approvable only if each meter is sized to meet the maximum fixture unit load as determined by the NC Plumbing Code for all connected plumbing. A building/structure may be constructed with independently plumbed and metered units or floors.

ii. Private Distribution Systems and Master Meters

Connection of a private distribution system to an OWASA water main where it is otherwise feasible and reasonable to have externally-located individual meters supplied from an OWASA water main is approved at the sole discretion of OWASA. Installation of a master meter and reselling to individual units may trigger creation of a state-regulated public water system. For master-metered systems meeting the threshold for state regulation, the applicant shall provide evidence of either a permit from the NCDEQ as a public water system or a certificate from the NC Utilities Commission as a water reseller. All state regulatory requirements shall be followed before a Permit to Construct is issued or a meter is set.

iii. Domestic/Irrigation Services

a) General

Effective October 1, 2024 and consistent with North Carolina General Statute 143.355.4 designed to improve drought preparedness and response, in-ground irrigation systems shall be installed with separate irrigation meters, and no connection for the irrigation service or meter shall occur behind (on the customer-side) the domestic water meter. This requirement applies to all new irrigation services and meters regardless of the date the property was platted and recorded. Backflow requirements as provided in OWASA's *Ordinance For The Control Of Backflow And Cross-Connections* and *Cross Connection Control Manual*, latest versions, shall be followed.

b) Specific Requirements

All irrigation services must connect to the public water system and all meters must be purchased from and installed by OWASA. All work to install irrigation services which connect to the existing, in-service water lines will be performed by OWASA personnel.

Standard irrigation service for a 5/8" meter shall be accomplished using a ¾" service line tapped to the public main. There will be no 'splitting' of service from an existing ¾" domestic line to connect a new irrigation service and meter.

Only 1-inch and larger services may be tapped into or 'split' for construction of a service line and irrigation meter. One-inch services that are already being utilized as a dual service setup for domestic service (i.e. already have two 5/8" meters connected) cannot be further 'split' for installing an additional irrigation meter.

iv. **Relationship Between the Size of the Water Meter, Water Service, and Meter Box/Vault**

Meters shall be sized for the minimum, maximum, low-normal, and high-normal flow rates in conformance with AWWA M22 based on the calculated fixture loads, with documentation as to the appropriateness of the size selected included in the sealed Engineer's Report. The required water service size for different meter sizes is shown below. The meter box or vault shall be sized to match the water service.

Meter, inches	Minimum Service Size, inches
5/8", 3/4"	3/4"
1"	1"
1.5", 2"	2"
3", 4"	4"
6"	6"
8"	8"

c. No new permanent structure or pond shall be constructed over water mains or located within water easements.

2) **Design - System Design:** As part of the design, the Engineer shall model all new systems using **WaterCAD**, or compatible, software. The design data shall include a sketch of the system showing assumed minor losses, pipe roughness ("C" Constants assumed), line lengths, fixed grade node elevations, node numbers, demands, pipe numbers, time of day of field test of hydrant (static pressure converted to elevation head) for verification of starting elevation head, the static water elevation in tank at the time a static pressure reading was taken, and ground elevation of hydrant tested.

a. **Pipeline Velocity**: 3 to 6-fps normal working conditions are preferred although higher velocities in short lengths of pipe may be tolerated for brief periods.

b. **Main Size, Type and Restraint**: Water mains shall be sized in accordance with OWASA's long-range water distribution system plans. Standard main sizes in OWASA's distribution system are 4, 6, 8, 12, 16, 24, and 30 inches. On a case-by-case basis, 2-inch diameter mains may be approved by OWASA for dead end lines with less than 20 services. The minimum diameter of public water main is 2 inches.

Fire hydrants shall not be installed on mains less than 6 inches in diameter. However, the Town of Chapel Hill requires an 8" main or larger to supply fire hydrants in all new developments.

All pipe shall be Ductile Iron. All joints shall be restrained by mechanical means.

c. **Looping/Interconnectivity**: Water mains shall be designed to be looped and interconnected; OWASA's Representative shall have final approval.

d. **Valving**: Valve shall be fully accessible from ground surface by means of a valve box or manhole. All valves 16 inches and larger shall be gate valves or butterfly valves, with a preference for gate valves, unless the valve type is specified by OWASA Representative for the specific installation. The installation of 16-inch and larger butterfly or gate valves in all areas shall be rated for 250 psi working pressure. Valves shall be installed at all branches from feeder mains and between mains and hydrants according to the following schedule:

i. One 6-inch valve shall be installed on each fire hydrant leg, with additional valving as determined by OWASA for flushing and sampling new mains;

ii. Three valves at tees (excluding fire hydrant tees); and

iii. Four valves at crosses.

iv. An in-line valve shall be installed on the water line and shall not exceed the distances given below:

Line size	Distance
4, 6 or 8-inch mains	450 feet
12-inch mains	600 feet
16-inch & larger mains	1000 feet

If required when tapping an existing live main and inserting a main line valve, the main being tapped must be shut off and a valve installed (cut-in) on the existing main within close proximity to the new connection. In lieu of shutting off the existing main and cutting in a valve, OWASA's Engineer may allow an insertion valve to be placed if the former is undesirable or impractical.

e. When downsizing a main, locate a valve after the reducer on the side with the smaller diameter. However, the designer must evaluate thrust forces and accommodate the forces by placement of a thrust collar (if required) on the larger main.

f. **Manholes Valves**: Unless approved otherwise by OWASA, valves 16 inches and larger shall be placed in a minimum 6-foot diameter precast concrete doghouse manhole. The operating nut must be positioned under the manhole opening. See Standard Details 513.06 and 513.08.

g. **Concrete Blocking under Valves**: Provide concrete blocking behind and beneath valves connected to tapping sleeves. See Standard Details 512.03 and 512.04.

3) **Piping Material Applications**

a. **General:** Use pipe, fittings, and methods of joining in accordance with the following:

MATERIAL	WATER MAINS	WATER SERVICES	BACKFLOW PREVENTION BOXES/VAULTS
UNDERGROUND APPLICATIONS			
Ductile Iron	4-inch thru 48-inch	2–inch and larger	4-inch thru 48-inch
Polyethylene	4-inch thru 12-inch	Not allowed	Not allowed
Type K Soft Copper	Not allowed	¾-inch and 1-inch	Not allowed
Type K Hard Drawn Copper	2-inch only	2-inch	¾-inch thru 2-inch
PVC	2-inch	Not allowed	Not allowed
Brass Pipe	Not allowed	Short sections of 2-inch	¾-inch thru 2-inch
ABOVE GROUND APPLICATIONS			
Ductile Iron	4-inch thru 48-inch	2" DI allowed	4-inch thru 48-inch
Brass Pipe	Not Allowed	2-inch only	¾-inch thru 2-inch

4) **Joint applications:**

PIPE	JOINT TYPE	COMMENT
UNDERGROUND APPLICATIONS		
Ductile Iron Pipe	Restrained Joint	4-inch thru 48-inch
Ductile Iron Fittings	Restrained Mechanical Joint	4-inch thru 48-inch
Polyethylene	Butt-Fused	4-inch thru 12-inch
Type K Soft Copper	Flare type brass fittings	¾-inch and 1-inch
Type K Hard Drawn Copper	Sweat type with silver brazed joints	2-inch
PVC	Bell end w/ gasket	2-inch only
Brass Pipe	NPT threaded	Short sections of 2-inch
Ductile Iron	NPT threaded	2-inch only
ABOVE GROUND APPLICATIONS		
Ductile Iron	Flange Joint	4-inch thru 48-inch
Brass	NPT threaded	¾" thru 2-inch
Stainless Steel	NPT threaded	¾" thru 2-inch

a. Galvanized pipe is not permitted in the OWASA water system.

b. Provide transition couplings and special fittings with pressure equal to or exceeding the pressure rating of the pipe or fitting to which they will be either connected or fitted.

c. Do not use flanges, unions, or keyed couplings for underground piping. With the approval of OWASA's Engineer, they may; however, be used in above ground applications such as vaults.

5) **Location**: Water mains shall be located within dedicated street rights-of-way or publicly dedicated OWASA water easements (see Standard Detail 534.02).

6) **Fire Hydrants:** Fire hydrants shall not be installed on mains less than 8 inches in diameter in the Town of Chapel Hill or 6 inches in the Town of Carrboro.

a. **Fire Hydrant Location**: The jurisdiction having authority, of the fire district, shall be responsible for providing direction on the number and location of hydrants.

b. All hydrants are to be located in a street right-of-way or OWASA public utility easement.

c. **Minimum Fire Flow at Hydrants**: **Chapel Hill:** Meet local requirements of Section 7.5.2 thru 7.5.3 in the Town of Chapel Hill design manual. **Carrboro**: Meet local requirements and NFPA Regulations. **Orange County**: Meet local requirements and NFPA Regulations.

d. **Maximum Distances from Structures**

Residential: 500 by the pull of the hose method (not as the crow flies).
Commercial: 300 feet by the pull of the hose method.

e. **Minimum Distances From a Structure**: No new hydrant shall be located closer than 40 feet from a structure.

f. **Hydrant in Relation to Street**: See Standard Details 514.02 and 514.03.

g. **Hydrant Requirements for Uses Other Than Residential Single Family**: Hydrant spacing and location shall be reviewed and approved by the Fire Marshall and/or the local governing Municipality, as applicable.

h. **Hydrant Location in Relation to Siamese Connection**: A hydrant shall be placed on the "supply" side of the Siamese connection no more than 75 feet from the Siamese connection to allow the fire suppression personnel to charge the closed system. The hydrant must be completely accessible for truck pumper connection.

i. **Services on Fire Hydrant Branches**: Services on fire hydrant branches are not permitted.

7) **Pressure**

a. **Minimum System Pressure:** Water distribution mains shall be sized to provide a minimum pressure at all points within the distribution system of not less than 20 psi (gauge) during periods of peak demand (fire flow). Systems not designed for fire flows shall have the capacity to maintain a pressure of at least 30 psi (gauge) throughout the system during periods of peak flow.

b. **Pressure Zones**: OWASA's distribution system consists of two pressure zones, 740 feet and 640 feet. Interconnection of pressure zones must be approved by the Director of Engineering, and shall be separated by a zone separation check valve assembly. Contact OWASA's Engineering Department to find out in which pressure zone an existing or proposed development is located.

Connecting Varying Pressure Zones: In the case where high- and low-pressure systems are to be connected, as directed by OWASA's Engineer, as shown in detail # 513.03. An OWASA Engineer may require a sign to be erected at or near the valve denoting the valve as a "Pressure Zone Division Valve."

c. **Limits of Service Based on Pressure**

740-foot Pressure Zone: OWASA will not serve elevations above 700 feet, based on United States Geological Survey (USGS) maps, in the 740-foot pressure zone. Elevations below 565 feet (USGS) may require a pressure-reducing valve on private service lines.

640-foot Pressure Zone: OWASA will not serve elevations above 600 feet (USGS) in the 640-foot pressure zone. Elevations below 465 feet (USGS) may require a pressure-reducing valve on private service lines.

d. **Pressure Reducing Valves**: When the maximum static pressure in a new system exceeds 75 psi, businesses and/or residences shall be equipped with a pressure-reducing valve. The valve shall be located on private service lines. The installation of pressure reducing valves is covered by the NC State Plumbing Code. The pressure reducing valves are neither owned by nor maintained by OWASA.

8) **Main Depths:** Water mains shall be designed with minimum and maximum depth of cover, as provided in Section 02275, Table 02275.1.

9) **Horizontal and Vertical Blocking:** Restrained joint pipe, tie rods with restrainer glands and/or other means of restraint shall be provided at all changes in pipe direction. Concrete thrust blocking is not to be used as the primary restraining method except when making connection or taps to existing in-service mains. Caution should be exercised where the blocking may bear on other utilities or where the area behind the block may be excavated in the future.

10) **Dead End Lines:** Blowoff assemblies shall be installed at the end of all water mains and as required for flushing, as directed by OWASA's Engineer. Temporary blowoff assemblies shall be installed on lines that may be extended. Permanent blowoff assemblies shall be installed on lines that will not be extended.

The following blowoff sizes shall apply for the applicable main size:

Main Line Size	Blowoff Size Required	Blowoff Valve Size	Standard Detail Reference
Permanent Blowoff Assemblies			
4, 6, and 8-inch mains	2-inch	2-inch	514.04
12-inch mains	4-inch	4-inch	514.06
16-inch mains and larger	6-inch	6-inch	514.06
Temporary Blowoff Assemblies			
4-inch thru 24-inch	2-inch	Valve to match main size[a]	514.05

[a]A temporary blowoff shall have a full 18-foot joint of pipe between the valve and the standpipe.

The maximum length of a permanent dead end 6 and 8-inch main shall be 600 feet and 1200 feet, respectively, except as provided in cul-de-sac design. A fire hydrant is required at the dead end.

11) **Sag Vertical- Sag Blowoffs:** When directed by an OWASA Engineer, provide a sag blow-off when lines have severe sag where sediment can accumulate and retard flow in water line (such as when running beneath large streams, ditches or culverts).

12) **Crest Vertical – Air Release Valves:** Where water mains are subject to air entrapment, provide an air release valve constructed in accordance with Standard Details 513.04 and 513.05, as applicable, located at the highest elevation on the main. Where the main undulates along its length and several crests are encountered, a separate air release manhole will be required at each crest. The OWASA Engineer, before placement, shall approve the final actual location of all air release manholes. Typically, when the relative elevation difference in a water main (from the main's sag elevation to the crest elevation) is greater than 25 feet, an air release valve will be needed.

A 1-inch air release valve shall be used on water mains from 2-inches to 12-inches in diameter. A 2-inch air release valve shall be used on water mains 16 inches and larger in diameter. Refer to air release valve manufacturer's recommendations for air release sizing and quantity.

The valve shall be used to bleed air from the line as it is filled with water for testing.

13) **Vertical Upward Thrust:** Vertical upward thrust at fittings or vertically deflected joints shall be restrained with the use of an approved mechanical means. Thrust collars of adequate size and weight, pilings, or other alternative method approved by OWASA.

14) **Relation of Water Mains to Sewers**

See **Specification Section 02510** – *Water Distribution*, Part 1 - General, paragraph 1.9, *Project Conditions - Separation of Water from Sewer and Other*

Structures for separation requirements between water mains and sewer mains/structures and between water mains and other utilities/structures.

15) **Stream Crossing**

Where possible, all stream crossings shall be made below water level. Stream crossings shall be made as close to a 90-degree angle as possible. All stream crossings shall be made with ductile iron pipe. A valve shall be placed on each side of the crossing and restrained, in the event the line is lost, by anchor blocks.

Below Streambed Crossing: Underwater stream crossings shall be encased in concrete (see Standard Detail 536.08).

Above Stream Crossing: Water mains crossing streams above normal water level shall be placed above the 25-year storm elevation when practical and otherwise meet NCDWR requirements for stream crossings. Stream crossings above water level shall be constructed with I-beam supports. Pier support shall be avoided if possible. (see Standard Details 536.02 and 536.04) both methods shall have the approval of OWASA's Engineer.

"Pedestrian crossing barriers shall be required at all aerial OWASA water, sewer, and reclaimed pipe line crossings. See OWASA detail **535.01**. Exceptions (variances) to this requirement shall be granted on a case-by-case basis. All requests for variances to this requirement shall be made in writing and shall include sufficient justification and rationale necessary for OWASA staff consideration. OWASA reserves the right of final decision."

Hanger Support from Bridges: In the design of the aerial system, provide both details and calculations showing the hanger type, hanger capacity, hanger-to-bridge attachment type (mechanical or chemical) capacity with a minimum safety factor of 3. Assume the pipe is full. Provide lateral bracing of hanger to a girder or to bottom of bridge deck. Two pipe hangers per pipe joint shall be required. Provide plans showing the plan view and elevation of the water line crossing.

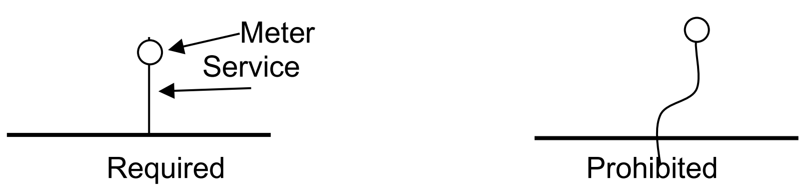
Thermal Protection, Allowance for Main Expansion: Where aerial crossings are approved by OWASA, install expansion devices as necessary to allow for expansion and contraction movement in pipe, such as on aerial bridge or creek crossings. Expansion joints are typically to be provided where the line transitions from aerial to underground. Provide calculations showing expected differential movement. To prevent freezing, provide either pipe insulation jackets that totally cover the pipe (so that the pipe and insulation is placed inside the hanger assembly) or an insulation system the covers both the pipe and hanger assembly.

16) **Taps:** taps shall be made in accordance with the following table:

Service Size	Type Tap Allowed	Standard Detail Reference	Comments
¾-inch and 1-inch	Single or Double Strap Bronze saddle	515.01, 515.02, & 512.06	Direct taps are not permitted
1 ½-inch	Not allowed	-	1 ½-inch water meters shall be served by 2-inch taps with 2-inch service lines.
2-inch	Double strap bronze saddle	515.04	None
3-inch	Not allowed	-	3-inch water meters shall be served by a 4-inch tap with 4-inch service lines.
4-inch thru 12-inch	Tapping sleeve & valve	512.04	None

17) **Water Services**

General: A water service shall be provided for each lot. The meter box shall be located 1 foot from the back of the curb, within the public right of way (see Standard Detail 515.01 and 515.02). Services shall be placed perpendicular to the main and shall not meander or snake in such a manner as to offset the meter from its main connection point (see schematic below). The meter box shall be set flush with the finished grade and shall not be installed in a ditch slope. In situations where the meter box is located outside of the public right-of-way, an easement shall be provided to OWASA.



For multi-family housing, individual water meters are recommended.

Meter Location – Double Frontage Lots: If a lot fronts on 2 or more streets, the meter shall front the same street as the lot's address.

18) **Combination Vaults:** Vaults shall be designed and constructed to provide minimum clearances between the pipe, fittings or vault walls per the dimensions prescribed in the applicable OWASA vault detail(s). *See the applicable detail for the particular type application proposed.*

19) **Multiple Feeds and Cross-Connection Prevention:**

Buildings/Structures with multiple feeds shall be installed in accordance with OWASA's *Cross-Connection Control Ordinance and Manual*. See Standard Details 515.06 through 515.11.

20) **Testing**

General: OWASA will provide water for testing purposes on water mains. Refer to technical **Specification Section 02510** – *Water Distribution*, paragraph 3.4, *Testing, Disinfection and Sampling* for required testing requirements and methods. Testing of completed water mains shall include the following:

a. Hydrostatic Testing.

b. Chlorination and Bacteriological Test; HPC Test.

21) **Public Easements:** The width of easements (except when adjacent and parallel to right-of-way) shall be based on the following, with the pipe centered in the easement:

Water Lines	Min. Easement Width (feet)
Water Easements	**30**
Combinations Easements (Water with Either Sewer or Storm Drainage)	**40**

If adjacent and parallel to a right-of-way, sufficient easement shall be added to ensure that the right-of-way plus easement provides the minimum public easement width required.

Consideration shall be given for deeper cuts (generally greater than 12') by including an additional temporary construction easement (usually 10' - 20'). OWASA's Engineer may require that the width of the permanent easement increase with a depth of sewer as determined by OWASA's Engineer for maintenance purposes.

Easements shall be fully accessible by rubber-tired vehicles in their entirety, with a maximum grade of 4:1.

OWASA may require stream fords for larger streams provided crossings are consistent with NCDEQ Division of Water Resources and USACOE requirements.

All road paving approved within an OWASA easement, such as for a greenway trail, shall be constructed in accordance with town roadway construction requirements to accommodate OWASA vehicles.

All easements shall be acquired by the developer and dedicated to OWASA by recorded map and by deed of easement prior to approval of the project for construction. Such easements are to be recorded as "Orange Water and Sewer Authority Water Easement."

1.3 GRAVITY COLLECTION SYSTEM DESIGN STANDARDS

The purpose of this module is to establish standard design procedures and criteria for sewer system design on systems owned and maintained by OWASA.

A. GENERAL

Gravity Collection systems shall generally meet the minimum requirements of the State of North Carolina Department of Environmental Quality, NCAC Title 15A 02T *Waste Not Discharged to Surface Waters*, latest revision. Any additions, deletions, or changes from the OWASA approved plan set must be submitted to OWASA's Engineer for approval, prior to making changes in the field.

B. DEFINITIONS

1) **Definitions**: For the purposes of this specification, the following definitions refer to sanitary sewer collection systems that come under the authority of OWASA as specified within this section and other sections of this manual.

   a. **Main or Trunk Sanitary Sewer**: Exterior gravity sanitary sewer systems receiving flow from one or more lateral or mains.

   b. **Sewer Service**: Exterior domestic sewer piping serving a private residence, business, commercial facility or industrial user.

   c. **Interceptor**: Sewer that receives flow from a number of gravity mains or trunk sewers, usually placed along a stream or river.

2) The following are industry abbreviation for various pipe materials:

   DIP: Ductile Iron Pipe

   PVC: Polyvinyl Chloride Plastic

C. COLLECTION SYSTEM DESIGN

1) **Minimum Size/Sizing:** No public gravity sewer conveying wastewater shall be less than 8 inches in diameter. No private gravity sewer conveying wastewater shall be less than 6 inches in diameter.

2) **System Design:** The system is to be designed taking into account the total natural drainage basin, land use, ultimate population estimates, maximum anticipated commercial and industrial contribution, infiltration and a 50-year design period. The capability of the downstream sewers to accept the future flow tributary to the collections system shall be evaluated by the design engineer. Sewer size shall be based on an average daily flow of 100 gpcd (gallons per capita per day) and a

peak/average ratio of 2.5. The ratio includes an allowance for infiltration but not inflow.

The following table should be used as a general guide for determining the equivalent persons per acre and the peak flow for various zones.

Zoning	Equivalent Person/Acre	Average Flow (gal/acre/day)	Peak Flow (gal/acre/day)
R-2	5	500	1,250
R-4	8	800	2,000
R-6	14	1,400	3,500
R-10	21	2,100	5,250
Shop Center	18	1,800	4,500
Bus/Commercial	25	2,500	6,250
Office & Institution (light)	13	1,300	3,250
Office & Institution (heavy)	30	3,000	7,500
Industrial	50	5000	12,500

[a]Table from the City of Raleigh Public Utilities Handbook

3) **Developments:** Wastewater flows for developments with localized sewers shall be determined in accordance with NCAC Title 15A 02T.

4) **Design Flow Depth:** It is customary to design sanitary sewers with some reserve capacity. Generally, sanitary sewers through 15 inches in diameter are designed to flow half full. Larger sanitary sewers are designed to flow three-fourths full. These factors include infiltration but exclude inflow. If inflow is anticipated or known to exist in upstream sewers, OWASA's Engineer may require that the design flow be increased accordingly, and the justification/computation/source referenced in the design calculations and provided to the OWASA's Engineer for review.

5) **Main Depths:** The depth of sewer mains shall be great enough to serve adjoining property, allowing for sufficient grade on service lines. Main depth shall also take into consideration potential conflicts with parallel pipe systems (such as water mains and storm drainage lines), providing room for the service laterals to pass either over or below lines. Minimum and maximum bury depth is per Section 02275, Table 02275.1.

6) **Extensions to Adjacent Property:** Where tributary flow is expected from an upstream natural drainage basin, designers shall provide easements for future extensions of sewer mains to the farthest property line of the tract. Manhole inverts shall be set sufficiently low to serve the upstream basin by gravity to the extent possible.

7) **Location:** All sewer mains shall be installed within the street right-of-way or within a dedicated OWASA sewer or utility easement (see Standard Detail 534.02). When located in street right-of-way, the sewer main shall be in the center of the pavement or right-of-way, as practical.

8) Plan Requirements:

   a. Manhole number and station.
   b. Manhole top and invert elevations.

c. Benchmark reference (elevations must be tied to mean sea level reference datum).

9) **Slope**

a. **General**: All sewers shall be designed and constructed to give mean self-cleansing velocities of not less than 2.0 feet per second, based on Manning's formula using an "n" value of 0.013 – this includes evaluating sewers flowing partly full. The following are the minimum slopes that shall be provided; however, slopes greater than these are recommended.

Minimum Slope for Gravity Sewers (15A NCAC 2T)	
Sewer Size (inches)	Minimum Slope (%)
8	0.40
10	0.28
12	0.22
15	0.15
16	0.14
18	0.12
21	0.10
24	0.08

b. **Uniform Slope Between Manholes**: Sewers shall be designed with uniform slope between manholes.

c. **Slope Increase**

i. On upper reaches of small services and mains, due to water saving fixtures now employed, the designer should give consideration to increasing the slope of gravity services above the minimum allowed in order to flush solids.
ii. Special attention must be given to the early years that the new public system is used, as initial flows may be substantially lower than design flows and the velocities well below the minimum. The designer or OWASA's Engineer may direct usage of greater slope.

d. **Pipe Size Increase**: Sewers shall not be oversized to justify flatter slopes. If the minimum scouring velocity cannot be maintained during initial operation prior to the design flow capacities being reached, the designer may be required to periodically flush the system until volume has increased to affect a self-cleansing velocity.

e. **Maximum Slope**: Maximum grade for sanitary sewers is 20%. Maximum grade for sanitary sewers in casing pipe is 5%.

f. **Steep Slope Protection**: Any time the grade is 20% or more, concrete collars shall be provided to prevent creep and/or to prevent water from flowing along the pipe and causing trench scour. Manholes shall be protected from corrosion generated by release of hydrogen sulfide gas from high turbulence associated with line velocity. See Standard Detail 536.01.

g. **High Velocity Protection**: Where design velocities are projected to be greater than 10 fps, the sewers and manholes shall be protected against displacement by erosion and impact. Pipe shall conform to ASTM, AWWA, ANSI, etc., which provide protection against erosion. For velocities greater than 20 fps, erosion control measures shall be documented on the "Record Drawings" and in the Engineer's Certification.

h. **Sewers Placed in Predominantly Silty Soils**: The designer should give consideration to placing either clay or concrete collars (dams) periodically along sewers constructed in and backfilled predominantly with silty soils – regardless of slope. A non-woven separation geotextile fabric should be placed between the stone and the earthen backfill.

10) **Alignment:** All sewers shall have a straight alignment between manholes.

11) **Changes in Pipe Size or Material**

a. **Pipe Size Changes**: Gravity sewer sizes shall remain constant between manholes. Pipe size changes shall occur only at manholes. When a smaller sewer joins a larger one, the inverts of the sewers shall be arranged to maintain approximately the same energy gradient whenever possible. 0.8 times the pipe diameter of the two lines shall match.

b. **Undersized or Substandard Downstream Sewers**: Sewer extensions shall be designed for projected flows even when the diameter of the receiving sewer is less than the diameter of the proposed extension at a manhole, with special consideration of an appropriate flow channel to minimize turbulence when there is a change in sewer size. Justification shall be provided at the end of the project with the as-built drawings indicating that the capacity of the downstream sewer will not be overloaded by the proposed upstream installation. OWASA reserves the right to prohibit additional flow into an undersized sewer for new growth.

c. **Pipe Material Changes**: To avoid couplings of dissimilar material, pipe material must remain consistent between manholes and may not be changed. The manhole drop material should conform to Standard Detail 532.03.

12) **Uneven Inverts of Parallel Pipe Lines in Same Trench**: Where more than one pipe line is laid in the same trench and the invert elevations are not identical, and where no concrete cradle or encasement is provided for the support of the high pipe line, its foundation shall be considered to be yielding. When bridging is required to support a portion of the pipeline over such yielding trench bottom, it shall not be considered to provide bridging strength. #57 stone shall be provided and used for this purpose.

13) **Buoyancy:** Buoyancy of sewers shall be considered, and flotation of the pipe shall be prevented with appropriate construction where shallow cover and/or high groundwater or flooding conditions are anticipated. For design purposes, assume water to top of pipe and pipe is empty.

14) **Service Connections**

a. Services connected to gravity sewers shall be connected using in line wyes or saddles. Service saddles may be used only on existing sewer mains. Tees/wyes shall be used for new construction. See Standard Detail 534.01 for service tap detail.

b. Four-inch sewer services are to be connected to the OWASA main except for cul-de-sacs, where connection to manholes is permitted. There must be a minimum of 5 feet between any manhole and the tap for a service connection. A minimum of three feet is required between service taps.

c. A cleanout will be installed on each house service. Unless topography permits otherwise, services are to be placed at the low side of the lot. The cleanout shall be located at the right-of-way or easement line on the customer's side of the right-of-way or easement line. An access port is to be set over the cleanout.

d. Minimum grade for 4-inch and 6-inch services shall be in accordance with the North Carolina State Plumbing Code, latest revision.

e. **Service Connections to Manholes**: All 6-inch and larger sewer services shall be connected to a manhole, with a maximum of four services per permanent dead-end manhole and three per manhole for all others. The angle of entry shall be 90 degrees or greater from the invert out. When connecting to manholes, services are to connect to the manhole within 18 inches of the invert. A service connection may not enter the cone or its joint. When a new manhole is anticipated to serve future upstream development, service connections shall be installed providing sufficient space to accommodate the sewer main.

f. Vertical stacks or standpipe services are not allowed.

g. **Services on Utility Easements**: Cleanouts, shall be located at the easement line, must be at ground level and in a sewer cleanout box in accordance with Section 3 (See Standard Detail 534.01).

h. Inspection by CCTV with video clearly demonstrating fitness for service is required before a sewer service may be reused for a new building or for a new business in an existing building or structure. If it is in disrepair, the lateral shall be repaired or replaced.

i. Connection of a private collection system to an OWASA sewer main where it is otherwise feasible and reasonable for individual sewer laterals to flow by gravity to an OWASA sewer main is approved at the sole discretion of OWASA. All state regulatory requirements, including those for projects not "deemed permitted" under 15A NCAC 18C 02T, shall be met before an OWASA Permit to Construct is issued.

15) **Public Easements:** The width of easements (except when adjacent and parallel to right-of-way) shall be based on the following, with the pipe centered in the easement:

Sewer Lines	Min. Easement Width (feet)
Sewer Easements	30
Combinations Easements (Sewer with Either Water or Storm Drainage)	40

If adjacent and parallel to a right-of-way, sufficient easement shall be added to ensure that the right-of-way plus easement provides the minimum public easement width required.

Consideration shall be given for deeper cuts (generally greater than 12’) by including an additional temporary construction easement (usually 10’ - 20’). OWASA’s Engineer may require that the width of the permanent easement increase with a depth of sewer as determined by OWASA’s Engineer for maintenance purposes.

Easements shall be fully accessible by rubber-tired vehicles in their entirety, with a maximum grade of 4:1.

OWASA may require stream fords for larger streams provided crossings are consistent with NCDEQ Division of Water Resources and USACOE requirements.

All easements shall be acquired by the developer and dedicated to OWASA by recorded map and by deed of easement prior to approval of the project for construction. Such easements are to be recorded as "Orange Water and Sewer Authority Sanitary Sewer Easement.”

16) **Testing:** See **Specification Section 02530** – *Sanitary Sewer*; paragraph 3.9 *Testing* for testing requirements.

17) **Allowable Leakage**: **100 gallons** per inch nominal diameter per mile of pipe per 24 hours. A weir flow test will not be allowed in lieu of a pressure test.

D. DESIGN – MANHOLES

1) **Location**

a. **General**: Manholes shall be installed on all mains 8 inches and larger. Manholes shall be installed at the end of each line, at all changes in grade, at changes in main size or alignment, at all intersections.

b. **Spacing**: Manholes shall be placed at distances not greater than 400 feet for all public sewer mains.

c. **Cleanouts:** Cleanouts may be used in lieu of manholes on 4 and 6-inch private lines with distances between cleanouts not exceeding 75 feet.

2) **Diameter**

a. **Minimum Diameter**: The minimum diameter of both standard and drop manholes shall be 4 feet.

b. **Manhole Diameter Based on Pipe Size**:

Line Size	Minimum Diameter
8 through 12 inches	4-foot in diameter
16 through 24 inches	5-foot in diameter

c. **Manhole Diameter Based on Depth**:

Depth	Minimum Diameter
Manholes 0 to 10'-0"	4-foot in diameter
Manholes greater than 10'-0" deep	5 feet in diameter

5-foot diameter manholes below 10 feet in depth may have a 5 x 4 transition slab, transitioning to 4-foot diameter, after a minimum of 6' of riser (height) from invert of manhole.

d. **Extended Bases**: Manholes over 12 feet in depth, as measured from top of casting to effluent invert, shall have extended bases with appropriate reinforcing.

e. **Cones**: Eccentric cones are required to be used on all mains.

f. **Minimum Drop Across Invert**: For an 8-inch main, the minimum drop between manhole invert in and invert out is 0.24 feet for a 4-foot diameter manhole and 0.30 feet for a 5-foot diameter manhole. Other drops (H), where there is no change in pipe size, can be computed by applying the following headloss (K) coefficients to the velocity head:

$H = K\left(\frac{V^2}{2g}\right)$, where

H = Vertical drop across invert of manhole (ft)
K = Headloss coefficient (from table below)
V = Average velocity in influent pipe (ft/sec)
g = Acceleration of gravity (32 ft/sec^2)

Condition	K
For bends at junctions of 25 degrees	0.30
For bends at junctions of 45 degrees	0.40
For bends at junctions of 90 degrees	0.60
For junctions of 3 pipes	0.80
For junction of 4 or more pipes	1.00

(Reference: King's handbook of Hydraulics)

3) **Drop Type**

a. An outside drop shall be provided for a sewer entering a manhole at an elevation greater than 18 inches above the invert of the manhole unless sewer pipe crown elevations match. See Standard Detail 532.03.

b. **Inside Drops:** Not permitted.

c. **Service taps in manholes**: If a service is proposed in the manhole, service must be installed at the bottom of the manhole.

4) **Water-Tightness**

a. Manholes shall be pre-cast concrete. **Infi-Shield**® Gator Wrap external sealing systems, as manufactured by Sealing Systems, Inc. and a butyl rubber seal, are to be placed on the exterior joints of manholes. **Infi-Shield**® Uniband and a buytl rubber seal shall be placed at the top of manholes where the iron casting mates with the precast concrete cone section and/or grade rings. See Standard Details 532.01, 532.03, 532.05, 532.06, and 532.08.

b. **Pipe connections to Manholes**: Inlet and outlet pipes shall be joined to the manhole with gasketed flexible watertight connections (rubber boots). See Standard Details 532.01 and 532.03.

c. **Manholes in streets or adjacent to streets**: Manholes subject to be flooded by street water or located in flood prone areas shall have watertight covers.

d. **All sanitary sewers in utility easements** (other than those running parallel to creeks and/or located in a flood plain): All manholes rims must be a minimum of 12-inches above grade.

e. **Sanitary Sewer Easements running parallel to creeks and/or located in flood plains:**

Manholes shall be designed for protection from the 100-year flood by one of the two methods:

i. Manholes shall be watertight and vented 24 inches above the 100-year base flood elevation. Manholes shall be vented every 1000 feet or every 3rd manhole, whichever is lesser. Maximum vent spacing shall not exceed 1000 feet on watertight sections of main. See Standard Detail 532.05, or
ii. Manholes rims shall be 24 inches above the 100-year base flood elevation.
iii. Odor control apparatuses may be required.

5) **Buoyancy**

Buoyancy shall be considered and flotation of the manholes shall be prevented with appropriate construction where high groundwater or flooded conditions are anticipated. For design purposes, assume water to top of manhole and that the manhole is empty.

6) **Corrosion Protection For Manholes**

a. Where corrosive conditions due to septicity or other causes are anticipated, consideration shall be given to providing corrosion protection on the interior of the manholes. Consequently, drops in interceptor lines or drops into interceptor lines <u>shall</u> be avoided. Drop manholes, if required, shall be provided upstream of interceptor line connection.

b. Where high flow velocities are anticipated, the manholes shall be protected against internal corrosive erosion and displacement from impact.

7) **Inspection And Testing**

See technical Specification Section 02530 – *Sanitary Sewer* for manhole testing requirements.

8) **Manhole Numbering/Annotation:**

a. **All Sanitary Sewers**: All manholes located in utility easements shall be labeled. OWASA will provide the number(s) to the Developer/Contractor.

b. **All Manholes Located in Utility Easements Running Parallel to Creeks**: Where overgrowth is likely to occur in utility easements running parallel to creeks, as determined by OWASA's Engineer, the manholes located in these easements shall have a sign marker. The sign marker is to be provided by the Developer. The marker shall be comprised of a standard steel signpost (3 lbs/ft) with a 3½" wide flange, 12 feet long. The post shall extend 10-feet out of the ground with a minimum of 2-feet of the post buried. The sign marker shall be a standard 18" x 24", 0.080" aluminum blank with the 24" dimension of the sign set horizontally.

c. **For Those Manholes Located in Utility Easements but Not Running Parallel to Creeks:** The number shall be stenciled on the manhole.

9) **Inspection And Testing**

See technical Specification Section 02530 – *Sanitary Sewer* for manhole testing requirements.

E. SEWERS IN RELATION TO STREAMS AND OTHER BODIES

Creek crossings shall be in accordance with OWASA's "Policy on Extension of Sewer Mains and Sewer Laterals." All creek crossings, unless otherwise approved by OWASA, shall be made with ductile iron pipe.

1) **Materials**: Sewers entering or crossing streams shall be constructed of ferrous material pipe with mechanical joints; otherwise they shall be constructed so they will remain watertight and free from changes in alignment of grade and tested to 150 psi. PVC pipe may be used where a minimum of three feet of cover can be maintained. Material used to backfill the trench shall be stone, coarse aggregate, washed gravel or other materials, which will not readily erode, cause siltation, damage pipe during placement, or corrode the pipe.

a. **Sewers Paralleling Creeks**: Sewers paralleling creeks shall be below the stream elevation, such that lateral connections will be below streambed. In certain circumstances where rock is present, sections of the main may be raised to allow lateral connections above the stream bed provided the ability to serve the upstream property is not compromised and the pipe crossing is designed sufficiently restrained to prevent line breakage by the dynamic effects of the stream flow. Sewers shall be placed outside of applicable Watershed and River Buffers.

b. **Perpendicular Crossings**: Creek crossings shall be as near to perpendicular to the stream as possible.

2) **Buried Pipe Cover Depth**: The top of all sewers entering or crossing streams shall be at a sufficient depth below natural bottom of the streambed to protect the sewer line. The following cover requirements shall be met:

   a. One foot of cover where the sewer is located in rock:

   b. Three feet of cover in other material. In major streams or rivers, more than three feet may be required; and

   c. With approval of OWASA's Engineer, in paved stream channels, the crown of the sewer line may be placed below the bottom of the channel pavement.

   d. With approval of OWASA's Engineer, less covering will be considered if the proposed sewer crossing is encased in concrete (see Standard Detail 536.08) provided the encasement will not interfere with future improvements to the stream channel. Alternatively, the sewer shall be designed as an aerial crossing in accordance with Paragraph 3.

3) **Aerial Crossings**

   a. Aerial crossings require prior approval of OWASA. See Standard Details 536.02, 536.04 and 536.06, as applicable.

   b. Creek crossings above water level shall be constructed with I-beam support carriage. If piers are necessary, approval shall be obtained from OWASA. The bottom of the pipe should be placed no lower than the elevation of the 25-year flood. Ductile iron pipe with mechanical joints shall be required. In the event the 25-year flood elevation cannot be determined or the proposed gravity sewer must be placed below the 25-year elevation, the applicant (for both private and public sewers) will have to issue a certification stating: *"Regular and proper inspection and maintenance of the aerial crossing shall be provided to ensure that the creek/stream flow is not impeded and that no damage will be caused to upstream or adjacent properties*."

   Pedestrian crossing barriers shall be required at all aerial OWASA water, sewer, and reclaimed pipe line crossings. See OWASA detail **535.01**. Exceptions (variances) to this requirement shall be granted on a case-by-case basis. All requests for variances to this requirement shall be made in writing and shall include sufficient justification and rationale necessary for OWASA staff consideration. OWASA reserves the right of final decision."

   c. Proper joint technology, such as flanged or restrained, adequate supports to prevent excessive deflection and flexion or a combination of both shall be provided for all aerial pipe crossings. Supports shall be designed to prevent heave, overturning, uplift, and settlement. Supports shall be designed to withstand the hydrodynamic effects of the stream flow pressure using the following formula:

$$P = 1.5KV^2$$

Where,

- P = pressure, psf
- **1.5** = safety factor against overturning (2.5 is recommended),
- V = velocity of water, fps
- K = 4/3 for square ends, ½ for angle ends when angle is < 30° or less and 2/3 for circular piers.

If it is probable that the aerial pipe could be submerged by the stream flow, the effects of the flow pressure on the pipe shall also be taken into account when computing pier-overturning moments. For aerial stream crossings, the impact of floodwaters and debris shall be considered. In streams subject to flooding velocities greater than 5 fps, pipe crossing shall be anchored in bank in such a way that if all supports are lost, the pipe system will not separate and will be restrained by anchor blocking of appropriate size in the bank. Provide applicable blocking computations and details.

c. Precautions against freezing, such as insulation and increased slope, shall be provided.

d. Expansion jointing shall be provided between above ground and below ground sewers. Where buried sewers change to aerial sewers, special construction techniques shall be used to minimize heaving. Similarly, special details may be required between above ground and below ground sewer transition to account for seismic forces.

e. **Computations**: Provide structural calculations for any elevated main and pier system where span of the main exceeds the joint length. Provide calculations for all aerial mains, and their supporting structures that are subject to hydrodynamic forces. Calculations are to provide for a minimum safety factor of 2.5 against overturning and 1.5 for uplift. Calculations shall also address applicable seismic loads if applicable. Where stream is subject to floating debris such that the pipe system could be broken or separated by the impact forces, pipe joints shall be flexible restrained joints. Pipe crossing shall be anchored in bank in such a way that if all supports are lost, the pipe system will not separate and will be restrained by anchor blocking in the bank. Provide applicable blocking computations and details for review.

f. **See** Standard Details 536.02, 536.03, 536.04**,** and 536.06**.**

4) **Structures**: The sewer interceptors, manholes, or other structures shall be located so they do not interfere with free discharge of flood flows of the stream. Portions of manholes above grade subject to hydrodynamic forces of flooding shall be designed to resist the flood forces with a safety factor of 2.5 considerations shall be given for impact from debris. See paragraph C above.

5) **Anti-Seepage Collars – Wetland Areas**: In areas where the sewer trench has the potential to drain wetlands, anti-seepage collars shall be installed. In these areas, a US Army Corps of Engineers 404 Wetland Permit and/or a NCDEQ 401 Water Quality Permit may be required.

6) **Environmental - Buffer Requirements**: A minimum buffer separation of 50 feet shall be maintained between sewers and streams/waters classified as nutrient

sensitive streams or watershed buffers (from normal high water). See also NCDEQ NCAC Title 15A 02T for other requirements regarding minimum separation with streams, lakes and impoundments. Before crossing streams or ditches, working within 100 feet of private or public water supply sources or 50 feet of non-water supply ponds, lakes, or rivers, the Designer shall verify whether either the line is exempt or obtain a permit to encroach into a watershed or nutrient sensitive river basin buffer. Unless otherwise permitted, water or sewer mains crossing a stream, river, pond, or lake buffers are to be as near perpendicular as possible (the crossing is considered to be perpendicular if it intersects the stream or surface water between an angle of 75 and 105 degrees). Do not disturb more than 40 linear feet (longitudinal) of a riparian buffer. Adhere to all of the following Best Management Practices in Zone 1 (the lower 30 feet beside the stream or water) during design/construction.

a. Woody vegetation is to be cleared by hand. No grading allowed.
b. Stumps to remain except in trench where trees are cut. Minimize disturbance to roots in buffer zone.
c. Backfill trench with the excavated soil immediately following installation.
d. Do not use fertilizer except for the one-time application to reestablish vegetation.
e. Minimize removal of woody vegetation, the amount of disturbed area, and the time the disturbed area remains disturbed.
f. Take measures to ensure diffuse flow of water through the buffer after construction.
g. In wetland areas, use mats to minimize soil disturbance.

F. PROTECTION OF POTABLE WATER SUPPLIES AND STORM SEWERS

1) **General**: See Specification Section 02530 – *Sanitary Sewer*, Part 1 - General, paragraph 1.10, *Project Conditions – Separation of Sanitary Sewer and Appurtenances from Water Mains and Other Structures* for separation requirements between water mains and sewer mains/manholes and water mains and drainage structures/streams.

2) **Sewer/Well Conflict**: If a sewer main must be placed closer than 100 feet of the well, ferrous sewer pipe with joints equivalent to NCDWR water main standards shall be used; however, no gravity sewer, force main, or manhole structure shall pass or be placed within 25 ft of a private well or 50 feet of a public water supply well, source or structure. If the sewer line must be installed within 25 feet of a well, the well shall be capped and the property shall be required either to connect to OWASA's water system, if available, or the existing well must be abandoned according to NCAC Title 15A 2C .0100 *Well Construction Standards*, latest revision, regarding guidelines for well abandonment and construction of a new well drilled meeting the setback requirements.

G. PUMP STATIONS

1) **General**

Pump stations and force mains will be allowed only with the permission of OWASA's Executive Director.

Pump stations shall be OWASA standard. Pumps may be either self-priming or submersible grinder pumps with electro-mechanical controls. Pumps shall be designed for continuous duty pumping raw, unscreened wastewater.

Self-priming pumps: **USE OF THESE PUMPS MUST BE APPROVED BY THE OWASA REPRESENTITIVE.** Self-priming pumps shall have bubble system switches. Pumps and related controls shall be enclosed in a rollback "Quonset" style fiberglass enclosure. Pumps shall be capable of handling a 3-inch solid and any trash or stringy material that can pass through a 4-inch hose unless mechanical means of solids reduction is installed at the pump. Pumps shall be made non-clog by passing solids, trash, and stringy material through a non-clog impeller. Impellers shall have blades that are generally forward rounded or otherwise configured to avoid catching solids, trash, and stringy material.

Submersible Pumps: Submersible pumps shall have mercury float control switches with electro-mechanical controls. See Standard Detail 539.01 for typical pump stations site layout. Pumps shall be capable of handling a 3-inch solid and any trash or stringy material that can pass through a 4-inch hose unless mechanical means of solids reduction is installed at the pump. Pumps shall be made non-clog either by passing solids, trash, and stringy material through a non-clog or vortex-type impeller or by grinding, chopping, or cutting them prior to passing them through the impeller. Impellers shall have blades that are generally forward rounded or otherwise configured to avoid catching solids, trash, and stringy material.

Lift stations shall include the following as a minimum:

a. Service head, meter base, service connection, disconnect, and area light with switch.
b. Audible and visual high-water alarm and alarm silence.
c. Auto-dialer (minimum 8 number, 4 channel). The automatic telephone dialer shall be a solid-state component capable of dialing up to 8 phone numbers, each up to 24 digits in length. The dialer shall have solid-state voice message recording and playback, all implemented with permanent nonvolatile solid-state circuitry with no mechanical tape mechanism. and playback, all implemented with permanent nonvolatile solid-state circuitry with no mechanical tape mechanism.
d. Automatic air release valves, as applicable.
e. For self-priming pumps, provide air bubbler type control system with hand-off-automatic (H-O-A) switches and an automatic alternator. For submersible pumps, provide mercury float switches for level control.
f. High water alarm circuitry.
g. 3-phase voltage monitor, if applicable. Indication of 3-phase power fail.
h. Suction and/or discharge gauges, as applicable.
i. Elapsed time indicators.
j. High pump temperature protection.
k. Pump run lights.
l. Motor overload resitter
m. Surge suppressor.
n. Duplex service receptacles on GFCI.
o. Surge relief valve and return piping to wetwell.
p. Start-up assistance and certification, including operational/witness/drawdown test. Certified pump curves shall be provided as part of the project closeout documents.
q. Dual power supply auto switchover, etc.

r. For self-priming pump stations, provide heaters and fluorescent lighting.

s. The lift station is to include back-up alarm system that operates off a 12-volt battery connection in the event of power failure. The battery system is to include a trickle charger to ensure battery integrity.

t. Provide auxiliary, natural gas or diesel fired automatically activated stand-by power generator source with automatic reset, placed on site. Pump manufacturer to provide power demand/ratings to Contractor before ordering pump and the power demand appropriately marked on the pump shop drawings. Generator shall have the capacity sufficient to sequentially start and run all pumps in the pump station. The Contractor shall provide a complete engine driven generator set. The generator set shall consist of four-cycle, radiator-cooled, engine direct connected to an alternating current generator, a unit-mounted control panel, all mounted on a common sub-base. The control panel shall be complete with engine controls and instruments, safety controls and panel lights including the following:

   i. The generation unit shall be capable of powering the pump motors starting current, electrical systems, instrumentation /controls and alarm systems, and other auxiliary equipment as may be necessary to provide for the safe and effective operation of the pump station. The generation unit shall have the appropriate power rating to start and continuously operate under all connected loads.
   ii. The generation unit shall be provided with special sequencing controls to delay lead and lag pump starts unless the generating unit has the capacity to start all pumps simultaneously while the auxiliary equipment is operating.
   iii. The generation unit shall be capable of shutting down and activating the audible and visual alarms and telemetry if a damaging operating condition develops.
   iv. The generation unit shall be protected from damage when restoration of power supply occurs.
   v. The generator shall be equipped with an automatic transfer switch to start generator and transfer load to emergency in case of utility under voltage, over voltage, power loss, phase reversal, or phase loss.
   vi. The control panel shall be complete with run-stop-remote switch; remote start-stop terminals; cranking limit; battery charge rate ammeter, oil pressure gauge, temperature gauge; low oil pressure shutdown; high engine temperature shutdown; over speed shutdown; AC voltmeter; voltage adjustment; frequency meter; and running time meter.
   vii. Circuit breakers shall be provided with a built-in control panel.
   viii. Provide manufacturer’s recommended anti-freeze, engine heaters, and suitable trickle battery charger. All accessories shall be engine-mounted and within the weatherproof sound attenuated housing.
   ix. The manufacturer of the unit shall completely assemble and test the unit before shipment. They shall be one who is regularly engaged in the production of such equipment, and who has spare parts and service facilities. They must also provide 1 complete set of filters.
   x. The controls must indicate engine run, common engine fail, transfer switch position, low fuel level, and fuel tank leak for remote telemetry purposes.
   xi. The automatic transfer switches must have a disconnect on the utility service main side.
   xii. The generator shall comply with the following minimum requirements:
      a. Engine: Four-cycle, 4-cylinder, radiator cooled, at 1800 RPM. Starting shall be from batteries, with capability to start the unit at 32 degrees temperature.

b. Generator: Rating shall be continuous standby service at 0.8 power factor, at 1800 RPM.
c. Voltage: Three-phase, 480 V. KW rating to match facility needs.
d. Engine shall be equipped with an isochronous governor as manufactured by Woodall.
e. Frequency regulation shall be less than 3-cycles from no-load to full load.

xiii. All accessories needed for the proper installation of the system shall be furnished. Included should be batteries, battery cables, exhaust piping, mufflers, vibration mounting, and three bound sets of detailed operation and maintenance manuals with parts list. Batteries should be lead acid.

xiv. The generator set shall be enclosed with a factory-installed weather-protective housing (sound abating enclosure to 68db @ 23 ft.) Housing shall provide easy access to the engine-generator and instrument panel. Muffler to be designed so exhaust is not blown or sucked across the set by cooling air.

xv. Included with the generator shall be a complete fuel system consisting of a fuel tank, fuel gauge, fuel lines, fuel pumps, valves and any and all other items incidental to a first-quality installation.

xvi. Provide integral sub-base double-walled diesel tank. The tank is to be UL approved closed-top dike type. The tank shall also be fitted with a leak sensor device. The tank must have a capacity to run the generator for a minimum of 48 hours at 100% load.

xvii. Tank shall consist of the fuel tank separate and contained within the frame. No generator weight is to be supported by the tank. Provide a drain plug at one end of the rupture basin. Provide vibration isolators between generator set and tank assembly. Provide fuel low-level alarm remote mounted.

xviii. Provide manufacturer's recommended anti-freeze and engine block heater, per manufacturer's recommendations, with thermostatic controls to maintain engine coolant at proper temperature to fulfill start-up requirements, adjustable if possible. Provide suitable trickle battery charger. All accessories shall be engine-mounted and within the weatherproof sound attenuated housing.

xix. Provide annunciator panels with visual and audible alarms to monitor and warn of emergency operation conditions affecting line and generator power sources.

xx. Provide stainless steel super critical grade type exhaust silencer mounted inside of the generator enclosure for corrosion protection.

xxi. Provide amp meter, voltmeter, and frequency meters with phase switches.

xxii. Provide fuses or circuit breakers for battery charger and engine.

xxiii. Provide an automatic battery charger, static type, magnetic amplifier control with DC voltmeter, DC ammeter and potentiometer for voltage adjustment. The charger is to be completely automatic and rated for the type of battery use. The charging rate is to be determined by the state of the battery and reducing to milliamp current on fully charged battery. The charger shall be 120 V., single-phase, 60 cycle, AC input with 6-amp maximum output.

xxiv. Operation and Maintenance instructions. The Contractor shall provide a minimum of 4 continuous hours of operation and maintenance instructions for the Owner's personnel.

xxv. OWASA must be furnished with one complete set of air, oil, and fuel filters.

2) **Station Design**

a. Design of station shall be according to the provisions of NCDEQ, Division of Water Resources' NCAC Section 15A 02T – *Waste Not Discharged to Surface Waters.*

b. The pump station shall have a 100% reserve peak pumping capacity (dual pumps) and be capable of pumping at a rate of 2.5 times the average daily flow rate with any one pump out of service. Pump on/off elevations shall be set to achieve 2 to 8 pumping cycles per hour at the average flow rate.

c. The power source, voltage and phasing shall be verified before ordering pumps.

d. Evaluate the capacity of the receiving sewer main at the point of discharge and downstream to determine that the line can handle the pumped sewer flow.

e. The pump station and force main must be sized to accommodate the total basin area that could gravity flow into it.

f. OWASA reserves the right to require odor control facilities at pump stations.

g. All control panels must be weatherproofed and have weatherproof identifying labels attached with stainless steel screws. An acceptable enclosure is RACO Guard-It system.

h. The use of metal rigid conduit is required THROUGHOUT THE ENTIRE STATION.

3) **Wetwells**

a. Wetwells shall have the interior walls painted in accordance with the technical Specifications **Section 02530** – *Sanitary Sewer*.
b. Buoyancy shall be considered and flotation of the wetwells shall be prevented with appropriate construction where high groundwater conditions are anticipated.
c. **Computations:** Provide buoyancy calculations to OWASA's Engineer. Assume water to top of structure and structure is empty except that you may include the weight of the liquid below pump off elevation.
d. Surface water shall be directed away from the station pad in all directions.
e. Wetwells, and the access road to the site, shall be located a minimum of 3 foot above the 100-year base flood elevation.
f. Provide a screened vent to prevent gas entry to either the panel or pump house enclosure.
g. Wetwell components shall be located such that normal maintenance and operation of the components can be performed without having to enter the wetwell.
h. Seal the electrical conduit running from the wetwell to the control panel to prevent gas entry into panel or pump house enclosure.
i. All bolts, mounting brackets, pump lift chains, etc. must be of proper corrosion resistance, sized to support the applicable static and dynamic loads imposed by the equipment.

4) **Site** (See Standard Details 539.01 through 539.05):

a. Provide a service head, meter base, service connection, disconnect, area light with photocell.

b. A 12-foot wide all-weather access road consisting of 8 inches of ABC is to be provided to the station with a turn-a-round area of sufficient size to accommodate turning of OWASA maintenance vehicles. There shall be a 10-foot maintenance area around the perimeter of the station fence. If the lift station easement does not directly abut a publicly dedicated road, a 30 ft. access easement shall be provided.

c. Provide an 8-inch thick concrete generator pad (see Standard Detail 539.01).

d. Unless otherwise allowed by OWASA's Engineer, all stations shall be fenced with an 8-foot high, GREEN COMMERCIAL GRADE PVC COATED galvanized chain link fence with 3 strands of razor wire across the top. A minimum of either two 6-foot-long gates or one 12-foot-wide hinged gate, WITH A LOCKING MECHANISM CAPABLE OF HANDLING MULTIPLE LOCKS, shall be provided. Green privacy fence slats shall be installed on all installations.

e. A photocell controlled area light, on a separate circuit from the pumps, shall be provided at the station. The light shall be a minimum of 138-watt LED, medium 350 mA, 9500 lumens area light, with a minimum clear mounting height (ground to fixture) of 15 feet.

f. Emergency pump connection with quick connect flange and gate valves.

g. A metered potable water source with an approved RPZ with enclosure and non-freeze yard hydrant is required, unless approved otherwise by OWASA's Engineer. The Non-Freeze Yard Hydrant shall be Clayton Mark model 5451 Lever type frost proof yard hydrant or approved equal.

h. Provide a non-freeze shower w/ eyewash and concrete pad.

H. FORCE MAINS

a. Force main materials shall minimum conform to the table in Section 02530 paragraphs 2.1 A, Acceptable Pipe Material, and 3.10 E.

b. Provide combination air vacuum air release valves at all high points with differential grade separation of 15 feet or more between high and low points. See Standard Detail 538.01. If not provided in the design, the Designer shall provide calculations to prove that a surge relief valve is not needed.

c. A plug valve or valve vault shall be placed outside of the pump station.

d. Sewer force main valve boxes shall have the valve cap marked SEWER.

END OF SECTION 3

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SECTION 4 - PROCEDURE FOR APPROVAL OF WATER AND/OR SEWER EXTENSION PROJECTS

(Revised 01/01/2025)

SUGGESTED SEARCH WORDS FOR THIS SECTION

- Attachments – Standard Forms
- Close-out Documents
- Construction
- Design and Plan Approval
- Final Acceptance
- Payment of Fees & Setting of Meters
- Plan Requirements – General
- Sewer Line Extension Plans
- Tentative Acceptance - Warranty
- Tests
- Water Line Extension Plans

WATER AND SEWER PLAN APPROVAL

1.1 INTRODUCTION

This document establishes the procedure for obtaining State of North Carolina (State) and Orange Water and Sewer Authority (OWASA) approvals for extending OWASA's water distribution and/or wastewater collection systems. All OWASA requirements, whether in ordinance, policy, guidance, or this manual, shall be followed.

Approvals from OWASA and certain state regulatory agencies are required in order to construct water and/or sewer extensions. Additional approvals from these agencies are required in order to discharge wastewater into a new sanitary sewer line or withdraw water from a new water main. Approvals from the local government with jurisdiction over the area in which the project is located may also be required.

Design and construction of public water and sewer mains must conform to the requirements of the Orange Water and Sewer Authority. All design and construction within the service area shall incorporate OWASA's long range planning objectives and shall provide for the orderly expansion of the system to adjacent properties. This shall include but not be limited to installation of public water and sewer mains in an alignment and of a size and length to adequately provide for development build-out and the provision of easements to allow for extension of water or sewer to adjacent or upstream properties. Costs incurred are entirely at the Applicant/Developer's expense, However, under our current guidelines (May 2007) OWASA may reimburse the cost for oversized mains under certain circumstances.

In addition, the North Carolina Department of Environmental Quality (NCDEQ) regulates public water and sewer main extensions. Water and sewer line extensions require approval from NCDEQ's Division of Water Resources (NCDWR). See **Section 3 –** *Water & Sewer Design* of this manual for more information.

Approval from the Town of Chapel Hill, Carrboro, or the North Carolina Department of Transportation (NCDOT) will be required for any project that will have work performed within that municipality or agency's right-of-way. Additionally, construction of water and sewer improvements within other utility or agency easements or rights of way must be approved, in writing, by that entity in addition to acquiring OWASA approval for same.

The guidelines and procedures in this document apply to any party proposing to undertake a water and/or sewer extension project in OWASA's service area. Such parties include, but are not limited to: builders, developers, property owners, Town of Carrboro, Town of Chapel Hill, Orange County, University of North Carolina at Chapel Hill, and UNC Hospitals.

1.2 PLAN REQUIREMENTS

Detailed plans shall be prepared by a professional engineer licensed to practice in the state of North Carolina. All plan sheets shall bear the registration seal of the engineer, signature, and date. The plans shall be clear and legible and drawn to a scale that permits all information to be clearly depicted and reviewed. Plans that are not legible or information that is unclear or incomplete shall be returned without review.

A. GENERAL

1) **Size**: Submitted plans shall be on 24"x36" or other suitable size paper, as well as electronically, and shall include all relevant sheets pertaining to public water and/or sewer main installation or any proposed work that may have an impact on the public water and sewer system. In addition, all drawings indicating landscaping or plantings shall be submitted and are to clearly identify existing and proposed water and sewer mains and easements.

2) **Grease and Oil Control**: Commercial development projects that include food handling or preparation facilities, vehicle maintenance facilities, car washes, dumpster pads, or hydraulic elevators which drain to an OWASA sewer must also include provisions for grease and oil control interceptors. Relevant plan sheets shall be submitted to OWASA for review. This shall include kitchen plumbing plan and plumbing plan including grease interceptor. In accordance with OWASA's Grease and Oil Control Standards and Sewer Use Ordinance, the following documentation regarding proposed grease interceptors/traps and oil sand separators to OWASA shall be submitted for review and approval:

   a. A site plan showing the location of the interceptor, lines, and cleanout or manhole;
   b. Details of the interceptor, lines, and cleanout or manhole; and
   c. Formula and calculations used to determine the interceptor capacity.
   d. For dumpster pads, the 10-year, 2-hour winter storm per the Town of Chapel Hill Public Works Engineering Design Manual shall be used to calculate inflow.

3) **RPZ/RPDA**: For specific projects that require installation of backflow assemblies (RPZ), a plan must be submitted indicating model, type, and location. Fire Lines require the installation of detector assembly (RPDA). The location of the ERT\Remote readout device shall also be shown. This device cannot be installed more than 200 linear feet from the backflow assembly. Devices and installation shall conform to the OWASA Cross-Connection Control Manual, latest revision.

4) **Submittal Requirements**

   General plan set submittal requirements are as follows:

   a. Cover Sheet with vicinity map,
   b. Index Sheet (if necessary),

c. Overall Plan,
d. Plan/Profile,
e. Landscaping plan with water and sewer easements and rights-of-way designated,
f. Easement Encroachment sheet(s) showing the proposed location of any proposed encroachment into an existing or planned OWASA easement,
g. Any relevant plumbing drawings, and
h. Details.

Digital Drawing Submittal: Plans shall be submitted in an AutoCAD format suitable to OWASA. These requirements for this submittal shall be as specified in Section 1.5, *Close-Out Documents*.

5) **Cover Sheet**

Submitted plans shall have a cover sheet, which contains the following:

a. Project Name,
b. Engineer's Name and Address,
c. Owner's Name and Address,
d. Area Map,
e. Vicinity Map with North Arrow,
f. Index of Plan Sheets,
g. Revision Block, and
h. Index Sheet.

6) **Overall Plan**

Submitted plans shall have an overall map which shall contain all water and sewer lines, water and sewer services, valves, hydrants, manholes, lot lines, phase lines, right-of-way limits, and easements. Note: If the intent of the developer or engineer is to phase the project in order to initiate service to a select group of buildings or facilities in advance of other units, a separate water and sewer phasing plan will be required to demonstrate feasibility. This plan must include and depict water and sewer phasing lines and be acceptable and suitable to OWASA. Any additional valves or valves required to construct, temporary blow-offs for water mains, or manholes for sewer lines shall be installed at the applicant’s expense. Sewer line pipes may not be stubbed to a dead-end but must terminate at a manhole. Projects requiring partial final approvals for phased activation of new infrastructure after the original construction drawings are approved are subject to additional plan review fees for the additional review.

7) **Plan/Profile Sheets**

All public water and sewer line extensions shall be shown on both plan and profile sheets. Plan and profile drawings shall be at a horizontal scale of 1" = 40' and a vertical scale of 1" = 4' or horizontal scale of 1" = 50' and vertical scale of 1" = 5' or other such scale that is clearly legible and allows for proper review. The scale shall be identified on all sheets.

All sheets shall have a title, a north arrow, a revision block, and show NC State Plane grid coordinates in North American Datum, NAD 1983 feet. Assumed base coordinate systems (i.e. N10,000, E10,000) are not to be used. Assumed elevations may not be used in preparation of profile or topography information.

Elevations must be correlated to the NC State Plane Coordinate System, NAVD 88 feet vertical datum. Elevations must be to a hundredth of a foot (0.01'). The design engineer's professional seal, signature, and date shall be imprinted on all sheets.

Plan/Profile Sheets shall show:

a. Plan and profile of water and sewer extensions, all above and below ground utility crossings shall be shown with stationing,
b. Water service lines and meters and sewer service laterals and clean-outs,
c. Contour lines at no greater than 2-foot contour intervals and elevations of low and high points,
d. Property lines, all public utility easements (OWASA and non-OWASA), public rights-of-way limits,
e. Existing and proposed streets,
f. Structures, plumbing plans,
g. Streams and water surfaces,
h. One-hundred-year flood elevations,
i. Supplemental drawings which may be needed to provide all information and additional details necessary to review the project, and
j. Any other miscellaneous information relevant to the design.

8) **Landscaping Plans**

Plantings near an OWASA main can interfere with ongoing access for operation and maintenance of the main, and roots can damage the pipe causing release of sewage or a water main break. All plantings within 15 feet of an OWASA main shall follow the OWASA Guide for Planting Within OWASA Water and Sewer Easements.

B. WATER LINE EXTENSION PLANS

All water mains and appurtenances shall be located within public right-of-way or a dedicated OWASA water easement. If, in the opinion of OWASA's staff, there is inadequate distance from the water main to the edge of the right-of-way for operation and maintenance of the line, OWASA water easement beyond the right-of-way may be required.

A comprehensive plan of the existing and proposed water system shall be submitted for review and approval. In addition to items identified in Section 1.2.A above, the plan shall include the following:

1) Services, including the diameter, material, and location of both the OWASA-owned and the privately owned portions;
2) Backflow prevention devices: type, size, model, and location;
3) Diameter and material of water mains;
4) Water meter size and location;
5) Vault dimensions;
6) Depth of cover;
7) Supplemental fire protection lines (pipe size and material);
8) Irrigation lines - pipe size and material;
9) Method and location of connection to existing line;
10) Valves;
11) Fire hydrants;

12) Siamese connections;
13) Air release valves;
14) Pressure zone separators, and
15) Any other water main appurtenance not otherwise identified above.

C. SEWER LINE EXTENSION PLANS

All sewer mains and appurtenances shall be located within public right-of-way or a dedicated OWASA water easement. If, in the opinion of OWASA’s staff, there is inadequate distance from the sewer main to the edge of the right-of-way for operation and maintenance of the line, OWASA sewer easement beyond the right-of-way may be required.

A comprehensive plan of the existing and proposed sewer system shall be submitted for review and approval. In addition to items identified in Section 1.2.A above, the plan shall contain the following:

1) Ground surface elevations;
2) Pipe diameter and material;
3) Distance between manholes;
4) Percent grade of sewer between two consecutive manholes;
5) Invert elevations (both in and out);
6) Manhole rim elevations;
7) Manhole numbers;
8) Depth of cover;
9) Concrete encasement location and dimensions;
10) Carrier pipes;
11) All known existing and proposed structures and utilities, identify all clearances between crossings and horizontal spacing;
12) Stream crossings (normal water level, 25-year flood, 100-year flood) and aerial sewers; and
13) Any other sewer main appurtenance not otherwise identified above.

1.3 DESIGN AND PLAN APPROVAL

A. DISCUSS PRELIMINARY DESIGN REQUIREMENTS WITH OWASA

The Applicant should meet with OWASA's Director of Engineering or their designated representative to determine the availability of water service and sewer service and the feasibility of extending water service and sewer service to the proposed project. OWASA design requirements and long-range system planning considerations will be discussed including line sizes, line routes, and easement requirements. The Applicant's design must consider both existing and planned features of OWASA's water distribution and wastewater collection systems, incorporate OWASA long-range planning considerations, and be in accordance with State and OWASA design guidelines.

If application is for non-residential, commercial establishment, a statement indicating the intended use of potable water and type of establishment will be required. Additionally, a statement will be required indicating the nature of wastewater discharge to be released must be submitted. If any food handling or preparation will occur, acknowledgement must be included in this statement.

B. DISCUSS AVAILABILITY FEES WITH OWASA

The Applicant is encouraged to discuss OWASA Availability and Connection Fees in the early stages of project planning to determine project budget implications. Estimates of water and sewer connection fees can be calculated for the project if the following information is provided to OWASA:

1) Tax map identification number,
2) Pin Number,
3) Plat with property lines,
4) Site plan indicating proposed method of water and sewer service,
5) Size and number of water meters,
6) Meter size and number of Commercial, Non-Residential Units, or
7) Number and square footages of residential structures.

Estimates are based on the project information available at that time and are not to be considered final. Estimates are based on the Schedule of Rates, Fees, and Charges in effect at the time. Should the proposed method of connecting to the OWASA water system and sewer system change, conditions relevant to the proposed connection change, or the Schedule of Rates, Fees, and Charges change, the estimate will require recalculation.

C. SUBMIT PRELIMINARY PROJECT PLANS TO LOCAL PLANNING UNIT AND OWASA

When evaluating development proposals, the Local Planning Unit will usually consult with OWASA about the availability of water and sewer service and utility design requirements for the approval of the project. However, if preliminary plans are not forwarded from the Local Planning Unit to OWASA for review, it is the responsibility of the Applicant or Applicant's representative (Engineer or Architect) to submit plans directly to OWASA for review. Preliminary drawings should show all existing and proposed water and sewer lines, water and sewer services, fire hydrants, lot lines, building footprints, easements, rights-of-way, other utilities, proposed plantings in easements and rights-of-way, and any other information necessary for OWASA to review the proposed development.

D. REVIEW OF PRELIMINARY (ZONING COMPLIANCE) PLANS BY OWASA

OWASA will review the preliminary drawings for compliance with OWASA extension and service policies, design requirements, standards, and specifications and return comments to the Local Planning Unit and Project Engineer.

E. PRELIMINARY DESIGN APPROVAL BY OWASA

OWASA will review revised preliminary drawings for compliance with OWASA Standards and Specifications and changes requested from the previous OWASA review comment letter. A summary of changes and clouded notes on the drawings are required to identify all changes made since the previous submittal.

If preliminary design is approved by OWASA, applicant may request a conceptual approval letter to be written to the Local Planning Unit. However, conceptual approval does not constitute final plan approval or approval for construction.

F. SUBMIT CONSTRUCTION DRAWINGS TO OWASA

To obtain OWASA approval of any project, the Project Engineer shall submit one set of paper and one set of electronic construction drawings with plan and profile for public water and sewer extension to OWASA for review and approval along with the plan review fee. Construction drawings shall be in accordance with State and OWASA design standards. Failure to comply with these standards will result in return of the Applicant's drawings without OWASA review. Upon completion of the review by OWASA, comments will be returned to the Project Engineer for revisions to the construction drawings. A summary of changes and clouded notes on the drawings are required to identify changes from a previous submittal.

At this time a Project Fact Sheet, Certification of Compliance, and an NCDWR Fast-track sewer application (if applicable) will be sent to the Project Engineer for completion.

G. CONSTRUCTION DESIGN APPROVAL BY OWASA

OWASA will review the revised construction drawings for compliance with OWASA Standards and Specifications and changes requested from the previous OWASA comment letter. <u>All changes or modifications to construction drawings resubmitted to OWASA shall be clearly indicated or the submittal will be returned. Plans submitted with modifications or changes other than those required by OWASA are subject to a complete second review and payment of additional plan review fees. All plans must comply fully with this Manual, regardless of whether the approved construction drawings identified every divergence, unless specifically identified in OWASA's approval letter.</u>

H. SUBMIT PROJECT FACT SHEET

The project fact sheet must be completed and returned to OWASA upon completion of the water and sewer design. OWASA will calculate the plan review and construction observation fees, which must be paid before construction drawings are approved.

I. RECORDED ON-SITE AND OFF-SITE DEEDS OF EASEMENT

Occasionally, to serve a project, water and sewer line extensions must be constructed across properties not owned by the project Owner. Deeds of easement are required for all water and sewer lines and appurtenances not located within a public right-of-way. The acquisition of all on-site and off-site easements by the Applicant should start as early in the planning process as possible. Prior to recordation all easements documents shall be submitted to OWASA for review. <u>All on-site and off-site plats and deeds of easement for the project shall be recorded and submitted to OWASA prior to construction approval.</u> Such easements are to be recorded as "Orange Water and Sewer Authority Water, Sanitary Sewer, and/or Reclaimed Water Easement," labeled to match the utility(ies) contained. OWASA cannot approve development plans without recorded on-site and off-site easements. Contact the OWASA Engineering Department to obtain a copy of the OWASA deed of easement. OWASA standard deed of easement forms must be used.

J. PROJECT CONSTRUCTION DRAWINGS APPROVAL

Upon receipt of four sets of construction drawings (and one reduced size set), plus one electronic set, with only those changes required by OWASA modified, payment of the plan review and construction observation fees, return of the Certification of Compliance, three plan sets for NCDWR water permit, return of the completed NCDWR Fast-track sewer application with an approved NCDEQ Watershed Classification Attachment, and check(s) payable to NCDEQ in the amount of the appropriate fees(s) an approval letter will be written by OWASA. The letter will outline conditions of approval specific to the project.

OWASA will prepare the NCDWR water permits, when required, and submit to the State with the three provided plan sets and the check(s) for the appropriate fees. OWASA will also submit the NCDWR Fast-track sewer application with the Watershed Classification and the check for the applicable fees.

K. PROJECT DRAWINGS, APPLICATIONS, AND APPLICATION FEES ARE SUBMITTED TO STATE REGULATORY AGENCY BY OWASA

OWASA will submit the water and/or sewer line extension applications to NCDWR. A copy of the OWASA letter of transmittal that accompanies the applications will be provided to the Project Engineer by OWASA.

L. NCDOT RIGHT OF WAY ENCROACHMENT

An NCDOT Three Party Encroachment Agreement (A-2) is required for all water and sewer lines that encroach within a NCDOT right-of-way. Applicant shall determine proper number of originals/copies required by NCDOT. The Owner shall complete and execute under Second Party to the Agreement and will forward to OWASA for execution. OWASA will sign the agreements as the third party and return them to the Applicant for submittal to NCDOT.

The Owner must post the required Bond with NCDOT. OWASA must have a completely executed copy of the encroachment agreement prior to any work being performed within a NCDOT right-of-way.

If a Town of Chapel Hill or Carrboro road will be disturbed, approval by the Town is required prior to beginning construction.

M. DESIGN APPROVAL BY STATE REGULATORY AGENCY (NCDWR)

The State agency will notify OWASA in writing of project approval and permit number. The State will mail a copy of the water and/or sewer line extension permit to the Project Engineer. Project Engineer is responsible for any additional information required by the State. All additional required information shall be copied to OWASA.

N. FINAL DESIGN APPROVAL BY OWASA

Upon receiving State Regulatory Permits, OWASA will issue water and/or sewer extension permits with conditions of approval. These permits are valid for one year. Should water and sewer utility construction not begin within the one-year period, the Applicant must resubmit the plans and acquire re-approval from OWASA. All re-submitted plans shall be required to meet current Standard and Specification at time of re-submittal, additionally; all appropriate review fees must be paid again. If the state permits have expired, new permits must be issued before water and sewer construction may begin.

1.4 CONSTRUCTION

A. PRECONSTRUCTION CONFERENCE

A preconstruction conference must be held with an OWASA Inspector before construction may begin. The Applicant shall contact an OWASA Inspector to schedule a preconstruction conference. The Owner/Developer, Project Engineer, Contractor, and appropriate Town personnel shall attend the preconstruction conference. The OWASA Inspector will discuss what is expected of the Contractor and inspection procedure and answer questions pertaining to construction. The Inspector shall provide a list of preconstruction comments that the Owner or Owner's Representative, Project Engineer, and Contractor are to acknowledge receipt of by signature.

B. BEGIN CONSTRUCTION

Work on the project shall not begin until final design approval is granted, and a preconstruction conference is held. Any work completed prior to OWASA final design approval is subject to rejection by OWASA.

Following the preconstruction meeting, OWASA's Inspector shall be notified at least 72 hours before the project's utility work commences. If notification is not provided, the Contractor shall be responsible for uncovering and/or removing lines installed prior to OWASA inspection. The Applicant will be responsible for all costs associated with verifying compliance with OWASA standards.

All permits required for the project must be kept valid. If construction is not started within the timeframe provided on the permits, the Applicant shall resubmit plans to OWASA for approval.

<u>Only OWASA personnel shall make taps to public water lines and sewer lines.</u> Taps will be made by OWASA after the OWASA Customer Service Department has received payment of the tap fees. Contact the OWASA Engineering Department to have a fee schedule calculated. Tap fees will not be accepted until final design approval is granted by OWASA and a preconstruction conference is held with an OWASA Inspector. Notice of 48 hours shall be given to OWASA's Operations Department in order to schedule the tap. The trench must be open and dewatered with shoring in-place, materials on-site, and traffic control devices in-place for OWASA personnel to perform the tap.

C. CONSTRUCTION INSPECTION

The Project Engineer is responsible for conducting all necessary inspection of utility construction to ensure compliance with the approved plans. An OWASA Inspector will make periodic inspections of the utility construction to verify compliance with OWASA Standards and Specifications and the approved project drawings. OWASA Inspector will not provide any engineer's certification of project. It is the responsibility of the Applicant's engineer to provide proper observation of construction.

If any conflicts arise, they will be brought to the attention of the OWASA Inspector and Engineer's on-site representative. These issues will be discussed and resolved between these parties to the satisfaction of OWASA. If the conflicts cannot be resolved in this manner, the Project Engineer will be so advised and will be required to submit a proposal to OWASA for resolution of any conflicts. OWASA's Director of Engineering or authorized representative must approve any proposal or changes to the approved plans before making any changes in the field.

D. PRESSURE, VACUUM, AND BACTERIOLOGICAL TESTS

Water mains must pass pressure and purity tests. Contractor shall be responsible for providing dechlorinating devices at their expense prior to any flushing or sampling. Sewer lines must pass pressure and deflection tests. Manholes must pass a vacuum test. The Contractor shall provide all materials for and perform pressure and vacuum tests. An OWASA Inspector shall be present to verify all tests. Detailed descriptions of the testing procedures and requirements can be found in OWASA's "Standard Specifications for Water Distribution and Wastewater Collection Systems."

E. PRELIMINARY FINAL INSPECTION

The OWASA Inspector will perform inspections with assistance from the Contractor. Any items to be completed or changed will be discussed with the Contractor's representative on the job and, if requested, a written "punch-list" will be provided to the Contractor.

F. CCTV

After sewer testing is complete and prior to acceptance by OWASA, all new mains will be assessed by CCTV video provided to OWASA, in accordance with Section 02530.3.9.

G. PROVISION OF CONSTRUCTION METERS BY OWASA

Temporary water service for construction may be provided through a one-inch (1"), two-inch (2") or three-inch (3") hydrant meter connected to a fire hydrant. Application for this service must be made to the OWASA Engineering Department and fees paid to the OWASA Customer Service Department. Hydrant Meters are subject to priority use and are restricted to a 60-day period. Service will be provided in accordance with the established policy for temporary hydrant meters and the OWASA "Schedule of Rates, Fees, and Charges." Charges for service related to the provision of temporary hydrant meters and water for construction purposes will begin when the meter is set.

H. FINAL INSPECTION BY OWASA

The OWASA Inspector will field verify that the water and sewer extensions and appurtenances have not been damaged or covered during landscaping and paving. The Inspector will also check to see that all deficiencies listed on the punch-list have been corrected. The Owner or Owner's Representative is responsible for any damage to the water and sewer extensions and appurtenances throughout the construction process.

1.5 CLOSE-OUT DOCUMENTS

All close-out documents must be submitted in a manner that allows OWASA's staff sufficient time to review the documents. OWASA's staff will return documents that require revision. Contact the OWASA Engineering Department with questions regarding close-out document submittals. **<u>Below are close-out submittal requirements necessary prior to OWASA initiating service to any site:</u>**

A. SUBMIT ENGINEER'S CERTIFICATION OF PUBLIC WATER LINES TO OWASA

Public water mains shall not be placed in service until a letter of **"<u>FINAL ACCEPTANCE</u>"** from NCDWR Public Water Supply Section has been received by OWASA. The Project Engineer must certify to NCDWR that the water mains were installed in accordance with the approved plans. The certification containing the permit number, the Project Engineer's original seal and signature, and the date must be submitted to OWASA. OWASA will submit the certification to NCDWR. OWASA's Standard Engineer's Certification of Public Water System (A-7) shall be used (See Forms Section).

B. SUBMIT ENGINEER'S CERTIFICATION OF PUBLIC SEWER LINES TO OWASA

Public sewer lines shall not be placed in service until the following documents have been submitted, accepted by OWASA and submitted to NCDWR. The Project Engineer must certify to NCDWR that the sewer lines were installed in accordance with the approved plans. The certification containing the permit number and the Project Engineer's original seal and signature, and the date must be submitted to OWASA. OWASA will submit the engineer's certification along with the record drawings to NCDWR. NCDWR's certification issued with the permit shall be used.

C. SUBMIT RECORDED FINAL PLAT TO OWASA

Plats shall be submitted to OWASA for review prior to recordation. The recorded final plat shall identify all OWASA easements. This plat will be used to establish water and sewer accounts for billing purposes and shall include street addresses and subdivision lot numbers.

D. SUBMIT ORIGINAL RECORDED DEED OF EASEMENT TO OWASA

The deed of easement shall be submitted to OWASA for review prior to recordation. **<u>This document must be provided before approval of project is granted.</u>** The deed of easement sets forth the conditions of use and rights of the water and sewer easement. OWASA's Standard Deed of Easement shall be recorded for all water and sewer easements. Contact OWASA's Engineering Department for a copy of OWASA's Standard Deed of Easement or for assistance in completing the document. This document must include a metes and bounds description of the relevant water and/or sewer easements and must be accompanied by an easement exhibit graphically depicting or representing the surveyed description.

OWASA will review recorded easements to verify the water lines, sewer lines, and appurtenances were constructed within the boundaries of the recorded easements.

E. SUBMIT LETTER OF DEDICATION TO OWASA

The letter of dedication transfers ownership of the water and sewer lines constructed for the project from the Owner to OWASA. The dedication letter must reference the recorded plat, approved construction plan title and date, and the Project Engineer. OWASA's Standard Dedication Form (A-5) shall be used (see Forms Section).

OWASA will not assume ownership and initiate service to any system constructed that has not been legally dedicated and rights of ownership conveyed to OWASA.

F. SUBMIT ASSET EVALUATION FORM TO OWASA

The asset evaluation form provides information on the value of the water and sewer utilities dedicated to OWASA. The asset evaluation from should include only the value of the lines and appurtenances dedicated to OWASA. The cost of water service lines beyond the meters, private fire lines, and sewer service laterals should not be included on the asset evaluation form. OWASA's Standard Asset Evaluation Form (A-6) shall be used (see Forms Section) for reporting this information.

G. SUBMIT RECORD DRAWINGS TO OWASA FOR REVIEW

1) Record or "as-built" drawings provide information regarding location and attributes of the water and sewer systems installed. This information is essential for the maintenance, repair, and operation of the water distribution and wastewater collection systems. Prior to placing sewer lines in-service, a set of record drawings must be submitted to NCDWR, along with the engineer's certification. OWASA will submit record drawings to NCDWR. Blue line or similar prints should be submitted for review prior to submitting reproducible mylar drawings. Record drawings must be submitted with sufficient lead-time to allow OWASA to review the drawings. As-builts shall include the final Easement Encroachment for recordation with the County Registrar.

2) **Record Drawings**

a. Record drawings shall have a cover sheet with a vicinity map showing the project location. If the project was developed in phases, the phasing of all lines shall be clearly indicated.

b. Record drawings shall accurately show and name all installed infrastructure with the same level of design detail as in the approved construction drawings for both plan and profile views, with location and attributes, including street names, right-of-way limits and easements, pipe material, pipe diameter, slope, manhole rim and invert elevations, backflows, grease interceptors/traps/oil sand separators, and service line location and materials (public and private).

c. Record drawings shall include a seal, signature, and statement by the Project Engineer attesting to the accuracy of the drawings.

d. Record drawings shall include and label all bends, fittings, valves, and appurtenances.

H. SUBMIT AS-BUILT SURVEY FILE TO OWASA

Electronic files of all drawings shall be submitted to OWASA. These files shall be in an AutoCAD format suitable to OWASA with a .dwg extension.

I. AS-BUILT SURVEY

All survey information must be performed by licensed surveyor (NCPLS). Horizontal tie to State Plane North American Datum (NAD 83) and Vertical tie to State Plane North American Vertical Datum (NAVD88). Information to include mains, valves, fittings, meters, backflows, grease traps, vaults, blow-offs, fire hydrants, manholes, and easement locations.

J. SUBMIT OPERATION AND MAINTENANCE MANUALS TO OWASA

The operation, maintenance, and service manuals (O&M) for each piece of equipment shall be provided to OWASA prior to startup. Three copies of the O&M manuals shall be submitted. The manuals shall be specific to the equipment supplied. The manuals shall include: parts list (including recommended spare parts list), guaranties, recommended maintenance instructions, recommended lubricants and lubrication instructions, detailed description of operating procedures for the item of equipment written specifically for this installation (including start-up and shut-down procedures), equipment performance specifications (including pump curves), and results of start-up and any further recommendations resulting from start-up. The O&M manual shall include a summary of all preventive maintenance and lubrication.

K. SUBMIT LETTER OF CREDIT TO OWASA

The letter of credit ensures any warranty work required within the one-year warranty period will be completed. If the Contractor does not correct any deficiencies that develop within the warranty period, the letter of credit will be used by OWASA to correct the problems. OWASA's Standard Letter of Credit (A-9) shall be used.

1.6 TENTATIVE ACCEPTANCE AND BEGINNING OF ONE-YEAR WARRANTY

Upon acceptance of all documents by OWASA and completion of a final inspection, OWASA will grant tentative acceptance of the water and/or sewer lines constructed for the project. The property owner shall guarantee the entire project against defective material and workmanship and consequential damages resulting therefrom for a period of twelve months from the date of acceptance of the project, including such incidental damages as may arise from such claims. OWASA will provide a letter of tentative acceptance to the Project Engineer and Owner, which includes the expiration date of the one-year warranty period. OWASA will perform a warranty inspection before the end of the one-year warranty period and provide a punch list of any noted deficiencies to be corrected to OWASA's satisfaction to the property Owner. Any emergency repair of the lines by OWASA during the one-year warranty period will be billed to the Owner.

1.7 PAYMENT OF FEES AND SETTING OF METERS

A. CALCULATION OF AVAILABILITY FEES BY OWASA

The following information must be provided to the OWASA Engineering Department for availability fees to be calculated:

Applicant's Name	County
Telephone Number	Subdivision Name
Complete Service Address	Subdivision Lot Number
Complete Billing Address	Water Meter Size
Parcel Identification Number (PIN)	Residential/Nonresidential
Building Permit or plans showing square footage of residential structures.	Single Family/Duplex/Multi-Family

B. PAY AVAILABILITY FEES TO OWASA CUSTOMER SERVICE DEPARTMENT FOR SERVICE INITIATION

Fees for service initiation are to be paid to OWASA Customer Service Department. Fees **will be accepted only after all above items are completed and the Applicant is ready for meter installation.** If the Applicant does not request meter installation within 30 days of payment, OWASA reserves the right to refund the fees without interest.

C. SETTING OF WATER METERS

All water meters are to be purchased from OWASA. The water meter is purchased at the time availability fees are paid by the Applicant. Meters that are 2-inches and smaller shall be delivered and set by OWASA. Depending on workload and schedule, the water meters will typically be set within three (3) working days of fee payment for 'meter only' installations. A complete water service installation for a 5/8" or 1" meter requires ten (10) working days from the date of receipt of payment for OWASA to install the service and set the meter.

A water meter can only be installed in an undamaged clean water meter box. The water meter box and setter must be free of debris, undamaged, and at the proper grade. Any damage and/or modification to the water meter box or setter will be the responsibility of the Applicant.

For meters 3-inches and larger, the OWASA inspector shall deliver the meter for Contractor installation under supervision of OWASA. Appropriate lead-time for supplying meters shall be given to OWASA by the Contractor or Owner requesting the water meter.

Meters are tested for accuracy by OWASA and are to be promptly installed by the Contractor. The Contractor is responsible for providing the meter box or vault in accordance with OWASA Standards and Specifications. OWASA will inspect the water meter installation prior to placing the meter in-service.

No meters will be installed until "Tentative Acceptance" of the lines has been granted and the appropriate fees paid.

1.8 FINAL ACCEPTANCE

A. WARRANTY CHECKS AND REPAIRS

The Owner will be responsible for all repairs required on the new water and/or sewer lines and appurtenances for a period of one year from the date of tentative acceptance. During this period, written notification of all deficiencies will be provided to the Owner and the Contractor by OWASA. The Contractor shall notify an OWASA Inspector when warranty repairs will be made so that inspections can be made during repairs. If OWASA determines that an emergency repair must be made, OWASA may make the repair and bill the Owner.

B. EXPIRATION OF WARRANTY

Prior to expiration of the one-year warranty period and final acceptance of the lines by OWASA, an OWASA Inspector will make a warranty inspection and video the inside of sewer mains. Any deficiencies found during this inspection will be noted and a letter sent to the Owner and Contractor. After the deficiencies have been corrected, the Contractor should contact an OWASA Inspector to schedule an inspection. Deficiencies documented within the warranty period must be corrected, regardless of whether completion of the corrections extends beyond the expiration of the warranty period.

C. LETTER OF FINAL ACCEPTANCE

If the OWASA Inspector finds that the Contractor has corrected all the deficiencies identified from the warranty inspection, OWASA will issue final acceptance. OWASA will write a letter of final acceptance to the Project Engineer.

END OF SECTION 4

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OWASA STANDARD DETAILS

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512.03	Blocking Detail For PVC Pipe In-Line Valve
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515.09 (3 of 3)	2 ½” To 10” RPZ Assembly (Indoor)
515.10 (1 of 3)	2 ½” To 10” RPZ Assembly (Above Ground)
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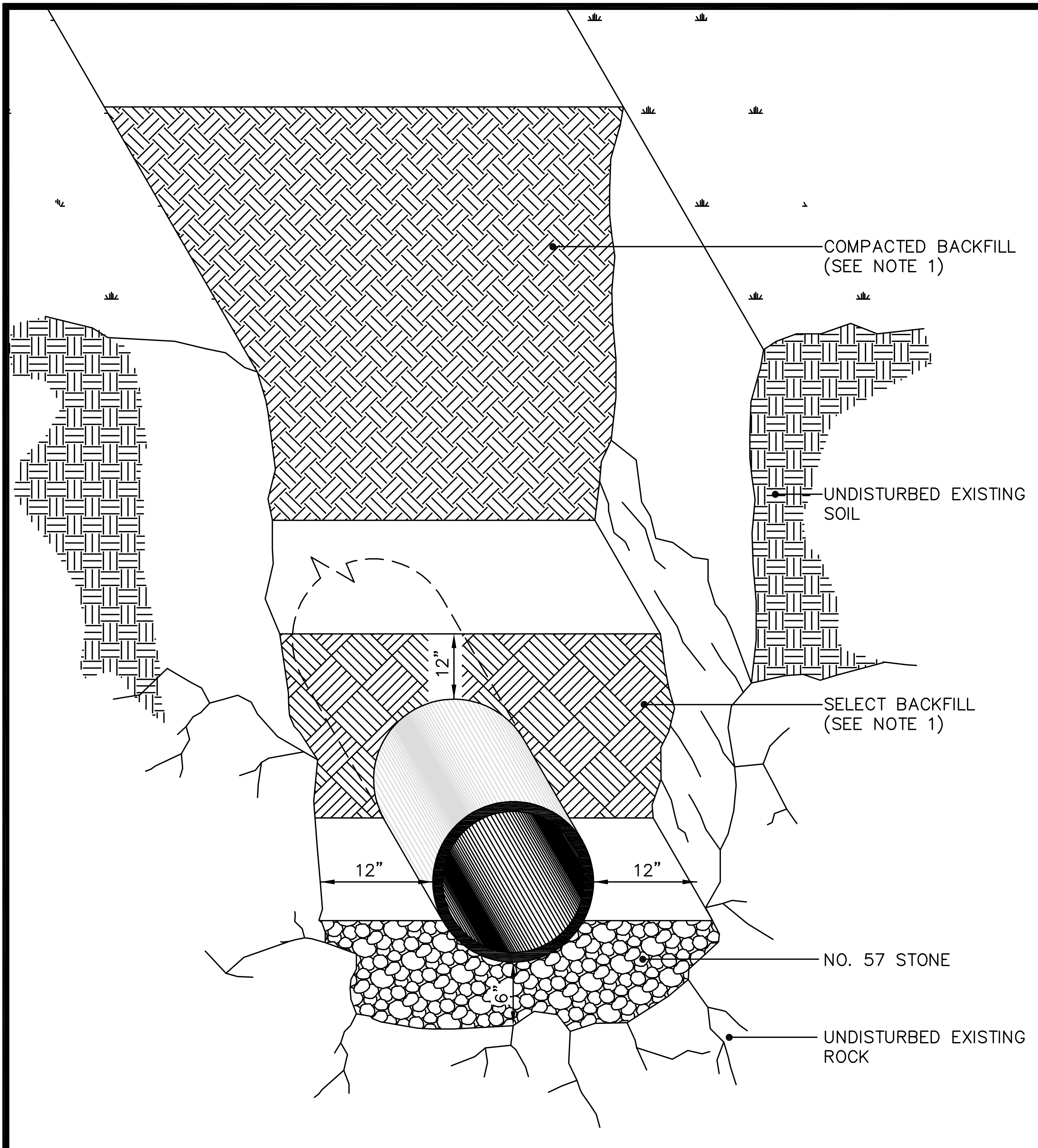


NOTES:

1. See specification section 02275 Trenching, Backfilling, and Compaction of Utilities for backfill and compaction requirements.

OWASA
Quality Service
Since 1977
400 Jones Ferry Road
PO Box 366
Carrboro, NC 27510-0366
ORANGE WATER AND SEWER AUTHORITY
USE WITH THE OWASA STANDARD SPECIFICATIONS ONLY
Voice (919) 968-4421
FAX (919) 968-4464
www.owasa.org

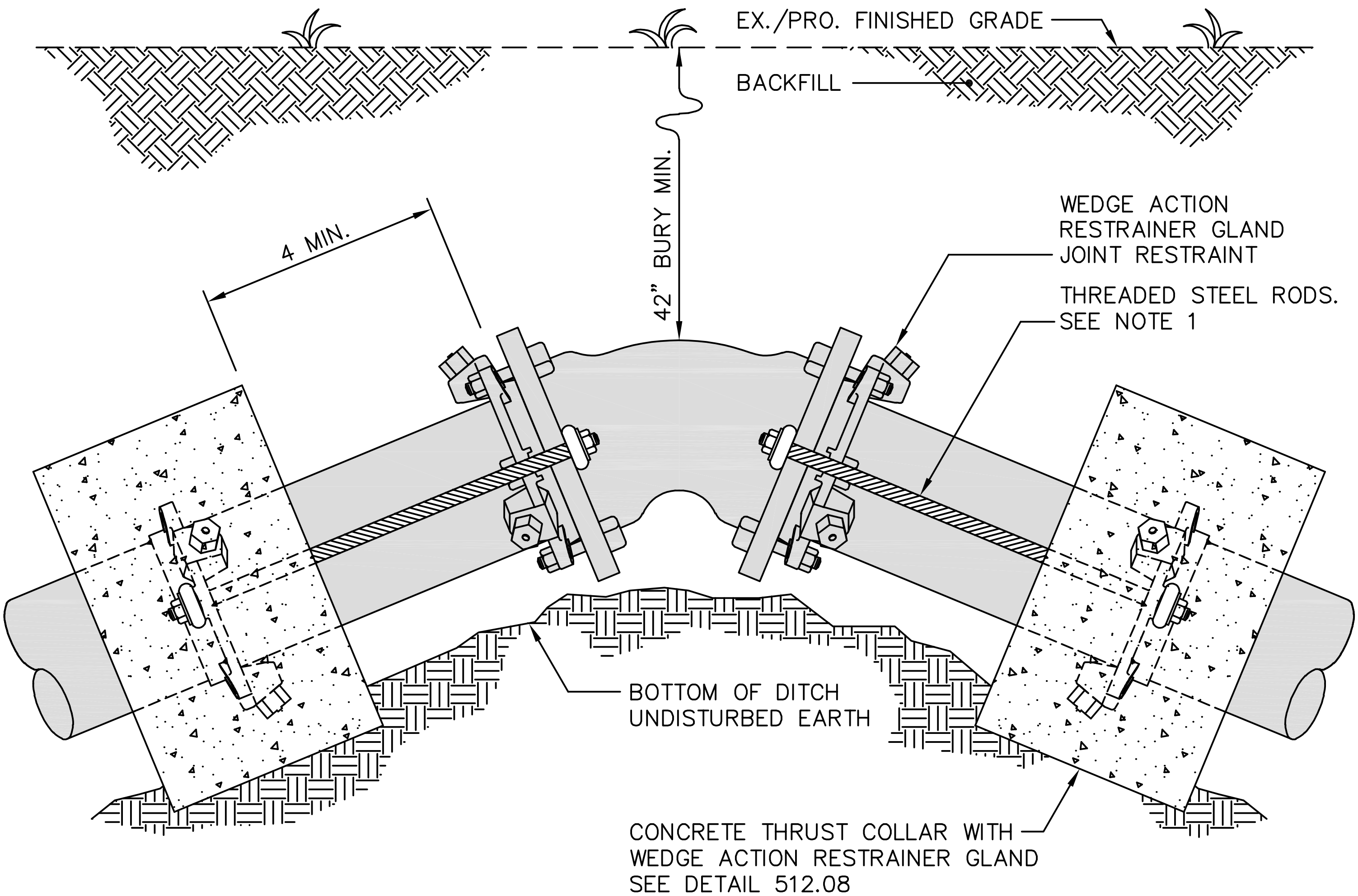
DETAIL of ROCK EXCAVATION

SCALE: Not To Scale

DETAIL # 2511.01

REVISION DATE: Jan 1, 2025

SHEET #: 1 of 1



PROFILE VIEW

NOTES:

1. If 42" bury depth is not maintained or located in high pressure zone, a minimum of (2) 3/4" dia. rods to be used for pipe thru 24" dia. per joint – a minimum of (2) 1" dia. rods to be used for pipe 30" & 36" dia. per joint – a minimum of (2) 1 1/4" dia. rods to be used for pipe 42" & 48" dia. per joint. (See detail 512.09)

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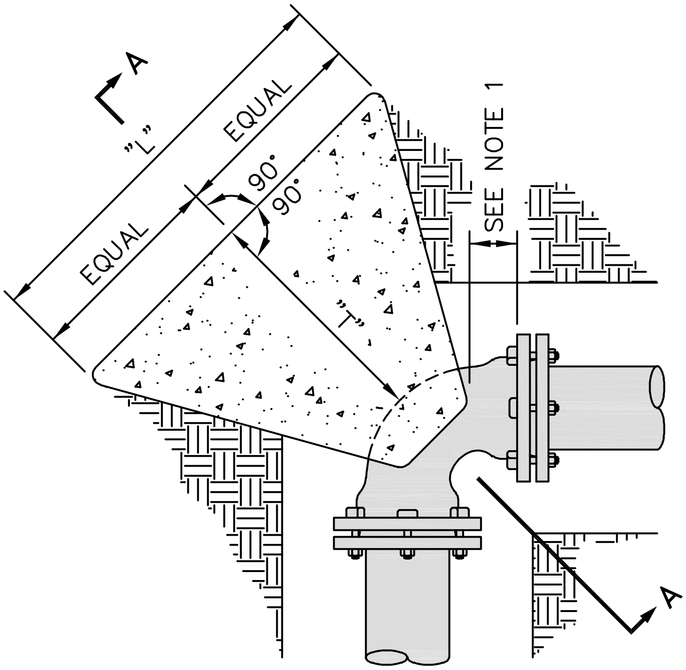
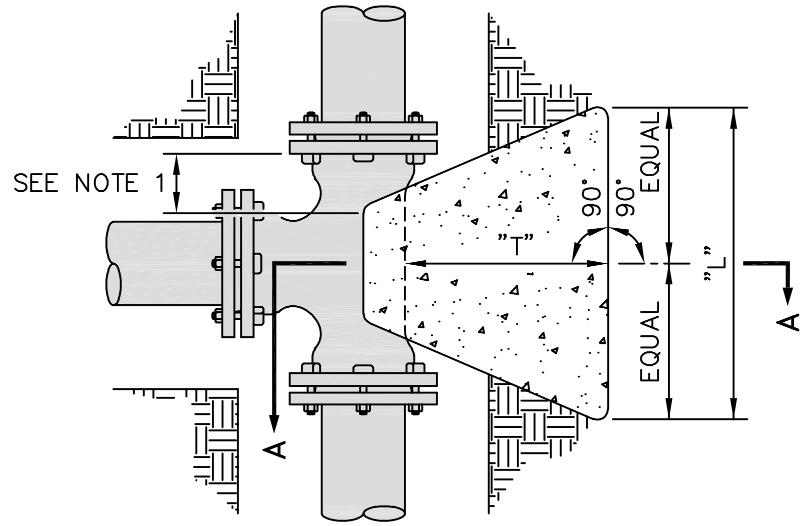
USE WITH THE OWASA STANDARD SPECIFICATIONS ONLY

STANDARD VERTICAL BEND DETAIL

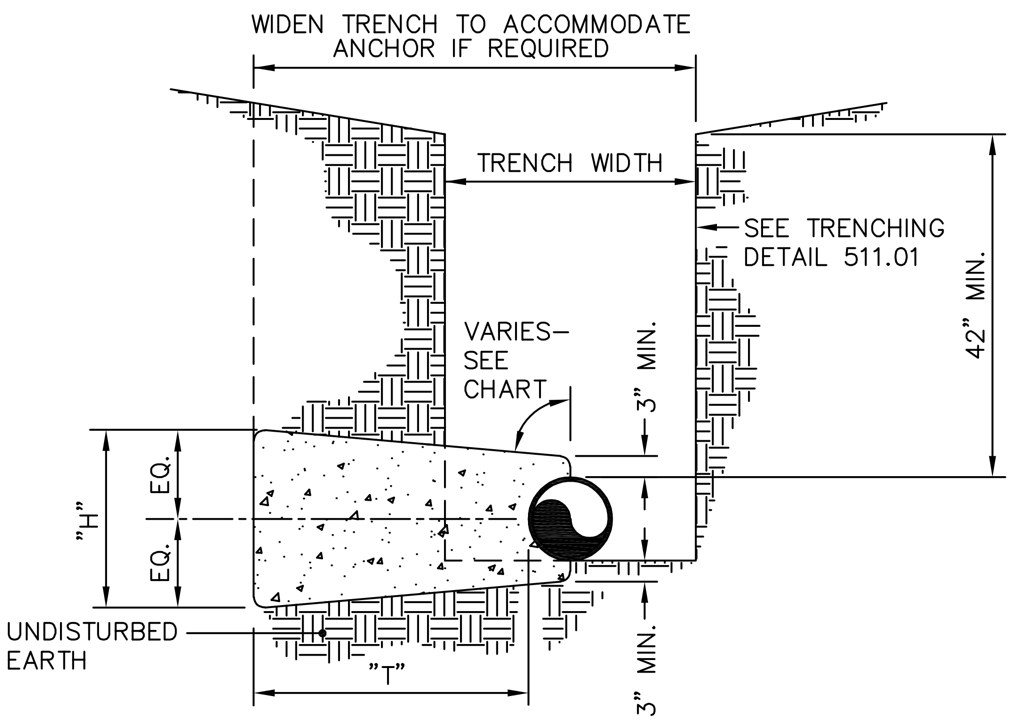
SCALE:	DETAIL #
Not To Scale	2 512.01
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 1



FOR ALL BEND FITTINGS



FOR TEE FITTING



SECTION A-A

NOTES:

1. Concrete blocking is to be formed to ensure accessibility to fittings and poured against undisturbed earth.
2. Fittings are to be completely wrapped with plastic, prior to pouring concrete.
3. Concrete to be minimum 3,000 psi. @ 28 days.

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Since 1977

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PO Box 366
Carrboro, NC 27510-0366

ORANGE WATER AND SEWER AUTHORITY

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BLOCKING DETAIL for HORIZONTAL BENDS AND TEE

SCALE: Not To Scale	DETAIL # 2512.02
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 4

TEST PRESSURE = 150 P.S.I.

PIPE SIZE	TYPE FITTING	DIMENSIONS (Ft.) "L"	DIMENSIONS (Ft.) "H"	DIMENSIONS (Ft.) "T"	VOLUME. CONCRETE CU. YD.
<4 INCHES	11 1/4°	---	---	---	---
	22 1/2°	1.00	1.00	1.50	0.06
	45°	1.00	1.00	1.50	0.06
	90°	1.00	1.00	2.50	0.09
	TEE / PLUG	1.00	1.00	2.00	0.07
4 INCHES	11 1/4°	1.00	1.00	2.50	0.09
	22 1/2°	1.00	1.00	2.50	0.09
	45°	1.00	1.00	2.50	0.09
	90°	1.50	1.50	2.50	0.15
	TEE / PLUG	1.50	1.50	2.00	0.12
6 INCHES	11 1/4°	1.50	1.50	2.50	0.15
	22 1/2°	1.50	1.50	2.50	0.15
	45°	1.50	1.50	2.50	0.15
	90°	2.00	2.00	3.00	0.28
	TEE / PLUG	2.00	2.00	2.50	0.23
8 INCHES	11 1/4°	2.00	2.00	2.50	0.23
	22 1/2°	2.00	2.00	2.50	0.23
	45°	2.00	2.00	2.75	0.25
	90°	3.00	2.00	3.00	0.39
	TEE / PLUG	3.00	2.00	2.50	0.32
12 INCHES	11 1/4°	2.00	2.00	3.00	0.28
	22 1/2°	2.00	2.00	3.00	0.28
	45°	3.00	2.50	3.00	0.47
	90°	4.50	3.00	3.50	0.94
	TEE / PLUG	4.50	3.00	3.00	0.81
16 INCHES	11 1/4°	2.00	2.00	3.00	0.28
	22 1/2°	3.00	2.00	3.00	0.39
	45°	4.00	3.00	3.50	0.84
	90°	6.50	3.50	3.50	1.54
	TEE / PLUG	6.50	3.50	3.00	1.32

CHART NOTES:

1. If blocking excavation is in lightly compacted fill areas, or in areas where boulders or stumps have been removed, blocking size must be re-sized for the specific location/circumstance by a NC licensed Professional Engineer.
2. Blocking sizes shown in these tables assume the following:
   a. Blocking is constructed in residual soils as shown in detail
   b. Soil bearing pressure = 2000 psf
   c. Velocity of flow = 15 fps
3. This detail not applicable to reducing bends.
4. Neither the weight of the concrete blocking nor friction between concrete blocking and soil was added into blocking sizes computation. Therefore, blocking size is conservative.

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400 Jones Ferry Road
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BLOCKING DETAIL for HORIZONTAL BENDS AND TEE

SCALE: Not To Scale
DETAIL #: 2 512.02
REVISION DATE: Jan 1, 2025

TEST PRESSURE = 200 P.S.I.

PIPE SIZE	TYPE FITTING	DIMENSIONS (Ft.) "L"	"H"	"T"	VOLUME. CONCRETE CU. YD.
<4 INCHES	11 1/4°	1.00	1.00	1.00	0.04
	22 1/2°	1.00	1.00	1.50	0.06
	45°	1.00	1.00	1.50	0.06
	90°	1.50	1.50	2.50	0.15
	TEE / PLUG	1.50	1.50	2.00	0.12
4 INCHES	11 1/4°	1.00	1.00	2.50	0.09
	22 1/2°	1.00	1.00	2.50	0.09
	45°	1.50	1.50	2.50	0.15
	90°	1.50	1.50	2.50	0.15
	TEE / PLUG	1.50	1.50	2.00	0.12
6 INCHES	11 1/4°	1.50	1.50	2.50	0.15
	22 1/2°	1.50	1.50	2.50	0.15
	45°	1.50	1.50	2.50	0.15
	90°	2.50	2.00	3.00	0.33
	TEE / PLUG	2.50	2.00	2.50	0.28
8 INCHES	11 1/4°	2.00	2.00	2.50	0.23
	22 1/2°	2.00	2.00	2.50	0.23
	45°	2.00	2.00	2.50	0.23
	90°	4.00	2.00	3.00	0.50
	TEE / PLUG	4.00	2.00	2.50	0.42
12 INCHES	11 1/4°	2.00	2.00	3.00	0.28
	22 1/2°	3.00	2.00	3.00	0.39
	45°	4.00	2.50	3.00	0.61
	90°	5.50	3.00	3.50	1.13
	TEE / PLUG	5.50	3.00	3.00	0.97
16 INCHES	11 1/4°	2.00	2.00	3.00	0.28
	22 1/2°	4.00	2.00	3.00	0.50
	45°	5.50	3.00	3.50	1.13
	90°	7.50	4.00	3.50	2.01
	TEE / PLUG	7.50	4.00	3.00	1.72

CHART NOTES:

1. If blocking excavation is in lightly compacted fill areas, or in areas where boulders or stumps have been removed, blocking size must be re-sized for the specific location/circumstance by a NC licensed Professional Engineer.
2. Blocking sizes shown in these tables assume the following:
   a. Blocking is constructed in residual soils as shown in detail
   b. Soil bearing pressure = 2000 psf
   c. Velocity of flow = 15 fps
3. This detail not applicable to reducing bends.
4. Neither the weight of the concrete blocking nor friction between concrete blocking and soil was added into blocking sizes computation. Therefore, blocking size is conservative.

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BLOCKING DETAIL for HORIZONTAL BENDS AND TEE

SCALE: Not To Scale
DETAIL #: 2512.02
REVISION DATE: Jan 1, 2025
SHEET #: 3 of 4

TEST PRESSURE = 250 P.S.I.

PIPE SIZE	TYPE FITTING	DIMENSIONS (Ft.) "L"	DIMENSIONS (Ft.) "H"	DIMENSIONS (Ft.) "T"	VOLUME. CONCRETE CU. YD.
<4 INCHES	11 1/4°	1.00	1.00	1.00	0.04
	22 1/2°	1.00	1.00	1.50	0.06
	45°	1.00	1.00	1.50	0.06
	90°	1.50	1.50	2.50	0.15
	TEE / PLUG	1.50	1.50	2.00	0.12
4 INCHES	11 1/4°	1.00	1.00	2.50	0.09
	22 1/2°	1.00	1.00	2.50	0.09
	45°	1.50	1.50	2.50	0.15
	90°	2.00	2.00	2.50	0.23
	TEE / PLUG	2.00	2.00	2.00	0.19
6 INCHES	11 1/4°	1.50	1.50	2.50	0.15
	22 1/2°	1.50	1.50	2.50	0.15
	45°	2.00	1.50	2.50	0.19
	90°	3.00	2.00	3.00	0.39
	TEE / PLUG	3.00	2.00	2.50	0.32
8 INCHES	11 1/4°	2.00	2.00	2.50	0.23
	22 1/2°	2.00	2.00	2.50	0.23
	45°	2.50	2.00	2.50	0.28
	90°	4.00	2.50	3.00	0.61
	TEE / PLUG	4.00	2.50	2.50	0.51
12 INCHES	11 1/4°	2.00	2.00	3.00	0.28
	22 1/2°	3.50	2.00	3.00	0.44
	45°	4.50	2.75	3.00	0.74
	90°	6.00	3.50	3.50	1.43
	TEE / PLUG	6.00	3.50	3.00	1.22
16 INCHES	11 1/4°	2.50	2.00	3.00	0.33
	22 1/2°	4.00	2.50	3.00	0.61
	45°	6.00	3.50	3.50	1.43
	90°	8.00	4.50	4.00	2.74
	TEE / PLUG	8.00	4.50	3.50	2.40

CHART NOTES:

1. If blocking excavation is in lightly compacted fill areas, or in areas where boulders or stumps have been removed, blocking size must be re–sized for the specific location/circumstance by a NC licensed Professional Engineer.
2. Blocking sizes shown in these tables assume the following:
   a. Blocking is constructed in residual soils as shown in detail
   b. Soil bearing pressure = 2000 psf
   c. Velocity of flow = 15 fps
3. This detail not applicable to reducing bends.
4. Neither the weight of the concrete blocking nor friction between concrete blocking and soil was added into blocking sizes computation. Therefore, blocking size is conservative.

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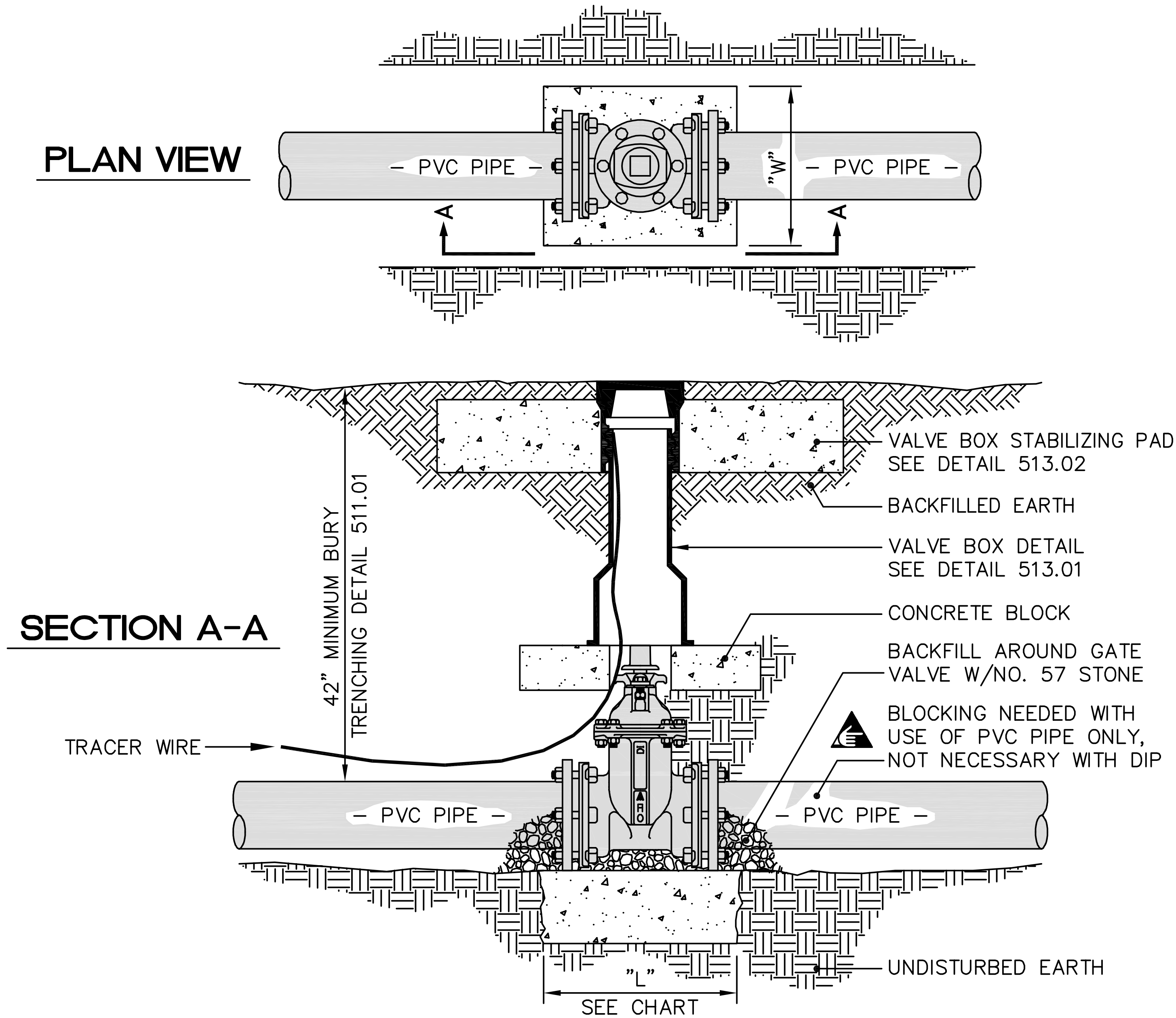
BLOCKING DETAIL for HORIZONTAL BENDS AND TEE

SCALE: Not To Scale	DETAIL # 2512.02
REVISION DATE: Jan 1, 2025	SHEET #: 4 of 4

VALVE SIZE	4”	6”	8”	12”	16”
”W”	10”	12”	15”	18”	21”
”L”	16”	18”	18”	20”	24”



NOTES:

1. The use of PVC must be approved by Director of Engineering.
2. Concrete blocking is to be formed to ensure accesibility to fittings and poured against undisturbed earth.
3. Fittings are to be completely wrapped with plastic, prior to pouring concrete.
4. Concrete to be minimum 3,000 psi. @ 28 days.
5. Solid concrete block may be substituted and must meet or exceed concrete area shown on chart above. Bed solid block on 2” to 4” of No. 57 stone.
6. Tracer Wire to be continuous AWG. No. 12 Gauge copper wire.

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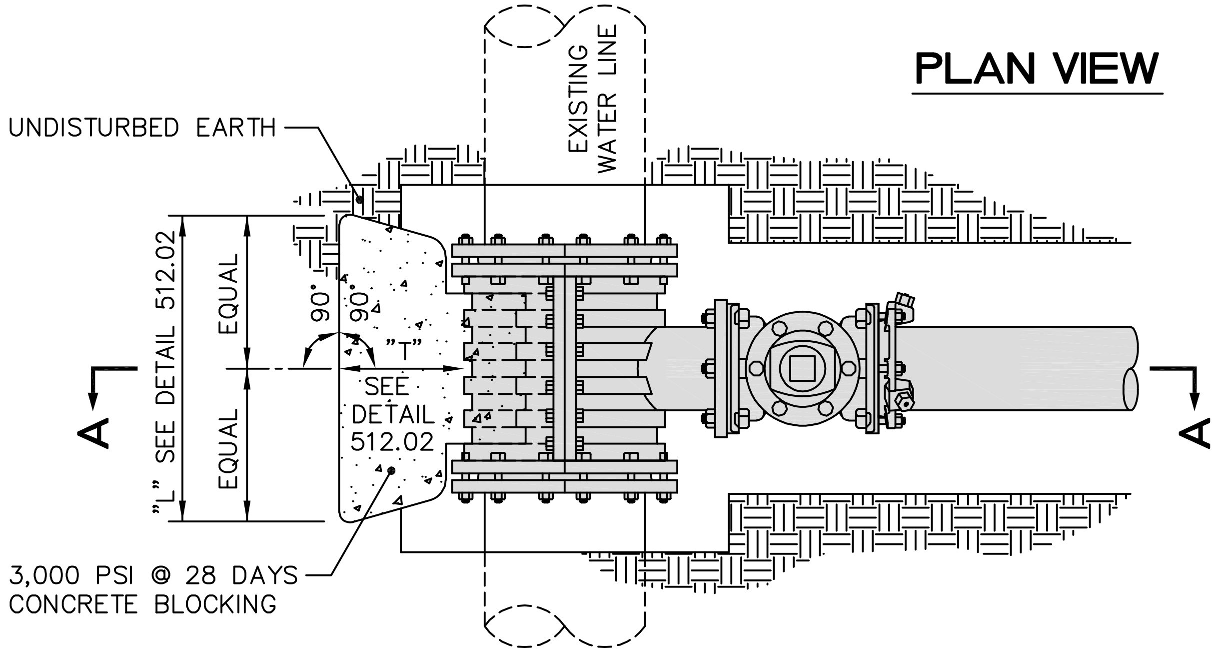
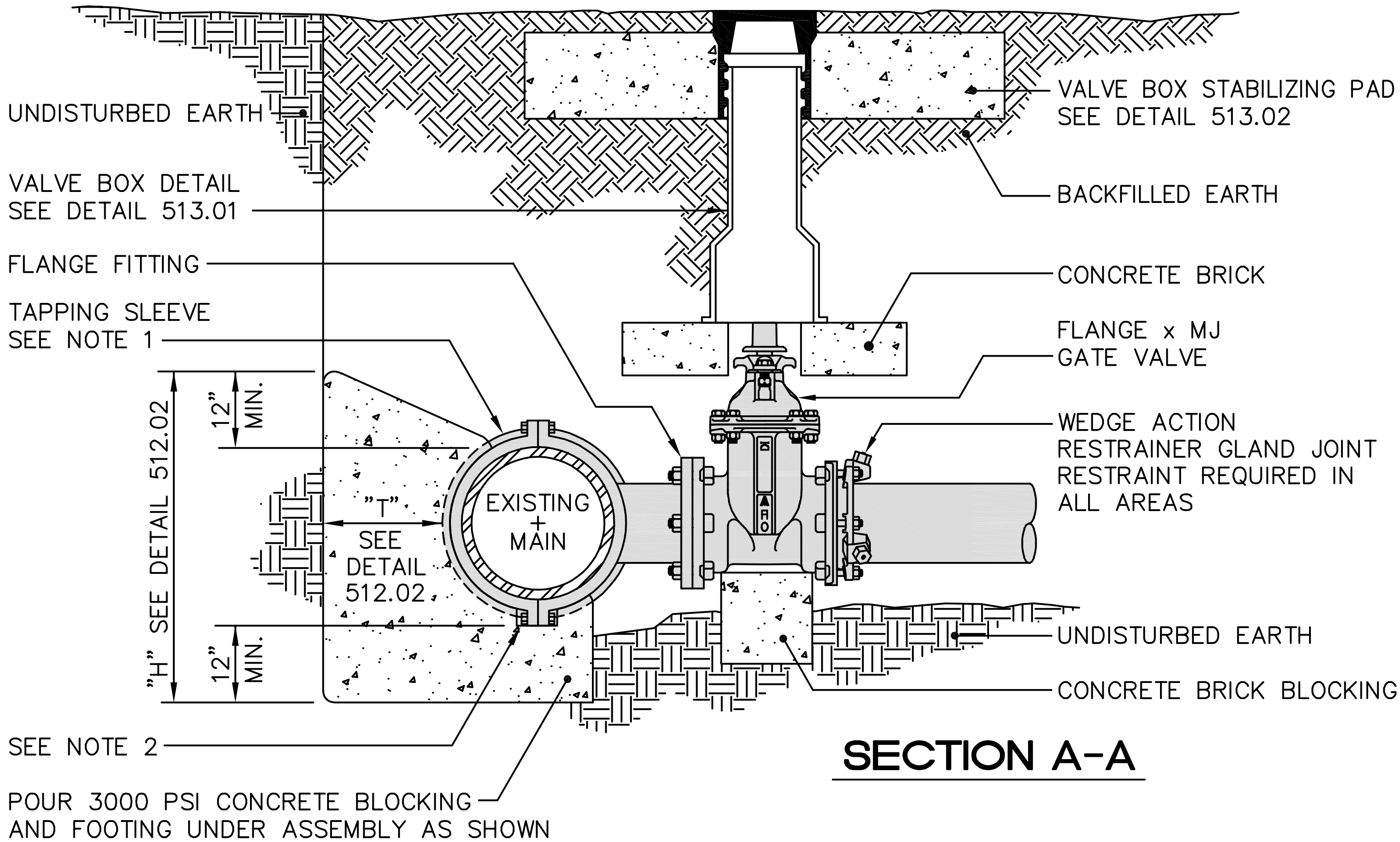
BLOCKING DETAIL for PVC PIPE IN-LINE VALVE

SCALE: Not To Scale
DETAIL # 2 512.03
REVISION DATE: Jan 1, 2025
SHEET #: 1 of 1

PLAN VIEW





SECTION A-A

NOTES:

1. Concrete blocking is to be formed to ensure accesibility to fittings and poured against undisturbed earth.
2. Fittings are to be completely wrapped with plastic, prior to pouring concrete.
3. Concrete to be minimum 3,000 psi. @ 28 days.
4. Taps onto in–service mains by OWASA personnel only.

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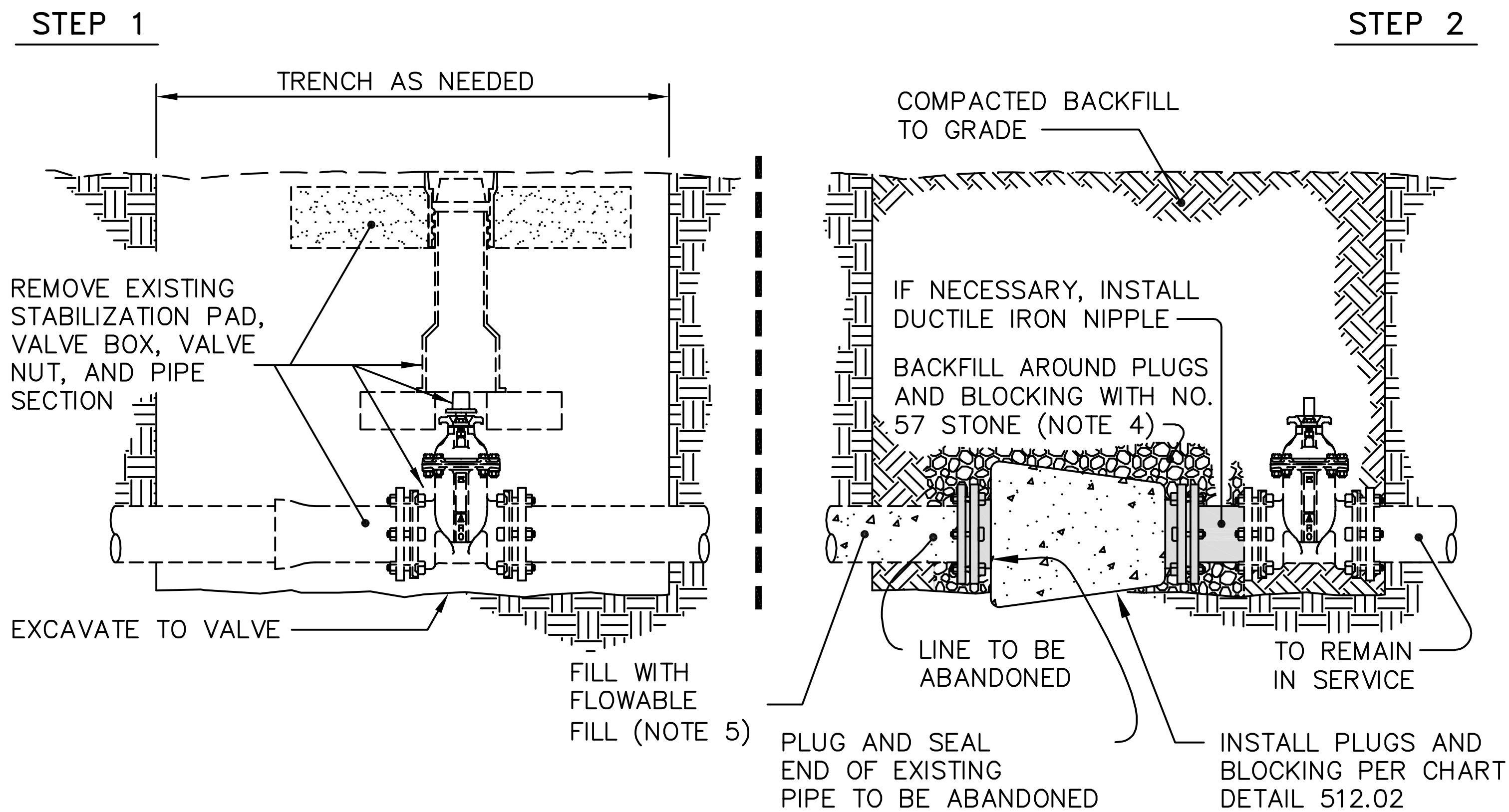
4" to 12" STANDARD TAPPING SLEEVE and VALVE ASSEMBLY

SCALE:	DETAIL #
Not To Scale	2 512.04
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 1



NOTES:

1. Concrete blocking is to be formed to ensure accessibility to fittings.
2. Fittings attached to in service lines are to be completely wrapped with plastic, prior to pouring concrete.
3. Concrete to be minimum 3,000 psi. @ 28 days.
4. Backfill with No. 57 stone compacted in place or with flowable fill concrete (50 psi minimum/ 150 psi maximum).
5. Remove or fill pipes with flowable fill concrete (50 psi minimum/ 150 psi maximum) in accordance with the following criteria:
    a. Pipes larger than 24–inches diameter.
    b. Pipes located within roadway section and meeting one of the following conditions:
        i. pipes that are 12–inches diameter up to and including pipes that are 24–inches diameter and are buried less than 20 feet below finished grade.
        ii. pipes that are 6–inches diameter up to 12–inches diameter that are not cast iron, ductile iron, PVC, or HDPE and are buried less than 12 feet below finished grade.
    c. Pipes located below groundwater table that could become a conduit for water movement.

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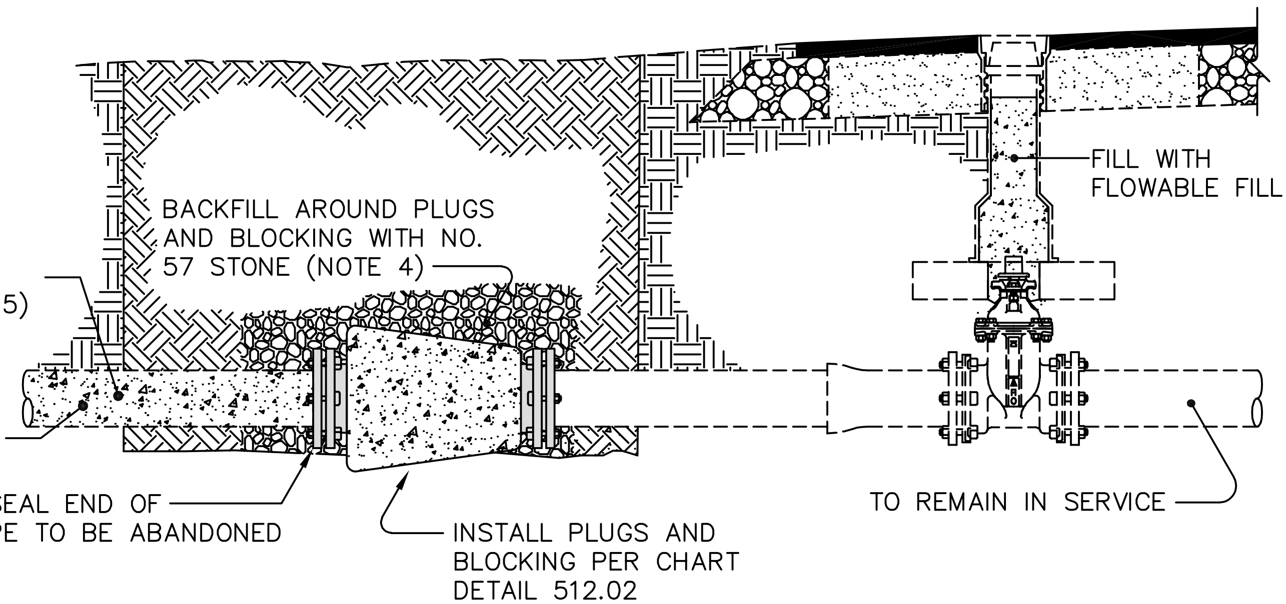
LINE ABANDONMENT DETAIL FOR UNPAVED AREAS

SCALE: Not To Scale	DETAIL # 2 512.05
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 2



NOTES:

1. Concrete blocking is to be formed to ensure accessibility to fittings.
2. Fittings attached to in service lines are to be completely wrapped with plastic, prior to pouring concrete.
3. Concrete to be minimum 3,000 psi. @ 28 days.
4. Backfill with No. 57 stone compacted in place or with flowable fill concrete (50 psi minimum/ 150 psi maximum).
5. Remove or fill pipes with flowable fill concrete (50 psi minimum/ 150 psi maximum) in accordance with the following criteria:
   a. Pipes larger than 24-inches diameter.
   b. Pipes located within roadway section and meeting one of the following conditions:
      i. pipes that are 12-inches diameter up to and including pipes that are 24-inches diameter and are buried less than 20 feet below finished grade.
      ii. pipes that are 6-inches diameter up to 12-inches diameter that are not cast iron, ductile iron, PVC, or HDPE and are buried less than 12 feet below finished grade.
   c. Pipes located below groundwater table that could become a conduit for water movement.

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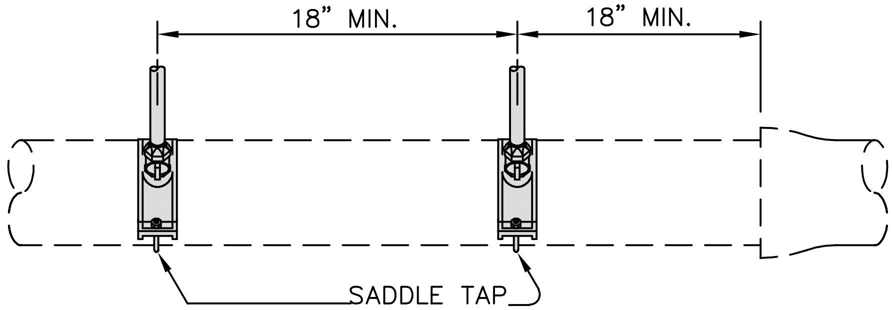
LINE ABANDONMENT DETAIL FOR PAVED AREAS

SCALE: Not To Scale	DETAIL # 2512.05
REVISION DATE: Jan 1, 2025	SHEET #: 2 of 2

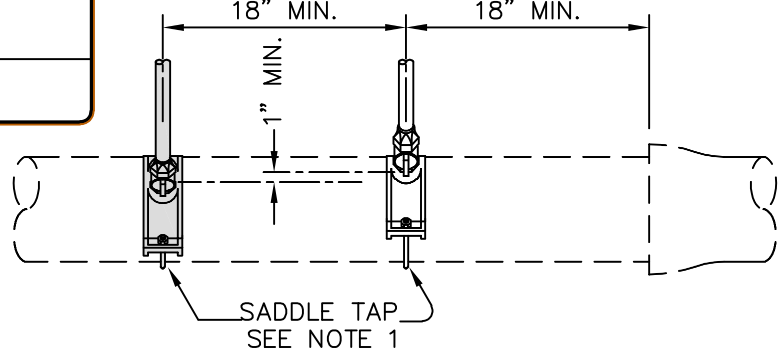
A/C or D.I.P.



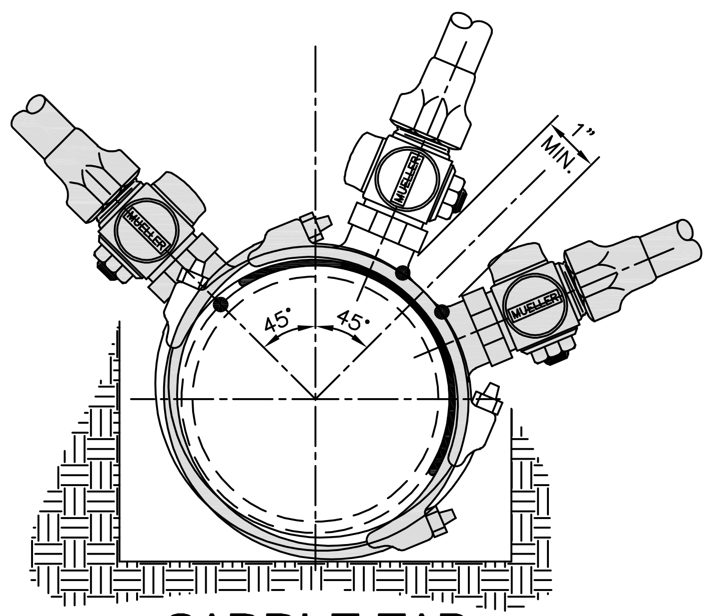
PART	MANUFACTURER MODEL / Cat. No.
SADDLE	FORD / 101B SERIES OR 202B SERIES MUELLER / BR1B OR BR2B
CORP. STOP	FORD / F600 SERIES MUELLER / H-15000 SERIES

PVC or C900

SEE NOTE 2



3/4" and 1" A/C, DIP, PVC, or C900



SADDLE TAP

NOTES:

1. All bronze saddle (Single or double strap for 3/4" and 1")
2. If 2 taps are made on each side of the main there shall be a minimum of 18" horizontal separation. Multiple taps on the same side shall have a minimum 18" horizontal separation and staggered a minimum of 1" vertically to prevent damage to the main.

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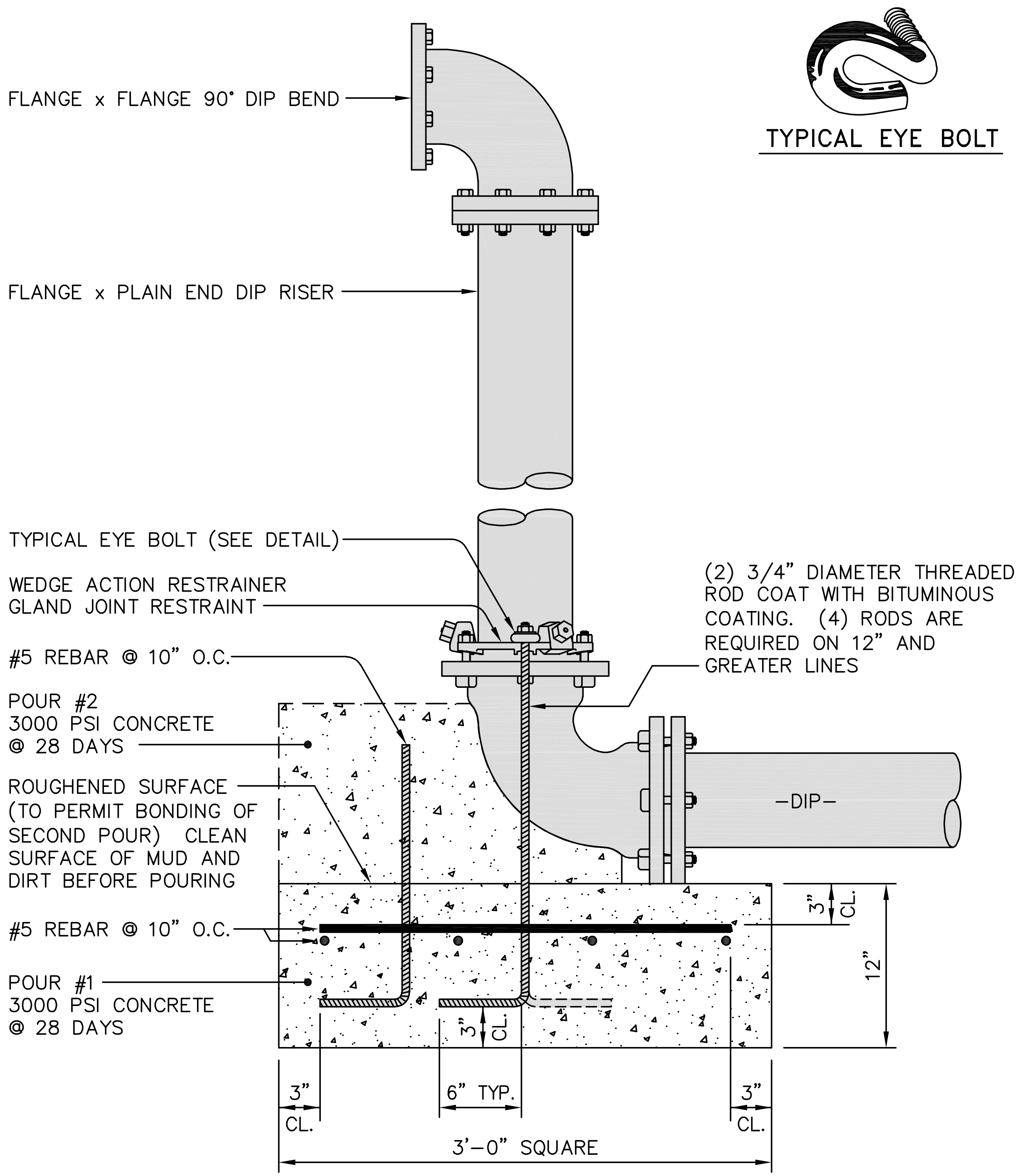
STANDARD 3/4" and 1" WATER TAPPING DETAIL

SCALE:	DETAIL #
Not To Scale	2 512.06
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 1



NOTES:

1. Excavate under elbow for footing, place steel & rods in footing & pour (pour #1)
2. Once concrete has set in footing pour horizontal blocking (pour #2)
3. Footing adequate for water mains up to 8". North Carolina licensed Professional Engineer to design footings for lines greater than 8" diameter.

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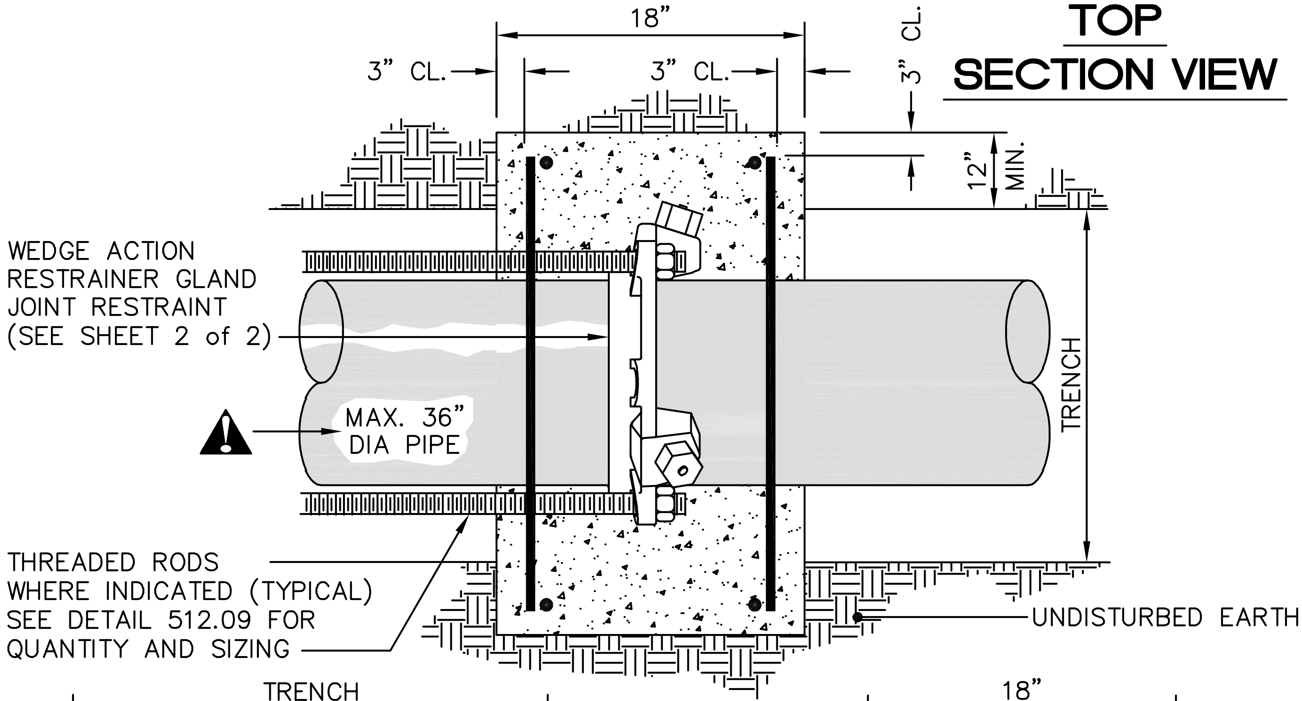
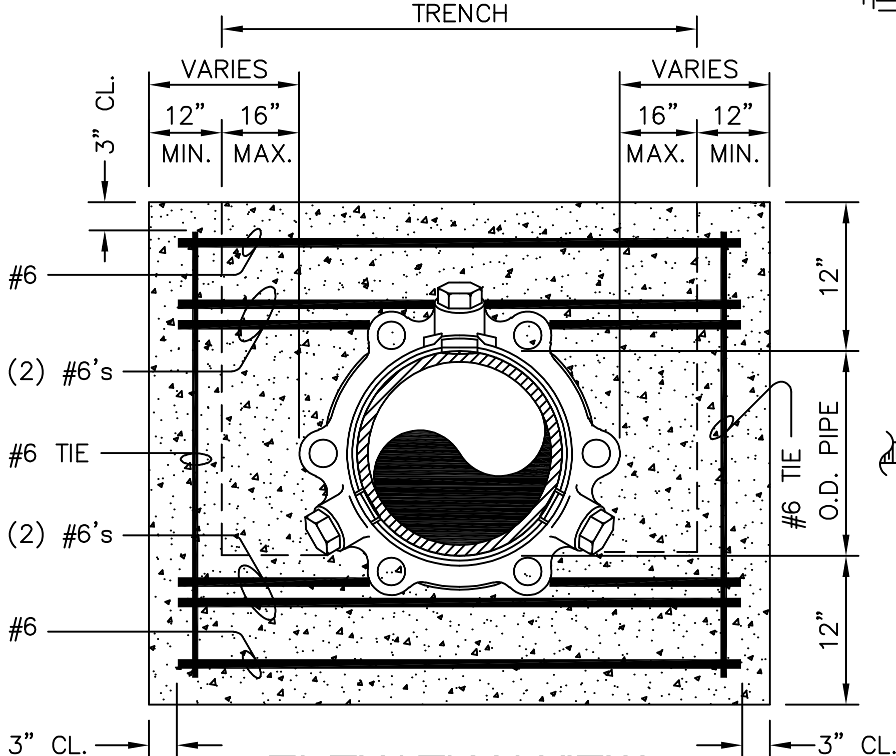
THRUST FOOTING DETAIL

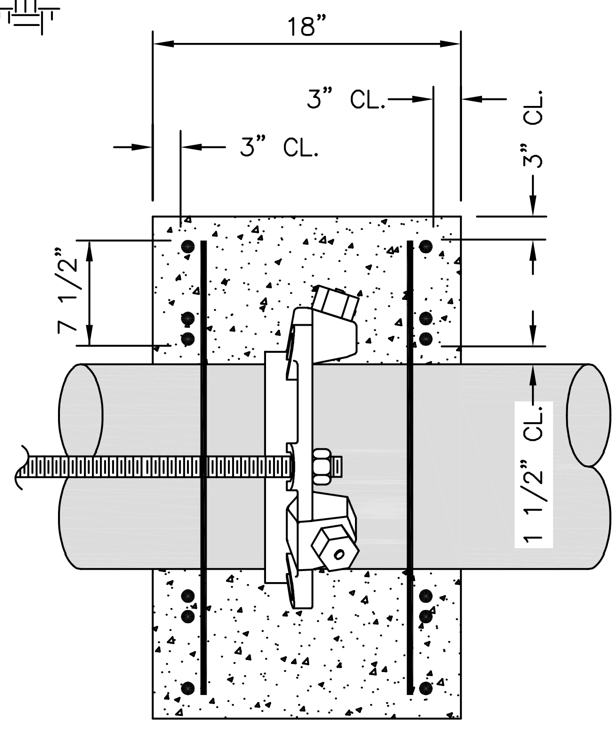
SCALE: Not To Scale	DETAIL # 2 512.07
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 1

TOP SECTION VIEW





ELEVATION VIEW



SIDE SECTION VIEW

NOTES:

1. Concrete shall 3000 P.S.I.
2. Reinforcing bars shall be deformed bars, and tied together.
3. Trench bottom width in vicinity of thrust block(s) installation shall be the minimum width for placement of pipe (Max trench width = pipe O.D.+2 Ft.)
4. Backfill and compact in 6" layers.
5. Place thrust collar on one full joint of pipe.
6. Last joint of pipe with thrust collar to be mechanical joint pipe.
7. Place wedge action restrainer gland joint restraint 4 feet from plug end of pipe.

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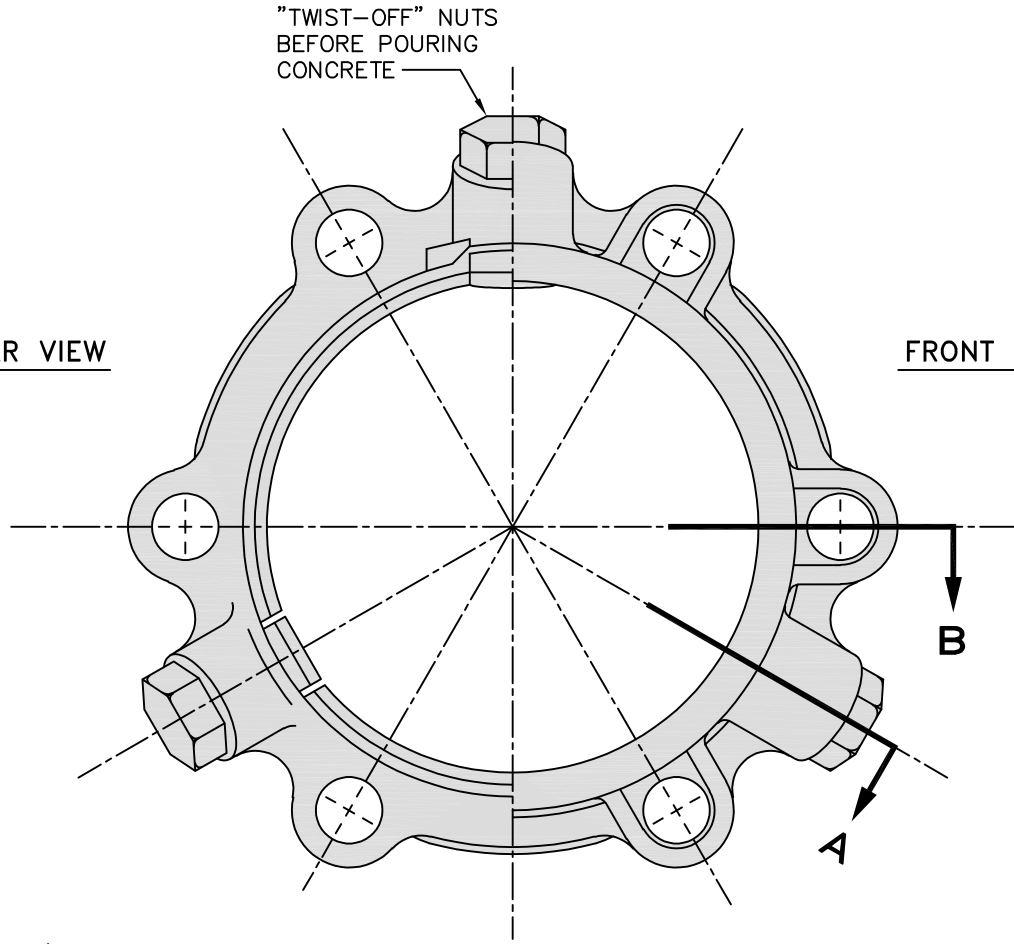
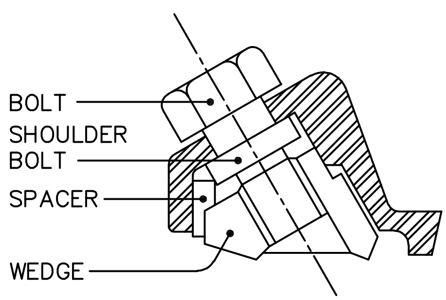
THRUST COLLAR & BLOCKING with WEDGE ACTION RESTRAINER GLAND

SCALE: Not To Scale	DETAIL #: 2512.08
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 2

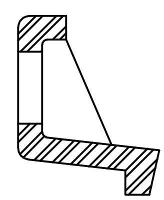
REAR VIEW

FRONT VIEW





SECTION A



SECTION B

⚠ A MEG-A-LUG SERIES 1100 or FORD WEDGE ACTION RESTRAINER GLAND UFR SERIES 1400 MECHANICAL JOINT RESTRAINT SHALL BE PLACED ON DIP and PVC. CONCRETE & REINFORCEMENT STEEL SHALL ALSO BE AS SHOWN ON SHEET 1 of 2.

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THRUST COLLAR & BLOCKING with WEDGE ACTION RESTRAINER GLAND

SCALE: Not To Scale	DETAIL # 2512.08
REVISION DATE: Jan 1, 2025	SHEET #: 2 of 2

TIE ROD ANCHORS DATUM

PIPE SIZE (INCHES)	ROD DIAMETER	NUMBER OF A307 RODS REQUIRED
TEST PRESSURE = 150 PSI		
6	3/4"	2
8	3/4"	2
10	3/4"	2
12	3/4"	4
16	3/4"	6
20	3/4"	8
24	3/4"	8
30	1"	10
TEST PRESSURE = 200 PSI		
6	3/4"	2
8	3/4"	2
10	3/4"	4
12	3/4"	6
16	3/4"	8
20	3/4"	12
24	3/4"	10
30	1"	14
TEST PRESSURE = 250 PSI		
6	3/4"	4
8	3/4"	4
10	3/4"	4
12	3/4"	6
16	3/4"	12
20	3/4"	14
24	3/4"	16
30	1"	20

ASTM A307 CADIUM COATED TIE RODS

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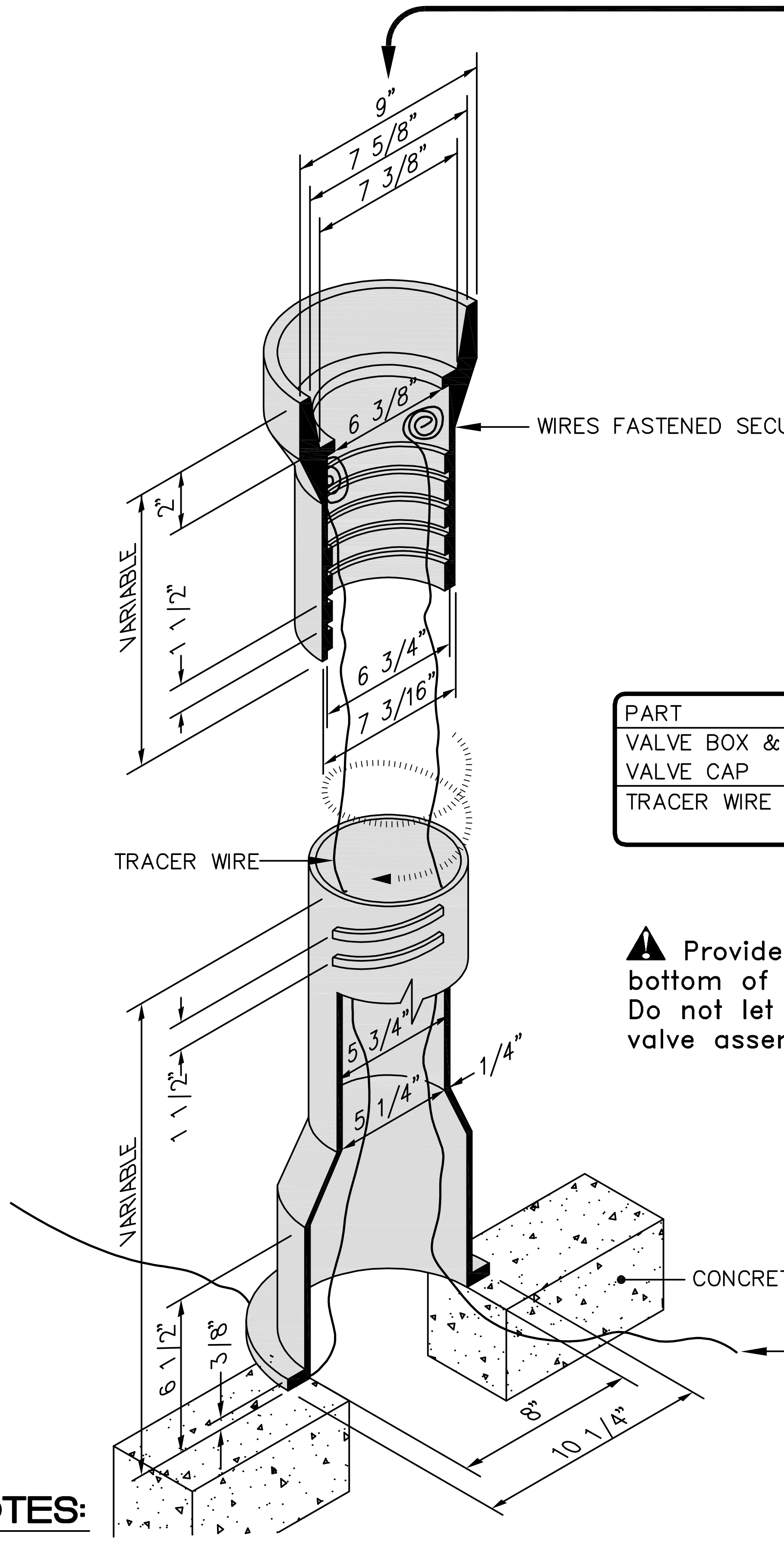
TIE ROD ANCHORS DATUM CHART

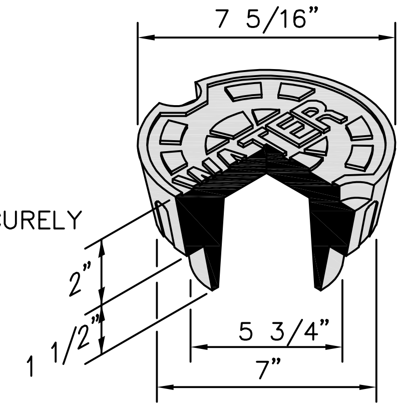
SCALE: Not To Scale

DETAIL # 2512.09

REVISION DATE: Jan 1, 2025

SHEET #: 1 of 1





PART	MANUFACTURER MODEL / Cat. No.
VALVE BOX & VALVE CAP	CHARLOTTE PIPE / UTL-273 TYLER PIPE CO. / 6850
TRACER WIRE	CONTINUOUS AWG NO. 12 GAUGE SOLID COPPER

⚠ Provide 1" earth cushion between bottom of concrete brick and valve. Do not let valve box or brick rest on valve assembly. — Typical all valves.

NOTES:

1. Use heavy duty traffic lid marked "WATER".

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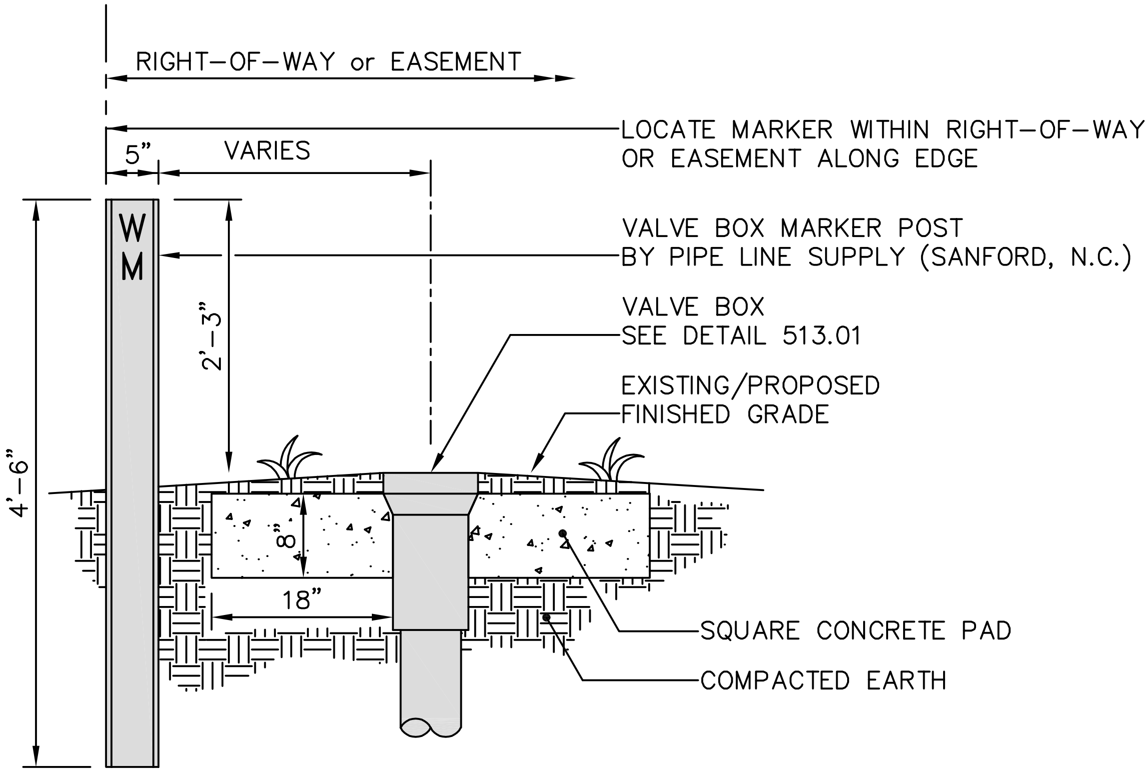
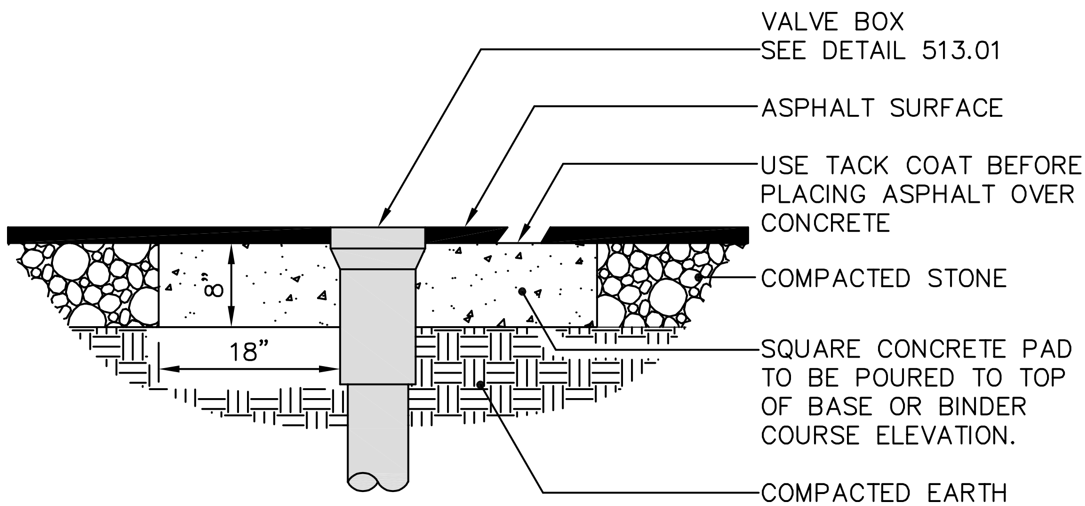
STANDARD SCREW VALVE BOX DETAIL

SCALE:	DETAIL #
Not To Scale	2513.01
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 1



FIELD AND EASEMENT OR SIDE OF ROAD LOCATION



IN STREET LOCATION

NOTES:

1. Concrete to be minimum 3,000 PSI @ 28 days.
2. Concrete to match Department of Transportation requirements

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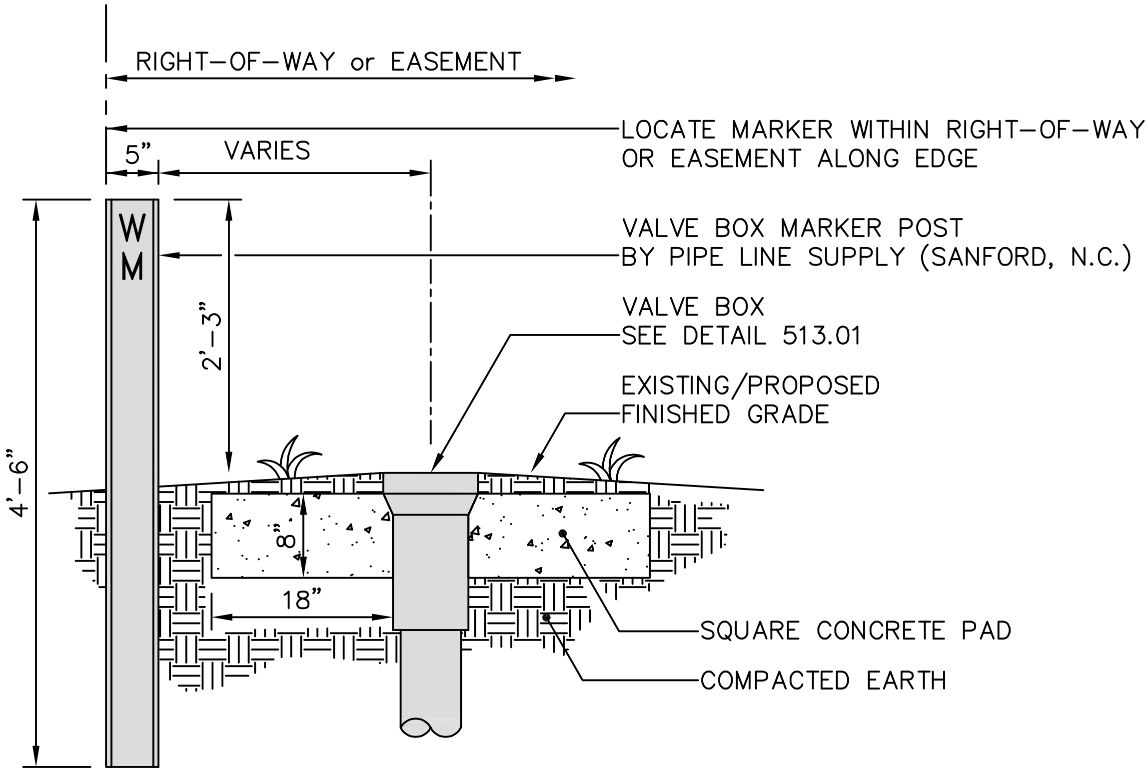
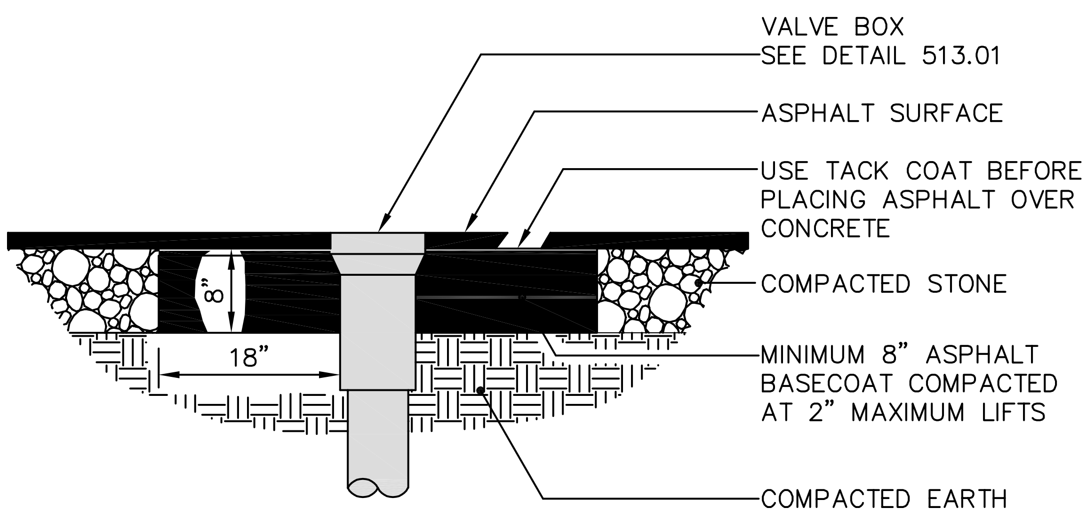
VALVE BOX STABILIZING PAD DETAILS - NC DOT ROAD	SCALE: Not To Scale	DETAIL #: 2 513.02
	REVISION DATE: Jan 1, 2025	SHEET #: 1 of 2



FIELD AND EASEMENT OR SIDE OF ROAD LOCATION



IN STREET LOCATION

NOTES:

1. Concrete to be minimum 3,000 PSI @ 28 days.

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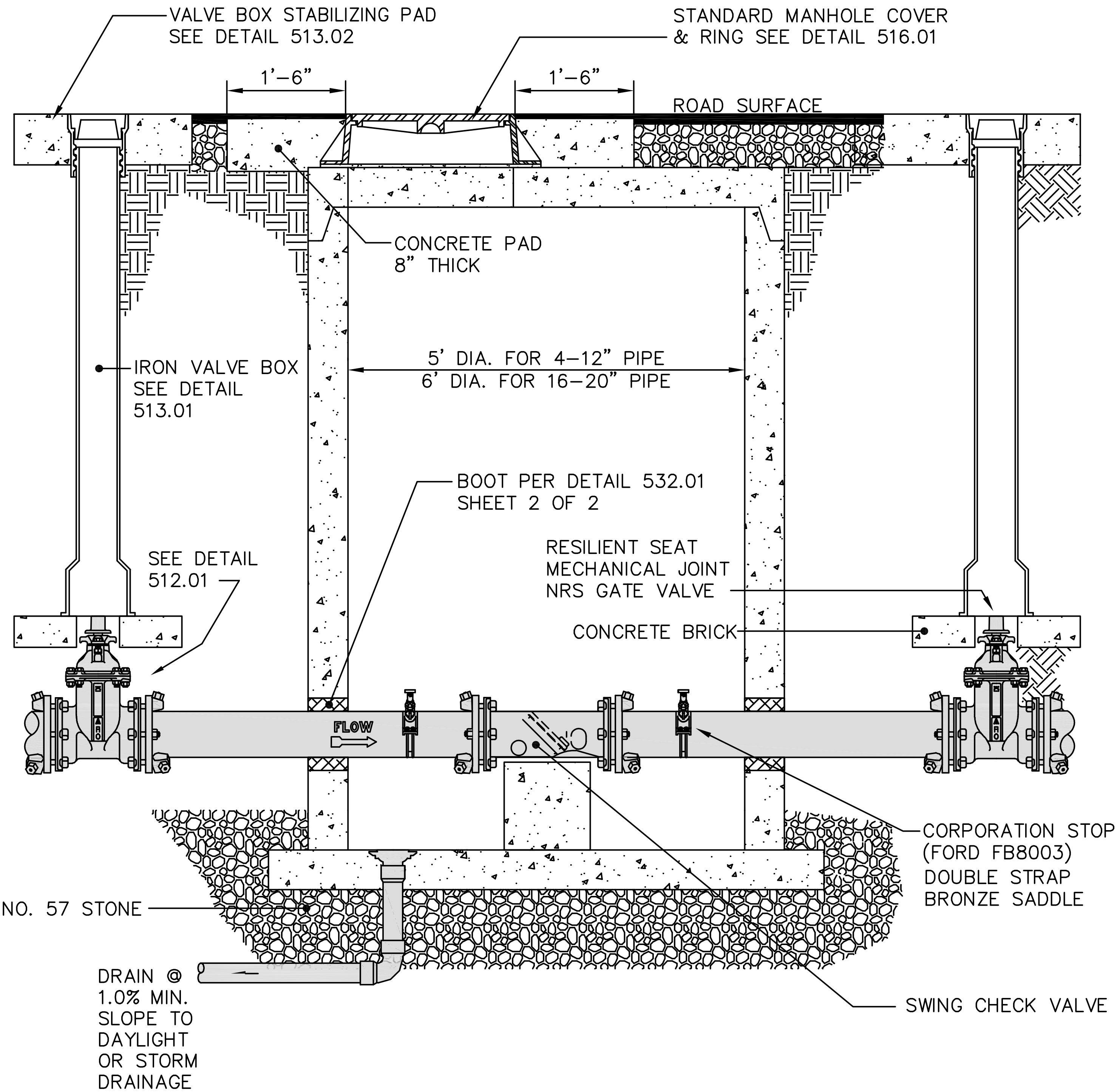
VALVE BOX STABILIZING PAD DETAIL - TOWN & PRIVATE ROADS

SCALE: Not To Scale	DETAIL # 2513.02
REVISION DATE: Jan 1, 2025	SHEET #: 2 of 2



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ZONE SEPARATOR DETAIL

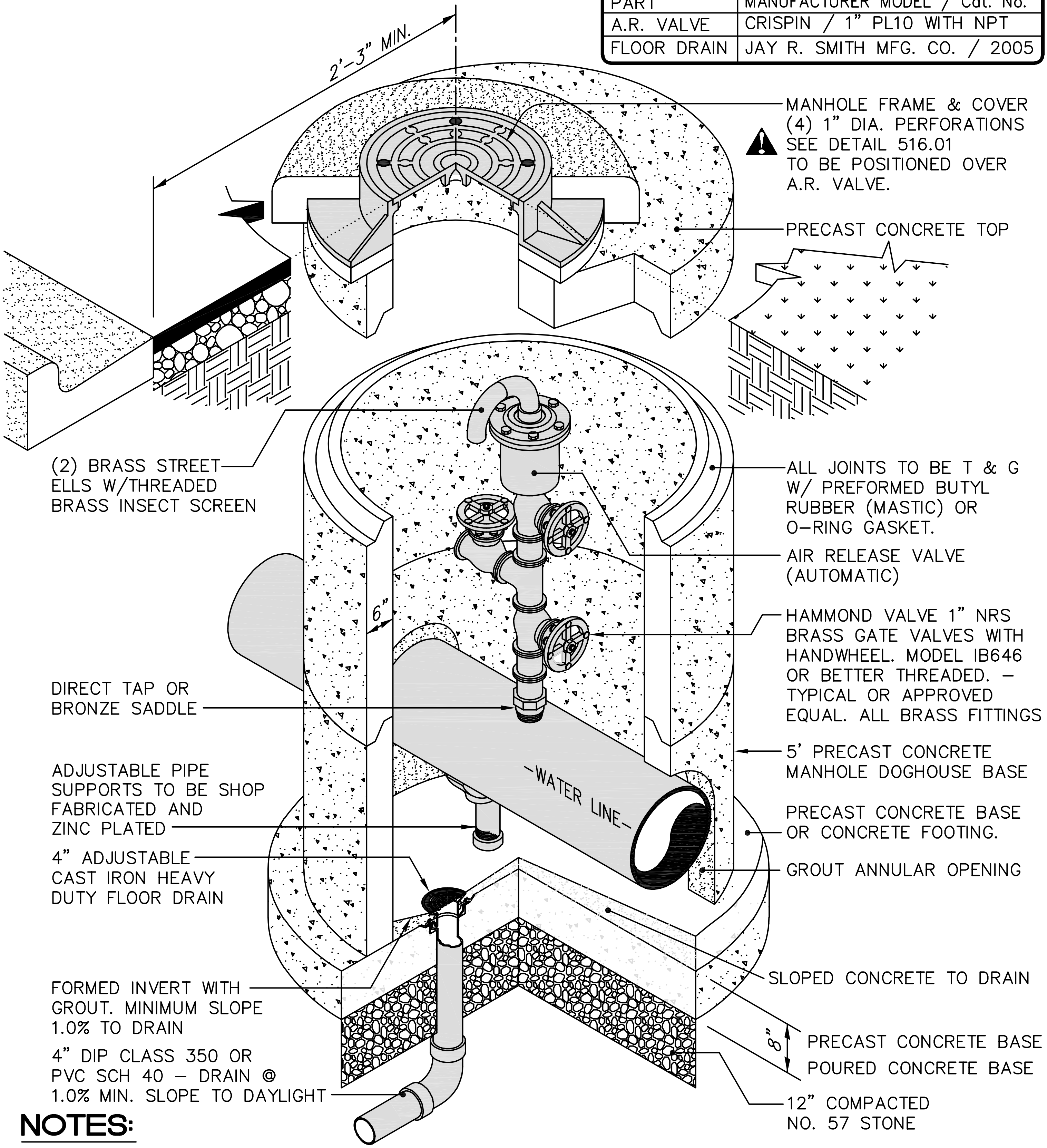
SCALE: Not To Scale

DETAIL #: 2 513.03

REVISION DATE: Jan 1, 2025

SHEET #: 1 of 1

PART	MANUFACTURER MODEL / Cat. No.
A.R. VALVE	CRISPIN / 1" PL10 WITH NPT
FLOOR DRAIN	JAY R. SMITH MFG. CO. / 2005



NOTES:

1. Provide a minimum of 3'–6" cover over water line.
2. Do not exceed allowable direct tap specified by pipe manufacturer. otherwise, use single strap bronze service saddle. See detail 512.06
3. Cone section may be substituted for flat top according to depth.

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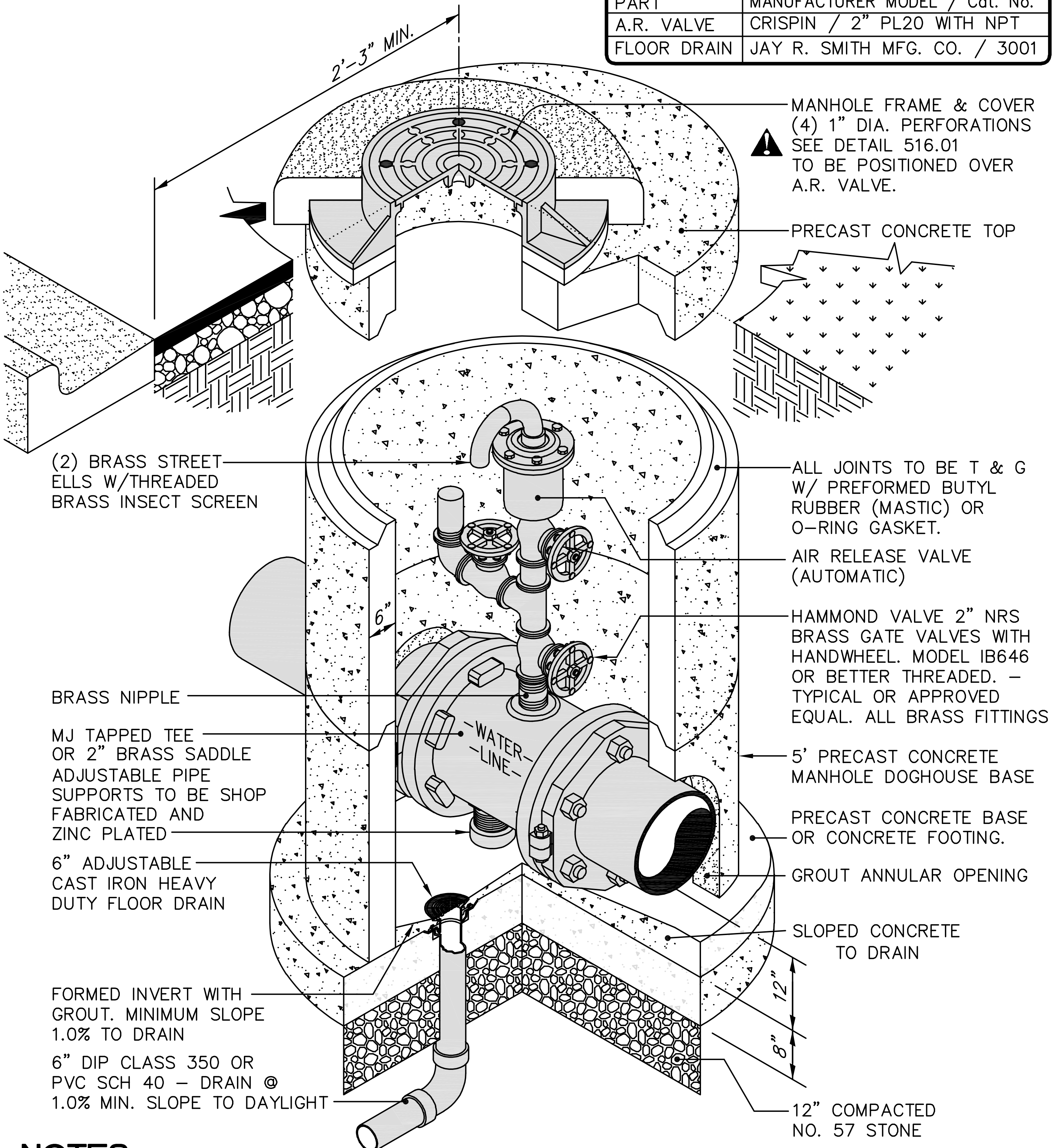
1" AIR RELEASE VALVE & MANHOLE (PIPE 2" to 12")

SCALE: Not To Scale	DETAIL #: 2513.04
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 1

PART	MANUFACTURER MODEL / Cat. No.
A.R. VALVE	CRISPIN / 2" PL20 WITH NPT
FLOOR DRAIN	JAY R. SMITH MFG. CO. / 3001



NOTES:

1. Provide a minimum of 3'-6" cover over water line.
2. All pipe fittings to be brass.
3. Cone section may be substituted for flat top according to depth.

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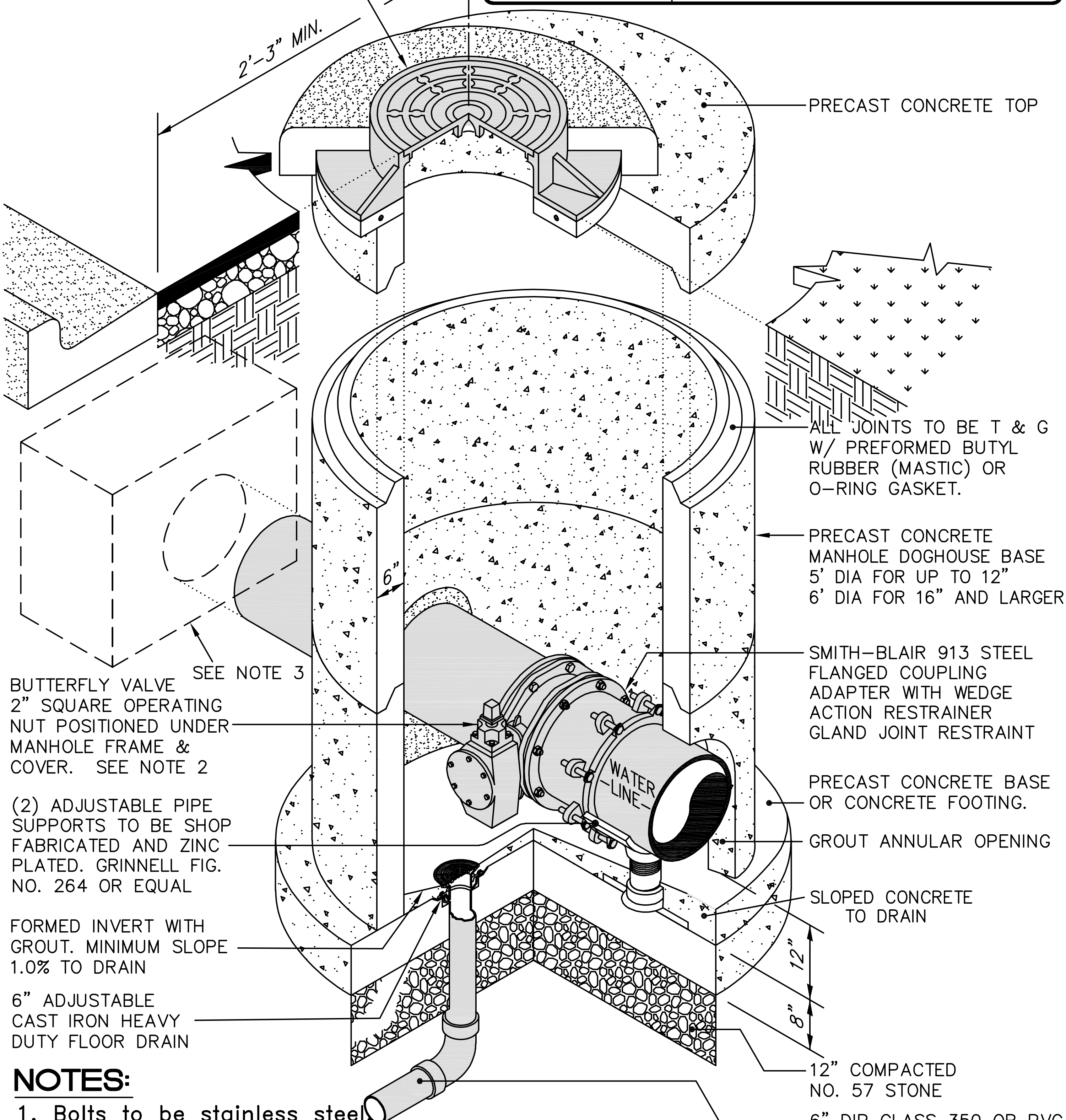
2" AIR RELEASE VALVE & MANHOLE (PIPE 16" and LARGER)

SCALE:	DETAIL #:
Not To Scale	2513.05
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 1

PART	MANUFACTURER MODEL / Cat. No.
BUTTERFLY VALVE 250 PSI CLASS	CLOW (M&H) / 4500-02 FLANGED MUELLER / LINSEAL XP 250B FLANGED
FLOOR DRAIN	JAY R. SMITH MFG. CO. / 3001



NOTES:

1. Bolts to be stainless steel.
2. Provide a minimum of 3'-6" cover over water line.
3. Manholes required when directed by OWASA
4. Thrust blocking to be provided on both sides of manhole. See OWASA detail 512.08.

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BUTTERFLY VALVE (16" and LARGER) WHEN PRECAST MANHOLE REQUIRED

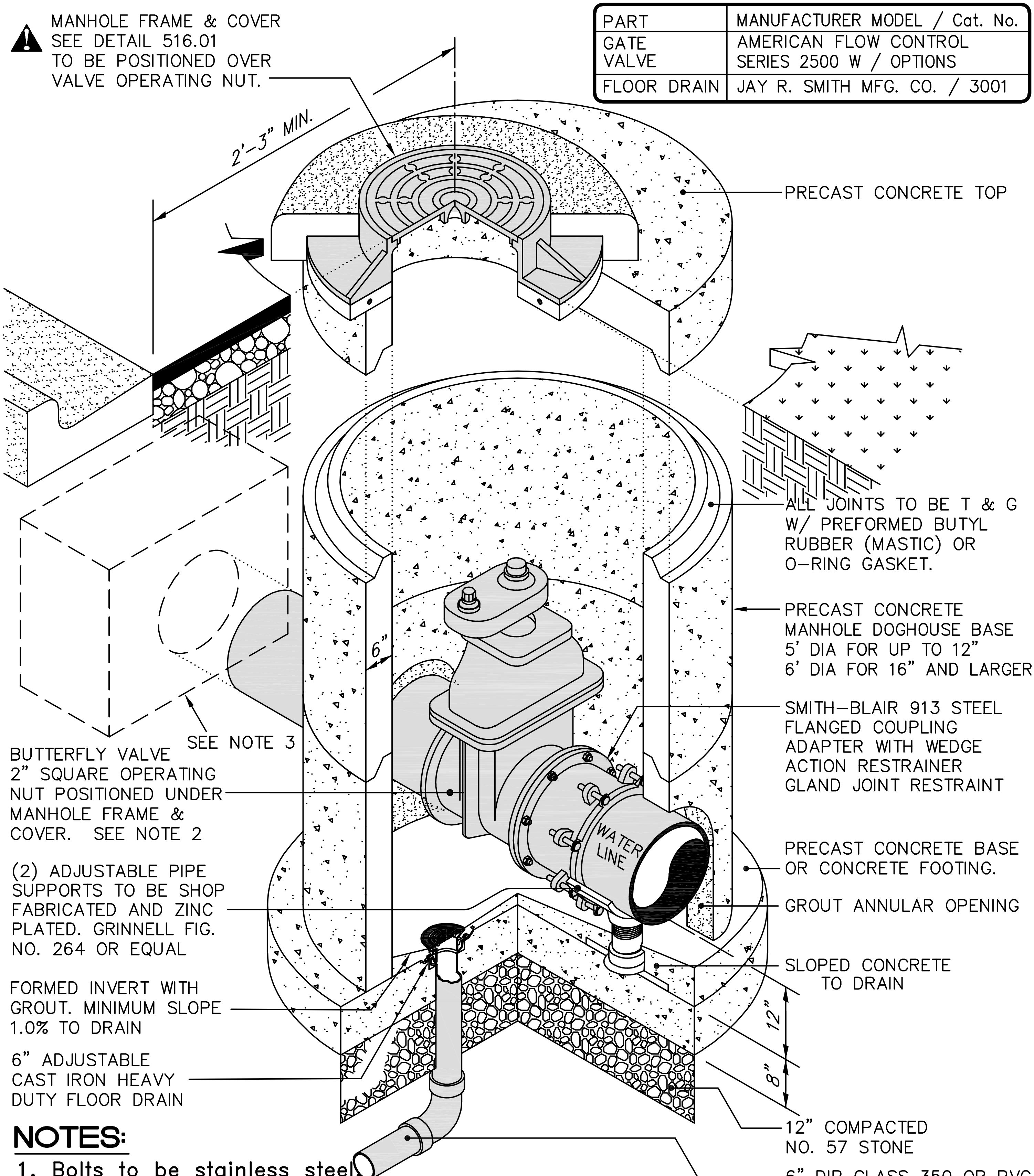
SCALE: Not To Scale

DETAIL #: 2513.06

REVISION DATE: Jan 1, 2025

SHEET #: 1 of 1

PART	MANUFACTURER MODEL / Cat. No.
GATE VALVE	AMERICAN FLOW CONTROL SERIES 2500 W / OPTIONS
FLOOR DRAIN	JAY R. SMITH MFG. CO. / 3001



NOTES:

1. Bolts to be stainless steel.
2. Provide a minimum of 3'–6" cover over water line.
3. Manholes required when directed by OWASA
4. Thrust blocking to be provided on both sides of manhole. See OWASA detail 512.08.

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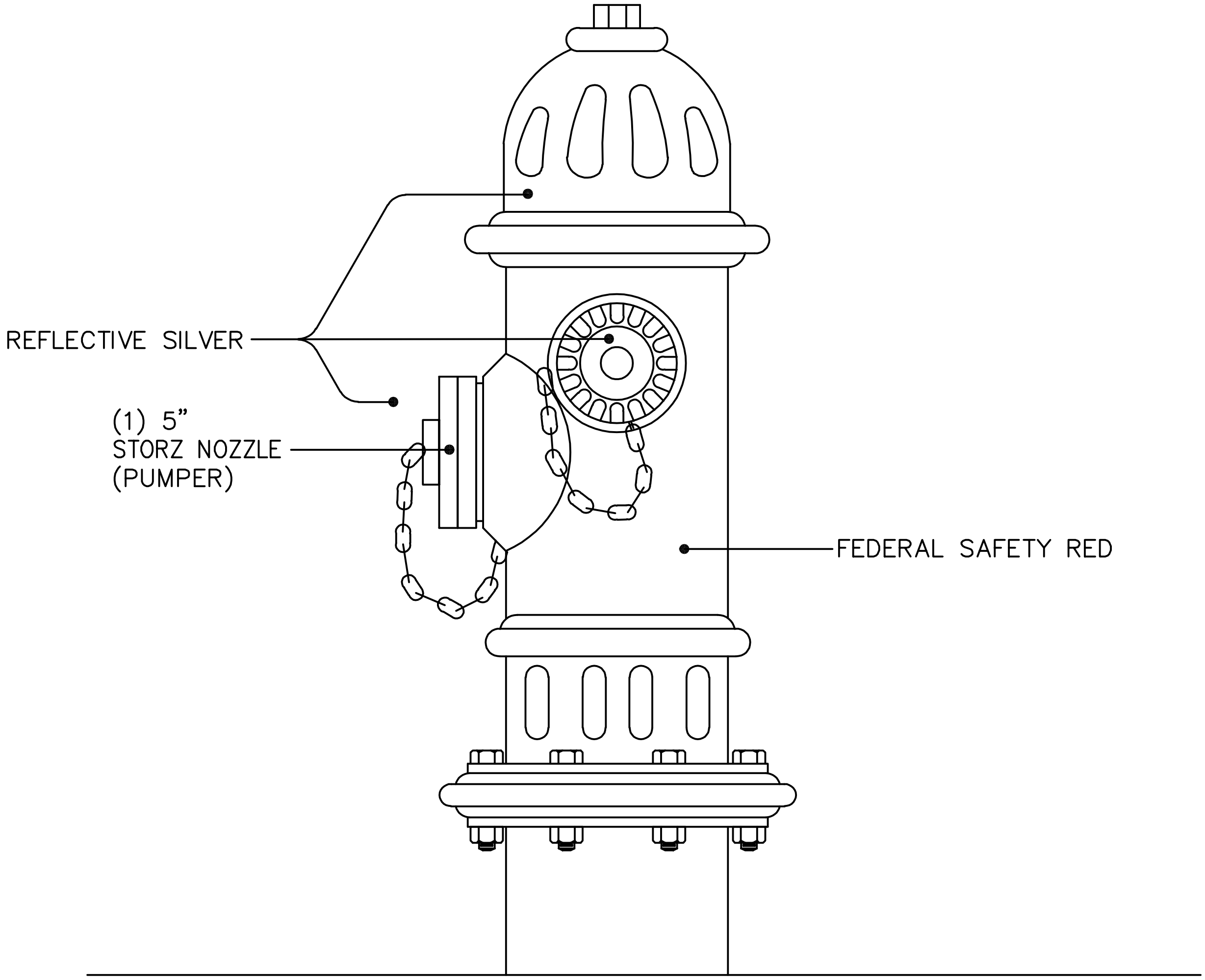
GATE VALVE (16" and LARGER) WHEN PRECAST MANHOLE REQUIRED

SCALE:	DETAIL #
Not To Scale	2513.08
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 1



NOTES:

1. Use sherwin-williams industrial enamel or equal.
2. Paint colors are applicable to the following locations:
   a. Town of Carrboro
   b. Town of Chapel Hill
   c. Durham County
   d. Orange County
   e. University of North Carolina
3. Privately owned hydrants shall not be the same color as OWASA hydrants.

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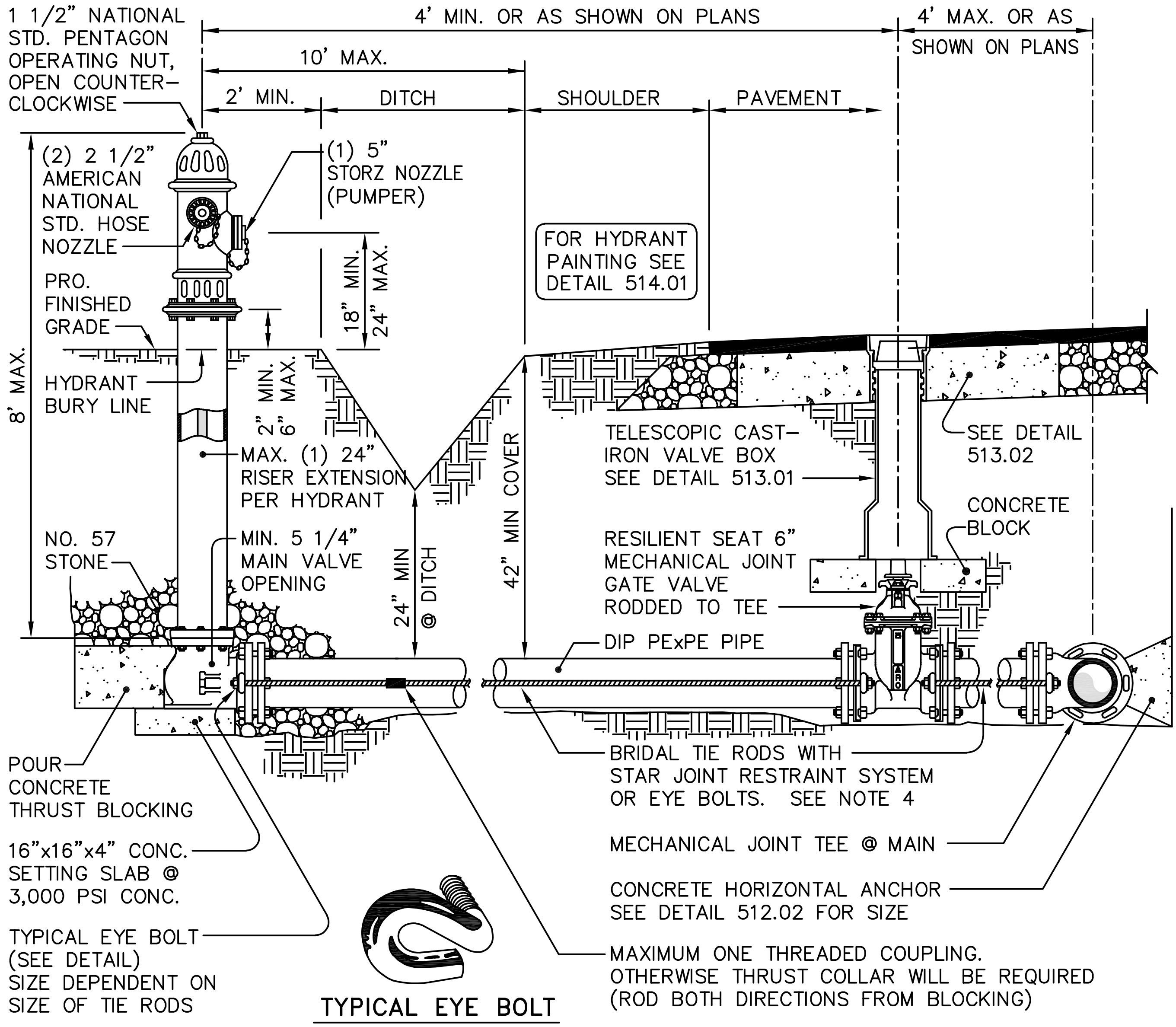
USE WITH THE OWASA STANDARD SPECIFICATIONS ONLY

FIRE HYDRANT PAINTING SPECIFICATIONS

SCALE: Not To Scale	DETAIL # 2514.01
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 1



HYDRANT MAKE	MUELLER	CLOW (M&H)	AMERICAN FLOW CONTROL
CAT No.	A–423 SUPER CENTURION 250	F–2545 MEDALLION	B62B– LONG BARREL

NOTES:

1. Wedge action restrainer gland joint restraints are preferred, and may be used with tie rods.
2. Hydrants to be placed with pumper nozzle facing the street or as otherwise directed by OWASA.
3. When valve box is placed outside of pavement, provide concrete stabilization pad. (detail 513.02)
4. Minimum of (2) 3/4" diameter rods w/standard coating.
5. Where hydrant is set behind guardrail, centerline of pumper nozzle to be a minimum of 12" and a maximum of 18" above top of guardrail.
6. Fire hydrant to be oiled & greased and cap to be sprayed (Non–petroleum – based) after installation.

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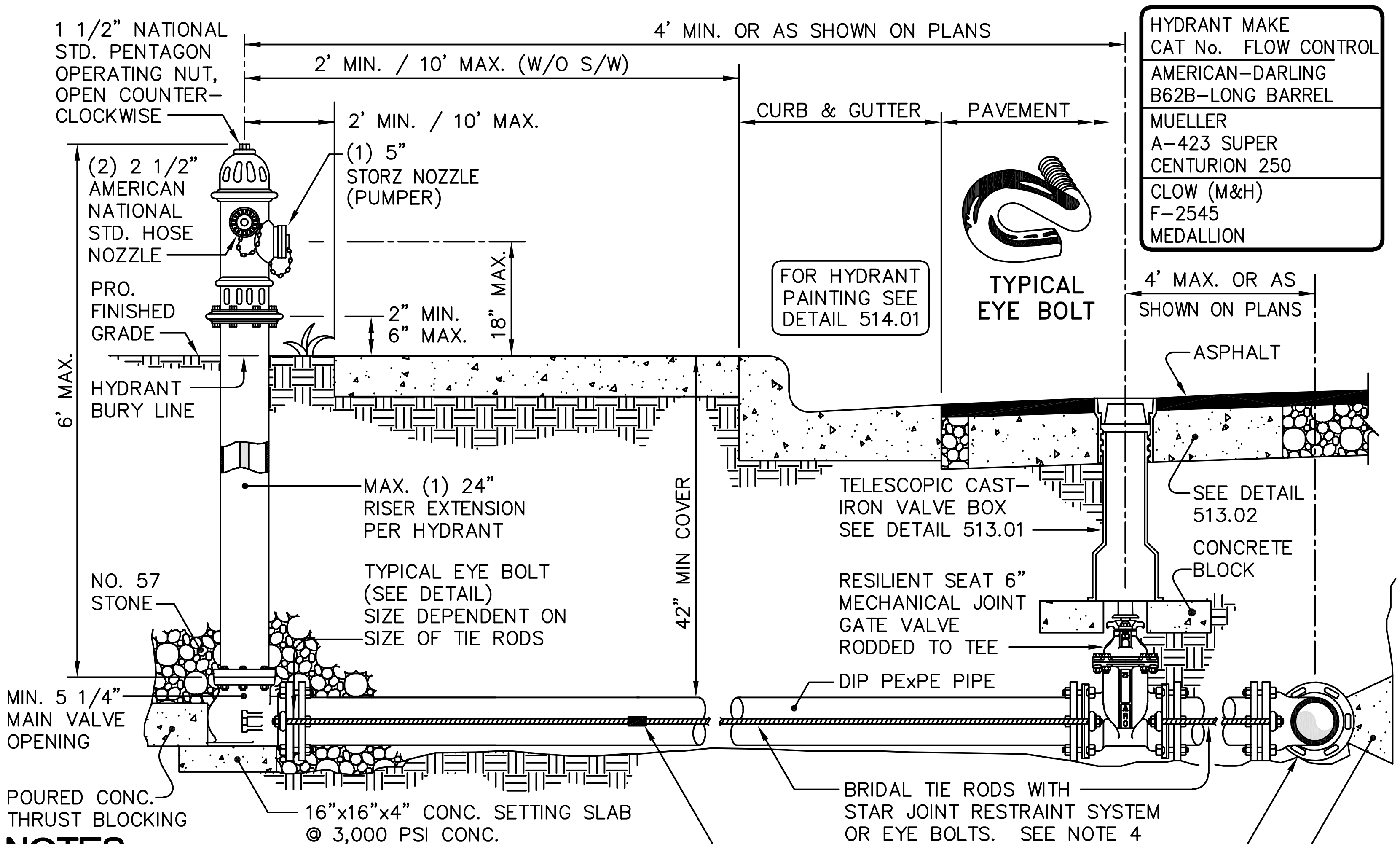
TYPICAL FIRE HYDRANT STREETS with BAR DITCH

SCALE:	DETAIL #
Not To Scale	514.02
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 1



NOTES:

1. Wedge action restrainer gland joint restraints are preferred, and may be used with tie rods.
2. Hydrants to be placed with pumper nozzle facing the street or as otherwise directed by OWASA.
3. When valve box is placed outside of pavement, provide concrete stabilization pad. (detail 513.02)
4. Minimum of (2) 3/4" diameter rods w/standard coating.
5. Where hydrant is set behind guardrail, centerline of pumper nozzle tobe a minimum of 12" and a maximum of 18" above top of guardrail. Center of hydrant to be a minimum of 3 feet from guardrail.
6. Fire hydrant to be oiled & greased and cap to be sprayed (Non-petroleum – based) after installation.
7. Do not locate hydrants in sidewalks or block pedestrian flow.

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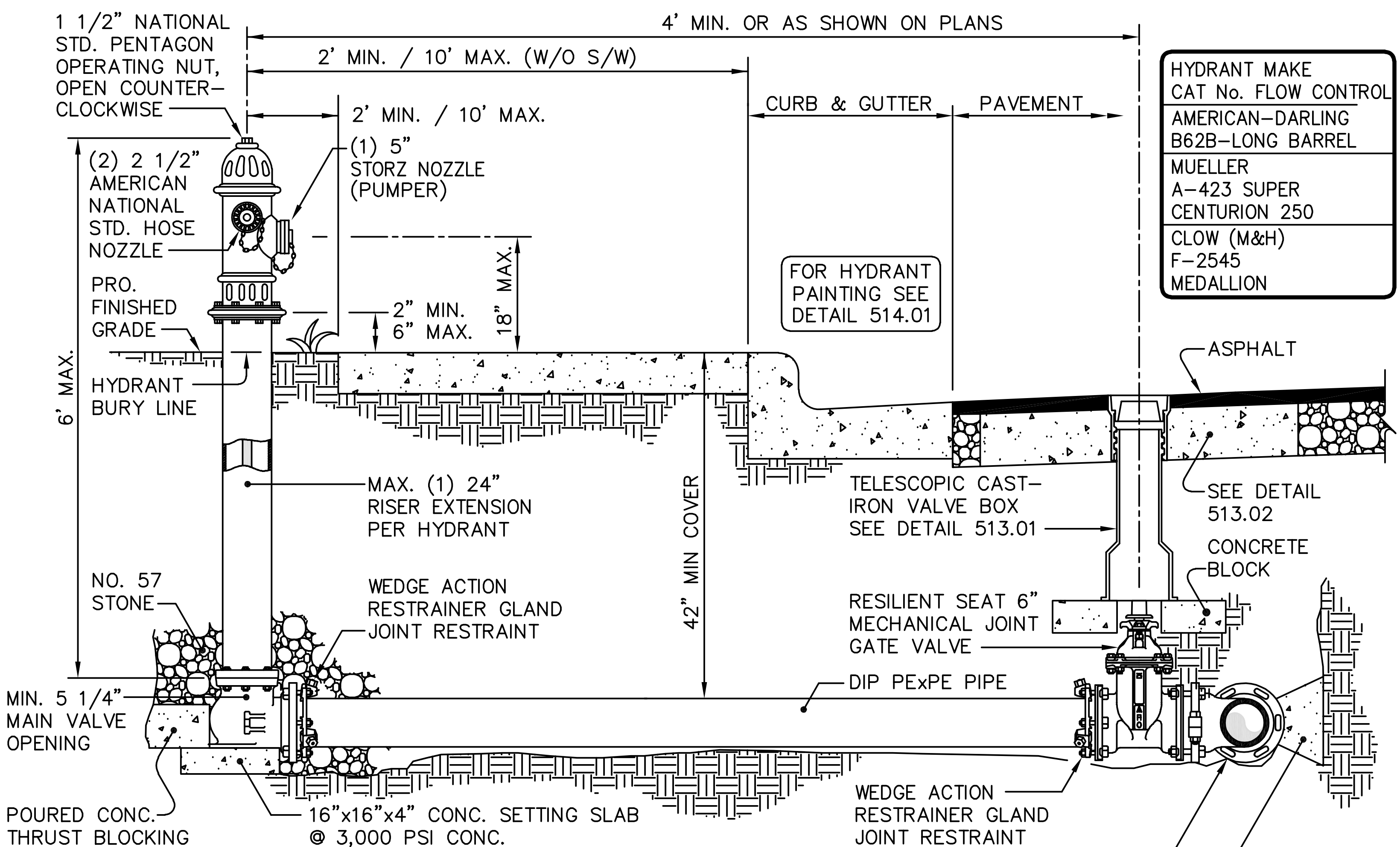
TYPICAL RODDED FIRE HYDRANT STREETS with CURB & GUTTER

SCALE: Not To Scale	DETAIL # 2514.03
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 2



HYDRANT MAKE	CAT No. FLOW CONTROL
AMERICAN–DARLING	B62B–LONG BARREL
MUELLER	A–423 SUPER CENTURION 250
CLOW (M&H)	F–2545 MEDALLION

NOTES:

1. Omitted
2. Hydrants to be placed with pumper nozzle facing the street or as otherwise directed by OWASA.
3. When valve box is placed outside of pavement, provide concrete stabilization pad. (detail 513.02)
4. Omitted
5. Where hydrant is set behind guardrail, centerline of pumper nozzle to be a minimum of 12" and a maximum of 18" above top of guardrail. Center of hydrant to be a minimum of 3 feet from guardrail.
6. Fire hydrant to be oiled & greased and cap to be sprayed (Non–petroleum – based) after installation.
7. Do not locate hydrants in sidewalks or block pedestrian flow.

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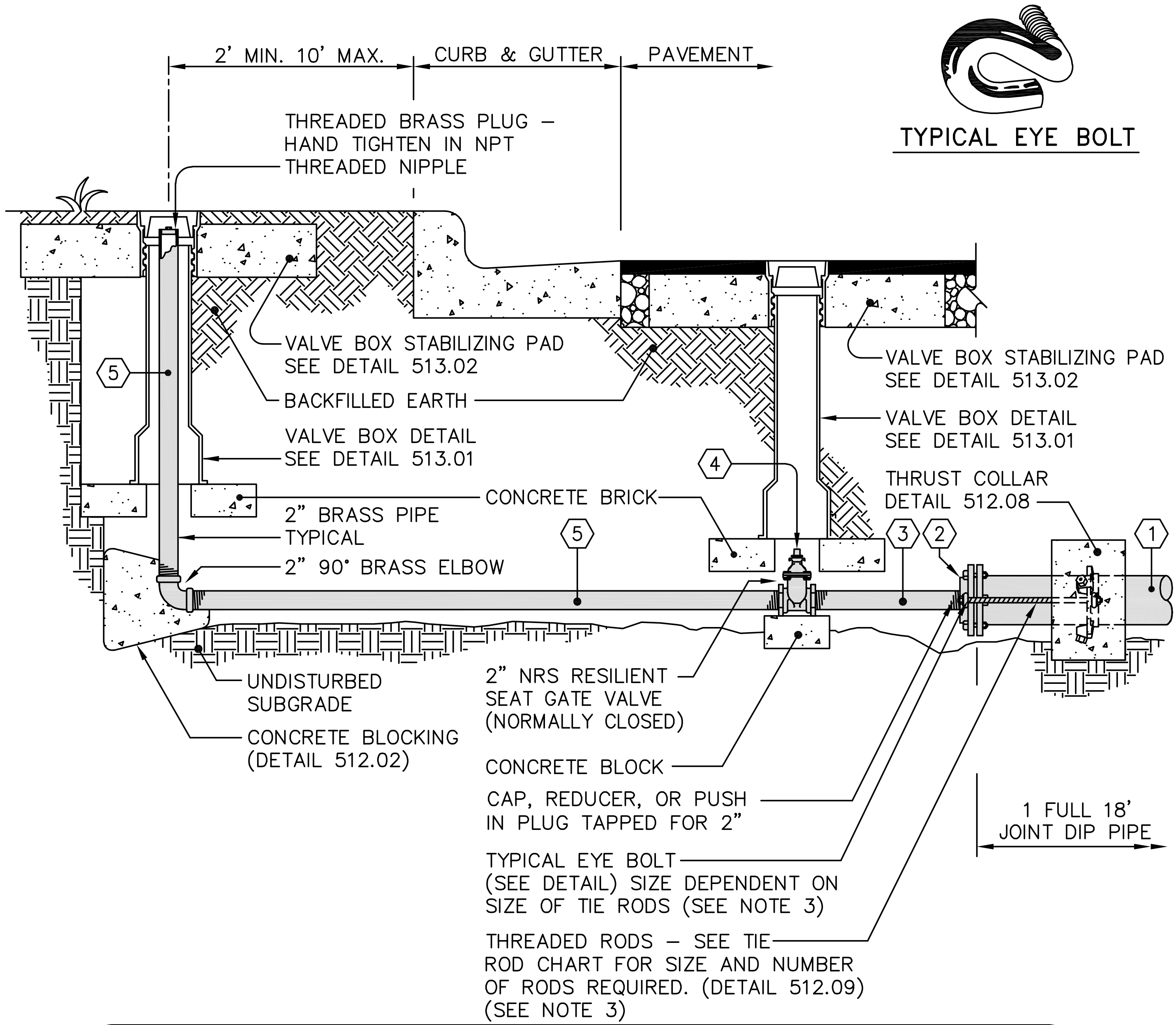
TYP. RESTRAINED JT. FIRE HYDRANT STREETS with CURB & GUTTER

SCALE:	DETAIL #
Not To Scale	2514.03
REVISION DATE: Jan 1, 2025	SHEET #: 2 of 2



1 MAIN	2 CAP OR REDUCER	3 NIPPLE	4 GATE VALVE	5 BLOW-OFF ASSEMBLY
4"	4" TAPPED FOR 2"	2" x 6"L BRASS	2" NRS	2" BRASS
6"	6" TAPPED FOR 2"	2" x 6"L BRASS	2" NRS	2" BRASS
8"	8" TAPPED FOR 2"	2" x 6"L BRASS	2" NRS	2" BRASS

NOTES:

1. No discharge from blow-off should go directly into a creek. OWASA must declorinate discharge before it enters a body of water.
2. Provide erosion and sedementation control for discharge.
3. In lieu of rodded fittings, contractor may use a wedge action restrained gland joint restraint on fittings.
4. A reducer will require a threaded fitting.

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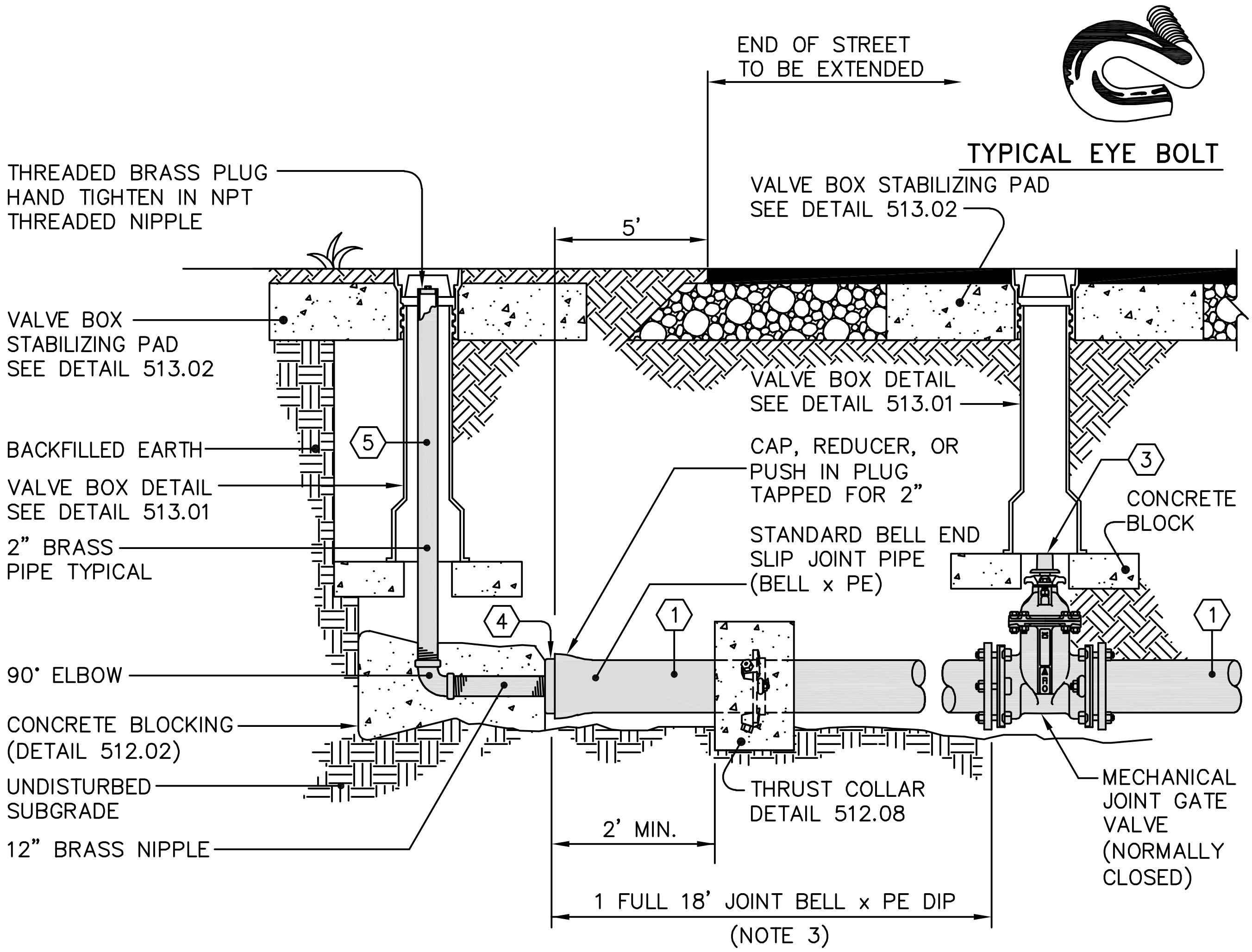
USE WITH THE OWASA STANDARD SPECIFICATIONS ONLY

PERMANENT 2" BLOW-OFF ASSEMBLY FOR MAINS UP TO 8"

SCALE: Not To Scale
DETAIL #: 514.04
REVISION DATE: Jan 1, 2025
SHEET #: 1 of 1



1 MAIN	2 REDUCER	3 GATE VALVE	4 PLUG	5 BLOW-OFF ASSEMBLY
4"	N/A	4"	4" TAPPED FOR 2"	2" BRASS
6"	N/A	6"	6" TAPPED FOR 2"	2" BRASS
8"	N/A	8"	8" TAPPED FOR 2"	2" BRASS
10"	N/A	10"	REFER TO OWASA DETAIL 514.06	REFER TO OWASA DETAIL 514.06
12"	N/A	12"	REFER TO OWASA DETAIL 514.06	REFER TO OWASA DETAIL 514.06
16"	N/A	16"	REFER TO OWASA DETAIL 514.06	REFER TO OWASA DETAIL 514.06
18"	N/A	18"	REFER TO OWASA DETAIL 514.06	REFER TO OWASA DETAIL 514.06
20"	N/A	20"	REFER TO OWASA DETAIL 514.06	REFER TO OWASA DETAIL 514.06
24"	N/A	24"	REFER TO OWASA DETAIL 514.06	REFER TO OWASA DETAIL 514.06

NOTES:

1. No discharge from blow-off should go directly into a creek. OWASA must declorinate discharge before it enters a body of water.
2. Provide erosion and sedementation control for discharge.
3. If pipe is PE, use MJ cap and rod to thrust collar (detail 512.08).
4. A reducer will require a threaded fitting.

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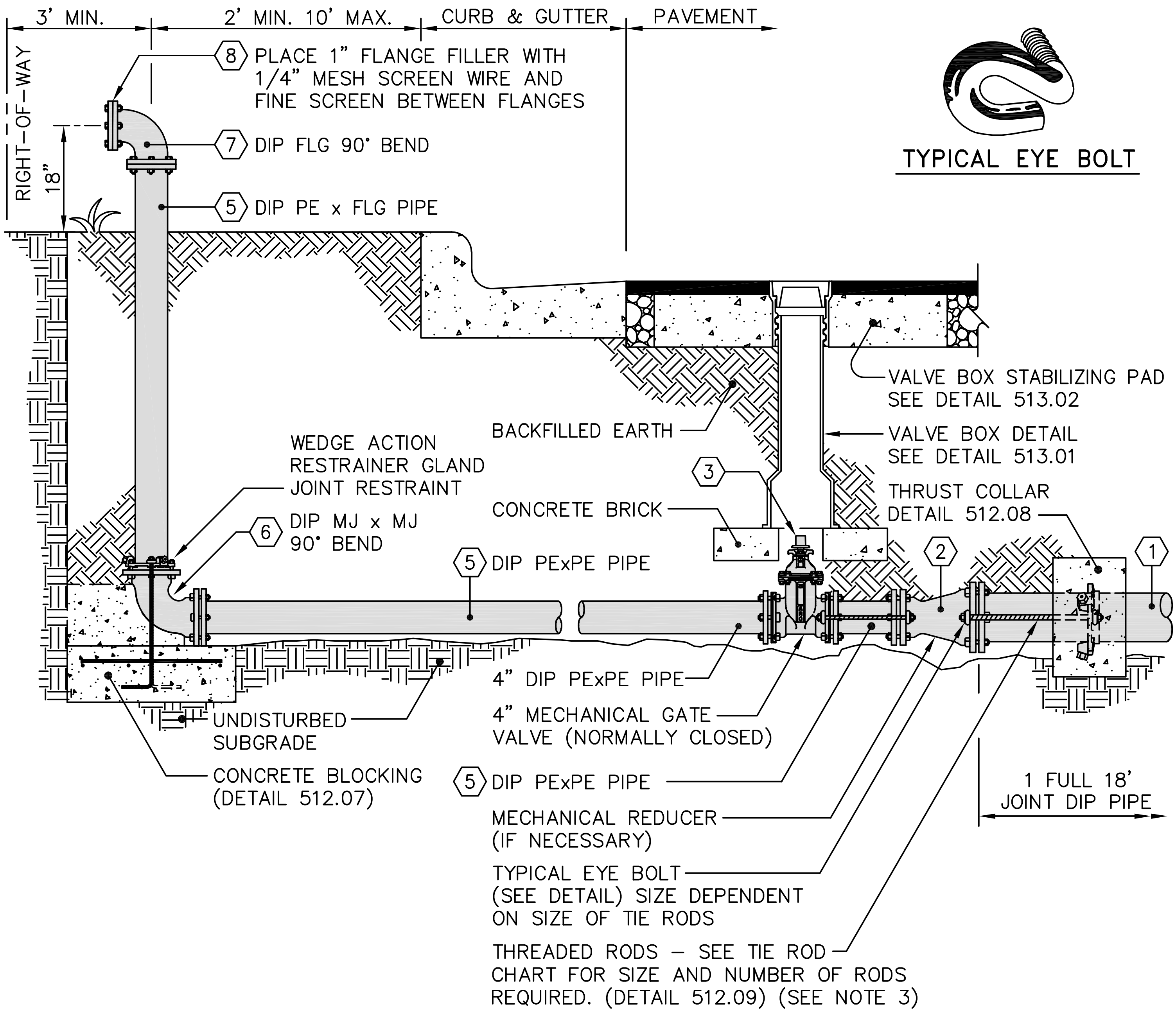
TEMPORARY 2" BLOW-OFF ASSEMBLY FOR MAINS UP TO 24"

SCALE: Not To Scale
DETAIL #: 2514.05
REVISION DATE: Jan 1, 2025
SHEET #: 1 of 1



1 MAIN	2 REDUCER	3 GATE VALVE	5 PIPE AS NOTED	6 90° MJ BEND	7 90° FLG BEND	8 FLANGE FILLER
12"	12"x4"	4"	4"	4"	4"	4"
16"	16"x6"	6"	6"	6"	6"	6"
18"	18"x6"	6"	6"	6"	6"	6"
20"	20"x6"	6"	6"	6"	6"	6"
24"	24"x6"	6"	6"	6"	6"	6"
30"	30"x6"	6"	6"	6"	6"	6"

NOTES:

1. No discharge from blow–off should go directly into a creek. OWASA must declorinate discharge before it enters a body of water.
2. Provide erosion and sedementation control for discharge.
3. In lieu of rodded fittings and eye bolts, contractor may use a wedge action restrainer gland joint restraint on fittings.

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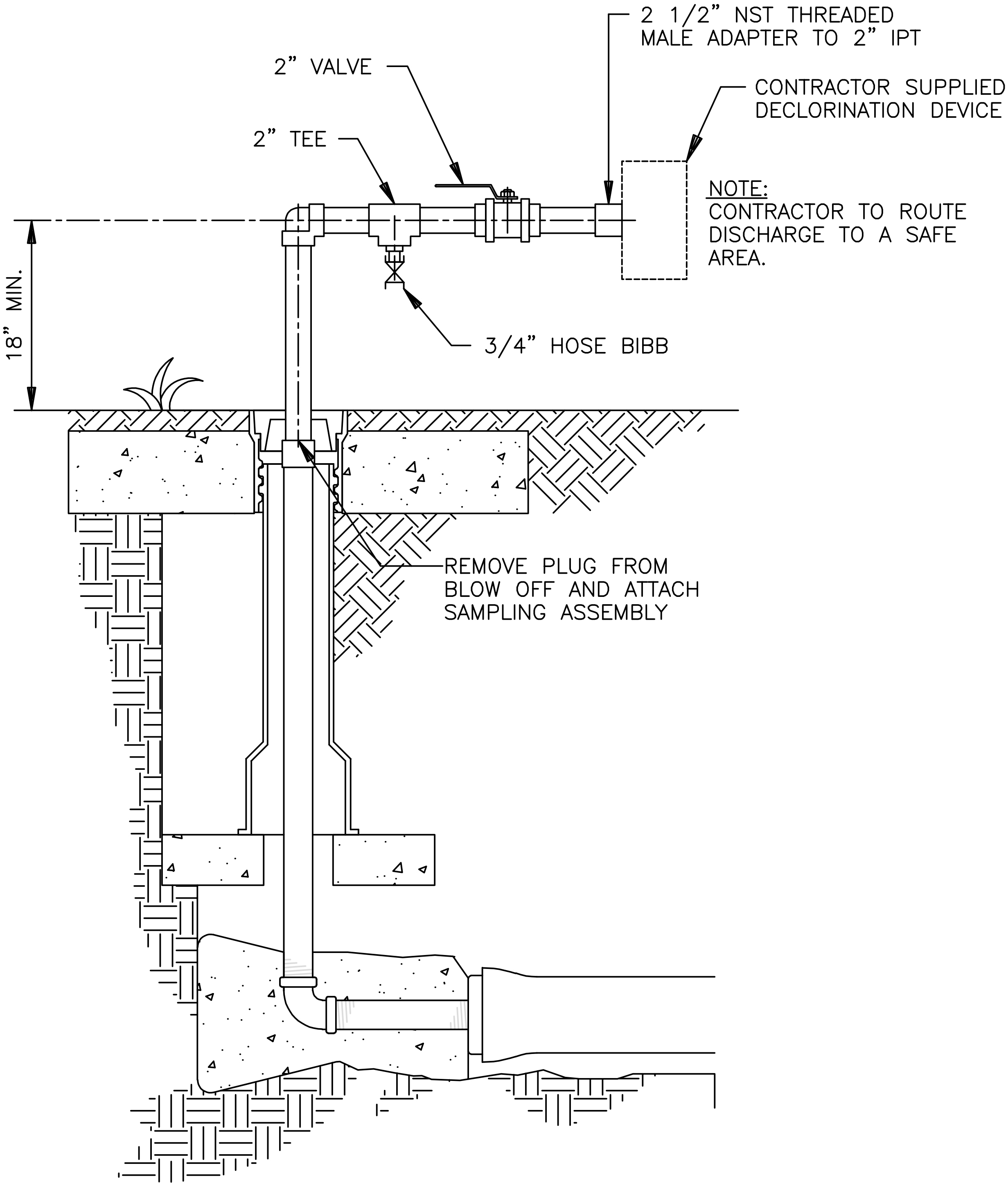
PERMANENT BLOW-OFF ASSEMBLY FOR MAINS 12" AND LARGER

SCALE: Not To Scale

DETAIL #: 514.06

REVISION DATE: Jan 1, 2025

SHEET #: 1 of 1



2" SAMPLING CONNECTION
ON 2" BLOW OFF

NOTE:

ALL PIPING, VALVES AND FITTINGS SHALL BE IN ACCORDANCE WITH OWASA SPECIFICATIONS.

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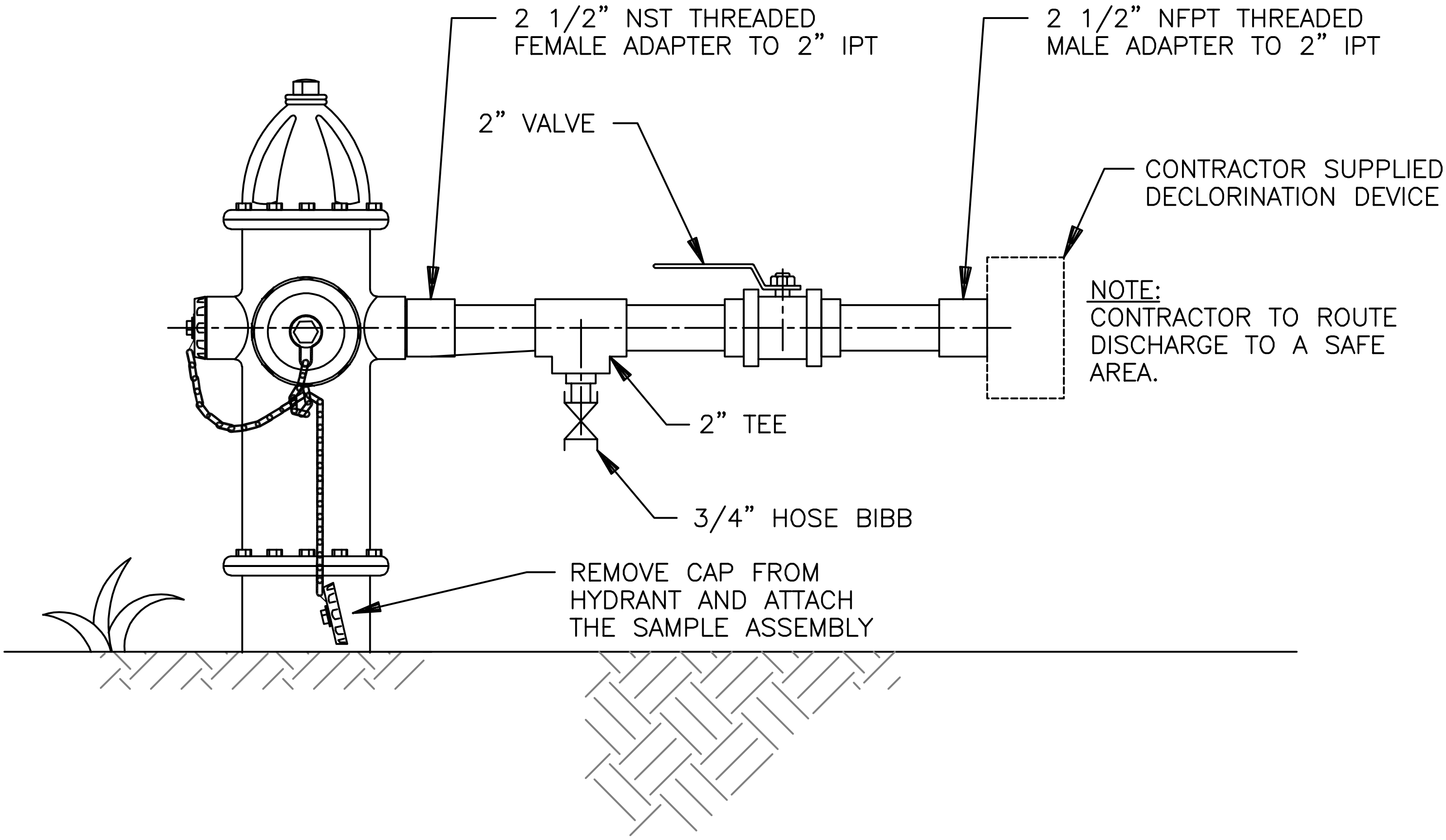
PURITY SAMPLING CONNECTION DETAILS - 2" BLOW OFF LINE	SCALE: Not To Scale	DETAIL # 2514.07
	REVISION DATE: Jan 1, 2025	SHEET #: 1 of 1



2" SAMPLING CONNECTION
ON FIRE HYDRANT

NOTE:

ALL PIPING, VALVES AND FITTINGS SHALL BE IN ACCORDANCE WITH OWASA SPECIFICATIONS.

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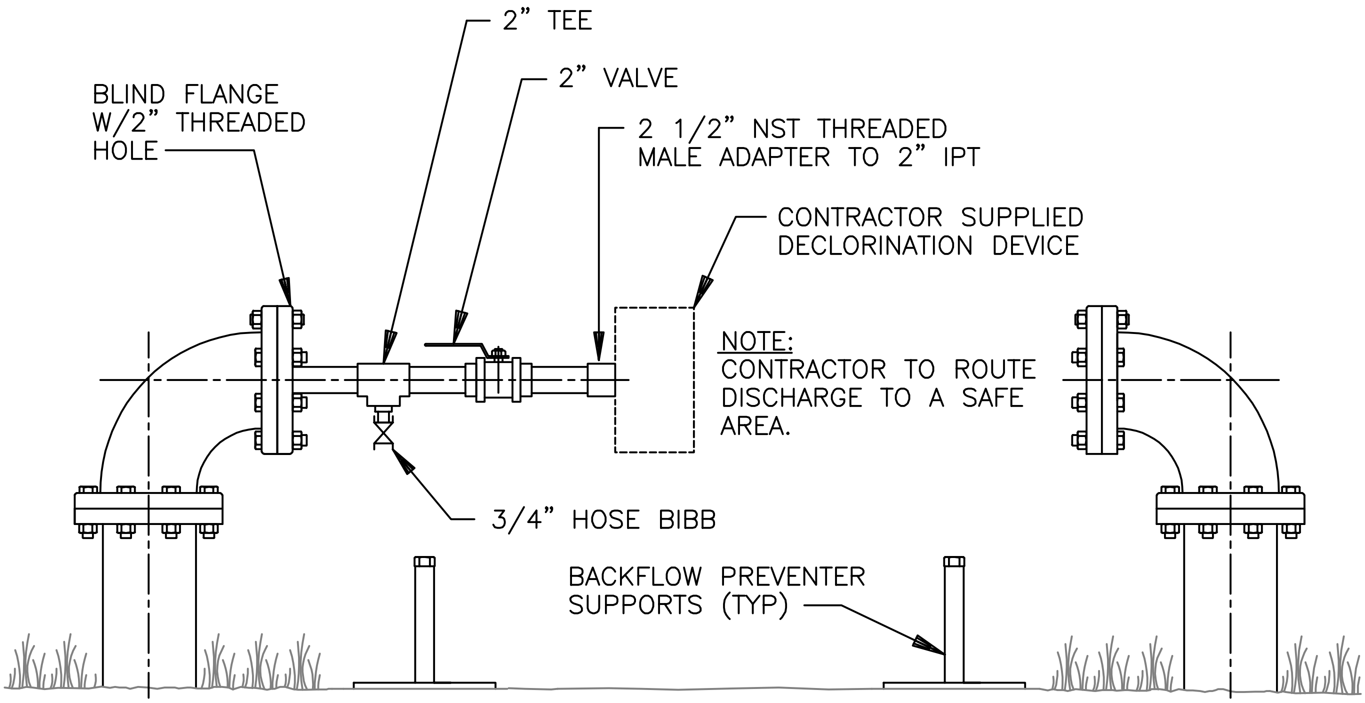
PURITY SAMPLING CONNECTION DETAILS - ON FIRE HYDRANT

SCALE:	DETAIL #
Not To Scale	2514.08
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 1



2" SAMPLING CONNECTION
ON BACKFLOW PREVENTER
TYPICAL 4" THRU 8"

NOTE:

ALL PIPING, VALVES AND FITTINGS SHALL BE IN ACCORDANCE WITH OWASA SPECIFICATIONS.

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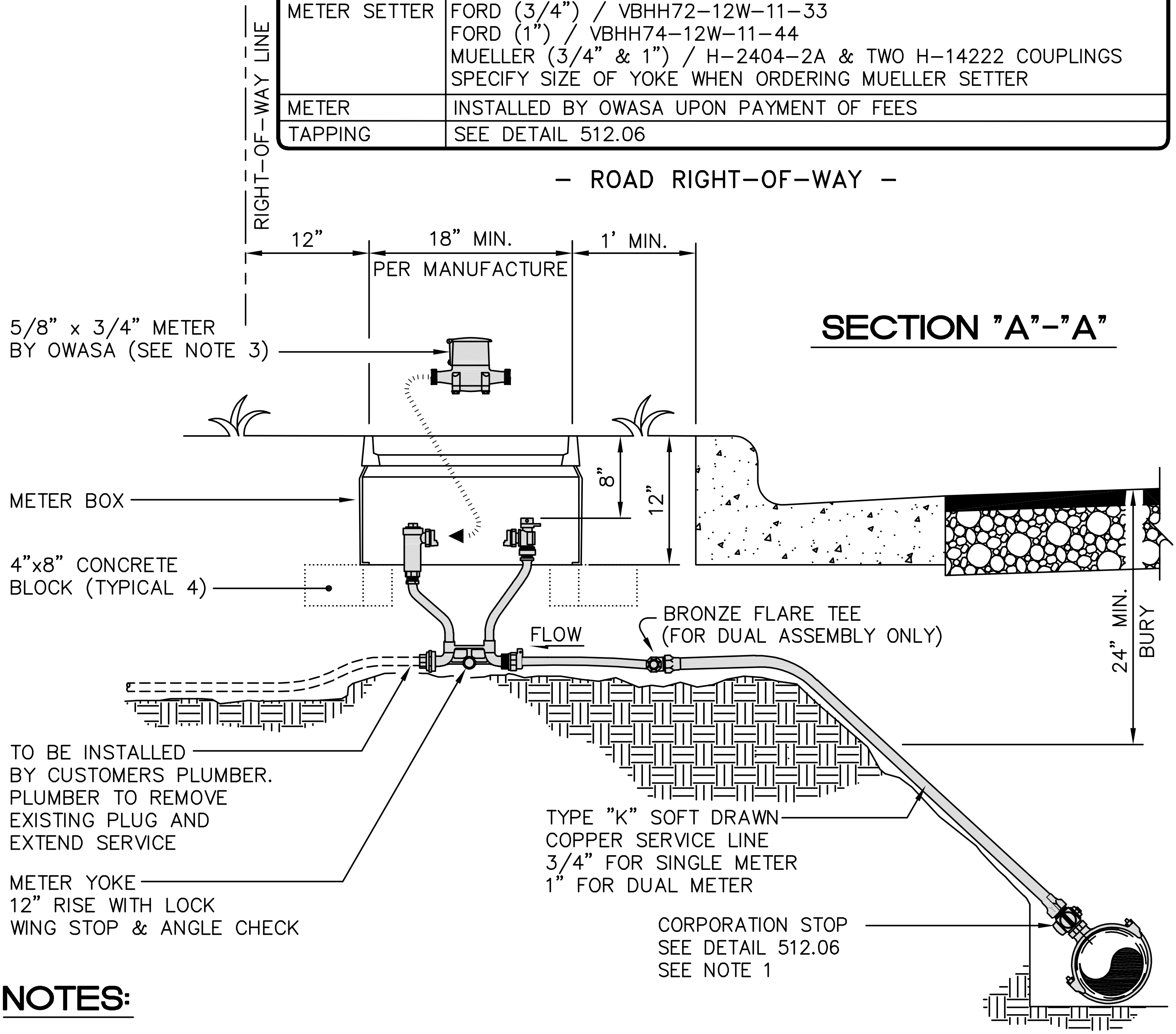
PURITY SAMPLING CONNECTION DETAILS - AT BACKFLOW PREVENTER

SCALE: Not To Scale	DETAIL # 2514.09
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 1

PART	MANUFACTURER MODEL / Cat. No.
METER BOX	OLDCASTLE / 1118-12 BCFXL BODY B-W 0 OR 2 MSHI PAVING
METER BOX LID	NICOR, INC / B12
METER SETTER	FORD (3/4") / VBHH72-12W-11-33 FORD (1") / VBHH74-12W-11-44 MUELLER (3/4" & 1") / H-2404-2A & TWO H-14222 COUPLINGS SPECIFY SIZE OF YOKE WHEN ORDERING MUELLER SETTER
METER	INSTALLED BY OWASA UPON PAYMENT OF FEES
TAPPING	SEE DETAIL 512.06



NOTES:

1. Bronze service saddles shall be used on all service connections. Direct taps shall be made only as directed by an OWASA representative. See tapping detail 512.06.
2. Omitted
3. If installation is for stub-out meter, meter should be purchased from OWASA. (At applicants expense)
4. Meter must be level across meter connections.
5. Substitution requires approval by OWASA's Director of Engineering.
6. When Required, Reduced Pressure Principle Back Flow Prevention Assembly (RPZ) to be installed 5' behind meter box in accordance with OWASA's Cross-Connection Control Manual.

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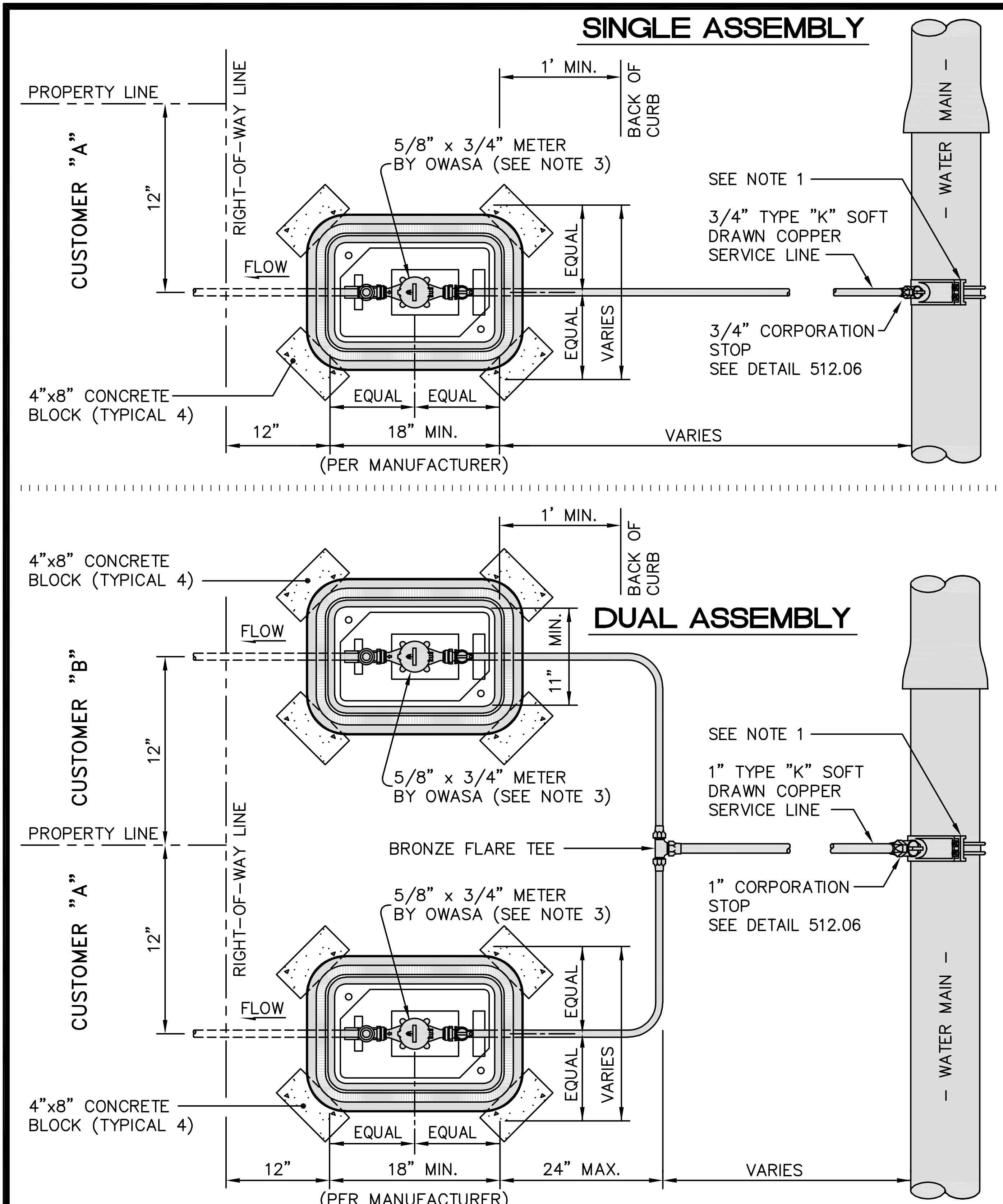
3/4" SINGLE & 1" DUAL SERVICE INSTALLATION

SCALE: Not To Scale
DETAIL #: 515.01
REVISION DATE: Jan 1, 2025



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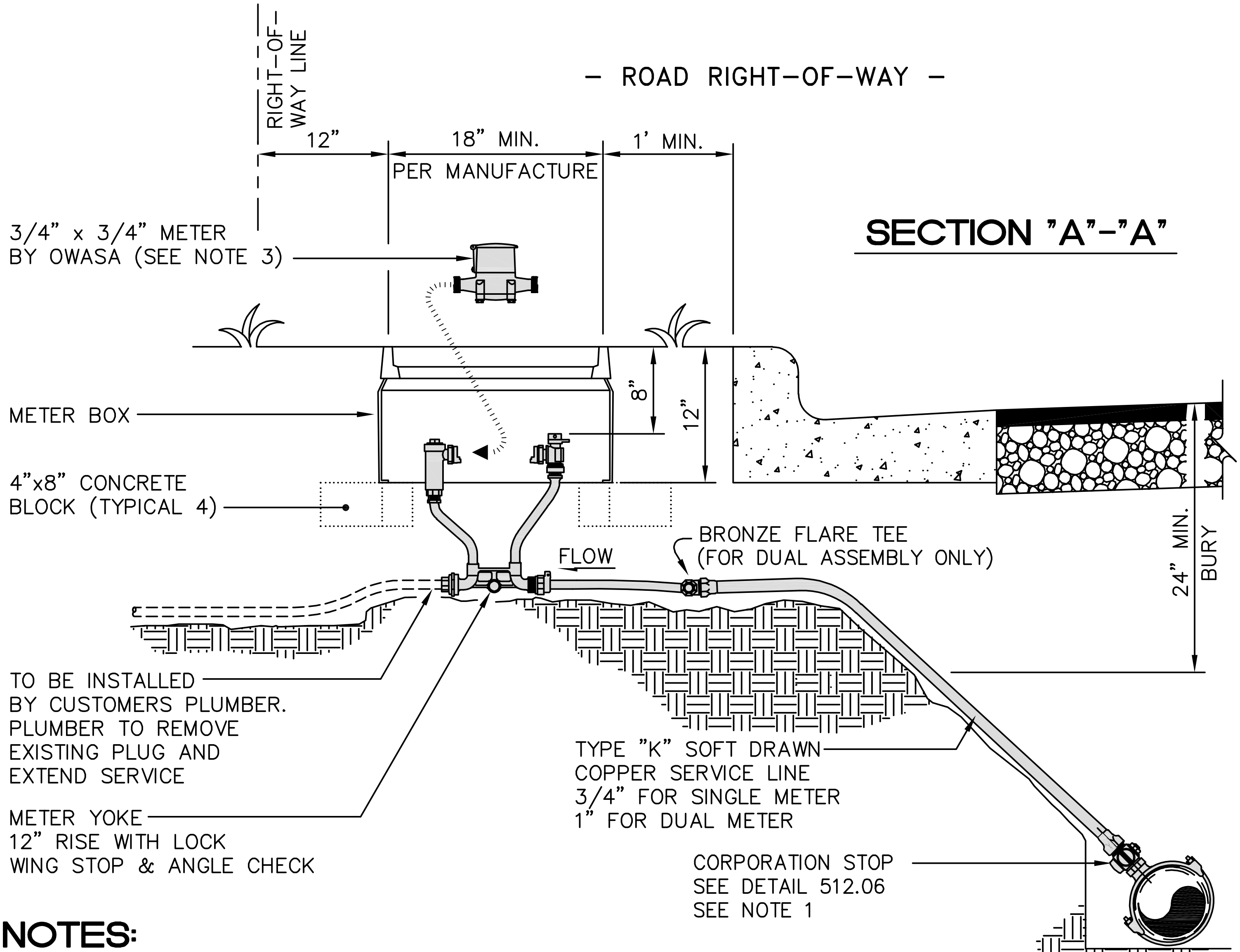
3/4" SINGLE & 1" DUAL SERVICE INSTALLATION

SCALE: Not To Scale	DETAIL # 2515.01
REVISION DATE: Jan 1, 2025	SHEET #: 2 of 2

PART	MANUFACTURER MODEL / Cat. No.
METER BOX	OLDCASTLE / 1118-12 BCFXL BODY B-W 0 OR 2 MSHI PAVING
METER BOX LID	NICOR, INC / B12
METER SETTER	FORD (3/4") / VBHH73-12W-11-33 FORD (1") / VBHH74-12W-11-44 MUELLER (3/4" & 1") / B-2404-2A & TWO H-14222 COUPLINGS SPECIFY SIZE OF YOKE WHEN ORDERING MUELLER SETTER
METER	INSTALLED BY OWASA UPON PAYMENT OF FEES
TAPPING	SEE DETAIL 512.06

SECTION "A"-"A"



NOTES:

1. Bronze service saddles shall be used on all service connections. Direct taps shall be made only as directed by an OWASA representative. See tapping detail 512.06.
2. Omitted
3. If installation is for stub-out meter, meter should be purchased from OWASA. (At applicants expense)
4. Meter must be level across meter connections.
5. Substitution requires approval by OWASA's Director of Engineering.
6. When Required, Reduced Pressure Principle Back Flow Prevention Assembly (RPZ) to be installed 5' behind meter box in accordance with OWASA's Cross-Connection Control Manual.

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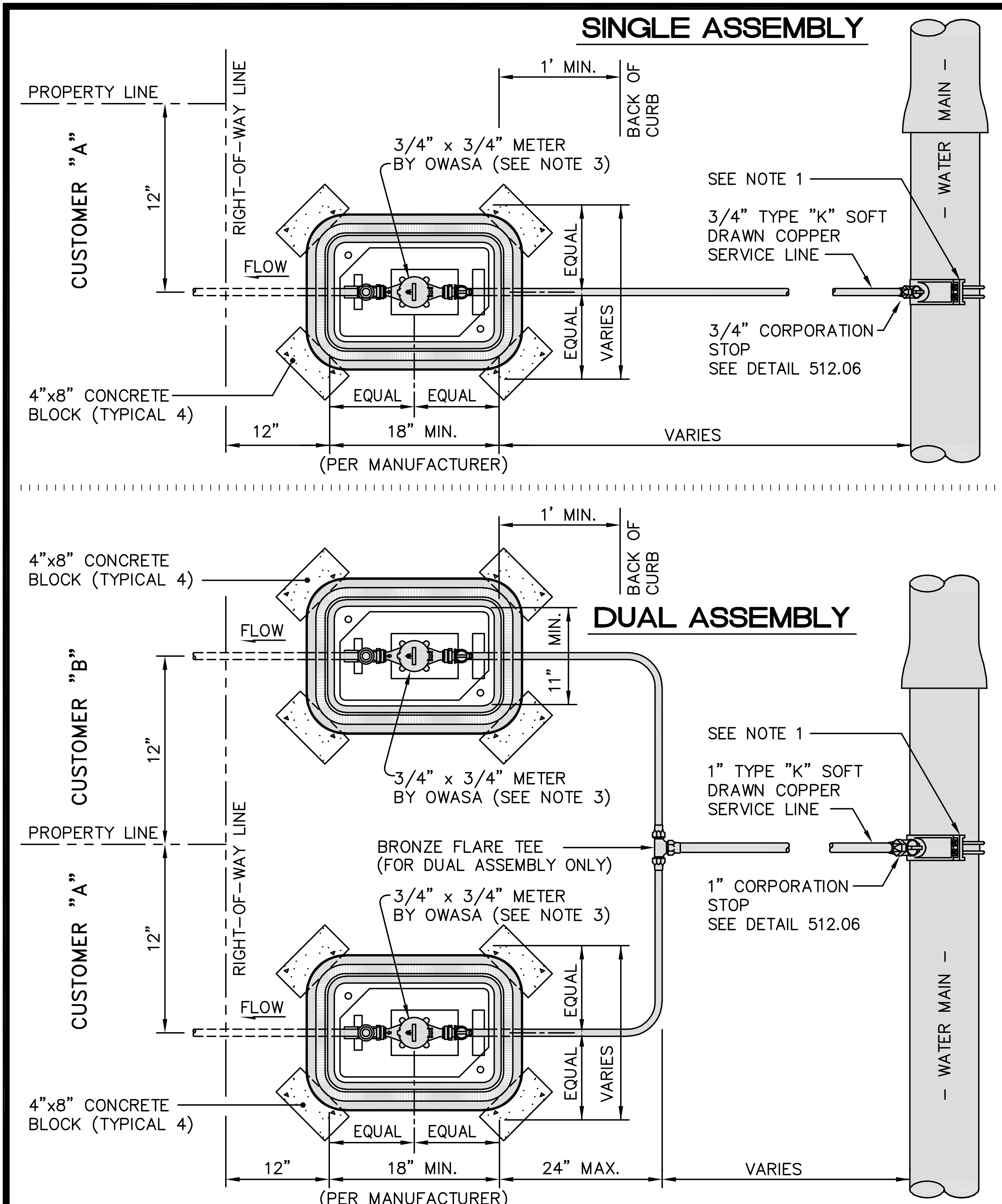
USE WITH THE OWASA STANDARD SPECIFICATIONS ONLY

3/4" SINGLE & 1" DUAL COMBINED DOMESTIC AND FIRE PROTECTION SERVICE INSTALLATION	SCALE: Not To Scale	DETAIL #: 2515.02
	REVISION DATE: Jan 1, 2025	SHEET #: 1 of 2



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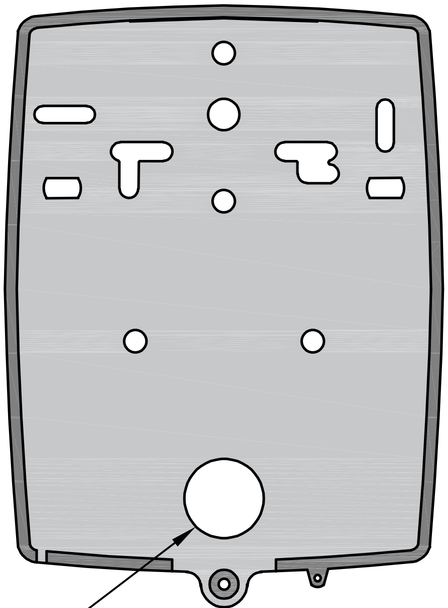
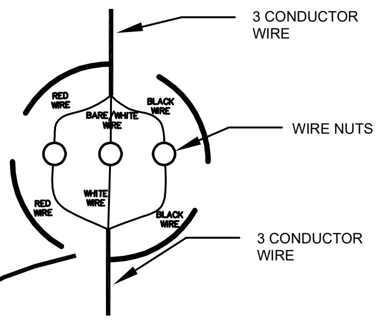
3/4" SINGLE & 1" DUAL COMBINED DOMESTIC AND FIRE PROTECTION SERVICE INSTALLATION

SCALE: Not To Scale	DETAIL # 2515.02
REVISION DATE: Jan 1, 2025	SHEET #: 2 of 2



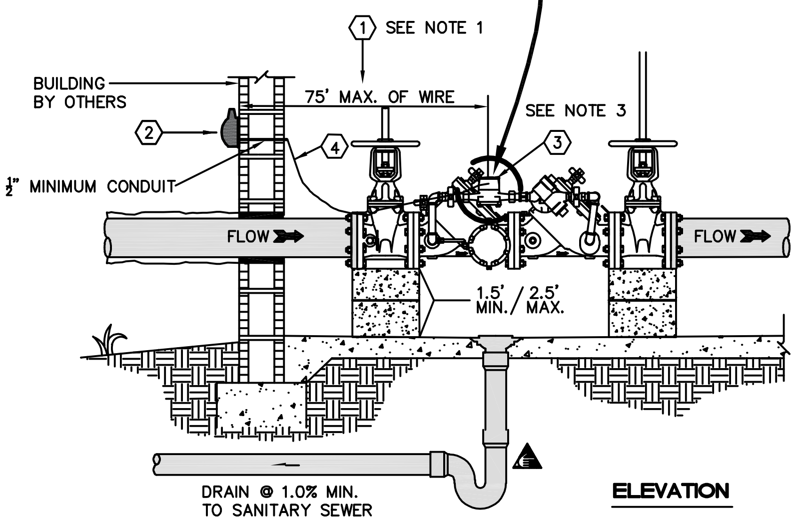
WALL MOUNTED BOX PLATE

HOLE TO BE DRILLED BY CONTRACTOR FOR 3 CONDUCTOR WIRE

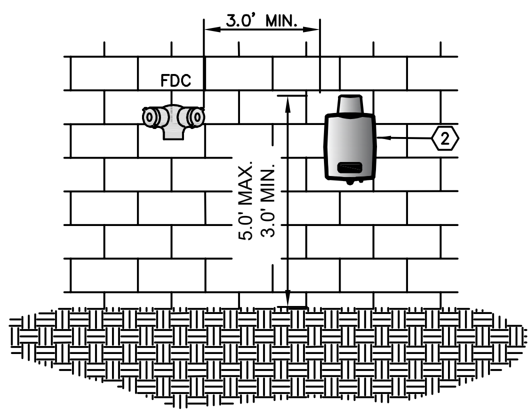


COLOR CODED WIRE CONNECTIONS

COMPLETE BOX



ELEVATION



BUILDING EXTERIOR

NOTES:

1. MAXIMUM OF 75' OF 22 GAUGE / 3 CONDUCTOR WIRE FROM METER TO MOUNTED REMOTE READ BOX
2. PURCHASE BOX FROM OWASA
3. WIRE TO BE PROVIDED BY CONTRACTOR
4. WIRE CONNECTIONS TO BE MADE BY CONTRACTOR
5. SEAL OPENING PER BUILDING CODE

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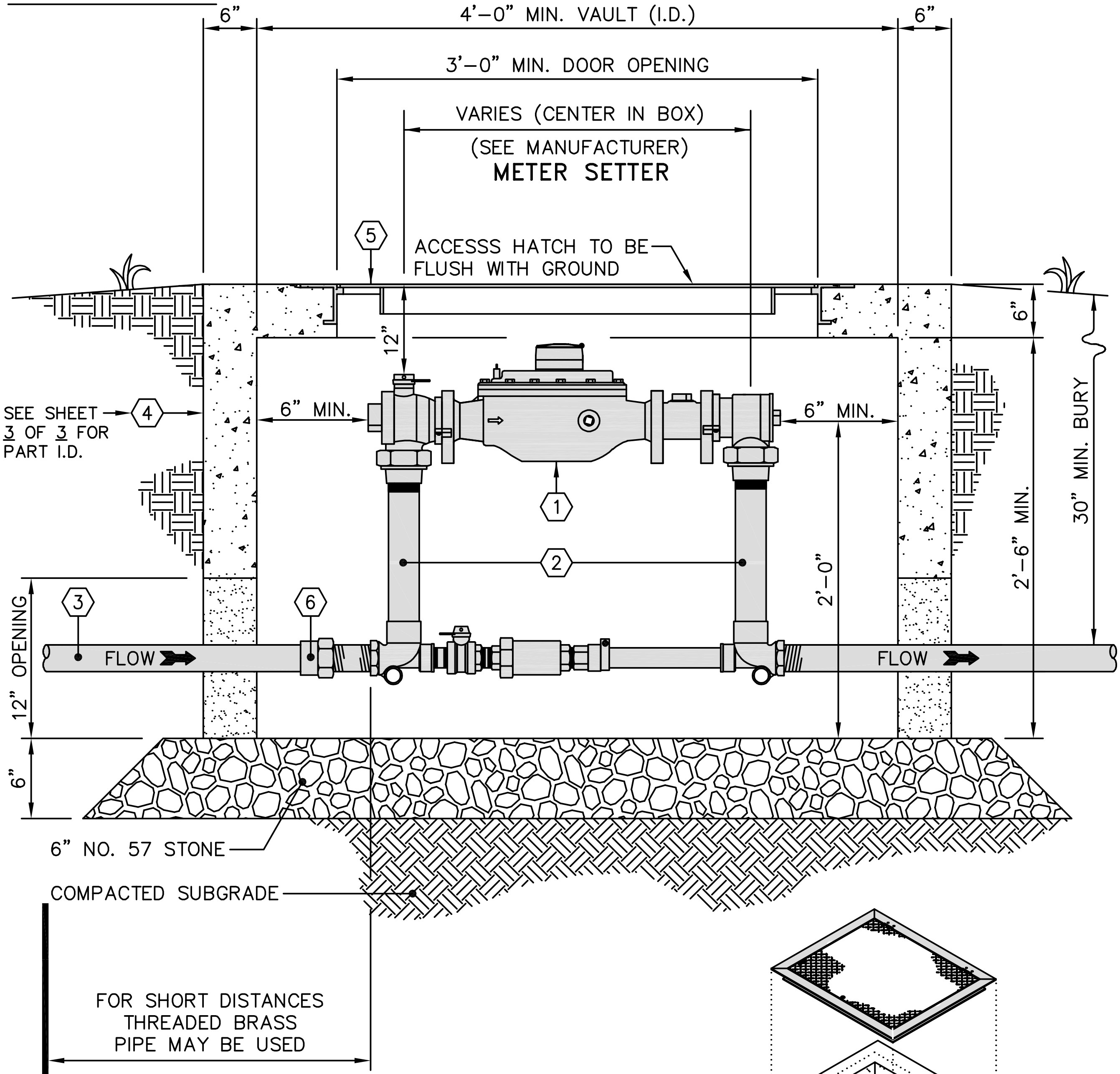
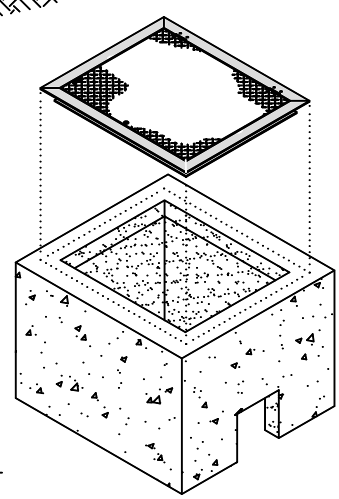
DETECTOR METER INSTALLATION (FIRE SYSTEM)

SCALE: Not To Scale	DETAIL #: 515.03
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 1

ELEVATION





TYPICAL BOX

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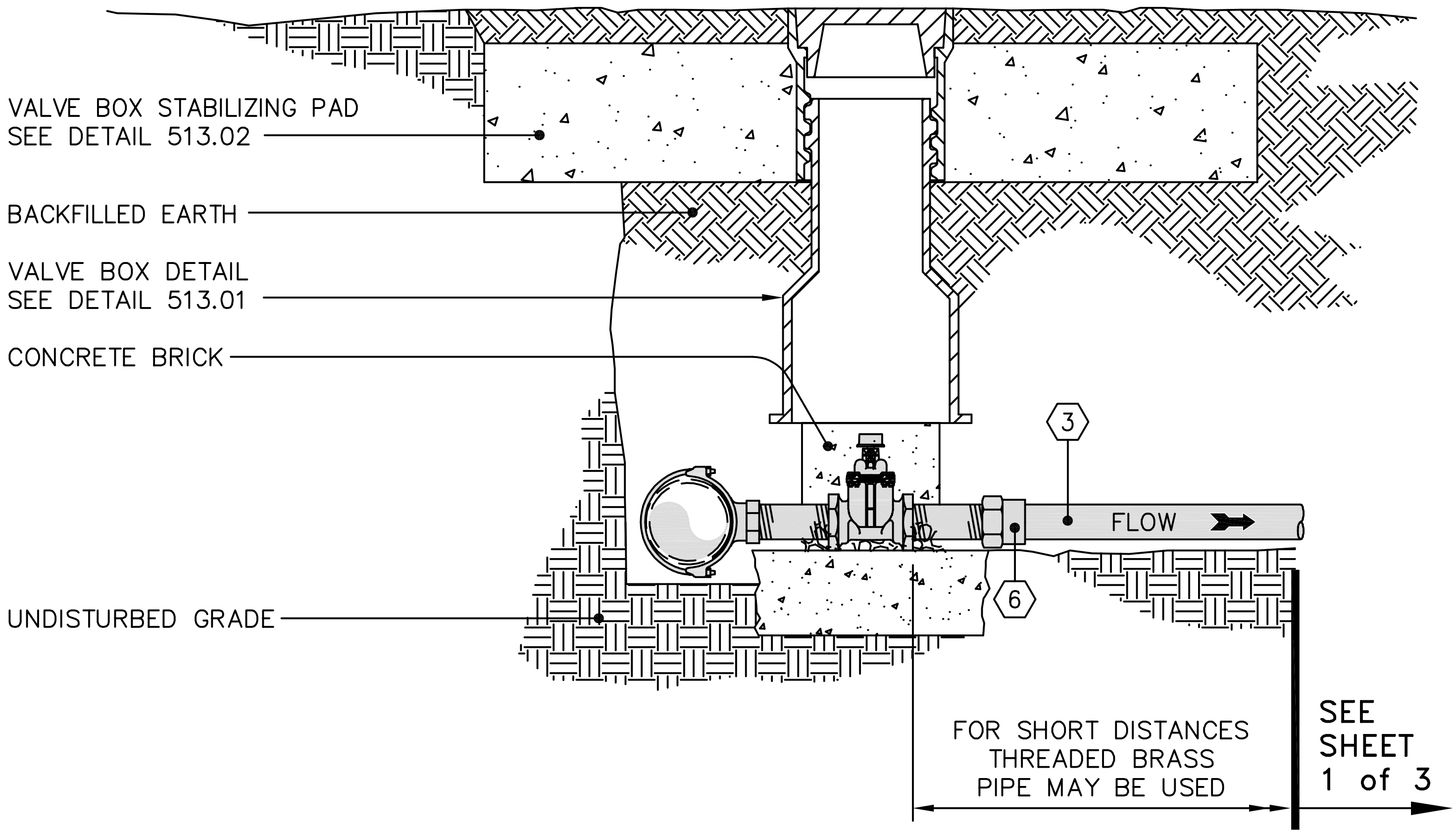
STANDARD 2" METER VAULT

SCALE: Not To Scale	DETAIL # 2515.04
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 3



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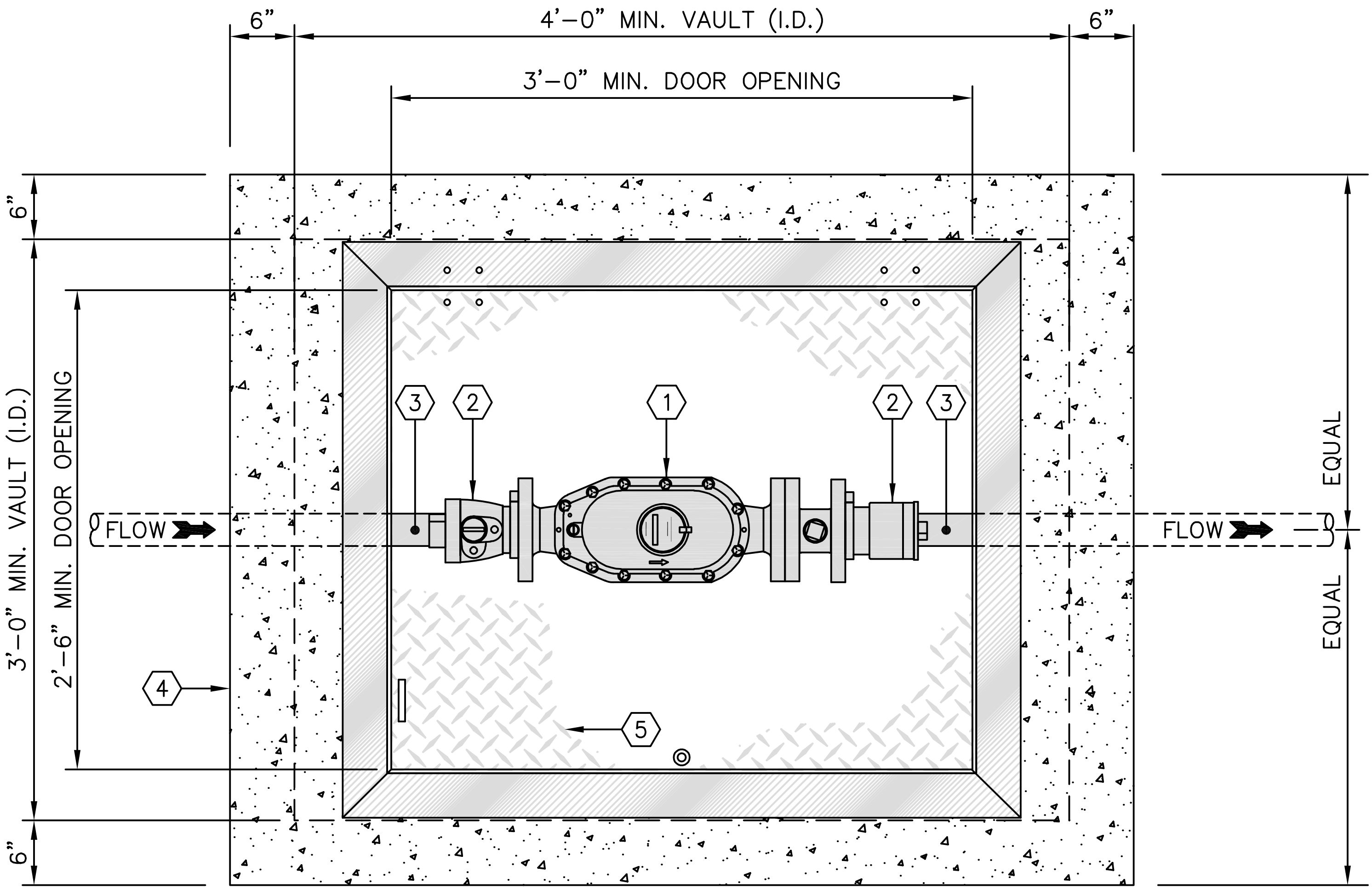
STANDARD 2" METER VAULT

SCALE:	DETAIL #
Not To Scale	2 515.04
REVISION DATE:	SHEET #:
Jan 1, 2025	2 of 3

PLAN VIEW



#	PART	MANUFACTURER MODEL / Cat. No.
1	1–1/2" AND 2" METER	FURNISHED BY OWASA
2	1–1/2" AND 2" METER SETTER	(2") FORD STD. 18" RISE VBHH77–18BHC–11–77 MUELLER 15" RISE MUELLER DWG No. B2423–2
3	2" TYPE "K" HARD DRAWN COPPER SERVICE	---
4	4' x 5' PRECAST CONCRETE METER VAULT	See Section 02510 Section 2 – Products
5	ACCESS HATCH NO EXPOSED HINGES OR LOCKS	See Section 02510 Section 2 – Products
6	SILVER BRAZED JOINT	See Section 02510 Section 2 – Products

NOTES:

1. Meter vault required for all 2" service line connections.
2. Ensure positive surface grade away from vault.
3. Reduced Pressure Principle Backflow Prevention Assembly installation 5 ft from meter box in accordance with OWASA's Cross–Connection Control Manual.

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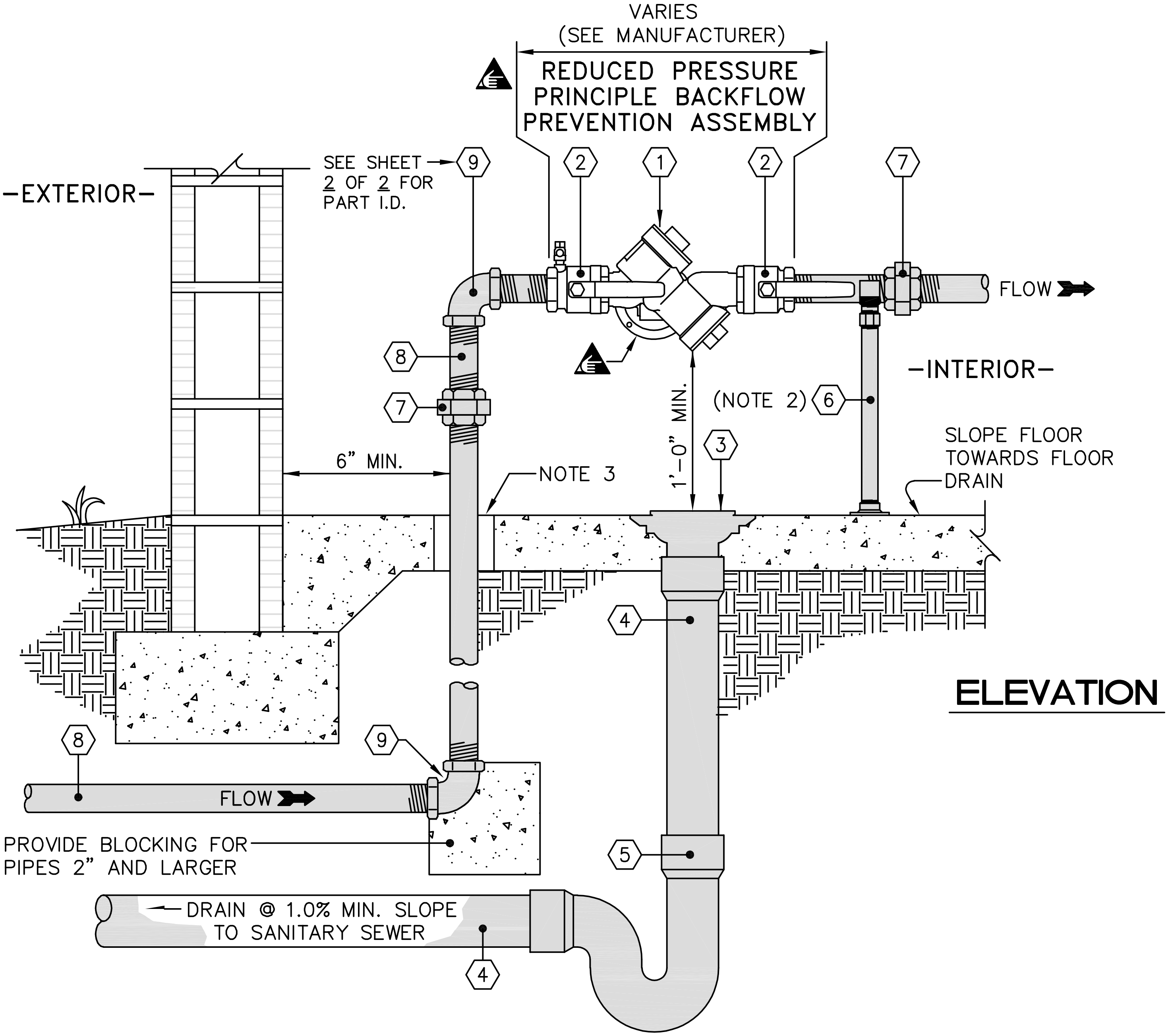
STANDARD 1-1/2" AND 2" METER VAULT

SCALE: Not To Scale

DETAIL #: 2515.04

REVISION DATE: Jan 1, 2025

SHEET #: 3 of 3



ELEVATION

NOTES:

1. Backflow assembly is to be installed in an accessible portion of the building. Backflow is not part of OWASA system.
2. Two pipe stands required for 1 1/2" and 2" backflow preventers.
3. Provide minimum 1" annular clearance around all risers and electrical conduit.
4. Interior installation only allowed with a variance in accordance with OWASA's Cross—Connection Control Manual.

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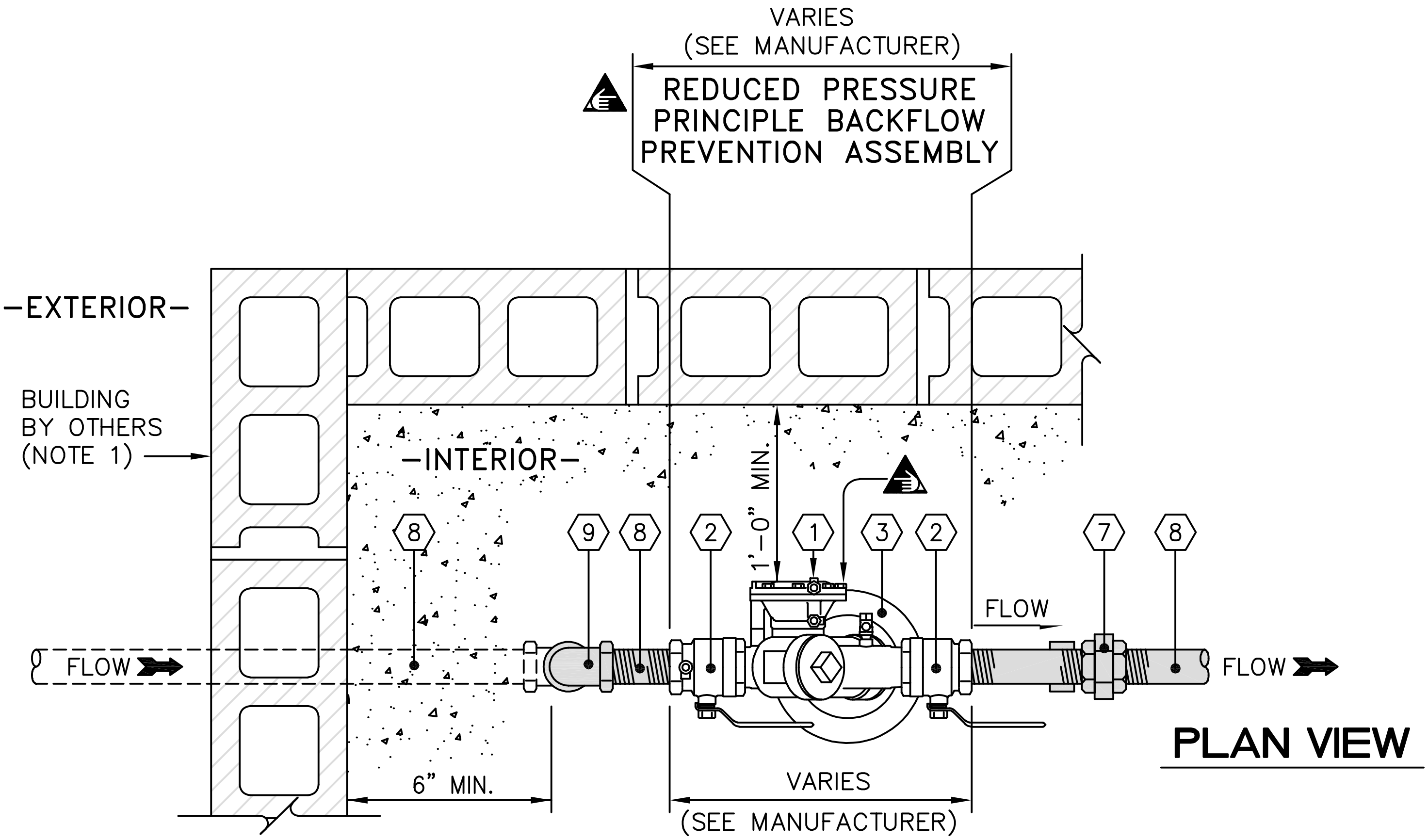
3/4" to 2" RPZ ASSEMBLY (INDOOR)

SCALE: Not To Scale	DETAIL # 2515.05
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 2



PLAN VIEW

#	PART	MANUFACTURER MODEL / Cat. No.
1	BACKFLOW PREVENTION ASSEMBLY, AS APPLICABLE	SEE SPECS. 02510 – PRODUCTS
2	1/4 TURN FULL PORT BRONZE BALL SHUT–OFF VALVE	---
3	FLOOR DRAIN	JAY R. SMITH MFG. CO. / 2005
4	4" CISP OR PVC SCH 40 PIPE	---
5	4" CISP OR PVC SCH 40 P TRAP	---
6	ADJUSTABLE PIPE SUPPORTS TO BE SHOP FABRICATED AND HOT DIP GALVANIZED.	STANDON / MODEL S92 SADDLE SUPPORT OR EQUAL
7	THREADED UNION	---
8	3/4" THRU 2" STAINLESS STEEL OR BRASS THREADED PIPE	---
9	90° BRASS ELBOW	---

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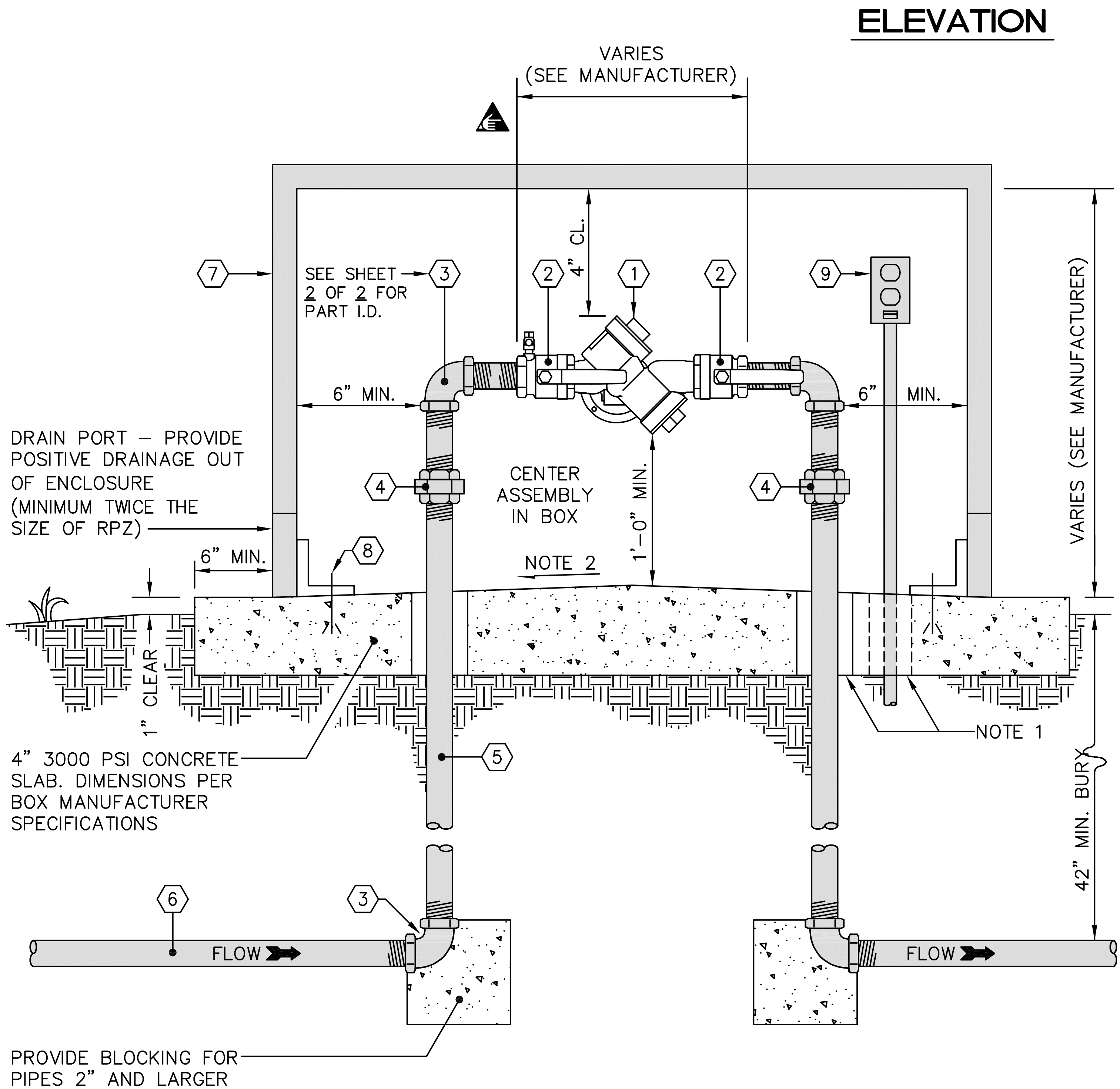
3/4" to 2" RPZ ASSEMBLY (INDOOR)

SCALE: Not To Scale

DETAIL # 2515.05

REVISION DATE: Jan 1, 2025

SHEET #: 2 of 2



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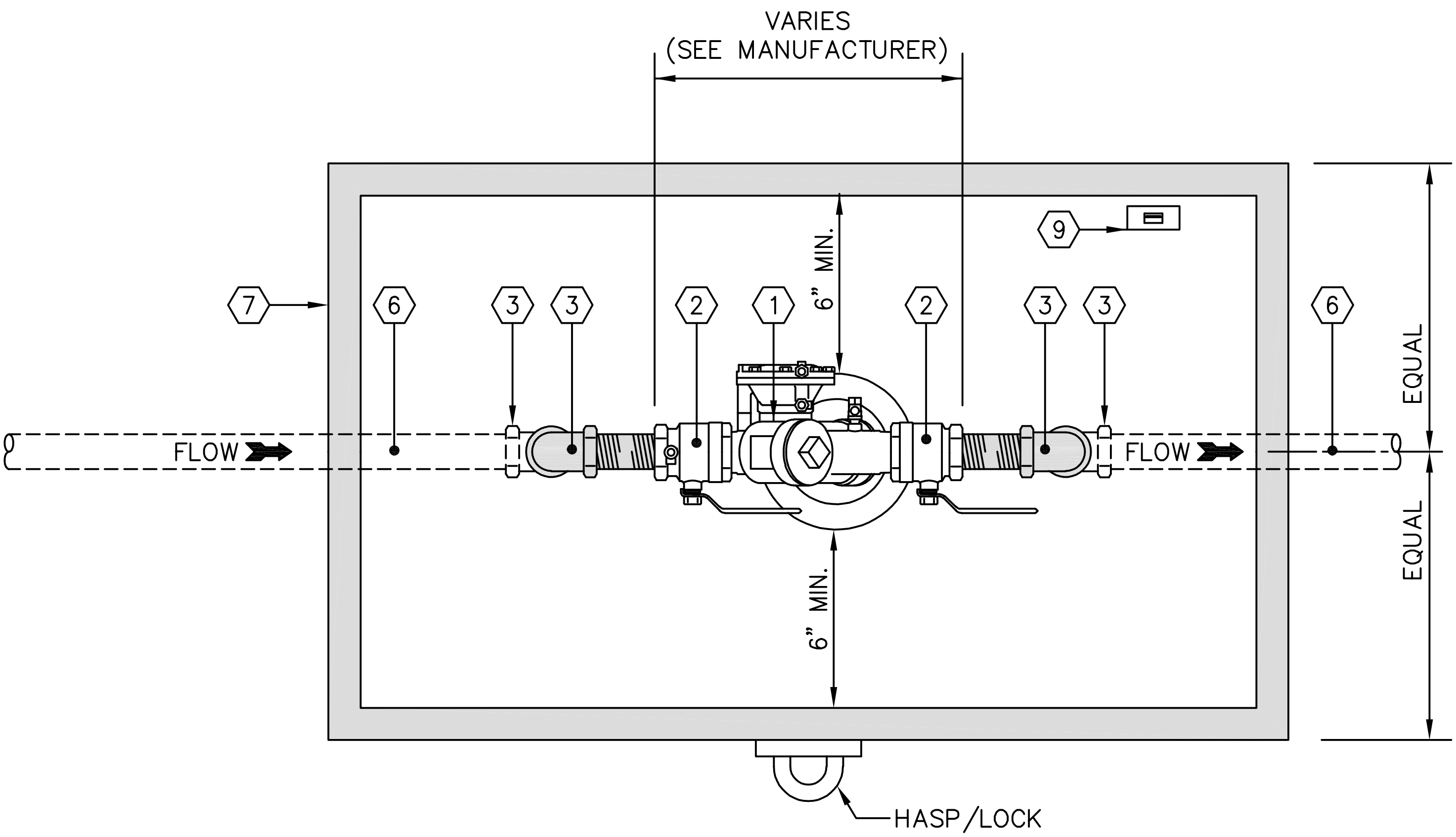
3/4" to 2" RPZ ASSEMBLY (ABOVE GROUND)

SCALE:	DETAIL #
Not To Scale	2515.06
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 3

PLAN VIEW



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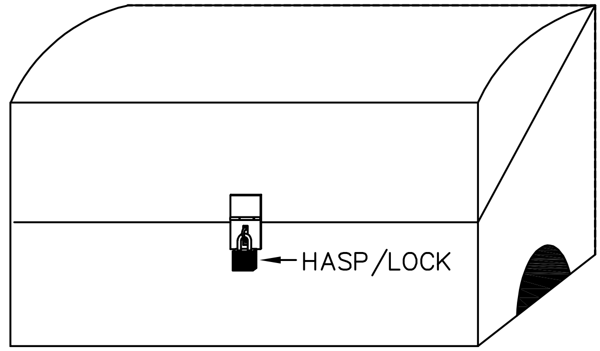
3/4" to 2" RPZ ASSEMBLY (ABOVE GROUND)

SCALE: Not To Scale	DETAIL # 2515.06
REVISION DATE: Jan 1, 2025	SHEET #: 2 of 3

TYPICAL ENCLOSURE



#	PART	MANUFACTURER MODEL / Cat No
1	BACKFLOW PREVENTION ASSEMBLY	SEE SPECS. 02510 — PRODUCTS
2	1/4 TURN FULL PORT BRONZE BALL SHUT-OFF VALVE	---
3	90° BRASS ELBOW	---
4	THREADED UNION	---
5	3/4" THROUGH 2 1/2" STAINLESS STEEL OR BRASS THREADED PIPE	---
6	3/4" THROUGH 2 1/2" STAINLESS STEEL OR BRASS THREADED PIPE	---
7	INSULATED ENCLOSURE WITH LOCKING ACCESS AND HEATER (120 V, 1 PHASE 60 HZ) VERIFY FITTINGS WILL FIT INSIDE BOX BEFORE ORDERING	HOTBOX / HB.75 — HB3E (OR APPROVED EQUIVALENT)
8	STAINLESS STEEL ANCHOR BOLTS PER BOX MANUFACTURER RECOMMENDED SIZE AND SPACING	---
9	PROVIDE 120V RECEPTACLE ON GFCI NEAR PIPE RISER (NOT REQUIRED FOR SINGLE FAMILY RESIDENTIAL), SET MINIMUM 18" ABOVE FLOOR	UL STD. 943-NEMA 3R.

NOTES:

1. Provide minimum 1" annular clearance around all risers and electrical conduit.
2. Slope floor to drain to ports at both ends.
   Ensure positive surface grade away from enclosure.

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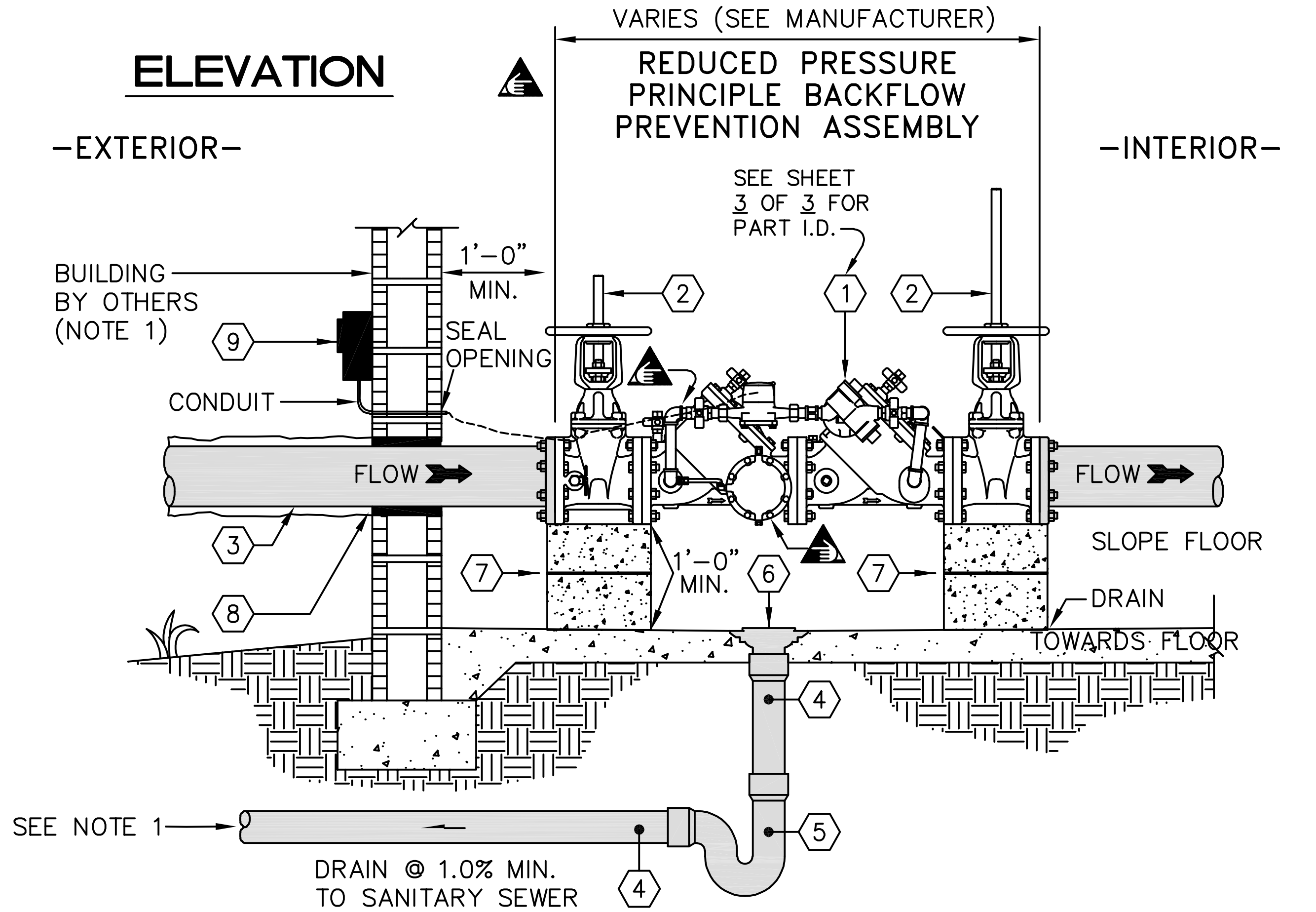
3/4" to 2" RPZ ASSEMBLY (ABOVE GROUND)

SCALE: Not To Scale

DETAIL #: 2515.06

REVISION DATE: Jan 1, 2025



SEE SHEET 3 of 3 FOR ALTERNATE THROUGH FLOOR ACCESS INTO BUILDING

NOTES:

1. INTERIOR INSTALLATION ONLY ALLOWED WITH A VARIANCE IN ACCORDANCE WITH OWASA'S CROSS-CONNECTION CONTROL MANUAL.

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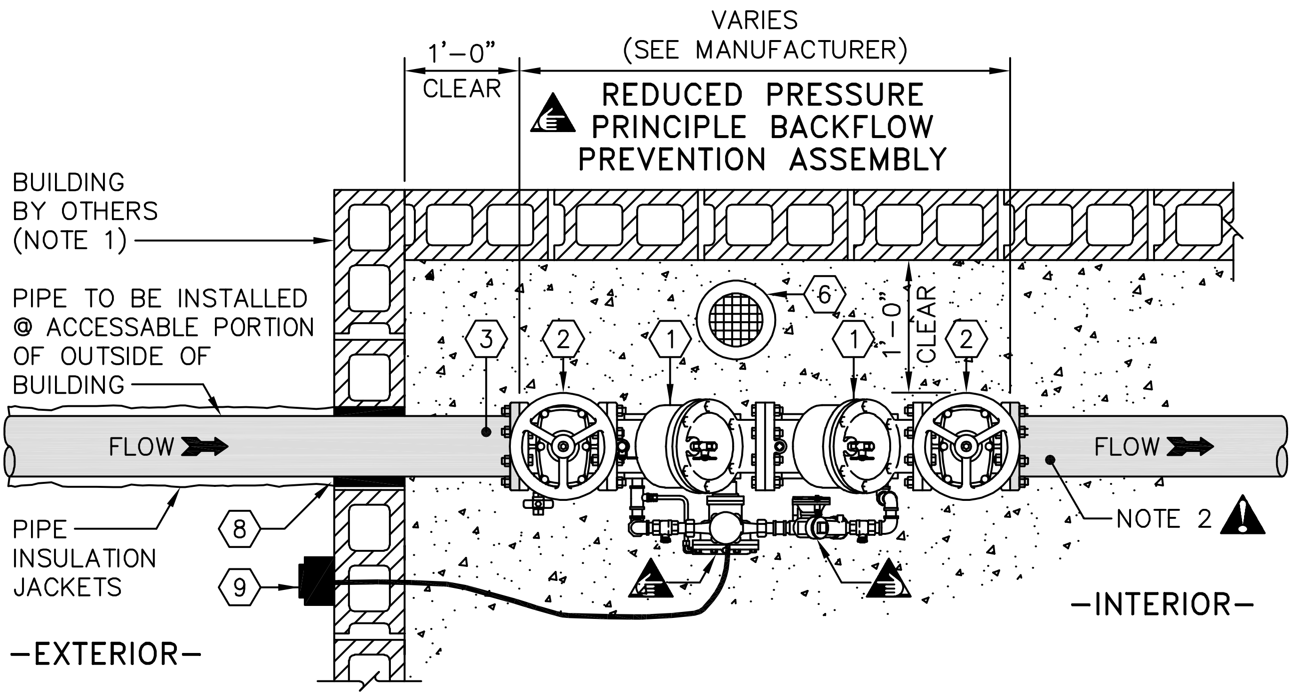
2 1/2" to 10" RPZ, RPDA ASSEMBLY (INDOOR)

SCALE: Not To Scale	DETAIL # 2515.09
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 3



PLAN VIEW

NOTES:

1. Backflow assembly is to be installed at an accessible portion of the building, provide doorway & key.
2. For critical facilities, provide bypass line with backflow assembly.
3. Provide minimum 3" annular clearance around riser.

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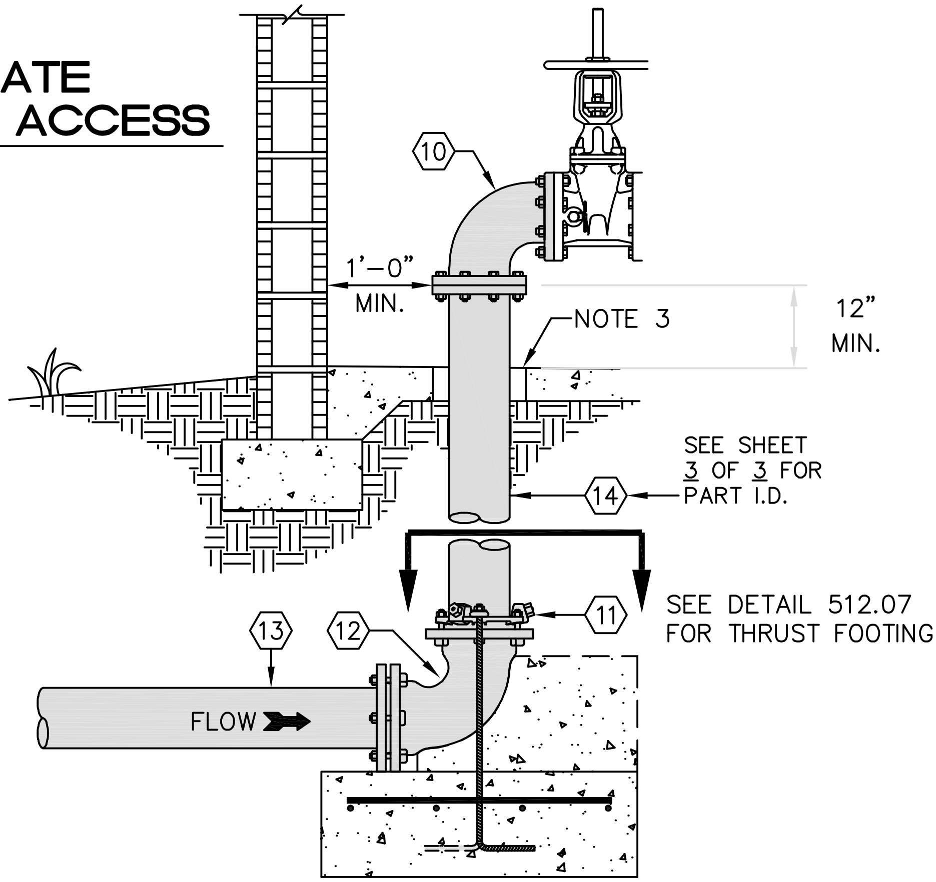
2 1/2" to 10" RPZ, RPDA ASSEMBLY (INDOOR)

SCALE: Not To Scale	DETAIL # 2515.09
REVISION DATE: Jan 1, 2025	SHEET #: 2 of 3

ALTERNATE THRU FLOOR ACCESS



#	PART	MANUFACTURER MODEL / Cat. No.
1	BACKFLOW PREVENTER, AS APPLICABLE	USC & ASSE APPROVED
2	OS&Y GATE VALVE WITH RESILIENT SEATS	TO BE APPROVED BY OWASA
3	DIP FLANGE x FLANGE PIPE (VERIFY LENGTH)	AMERICAN CAST IRON PIPE, or GRIFFIN PIPE CO. TO BE APPROVED BY OWASA
4	CISP OR PVC SCH 40 PIPE	---
5	CISP OR PVC SCH 40 "P" TRAP	---
6	FLOOR DRAIN	SIZE & TYPE DETERMINED BY NC PE. TO BE APPROVED BY OWASA
7	MASONRY BLOCK	
8	WALL SLEEVE with LINK SEAL	TO BE APPROVED BY OWASA
9	METER BOX WITH ERT AND METER	PURCHASED FROM OWASA
10	90° DIP FLANGE x FLANGE ELBOW	AMERICAN CAST IRON PIPE, or GRIFFIN PIPE CO., or UNION–TYLER PIPE CO., or U.S. PIPE & FOUNDRY
11	WEDGE ACTION RESTRAINER GLAND JOINT RESTRAINT	EBAA IRON SALES, INC. , FORD
12	90° DIP MJ x MJ ELBOW	AMERICAN CAST IRON PIPE, GRIFFIN PIPE CO., UNION–TYLER PIPE CO., U.S. PIPE & FOUNDRY
13	DIP FLANGE x PE PIPE (VERIFY LENGTH)	AMERICAN CAST IRON PIPE, GRIFFIN PIPE CO., UNION–TYLER PIPE CO., U.S. PIPE & FOUNDRY
14	3" THRU 10" DIP	AMERICAN CAST IRON PIPE, GRIFFIN PIPE CO., UNION–TYLER PIPE CO., U.S. PIPE & FOUNDRY

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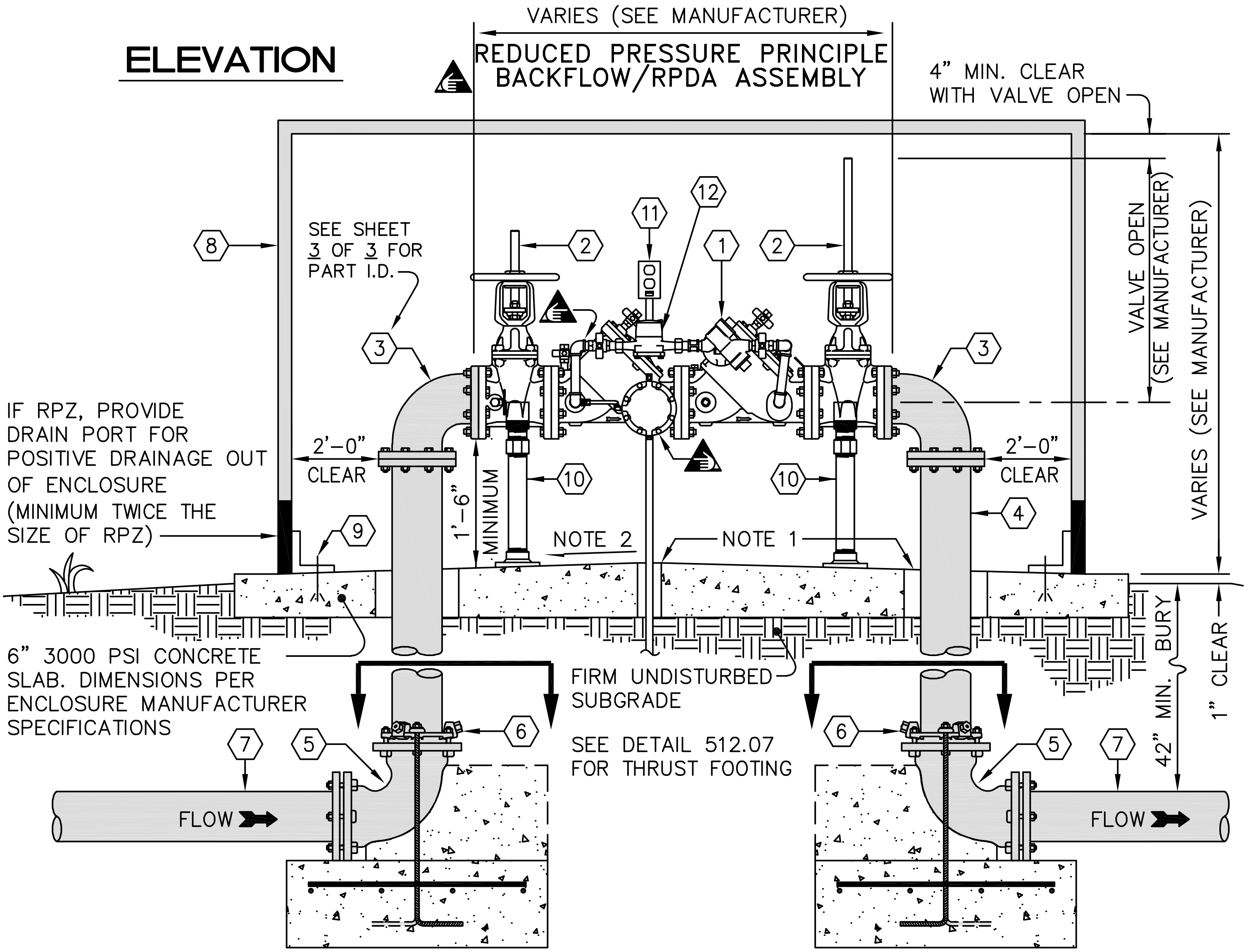
2 1/2" to 10" RPZ, RPDA ASSEMBLY (INDOOR)

SCALE: Not To Scale	DETAIL # 2515.09
REVISION DATE: Jan 1, 2025	SHEET #: 3 of 3

ELEVATION



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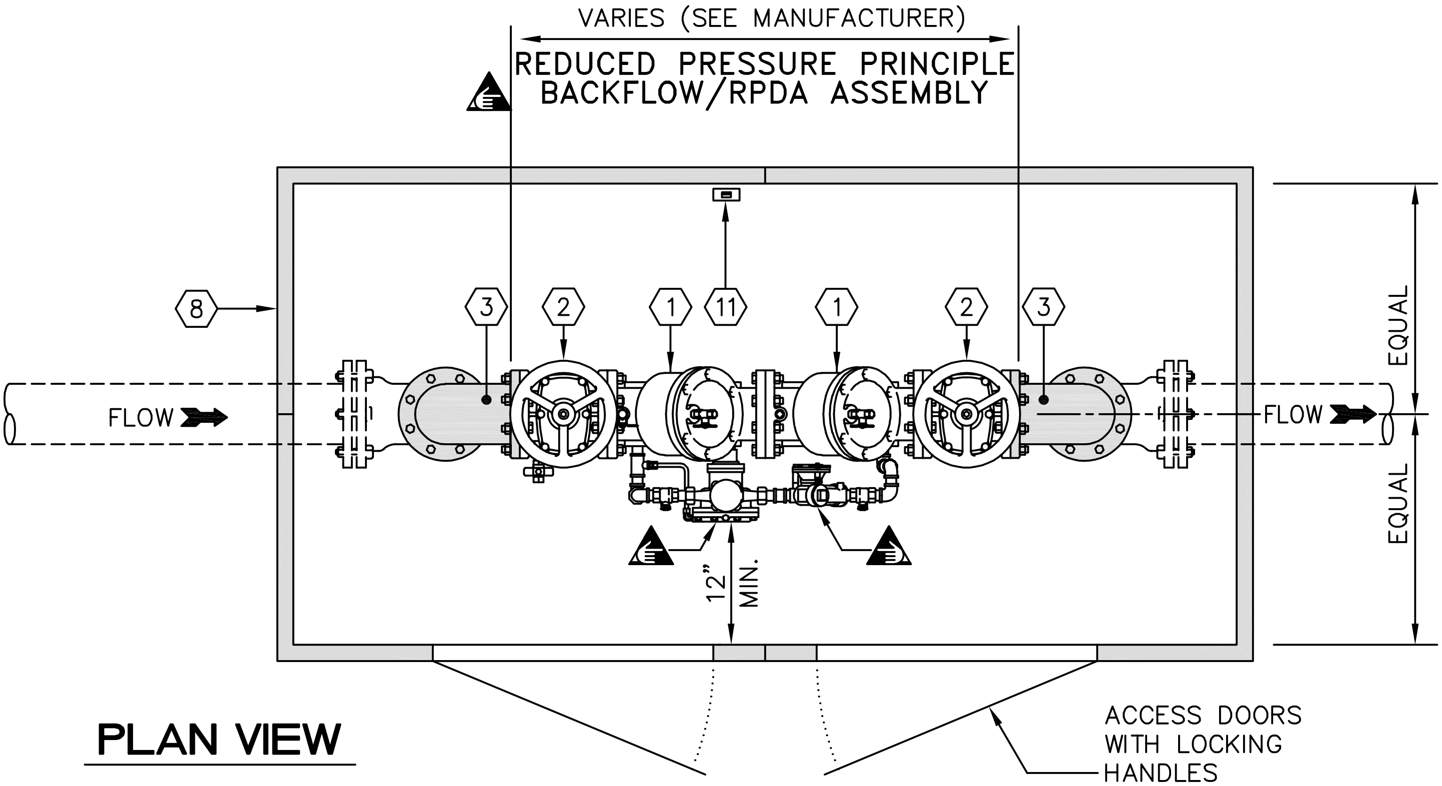
2 1/2" to 10" RPZ, RPDA ASSEMBLY (ABOVE GROUND)

SCALE: Not To Scale	DETAIL # 2515.10
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 3



PLAN VIEW

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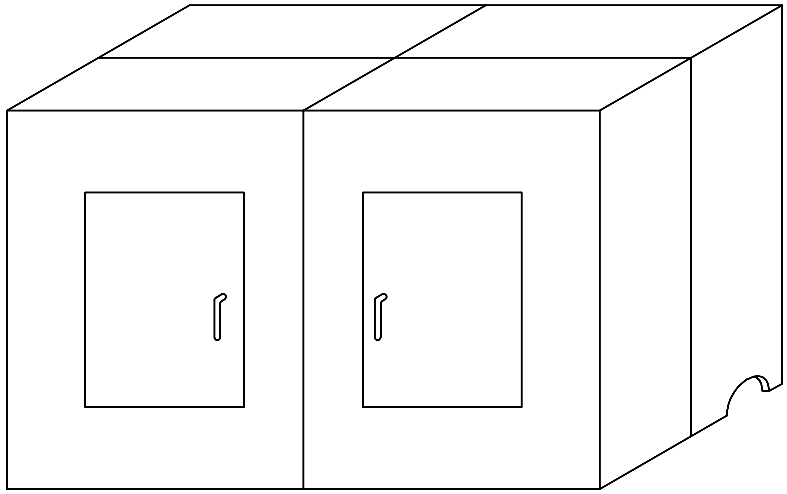
2 1/2" to 10" RPZ, RPDA ASSEMBLY (ABOVE GROUND)

SCALE: Not To Scale	DETAIL # 2515.10
REVISION DATE: Jan 1, 2025	SHEET #: 2 of 3

TYPICAL BOX



#	PART	MANUFACTURER MODEL / Cat. No.
1	BACKFLOW ASSEMBLY	USC & ASSE APPROVED
2	OS&Y GATE VALVE WITH RESILIENT SEATS	TO BE APPROVED BY OWASA
3	90° DIP FLANGE x FLANGE ELBOW	AMERICAN CAST IRON PIPE, GRIFFIN PIPE CO., UNION–TYLER PIPE CO., or U.S. PIPE & FOUNDRY
4	DIP FLANGE x PE PIPE (VERIFY LENGTH)	AMERICAN CAST IRON PIPE, GRIFFIN PIPE CO., U.S. PIPE & FOUNDRY
5	90° DIP MJ x MJ ELBOW	AMERICAN CAST IRON PIPE, GRIFFIN PIPE CO., UNION–TYLER PIPE CO., or U.S. PIPE & FOUNDRY
6	WEDGE ACTION RESTRAINER GLAND JOINT RESTRAINT	EBBA IRON SALES, INC., FORD
7	3" THRU 10" DIP	AMERICAN CAST IRON PIPE, GRIFFIN PIPE CO., UNION–TYLER PIPE CO., or U.S. PIPE & FOUNDRY
8	INSULATED ENCLOSURE WITH LOCKING ACCESS DOORS AND HEATER (120 V, 1 PHASE, 60 HZ) VERIFY FITTINGS WILL FIT INSIDE BOX BEFORE ORDERING	HOTBOX / HB4E – HB10E (OR APPROVED EQUIVALENT)
9	STAINLESS STEEL EXPANSION ANCHOR BOLTS PER BOX MANUFACTURER RECOMMENDED SIZE & SPACING	---
10	ADJUSTABLE PIPE SUPPORTS HOT DIP GALVANIZED	SHOP FABRICATED AND HOT DIP GALVANIZED OR "STANDON" MODEL S92 SADDLE SUPPORT
11	PROVIDE 120V RECEPTACLE ON GFCI NEAR PIPE RISER, SET MINIMUM 12" ABOVE DISCHARGE POINT OF RPZ. (AS APPLICABLE)	UL STD. 943–NEMA 3R.
12	METER WITH ERT	PURCHASE FROM OWASA

NOTES:

1. Provide minimum 3" annular clearance around all DIP risers and 1" around electrical conduit.
2. Slope floor to drain to ports at both ends. Ensure positive surface grade away from enclosure.
3. If metal enclosure issued, mount ERT on outside of box.

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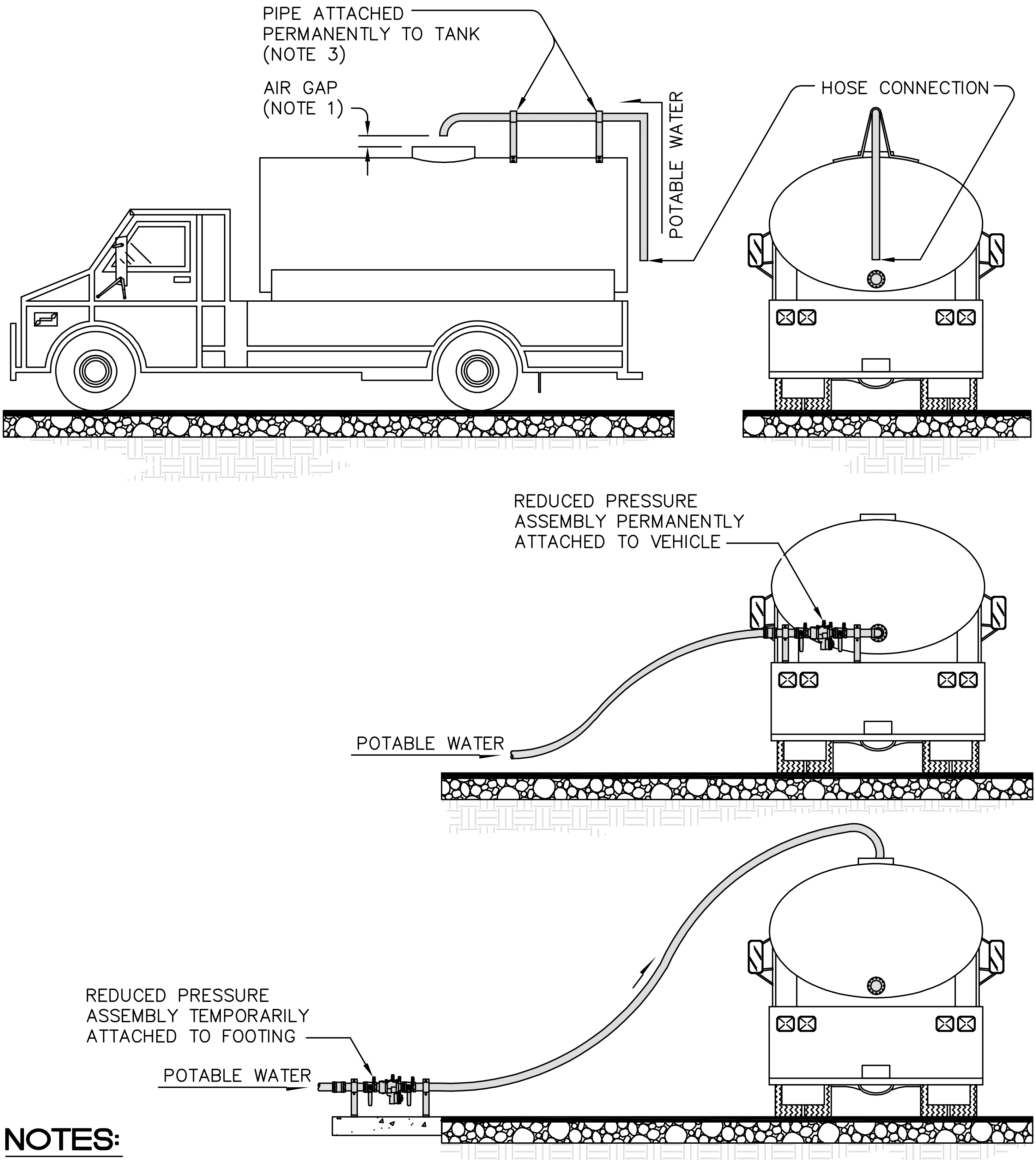
2 1/2" to 10" RPZ, RPDA ASSEMBLY (ABOVE GROUND)

SCALE: Not To Scale
DETAIL # 2515.10
REVISION DATE: Jan 1, 2025



NOTES:

1. Air gap must be twice the diameter of the supply outlet and never less than 1".
2. All tanks shall supply a gallon register meter of the same pipe diameter.
3. Piping must be "hard-piped", fire hose is not acceptable.
4. Hydrant Meter may be available from OWASA in accordance with policy.

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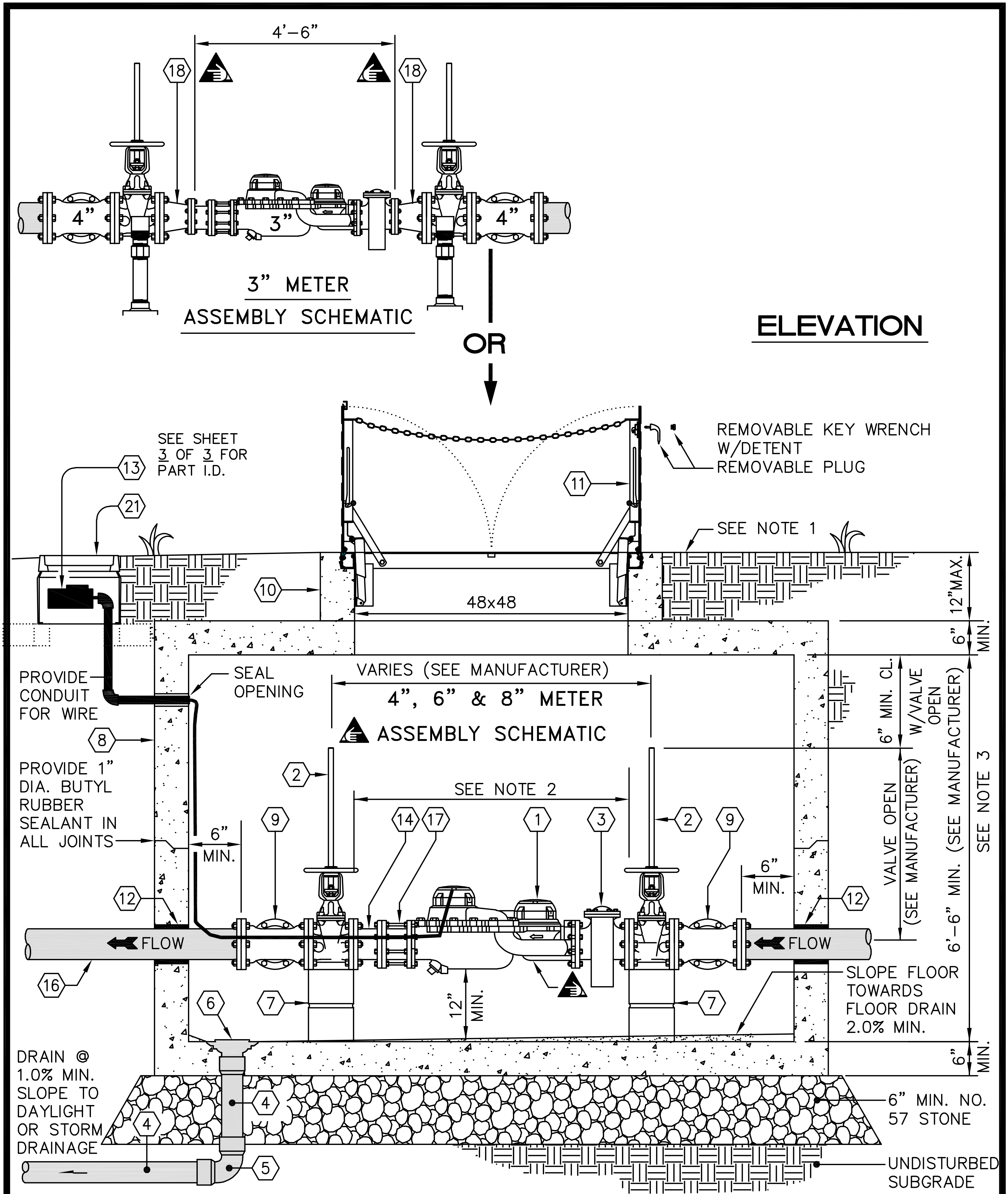
BACKFLOW PREVENTION TANKER TRUCK (AIR GAP & REDUCED PRESSURE)

SCALE: Not To Scale	DETAIL # 2515.12
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 1



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ORANGE WATER AND SEWER AUTHORITY

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FAX (919) 968-4464
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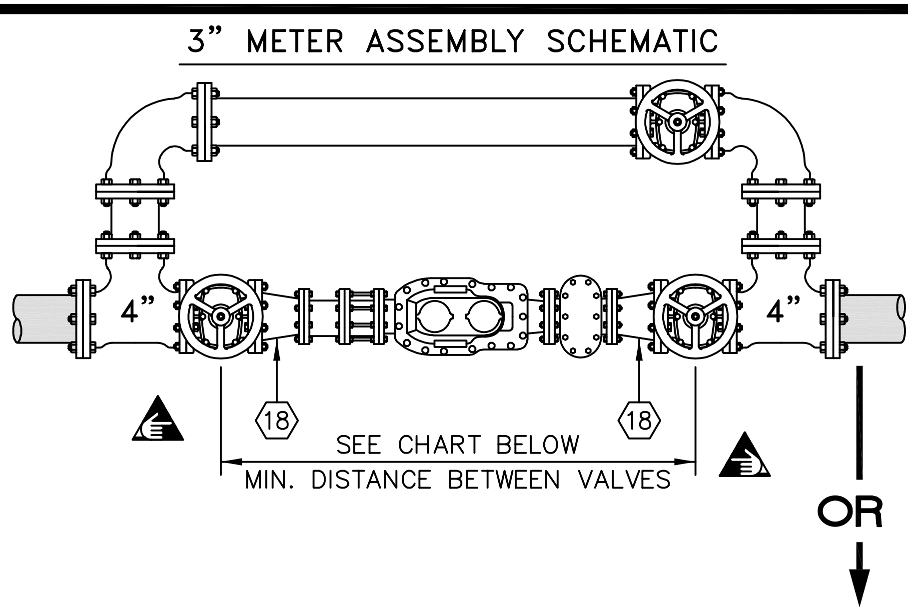
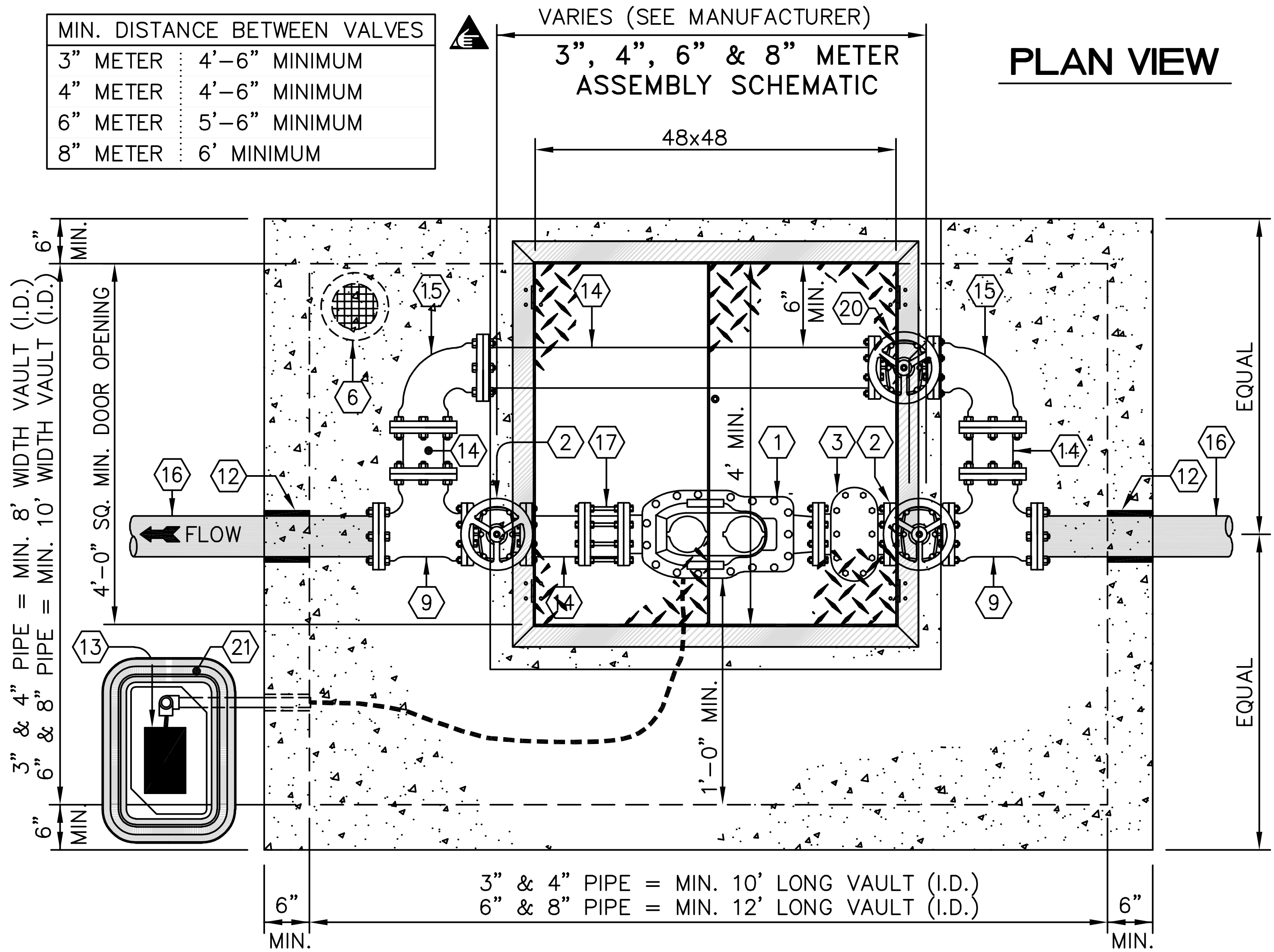
USE WITH THE OWASA STANDARD SPECIFICATIONS ONLY

3" to 8" WATER METER WITH BYPASS (UNDER GROUND VAULT)

SCALE: Not To Scale	DETAIL # 2515.13
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 3



MIN. DISTANCE BETWEEN VALVES	
3" METER	4'–6" MINIMUM
4" METER	4'–6" MINIMUM
6" METER	5'–6" MINIMUM
8" METER	6' MINIMUM



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USE WITH THE OWASA STANDARD SPECIFICATIONS ONLY

3" to 8" WATER METER WITH BYPASS (UNDER GROUND VAULT)

SCALE:	DETAIL #
Not To Scale	2515.13
REVISION DATE: Jan 1, 2025	SHEET #: 2 of 3

#	PART	MANUFACTURER MODEL / Cat. No.
1	COMPOUND METER OR TURBINE METER	TO BE APPROVED BY OWASA
2	OS&Y D.I. GATE VALVE WITH RESILIENT SEATS	TO BE APPROVED BY OWASA
3	STRAINER	TO BE APPROVED BY OWASA
4	DIP CLASS 350	SIZE & TYPE DETERMINED BY NC PE.
5	DIP CLASS 350	SIZE & TYPE DETERMINED BY NC PE.
6	FLOOR DRAIN WITH STRAINER	SIZE & TYPE DETERMINED BY NC PE BASED ON SIZE OF WATER MAIN. (TO BE APPROVED BY OWASA)
7	MORTARED MASONRY BLOCK PIPE SUPPORTS (MINIMUM 4 REQUIRED)	
8	PRECAST CONCRETE UTILITY VAULT BOX. MIN. 4,000 PSI @ 28 DAYS VERIFY FITTINGS WILL FIT INSIDE BOX BEFORE ORDERING	STAY-RIGHT PRECAST VAULT, H20 LOAD RATING (OR APPROVED EQUIVALENT)
9	DIP FLANGED TEE	AMERICAN CAST IRON PIPE, UNION-TYLER PIPE CO., or U.S. PIPE & FOUNDRY
10	4'-0" MIN. WIDTH (I.D.) x 4'-0" LONG (I.D.) RISER. SEE SHEET 2 of 3 FOR MINIMUM LENGTH.	STAY-RIGHT PRECAST VAULT, H20 LOAD RATING (OR APPROVED EQUIVALENT)
11	4' WIDE x 4' LONG DOOR CAST INTO RISER (DRAIN TO OUTSIDE) SEE SHEET 2 of 3 FOR MINIMUM LENGTH.	BILCO OR HALIDAY PRODUCTS DOUBLE LEAF ACCESS DOOR. USE H20 LOADING IN ALL AREAS. DRAIN TO OUTSIDE (OR APPROVED EQUAL)
12	WALL SLEEVE WITH LINK SEAL (OR APPROVED EQUIVALENT)	TO BE APPROVED BY OWASA
13	REMOTE METER READOUT (IN GALLONS) ELECTRONIC ERT	TO BE APPROVED BY OWASA
14	DIP FLANGE x FLANGE SPOOL PIPE OR THREADED END FOR FLANGE (VERIFY LENGTH)	AMERICAN CAST IRON PIPE, U.S. PIPE & FOUNDRY
15	DIP FLANGED 90° ELBOW (SHORT RADIUS)	AMERICAN CAST IRON PIPE, UNION-TYLER PIPE CO., or U.S. PIPE & FOUNDRY
16	4", 6" OR 8" DIP FLANGED x PE PIPE (USE 1 FULL LENGTH JOINT PIPE)	AMERICAN CAST IRON PIPE, UNION-TYLER PIPE CO., or U.S. PIPE & FOUNDRY
17	FLANGED ADAPTOR	UNIFLANGE (TO BE APPROVED BY OWASA)
18	DIP FLANGED 4"x3" REDUCER	AMERICAN CAST IRON PIPE, UNION-TYLER PIPE CO., or U.S. PIPE & FOUNDRY
19		
20	OS&Y GATE VALVE WITH RESILIENT SEATS	DRILL STEM FOR SEALING IN CLOSED POSITION (TO BE APPROVED BY OWASA)
21	METER BOX	CDR SYSTEMS CORP. / WA04-1118-12C MID-STATES PLASTICS, INC. / MSBC 1118-12

NOTES:

1. Ensure positive surface grade away from box.
2. 3" Meter to use 4" OS&Y DI valves and (2) 4"x3" DI flanged reducers with section of 3" flanged DI pipe and 3" DI flanged coupling adaptor.
3. For vaults less than 6'-6" high see detail 515.14

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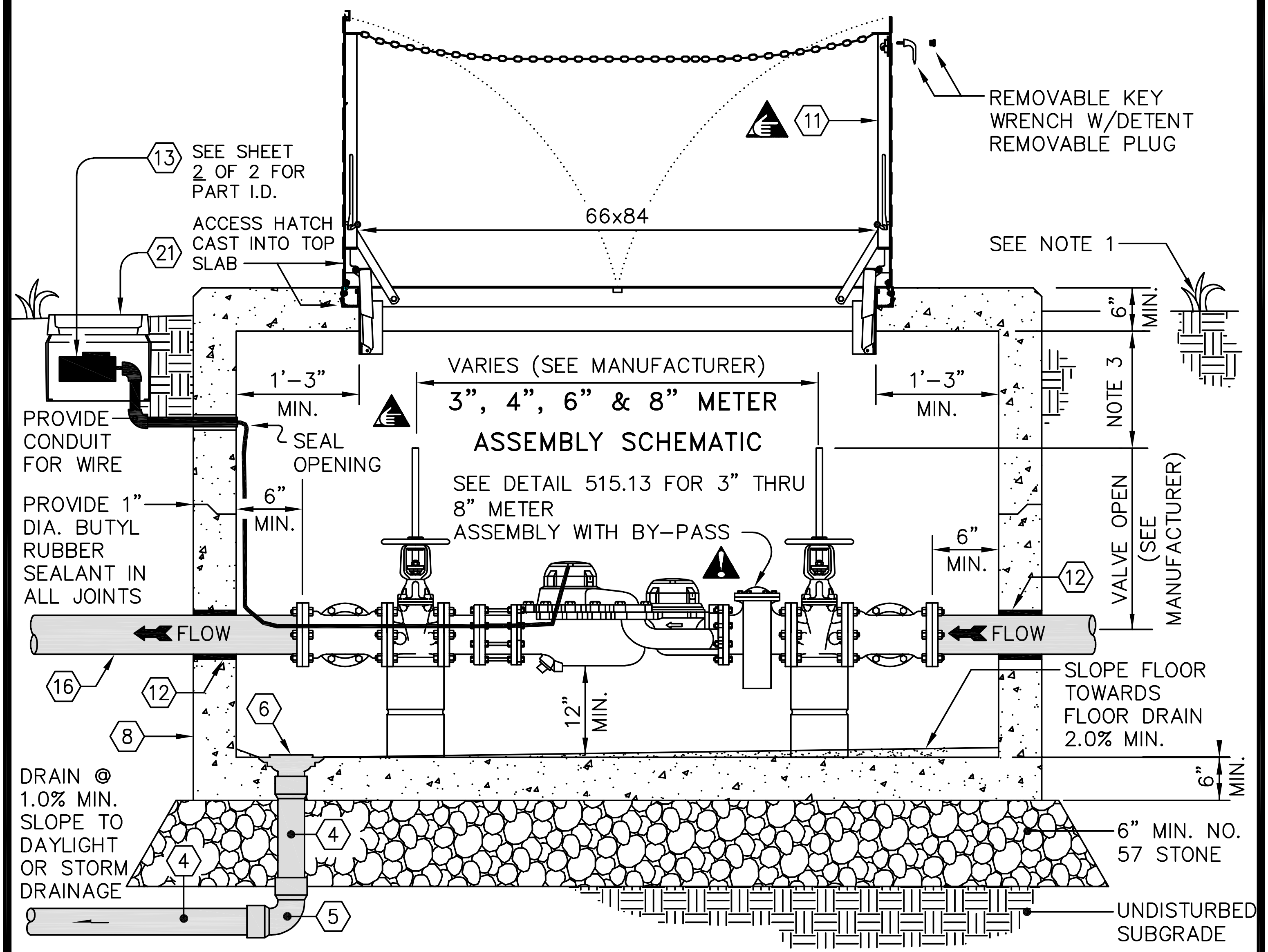
USE WITH THE OWASA STANDARD SPECIFICATIONS ONLY

3" to 8" WATER METER WITH BYPASS (UNDER GROUND VAULT)

SCALE:	DETAIL #
Not To Scale	515.13
REVISION DATE: Jan 1, 2025	SHEET #: 3 of 3

ELEVATION



NOTES:

1. Ensure positive surface grade away from box.
2. This detail, with OWASA's approval, may be used when inside vault height needs to be less than 6'-6".
3. Engineer must verify that valve stem, in fully open position, does not interfere with vault top or access door in closed position.

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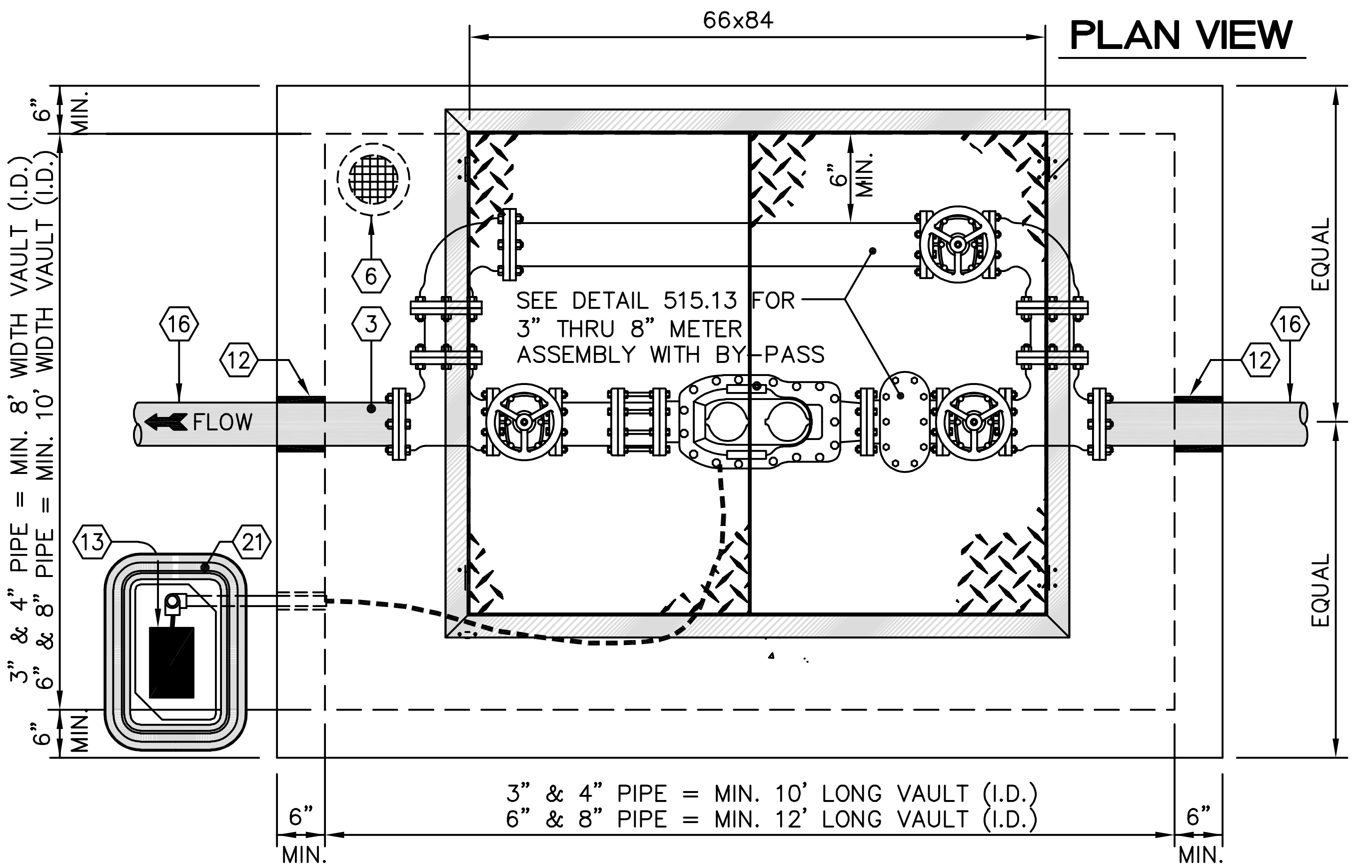
USE WITH THE OWASA STANDARD SPECIFICATIONS ONLY

LOW PROFILE VAULT / OVERSIZED ACCESS (3" - 8" UNDERGROUND METER VAULT)

SCALE:	DETAIL #
Not To Scale	2 515.14
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 2

#	PART	MANUFACTURER MODEL / Cat. No.
4	DIP CLASS 350	SIZE & TYPE DETERMINED BY NC PE BASED ON SIZE OF WATER MAIN.
5	DIP CLASS 350	SIZE & TYPE DETERMINED BY NC PE.
6	FLOOR DRAIN WITH STRAINER	SIZE & TYPE DETERMINED BY NC PE. TO BE APPROVED BY OWASA
8	PRECAST CONCRETE UTILITY VAULT BOX. MIN. 4,000 PSI @ 28 DAYS VERIFY FITTINGS WILL FIT INSIDE BOX BEFORE ORDERING	STAY-RIGHT PRECAST VAULT, H20 LOAD RATING (OR APPROVED EQUIVALENT)
11	5 1/2' WIDE x 7' LONG. DOOR CAST INTO TOP (DRAIN TO OUTSIDE)	BILCO OR HALIDAY PRODUCTS DOUBLE LEAF ACCESS DOOR. USE H20 LOADING IN ALL AREAS. DRAIN TO OUTSIDE (OR APPROVED EQUAL)
12	WALL SLEEVE WITH LINK SEAL (OR APPROVED EQUIVALENT)	TO BE APPROVED BY OWASA
13	REMOTE METER READOUT (IN GALLONS) ELECTRONIC ERT	TO BE APPROVED BY OWASA
16	4", 6" OR 8" DIP FLANGED x PE PIPE (USE 1 FULL LENGTH JOINT PIPE)	AMERICAN CAST IRON PIPE UNION-TYLER PIPE CO., or U.S. PIPE & FOUNDRY
21	METER BOX	CDR SYSTEMS CORP. / WA04-1118-12C MID-STATES PLASTICS, INC. / MSBCF 1118-12

PLAN VIEW



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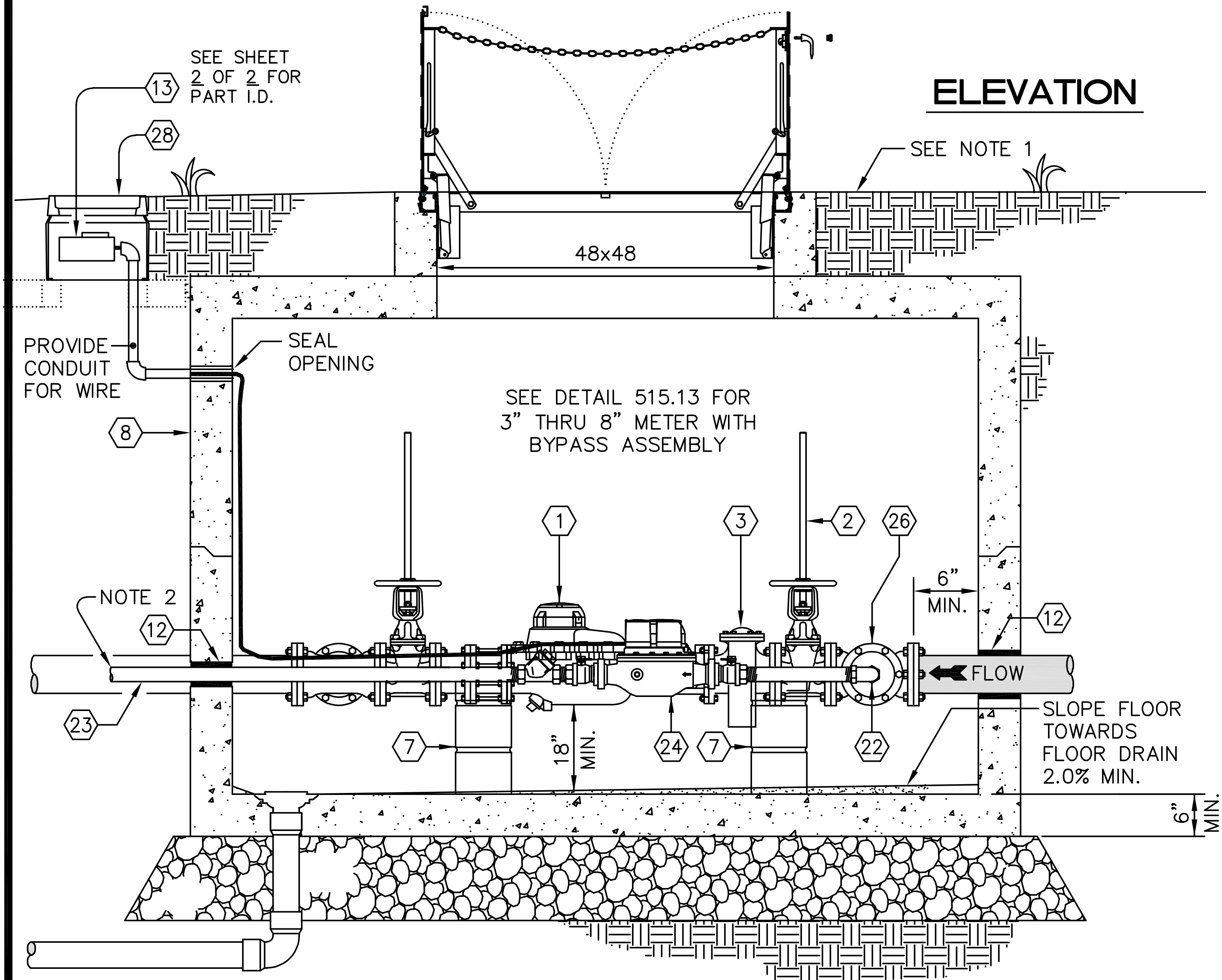
USE WITH THE OWASA STANDARD SPECIFICATIONS ONLY

LOW PROFILE VAULT / OVERSIZED ACCESS (3" - 8" UNDERGROUND METER VAULT)

SCALE:	DETAIL #
Not To Scale	2515.14
REVISION DATE: Jan 1, 2025	SHEET #: 2 of 2



(2" IRRIGATION LINE SHOWN)

NOTES:

1. Ensure positive surface grade away from box.
2. See std. details 515.06, 515.07 and 515.08 for backflow prevention assembly and vault box as applicable.

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USE WITH THE OWASA STANDARD SPECIFICATIONS ONLY

1" OR 2" IRRIGATION METER ON A 3" TO 8" UNDERGROUND METER VAULT

SCALE: Not To Scale

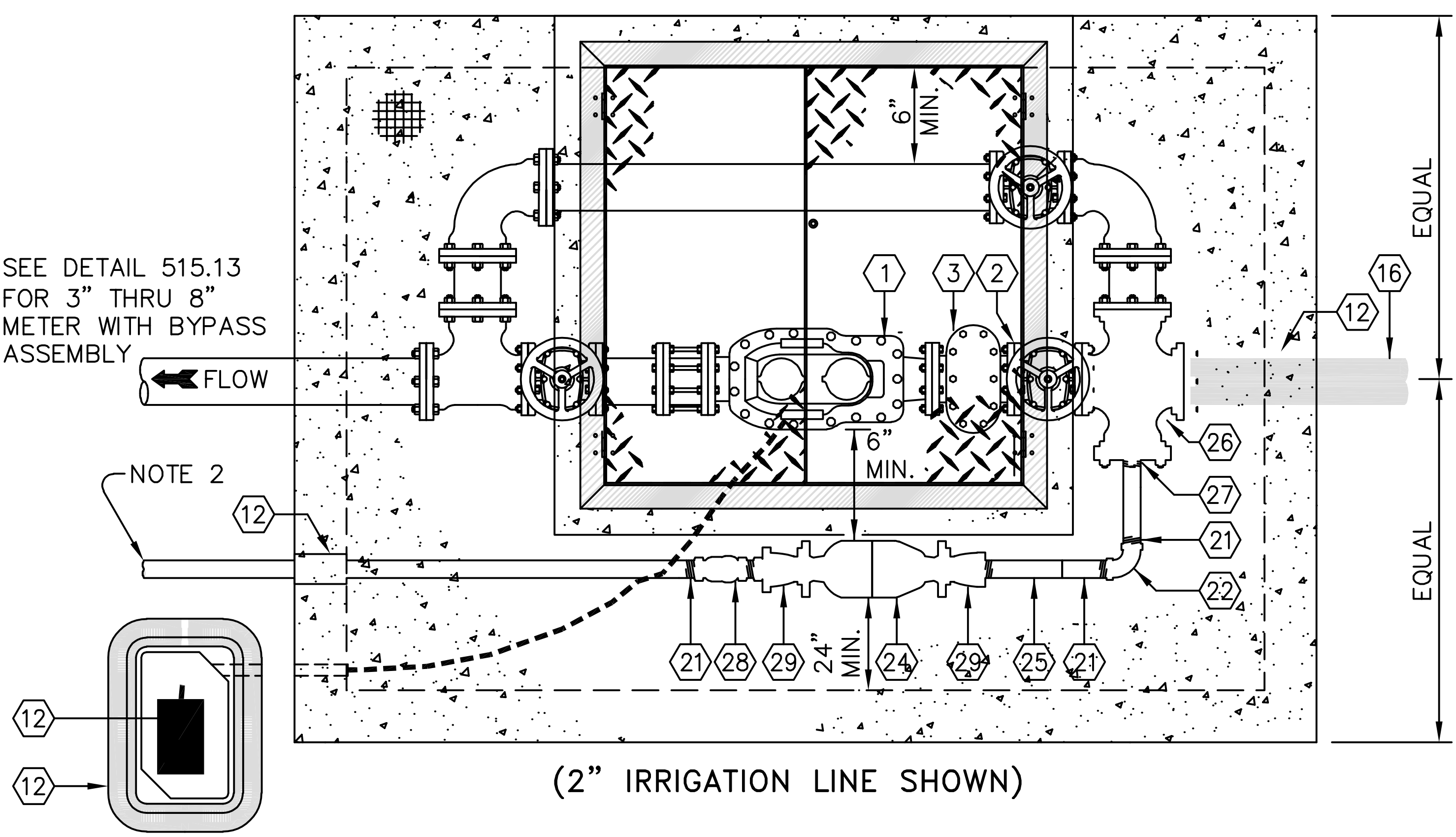
DETAIL #: 515.15

REVISION DATE: Jan 1, 2025

SHEET #: 1 of 2

#	PART	MANUFACTURER MODEL / Cat. No.
1	COMPOUND METER OR TURBINE METER	TO BE APPROVED BY OWASA
2	OS&Y GATE VALVE WITH RESILIENT SEATS	TO BE APPROVED BY OWASA
3	STRAINER	TO BE APPROVED BY OWASA
7	MORTARED MASONRY BLOCK PIPE SUPPORTS	
8	PRECAST CONCRETE UTILITY VAULT BOX. MIN. 4,000 PSI @ 28 DAYS VERIFY FITTINGS WILL FIT INSIDE BOX BEFORE ORDERING	STAY–RIGHT PRECAST VAULT, H20 LOAD RATING (OR APPROVED EQUIVALENT)
12	WALL SLEEVE WITH LINK SEAL (OR APPROVED EQUIVALENT)	TO BE APPROVED BY OWASA
13	REMOTE METER READOUT (IN GALLONS) ELECTRONIC ERT	TO BE APPROVED BY OWASA
21	THREADED PIPE NIPPLE (BRASS ONLY)	
22	THREADED 90° ELBOW (BRASS ONLY)	
24	1" OR 2" METER (FOR IRRIGATION SERVICE)	TO BE APPROVED BY OWASA
26	DIP FLANGED CROSS	AMERICAN CAST IRON PIPE, UNION–TYLER PIPE CO., or U.S. PIPE & FOUNDRY
27	DIP FLANGED PLUG TAPPED FOR 1" OR 2" (AS APPLICABLE)	AMERICAN CAST IRON PIPE, UNION–TYLER PIPE CO., or U.S. PIPE & FOUNDRY
28	METER BOX	CDR SYSTEMS CORP. / WA04–1118–12C MID–STATES PLASTICS, INC. / MSBC 1118–12
29	STANDARD 1" OR 2" SETTER	

PLAN VIEW



(2" IRRIGATION LINE SHOWN)

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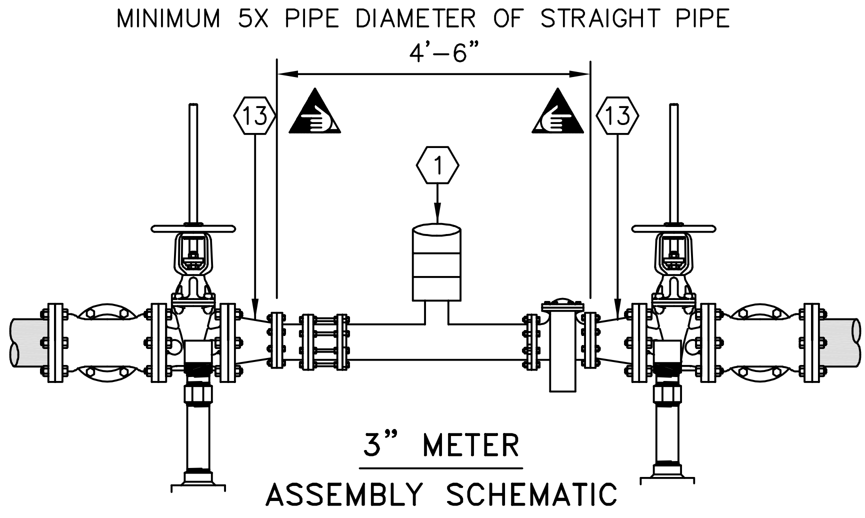
USE WITH THE OWASA STANDARD SPECIFICATIONS ONLY

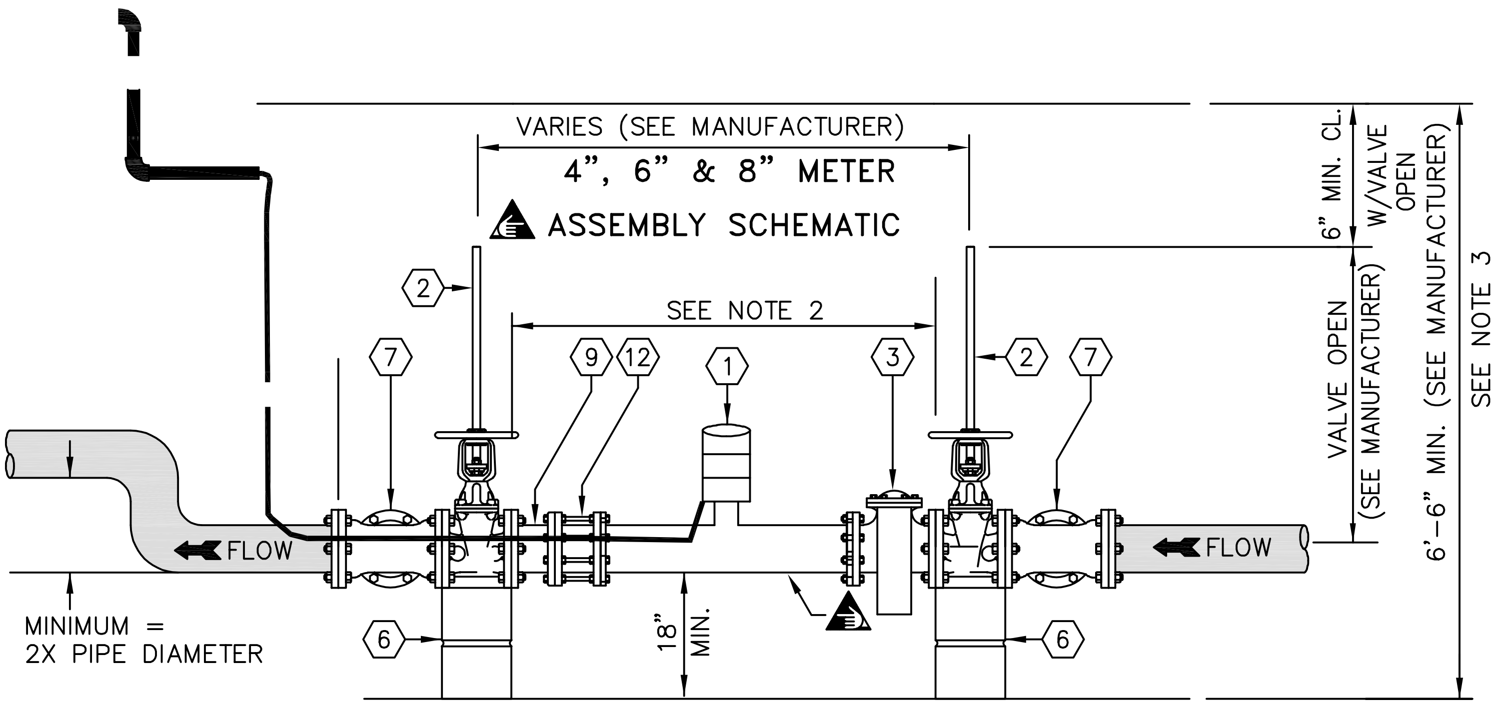
1" OR 2" IRRIGATION METER ON A 3" TO 8" UNDERGROUND METER VAULT

SCALE: Not To Scale

DETAIL #: 2515.15

REVISION DATE: Jan 1, 2025





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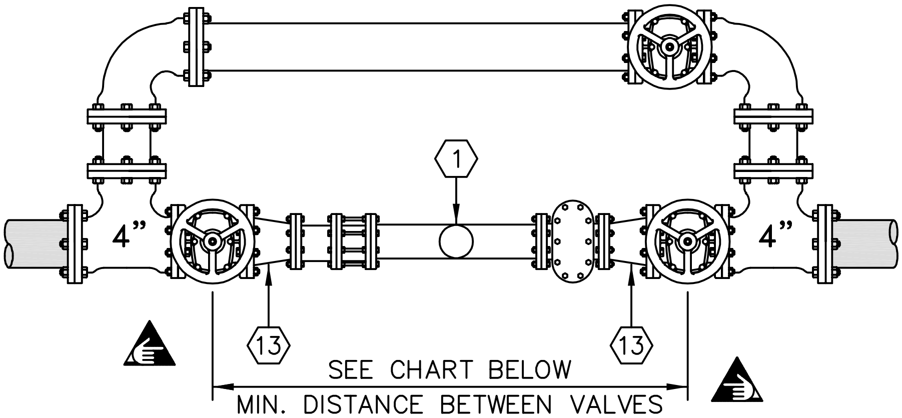
CHILLER DEDUCT METER WITH P-TRAP (ON DISCHARGE LINE)

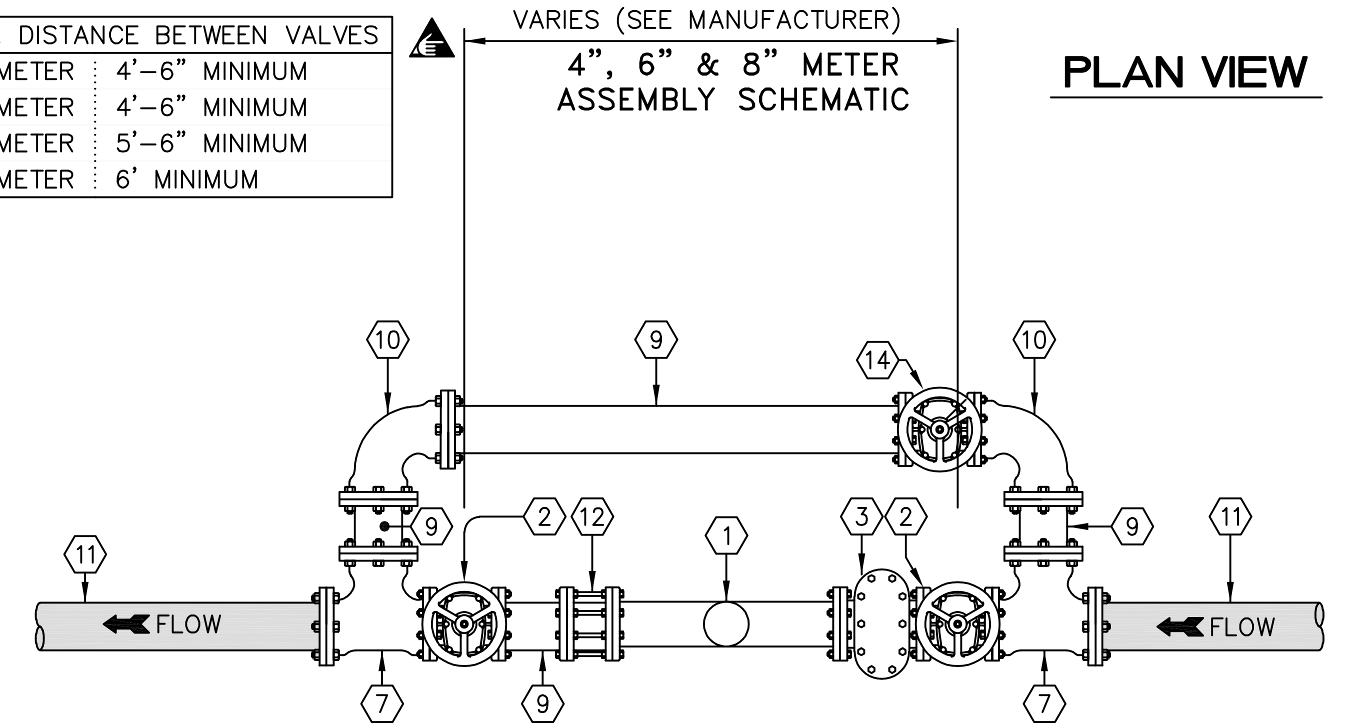
SCALE: Not To Scale	DETAIL # 2 515.16-A
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 3

3" METER ASSEMBLY SCHEMATIC



MIN. DISTANCE BETWEEN VALVES	
3" METER	4'–6" MINIMUM
4" METER	4'–6" MINIMUM
6" METER	5'–6" MINIMUM
8" METER	6' MINIMUM

PLAN VIEW



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CHILLER DEDUCT METER WITH P-TRAP (ON DISCHARGE LINE)

SCALE:	DETAIL #
Not To Scale	2 515.16-B
REVISION DATE: Jan 1, 2025	SHEET #: 2 of 3

#	PART	MANUFACTURER MODEL / Cat. No.
1	ELECTROMAGNETIC METER (HERSEY HbMAG OR COMPARABLE)	TO BE APPROVED BY OWASA
2	OS&Y D.I. GATE VALVE WITH RESILIENT SEATS	TO BE APPROVED BY OWASA
3	STRAINER	TO BE APPROVED BY OWASA
6	MORTARED MASONRY BLOCK PIPE SUPPORTS (MINIMUM 4 REQUIRED)	
7	DIP FLANGED TEE	AMERICAN CAST IRON PIPE, UNION–TYLER PIPE CO., or U.S. PIPE & FOUNDRY
8	REMOTE METER READOUT (IN GALLONS) ELECTRONIC ERT	TO BE APPROVED BY OWASA
9	DIP FLANGE x FLANGE SPOOL PIPE OR THREADED END FOR FLANGE (VERIFY LENGTH)	AMERICAN CAST IRON PIPE, U.S. PIPE & FOUNDRY
10	DIP FLANGED 90° ELBOW (SHORT RADIUS)	AMERICAN CAST IRON PIPE, UNION–TYLER PIPE CO., or U.S. PIPE & FOUNDRY
11	4", 6" OR 8" DIP FLANGED x PE PIPE (USE 1 FULL LENGTH JOINT PIPE)	AMERICAN CAST IRON PIPE, UNION–TYLER PIPE CO., or U.S. PIPE & FOUNDRY
12	FLANGED ADAPTOR	UNIFLANGE (TO BE APPROVED BY OWASA)
13	DIP FLANGED 4"x3" REDUCER	AMERICAN CAST IRON PIPE, UNION–TYLER PIPE CO., or U.S. PIPE & FOUNDRY
14	OS&Y GATE VALVE WITH RESILIENT SEATS	DRILL STEM FOR SEALING IN CLOSED POSITION (TO BE APPROVED BY OWASA)

NOTES:

1. Minimum 2" Setter.
2. 3" Meter to use 4" OS&Y DI valves and (2) 4"x3" DI flanged reducers with section of 3" flanged DI pipe and 3" DI flanged coupling adaptor.
3. For vaults less than 6'–6" high see detail 515.14

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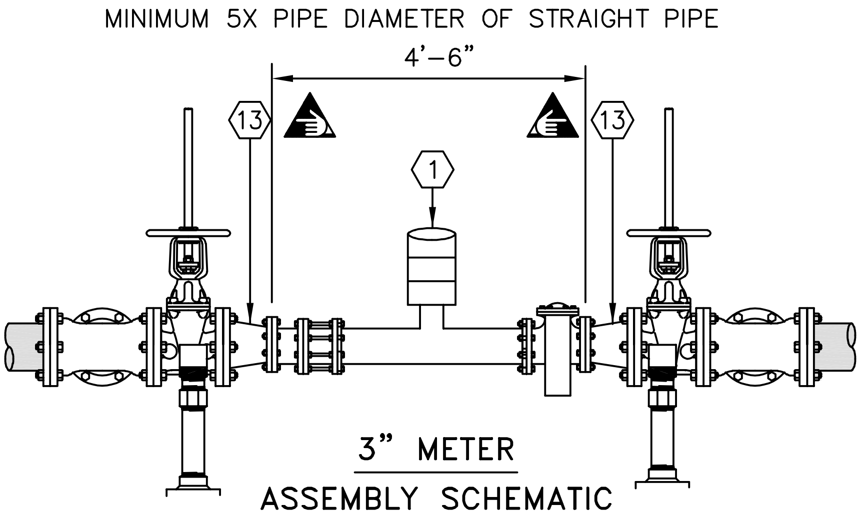
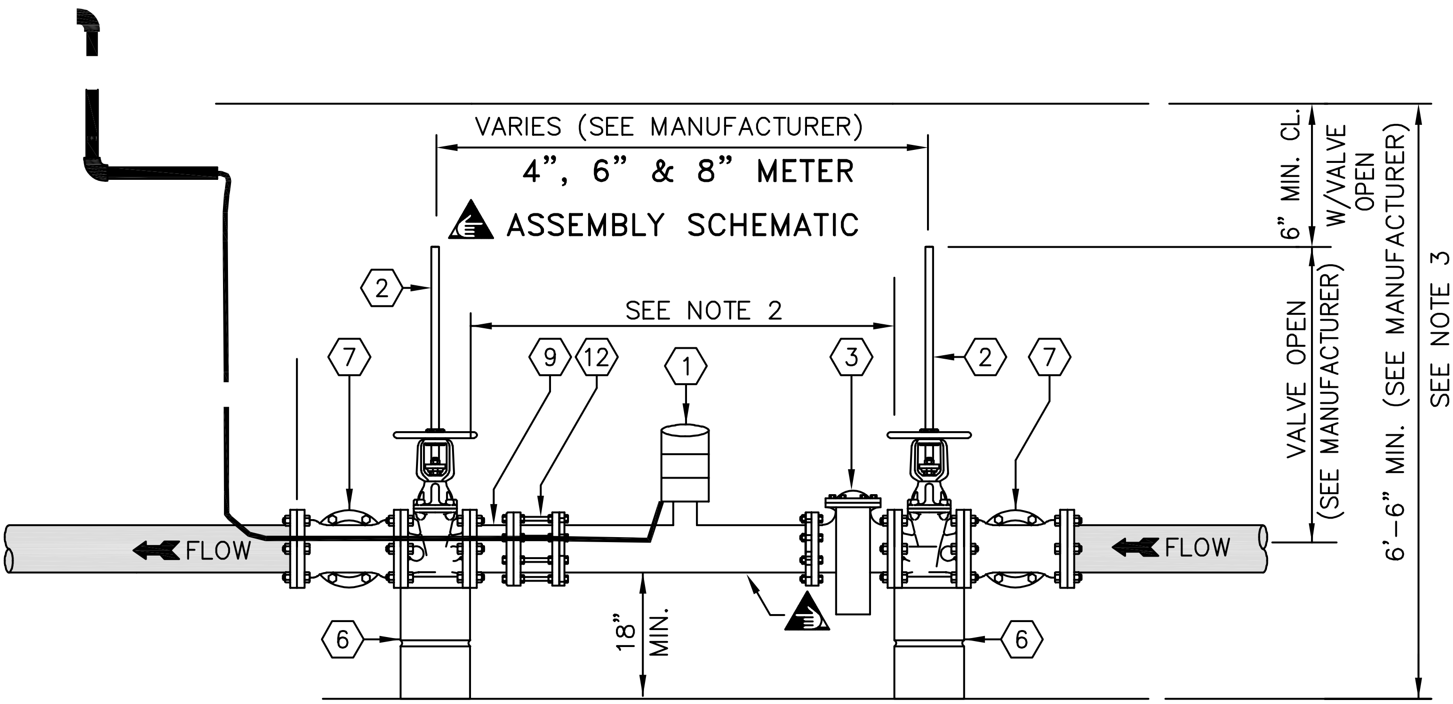
CHILLER DEDUCT METER WITH P-TRAP (ON DISCHARGE LINE)

SCALE:	DETAIL #
Not To Scale	2 515.16-C
REVISION DATE: Jan 1, 2025	SHEET #: 3 of 3





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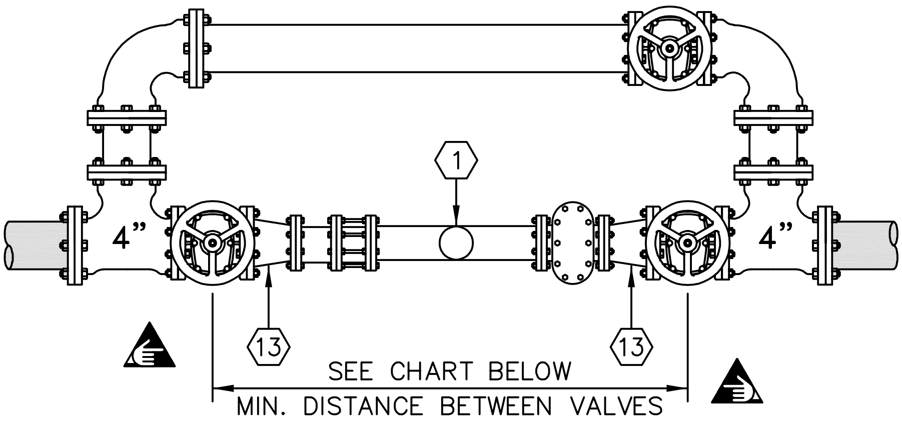
CHILLER DEDUCT METER (ON INTAKE LINE)

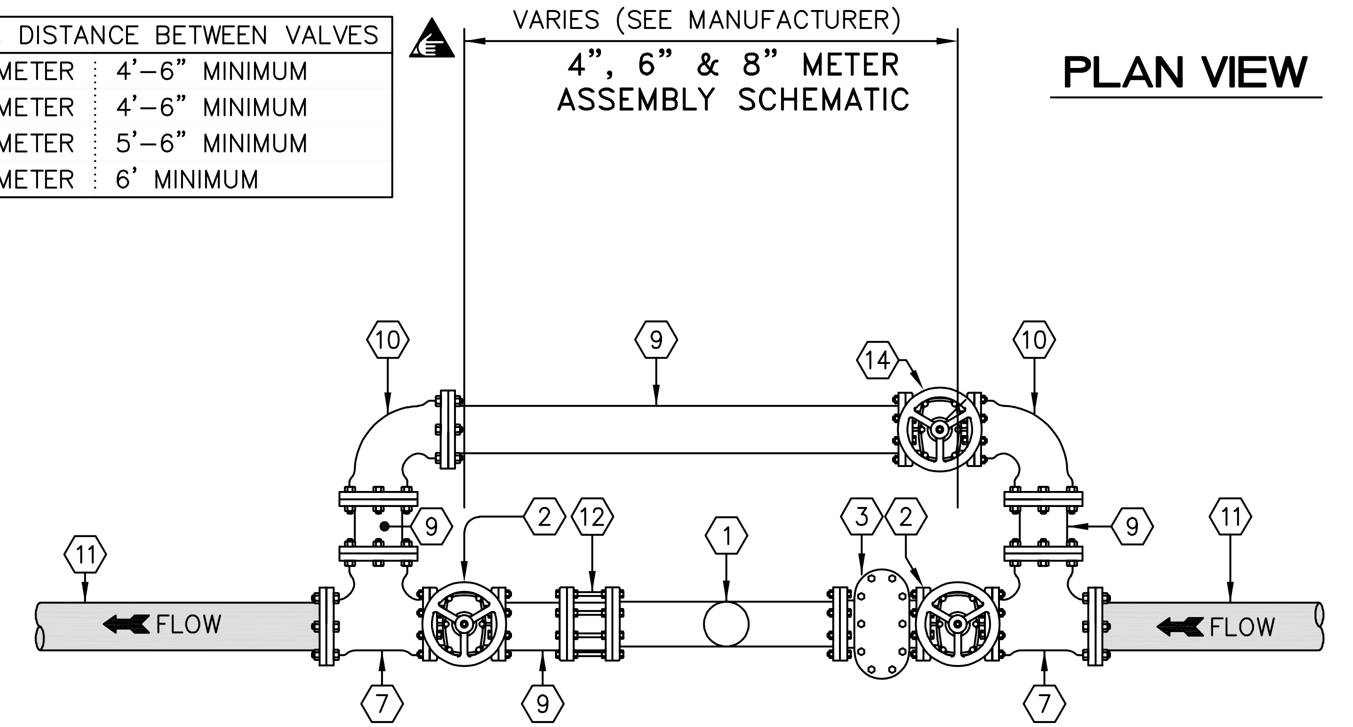
SCALE:	DETAIL #
Not To Scale	2 515.17-A
REVISION DATE:	SHEET #:
Jan 1, 2025	1 of 3

3" METER ASSEMBLY SCHEMATIC



MIN. DISTANCE BETWEEN VALVES	
3" METER	4'–6" MINIMUM
4" METER	4'–6" MINIMUM
6" METER	5'–6" MINIMUM
8" METER	6' MINIMUM

PLAN VIEW



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USE WITH THE OWASA STANDARD SPECIFICATIONS ONLY

CHILLER DEDUCT METER (ON INTAKE LINE)

SCALE: Not To Scale	DETAIL # 2 515.17-B
REVISION DATE: Jan 1, 2025	SHEET #: 2 of 3

#	PART	MANUFACTURER MODEL / Cat. No.
1	ELECTROMAGNETIC METER (HERSEY HbMAG OR COMPARABLE)	TO BE APPROVED BY OWASA
2	OS&Y D.I. GATE VALVE WITH RESILIENT SEATS	TO BE APPROVED BY OWASA
3	STRAINER	TO BE APPROVED BY OWASA
6	MORTARED MASONRY BLOCK PIPE SUPPORTS (MINIMUM 4 REQUIRED)	
7	DIP FLANGED TEE	AMERICAN CAST IRON PIPE, UNION–TYLER PIPE CO., or U.S. PIPE & FOUNDRY
8	REMOTE METER READOUT (IN GALLONS) ELECTRONIC ERT	TO BE APPROVED BY OWASA
9	DIP FLANGE x FLANGE SPOOL PIPE OR THREADED END FOR FLANGE (VERIFY LENGTH)	AMERICAN CAST IRON PIPE, U.S. PIPE & FOUNDRY
10	DIP FLANGED 90° ELBOW (SHORT RADIUS)	AMERICAN CAST IRON PIPE, UNION–TYLER PIPE CO., or U.S. PIPE & FOUNDRY
11	4", 6" OR 8" DIP FLANGED x PE PIPE (USE 1 FULL LENGTH JOINT PIPE)	AMERICAN CAST IRON PIPE, UNION–TYLER PIPE CO., or U.S. PIPE & FOUNDRY
12	FLANGED ADAPTOR	UNIFLANGE (TO BE APPROVED BY OWASA)
13	DIP FLANGED 4"x3" REDUCER	AMERICAN CAST IRON PIPE, UNION–TYLER PIPE CO., or U.S. PIPE & FOUNDRY
14	OS&Y GATE VALVE WITH RESILIENT SEATS	DRILL STEM FOR SEALING IN CLOSED POSITION (TO BE APPROVED BY OWASA)

NOTES:

1. Minimum 2" Setter.
2. 3" Meter to use 4" OS&Y DI valves and (2) 4"x3" DI flanged reducers with section of 3" flanged DI pipe and 3" DI flanged coupling adaptor.
3. For vaults less than 6'–6" high see detail 515.14

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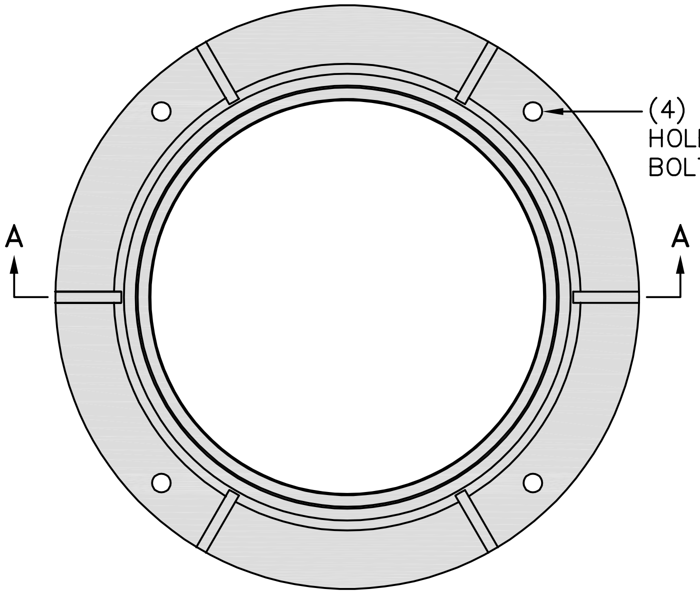
CHILLER DEDUCT METER (ON INTAKE LINE)

SCALE: Not To Scale

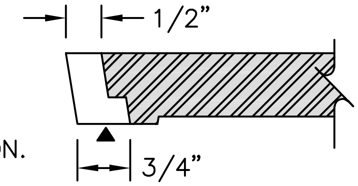
DETAIL #: 2 515.17-C

REVISION DATE: Jan 1, 2025



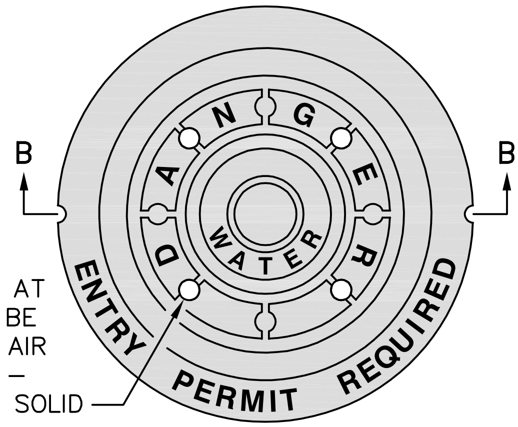
(4) 1" DIA. ANCHOR BOLT.
HOLES EQUALLY SPACED.
BOLT FRAME TO CONE SECTION.

FRAME TOP



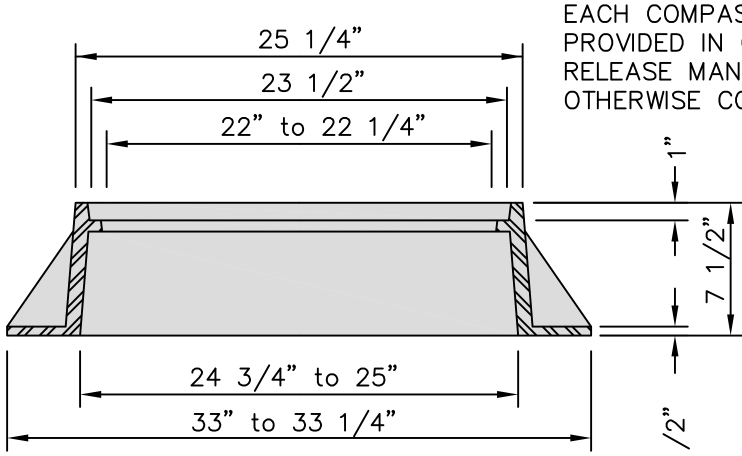
(2) TYPE ONE PICKSLOTS

PICKHOLE DETAIL

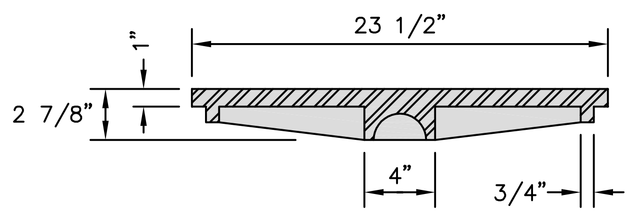


(4) 1" DIA. PERFORATIONS AT EACH COMPASS POINT TO BE PROVIDED IN COVERS FOR AIR RELEASE MANHOLES ONLY – OTHERWISE COVERS TO BE SOLID

COVER FACE

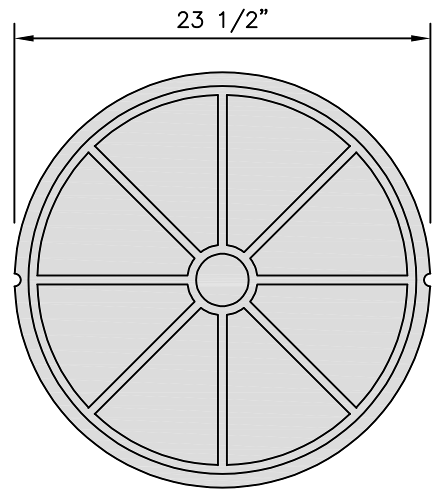


FRAME SECTION A-A



COVER SECTION B-B

ISOMETRICS



COVER BACK

APPROVED MODELS	EAST JORDAN IRON WORKS V–1384	US FOUNDRY USF–669	CAPITOL FOUNDRY MH–2001
COVER WEIGHT	135 Lbs.	125 Lbs.	120 Lbs.
FRAME WEIGHT	180 Lbs.	190 Lbs.	190 Lbs.
LOAD RATING	HEAVY DUTY	HEAVY DUTY	HEAVY DUTY
MATERIAL	ASTM A 48 CLASS 35B	ASTM A 48 CLASS 35B	ASTM A 48 CLASS 35B
FINISH	UNCOATED	UNCOATED	UNCOATED

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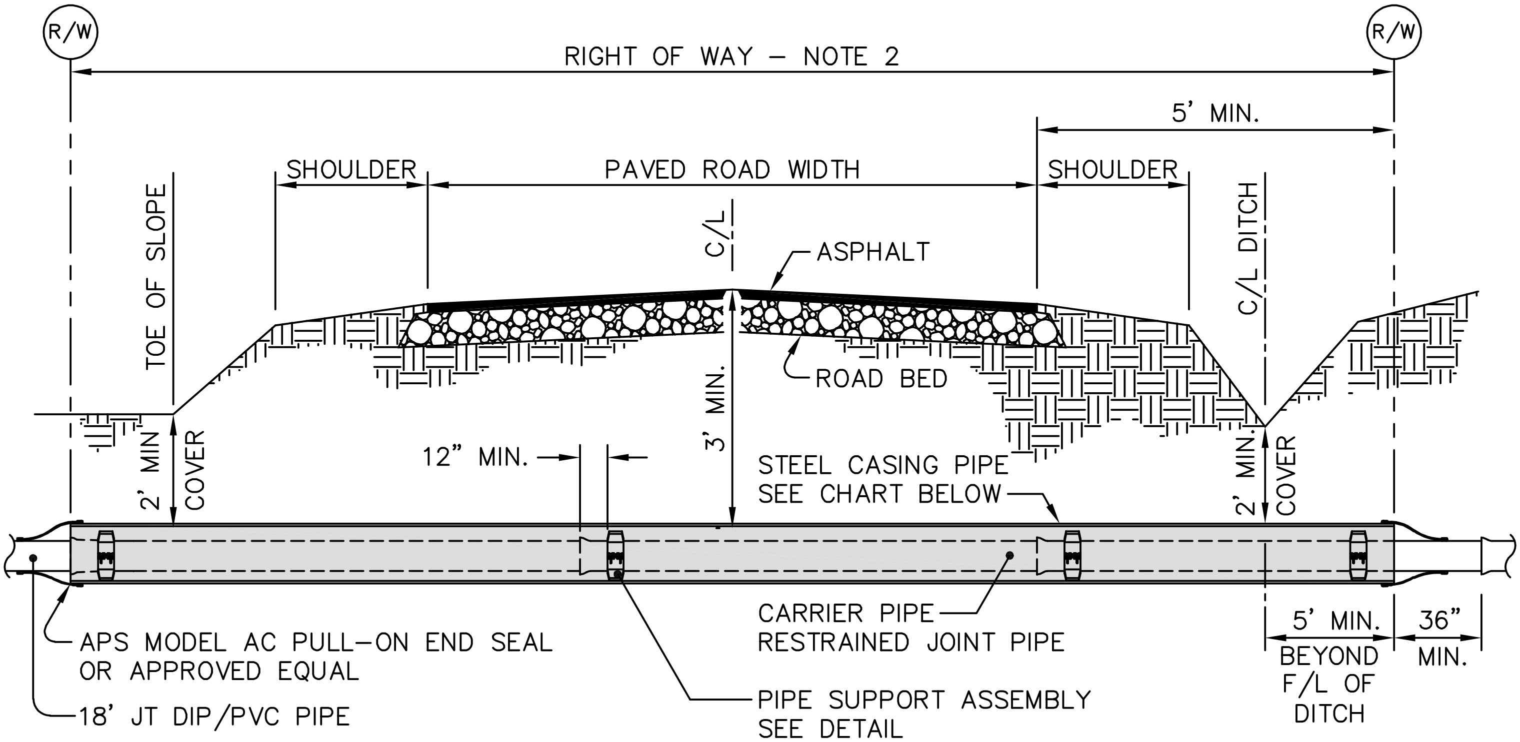
STANDARD WATER MANHOLE FRAME and COVER

SCALE: Not To Scale

DETAIL #: 2516.01

REVISION DATE: Jan 1, 2025

SHEET #: 1 of 1



CARRIER PIPE		CASING PIPE *			
		RAILROAD		HIGHWAY	
NOMINAL DIAMETER	OUTSIDE DIAMETER	OUTSIDE DIAMETER	WALL THICKNESS	OUTSIDE DIAMETER	WALL THICKNESS
6" & UNDER	6.90"	12 3/4"	0.188"	12 3/4"	0.250"
8"	9.05"	16"	0.250"	16"	0.250"
10"	11.10"	20"	0.281"	20"	0.250"
12"	13.20"	24"	0.344"	24"	0.250"
14"	15.30"	28"	0.406"	28"	0.312"
16"	17.40"	30"	0.406"	30"	0.312"
20"	21.60"	42"	0.563"	42"	0.312"
24"	25.80"	42"	0.563"	42"	0.312"

*DIMENSIONS ARE WITHOUT COATINGS

NOTES:

1. Installation by dry bore & jacking.
2. Bore to run from Right-of-Way to Right-of-Way unless approved otherwise by OWASA.
3. Grease encasement pipe as required for ease of installation.
4. Steel pipe to be 35,000 psi min. yield strength, grade B.
5. All exposed metal to be coated with epoxy or asphaltic material.
6. Skids to be installed, manufactured by ITT Grinnell, Charlotte, N.C. / Spider Manufacturing, Durham, N.C. / APS casing spacers by Advanced Products Systems Inc, Lafayette, LA. / or approved equal.

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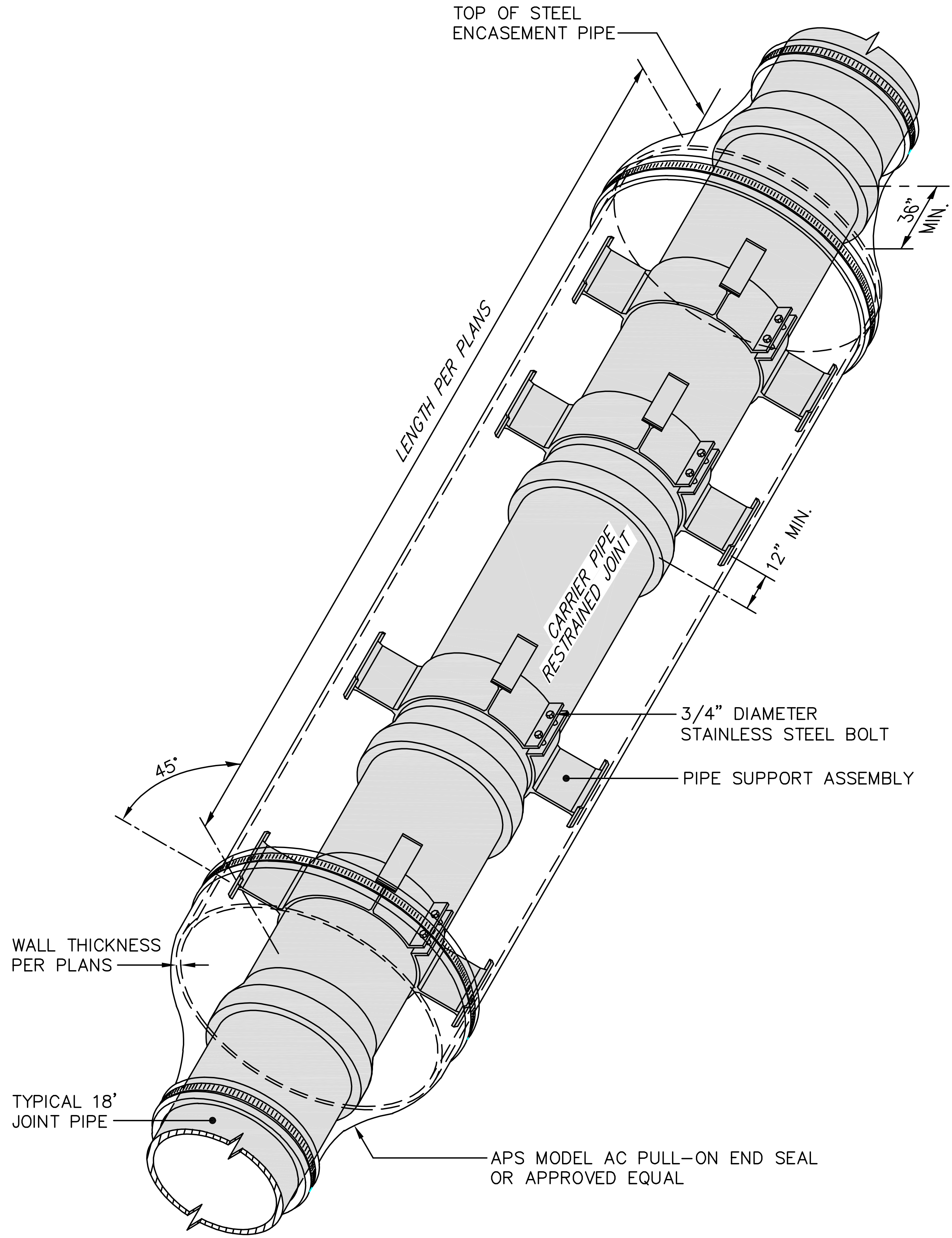
TYPICAL DETAIL for BORE UNDER PAVED ROADS / HIGHWAYS

SCALE: Not To Scale

DETAIL #: 2517.01

REVISION DATE: Jan 1, 2025



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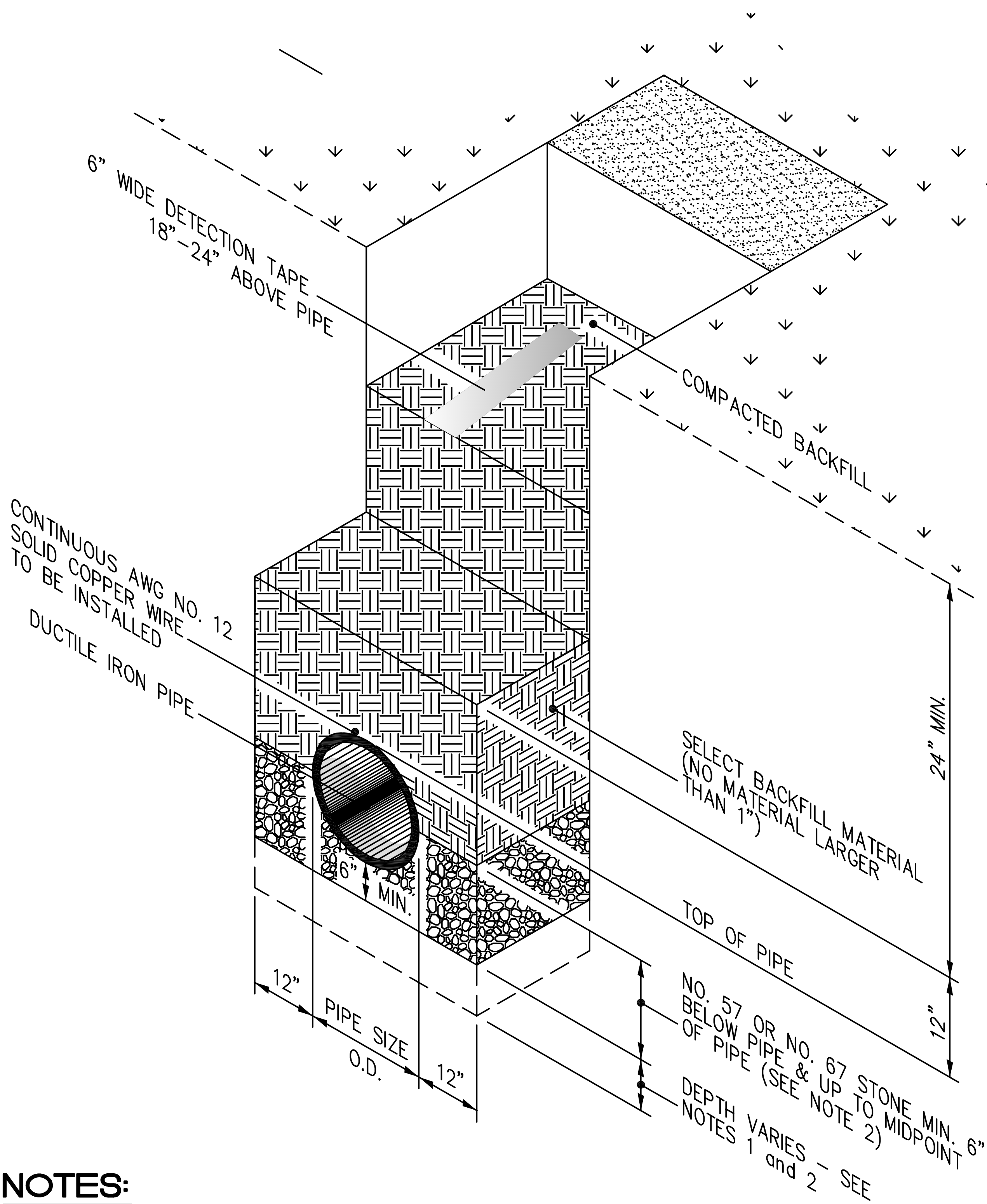
TYPICAL DETAIL for BORE UNDER PAVED ROADS / HIGHWAYS

SCALE: Not To Scale	DETAIL # 2517.01
REVISION DATE: Jan 1, 2025	SHEET #: 2 of 2



NOTES:

1. Foundation stone shall be required when soil conditions are unsuitable.
2. An additional 1 inch depth of cushioning material will be required for each additional 2 feet of trench depth in excess of 16 feet up to a maximum of 12 inches of cushioning material.

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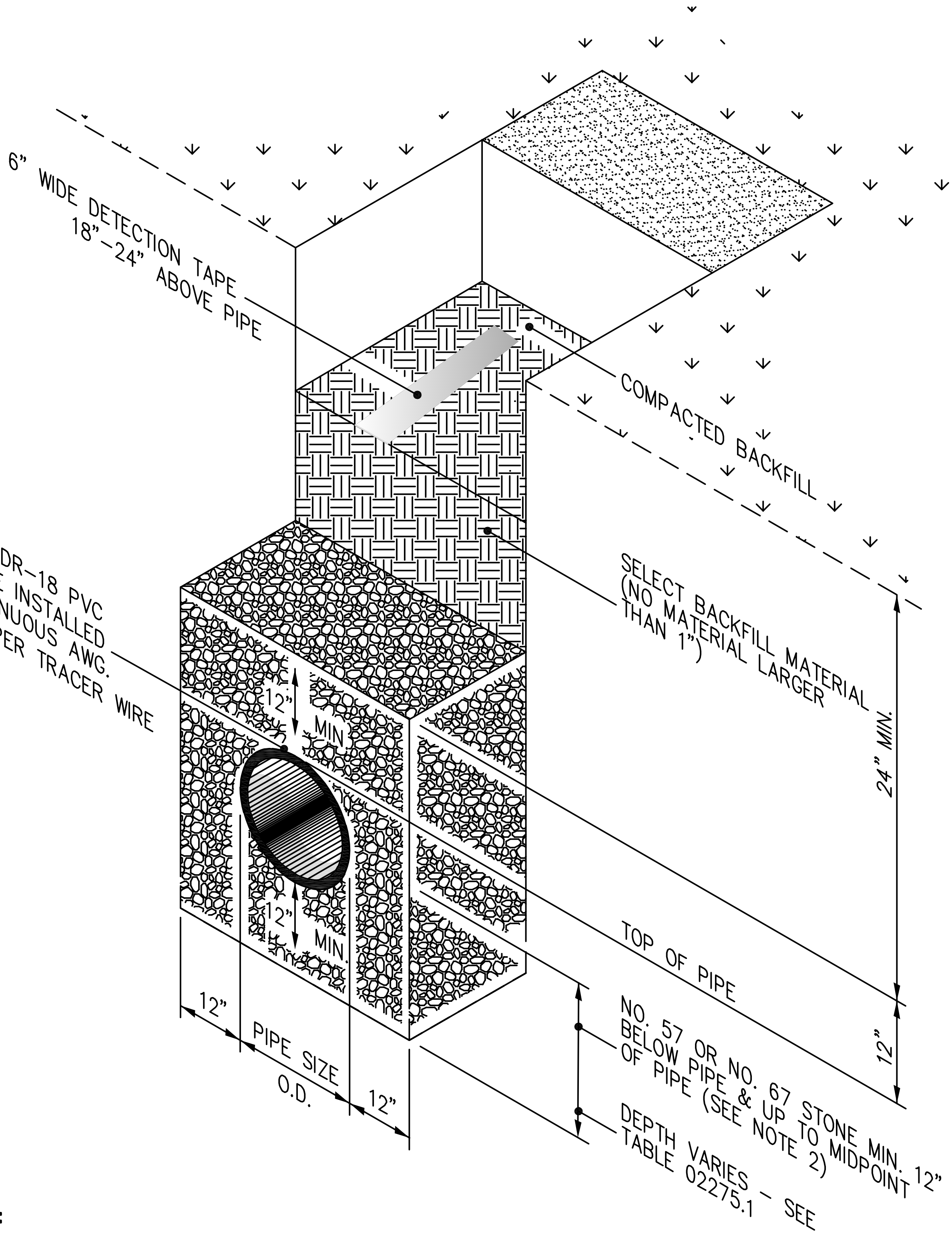
DUCTILE IRON SANITARY SEWER BEDDING DETAIL

SCALE:	DETAIL #
Not To Scale	2531.01
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 2



NOTES:

1. Foundation stone shall be required for all soil types.
2. An additional 1 inch depth of cushioning material will be required for each additional 2 feet of trench depth in excess of 16 feet up to a maximum of 12 inches of cushioning material.
3. 3 feet minimum cover.

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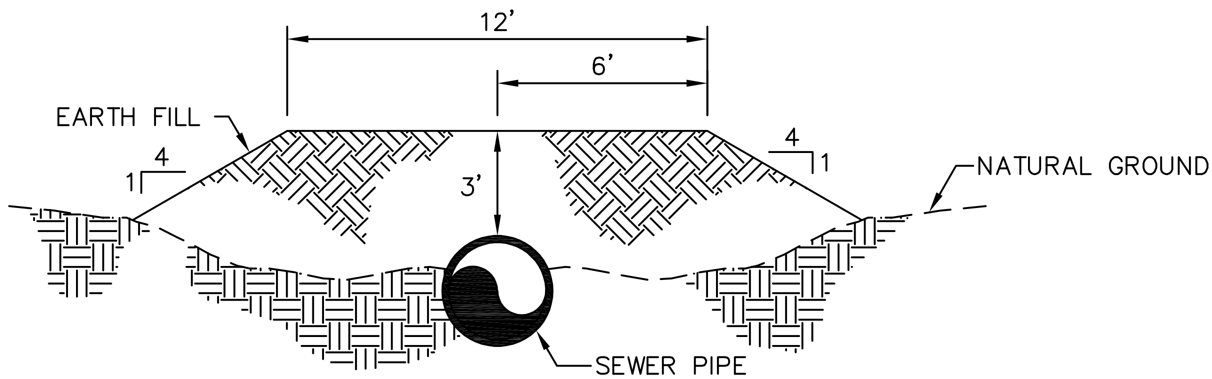
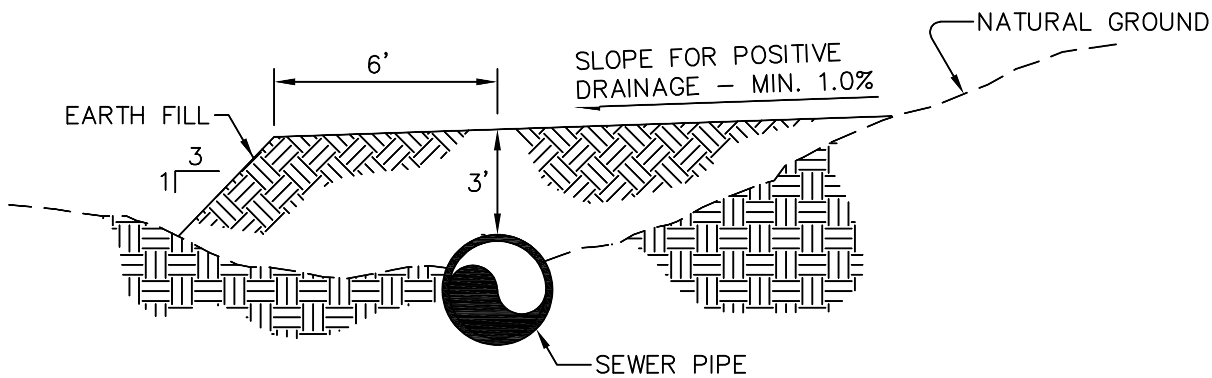
PVC SANITARY SEWER BEDDING DETAIL

SCALE: Not To Scale	DETAIL # 2531.01
REVISION DATE: Jan 1, 2025	SHEET #: 2 of 2





NOTES:

1. Sewer pipe to be bedded and backfilled in accordance with detail 531.01 and specification Section 02530, Part 3, Execution.
2. 4" top soil to be placed over earthfill and seeded in accordance with standard specifications.
3. Ground is to be graded for proper drainage.
4. For maximum and minimum cover see TABLE 02275.1

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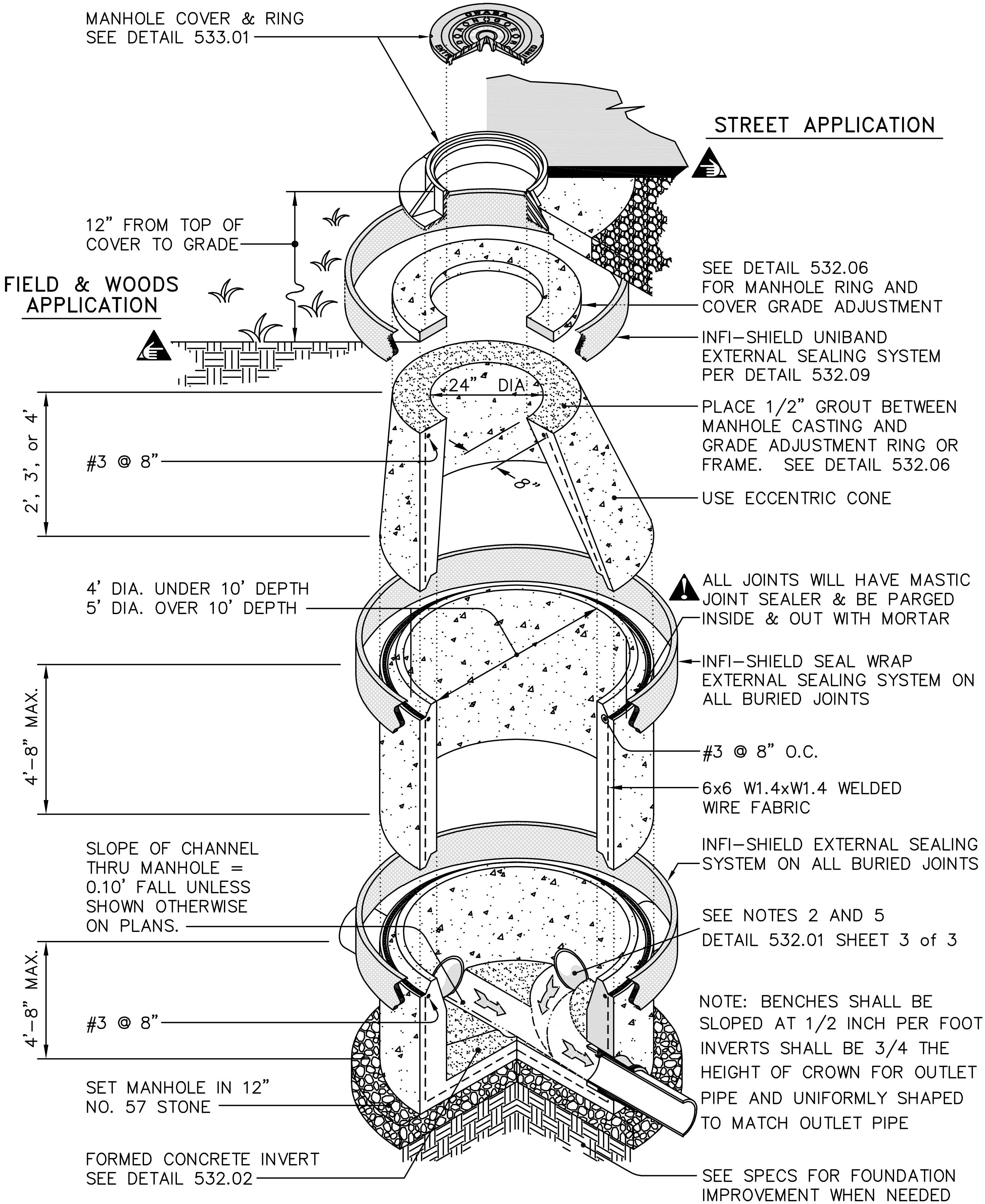
EARTH FILL OVER SEWER PIPE DETAIL

SCALE:	DETAIL #
Not To Scale	2 531.02
REVISION DATE:	SHEET #:
Jan 1, 2025	1 of 1



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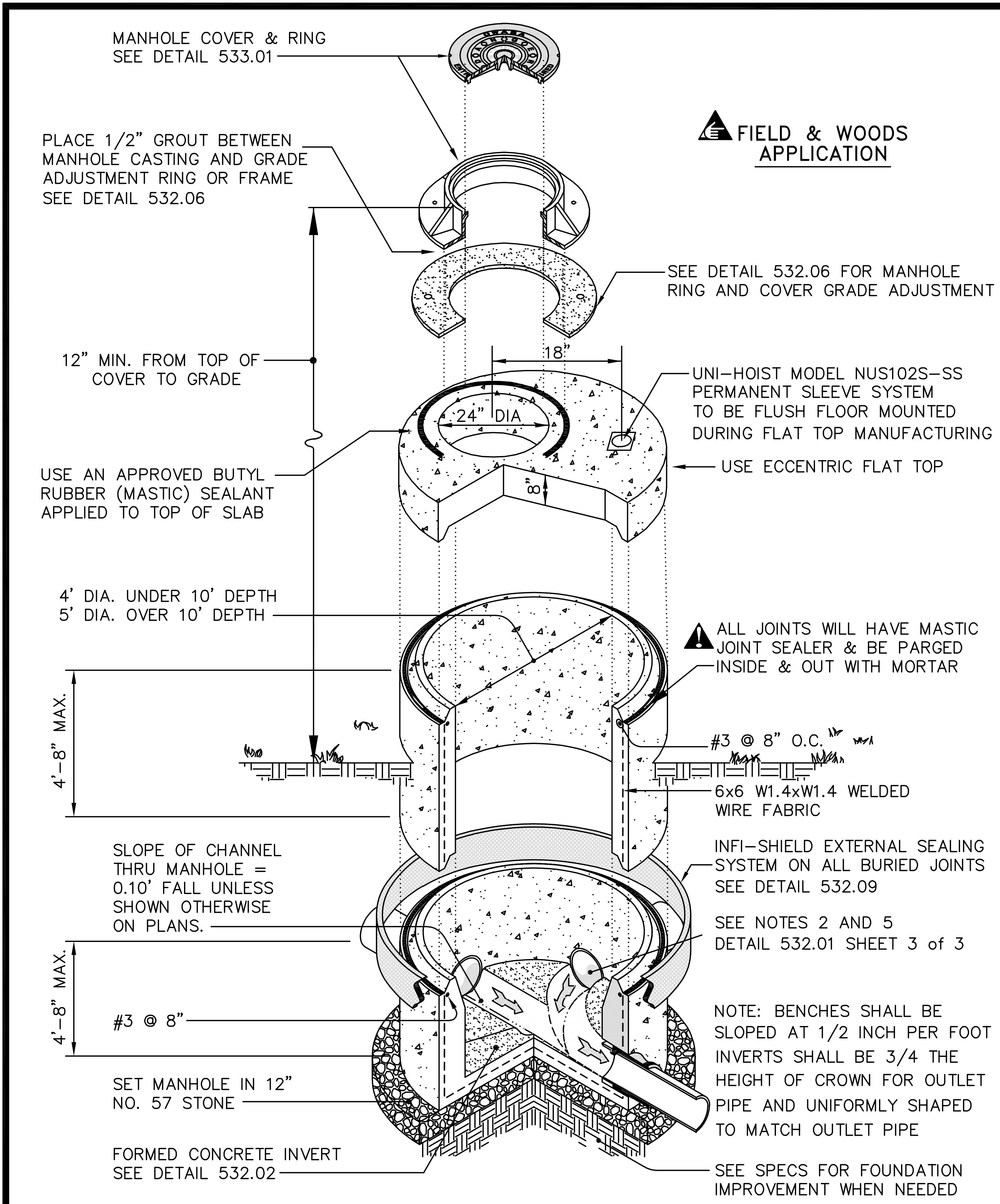
STANDARD ECCENTRIC CONE MANHOLE DETAIL

SCALE:	DETAIL #
Not To Scale	2 532.01
REVISION DATE:	SHEET #:
Jan 1, 2025	1 of 3



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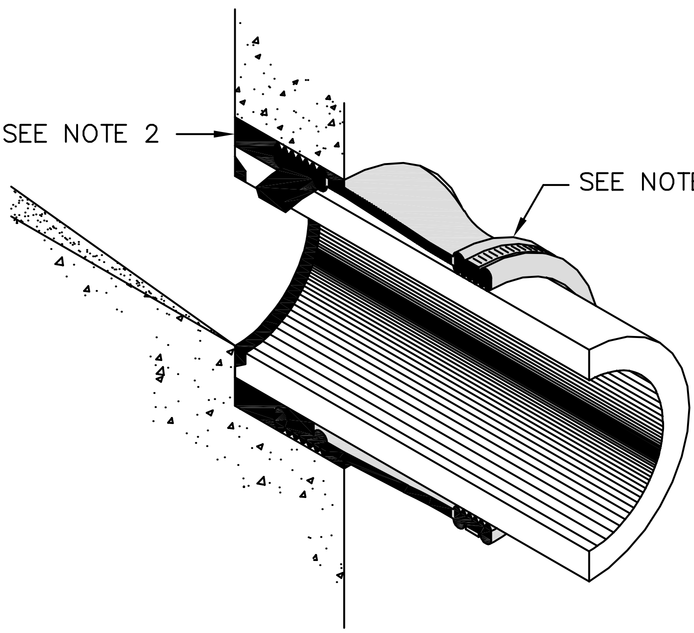
STANDARD ECCENTRIC FLAT TOP MANHOLE DETAIL

SCALE: Not To Scale	DETAIL # 2 532.01
REVISION DATE: Jan 1, 2025	SHEET #: 2 of 3

PART	MANUFACTURER MODEL / Cat. No.
SLEEVE BOOTS	KOR-N-SEAL or PSX



NOTES:

1. Concrete strength to be 4,000 PSI minimum.
2. Pipes will be grouted inside and out.
3. Joints will have mastic joint sealer and be parged inside and out with mortar.
4. Reinforcement design to conform to the requirements of ASTM C478.
5. Flexible sleeve boots cast in place or installed with stainless steel expander rings as manufactured by Kor-N-Seal or PSX shall be used for pipe connections. Boots shall be secured to pipe using (2) stainless steel bands. Precast inverts will not be accepted, unless otherwise directed by OWASA's inspectors.

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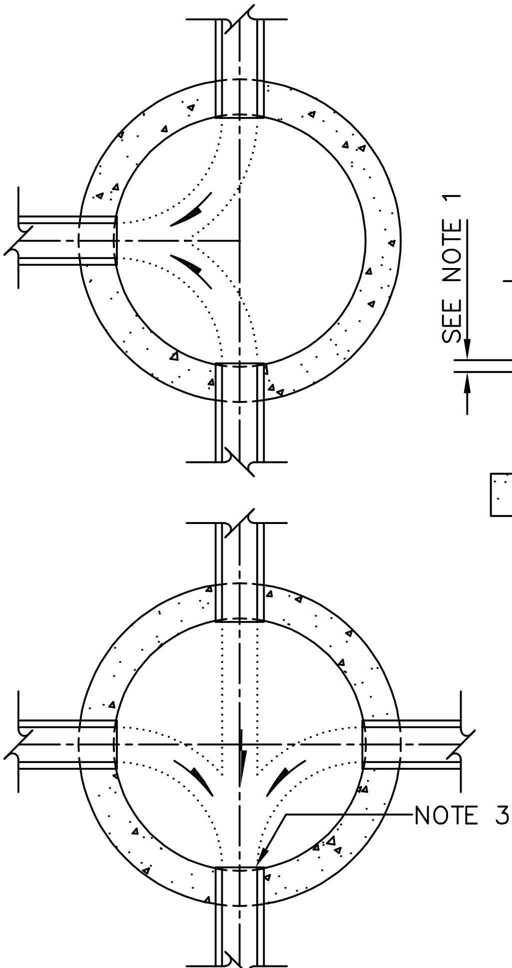
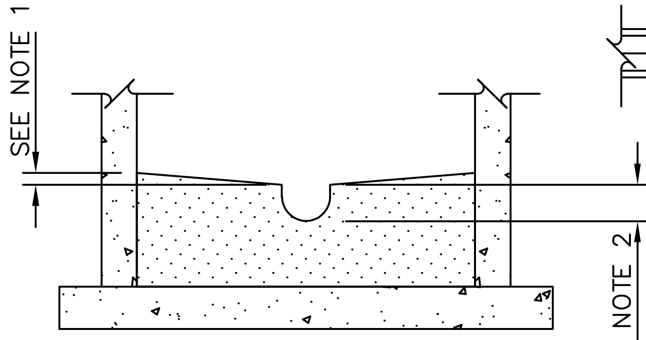
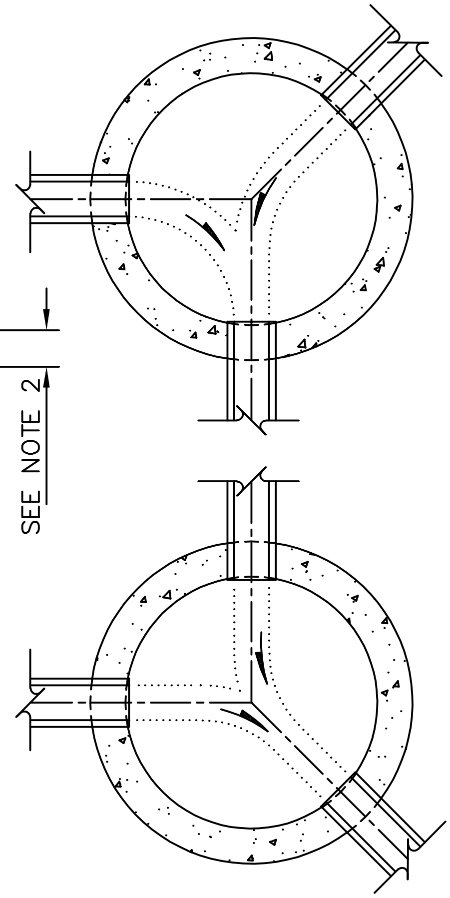
STANDARD ECCENTRIC MANHOLE DETAIL

SCALE:	DETAIL #
Not To Scale	2532.01
REVISION DATE: Jan 1, 2025	SHEET #: 3 of 3



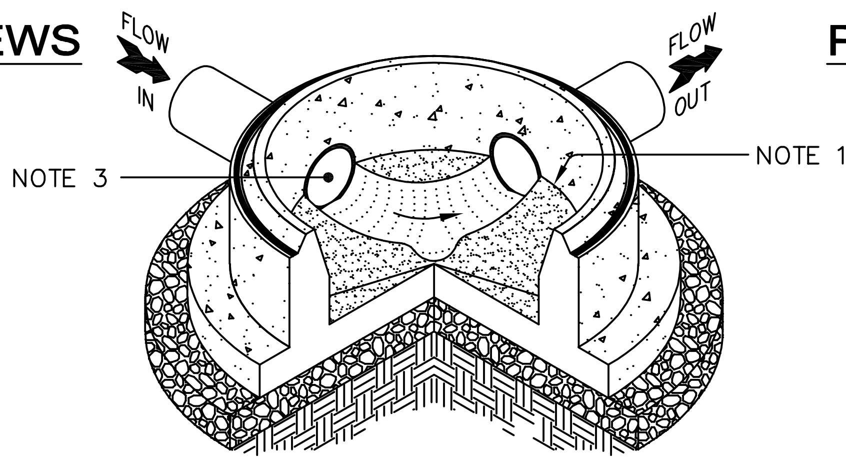


ELEVATION VIEW



PLAN VIEWS

PLAN VIEWS



ISOMETRIC VIEW

NOTES:

1. Benches shall be sloped at 1/2 inch per foot (4%).
2. Inverts shall be 3/4 the height of crown for outlet pipe and uniformly shaped to match outlet pipe.
3. Inverts can be shaped onsite or be preformed in a monolithic pour. No field adjustments or shaping is allowed for performed inverts.
4. Radius of invert must have enough room to be able to insert air plugs and TV equipment.
5. Service line entries to have cast in place troughs.

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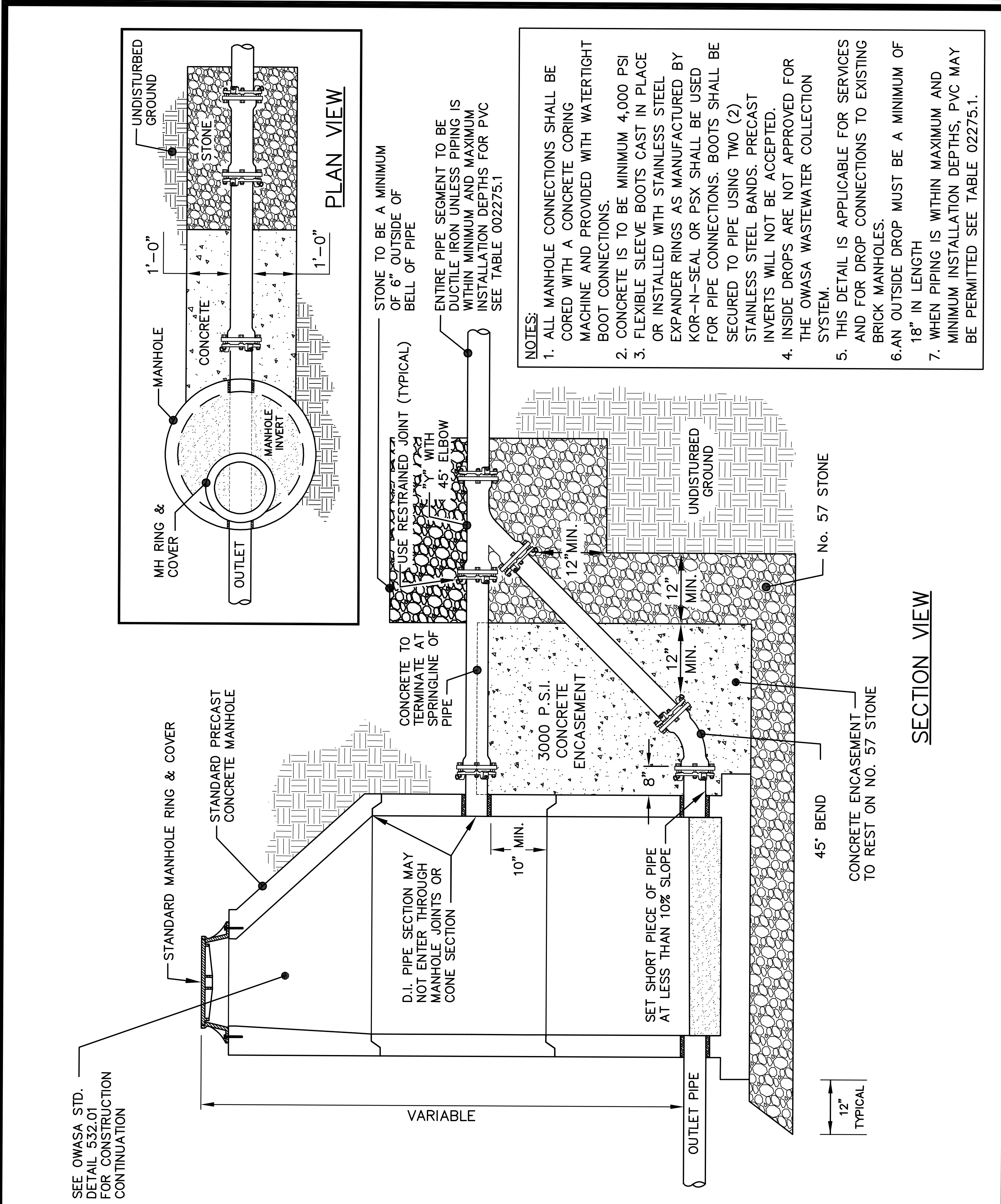
STANDARD SEWER INVERT PLANS FOR MANHOLE

SCALE:	DETAIL #
Not To Scale	2532.02
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 1



NOTES:
1. ALL MANHOLE CONNECTIONS SHALL BE CORED WITH A CONCRETE CORING MACHINE AND PROVIDED WITH WATERTIGHT BOOT CONNECTIONS.
2. CONCRETE IS TO BE MINIMUM 4,000 PSI
3. FLEXIBLE SLEEVE BOOTS CAST IN PLACE OR INSTALLED WITH STAINLESS STEEL EXPANDER RINGS AS MANUFACTURED BY KOR-N-SEAL OR PSX SHALL BE USED FOR PIPE CONNECTIONS. BOOTS SHALL BE SECURED TO PIPE USING TWO (2) STAINLESS STEEL BANDS. PRECAST INVERTS WILL NOT BE ACCEPTED.
4. INSIDE DROPS ARE NOT APPROVED FOR THE OWASA WASTEWATER COLLECTION SYSTEM.
5. THIS DETAIL IS APPLICABLE FOR SERVICES AND FOR DROP CONNECTIONS TO EXISTING BRICK MANHOLES.
6. AN OUTSIDE DROP MUST BE A MINIMUM OF 18" IN LENGTH
7. WHEN PIPING IS WITHIN MAXIMUM AND MINIMUM INSTALLATION DEPTHS, PVC MAY BE PERMITTED SEE TABLE 02275.1.

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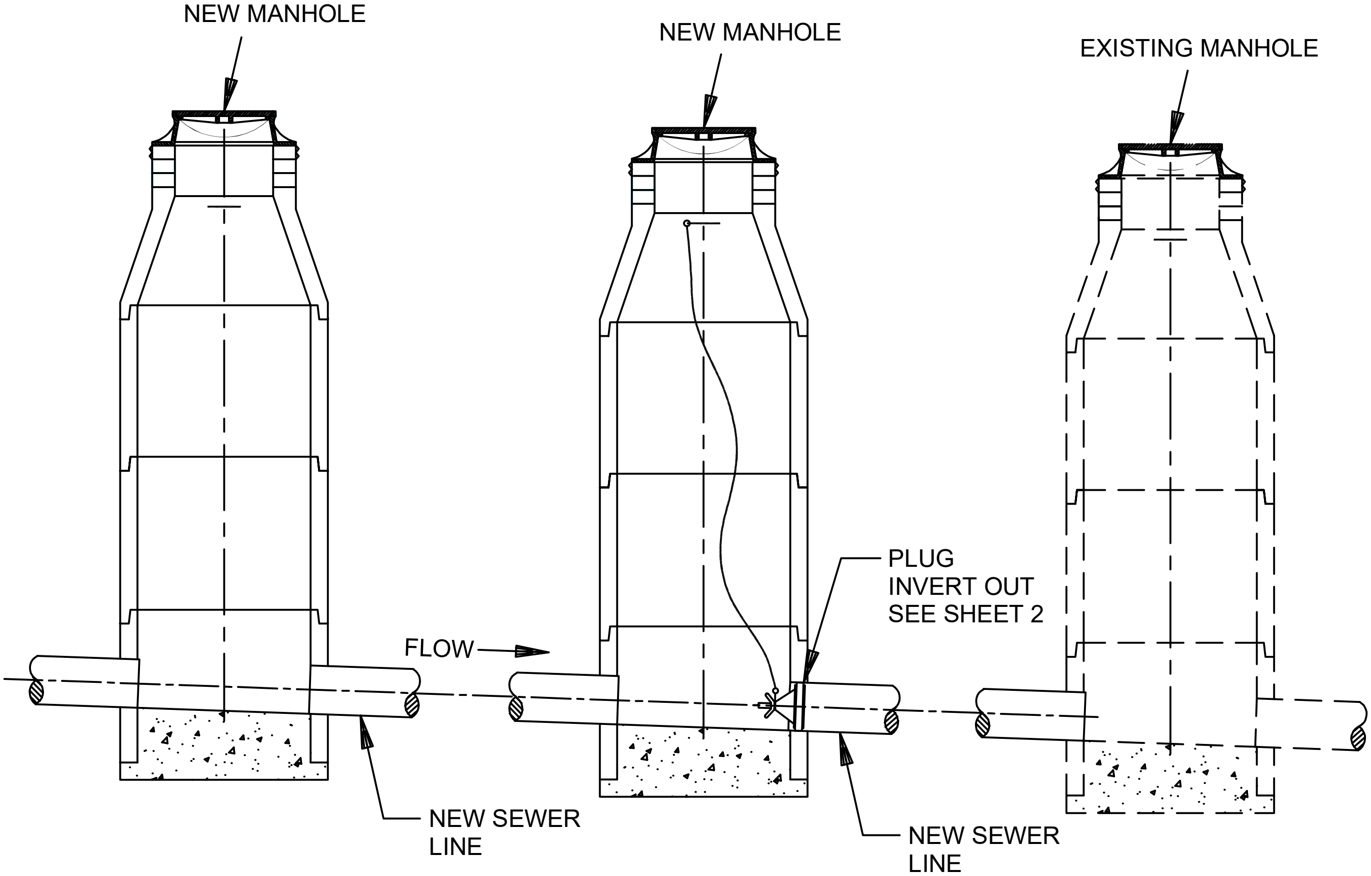
STANDARD OUTSIDE DROP MANHOLE DETAIL

SCALE: Not To Scale	DETAIL # 2 532.03
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 1



NOTES:

1. PRIOR TO OWASA ACCEPTANCE, ALL NEW SEWER LINES SHALL BE ISOLATED FROM EXISTING PARTS OF THE SYSTEM BY MEANS OF A MECHANICAL PLUG. SEE SHEET 2 FOR PLUGGING DETAILS.

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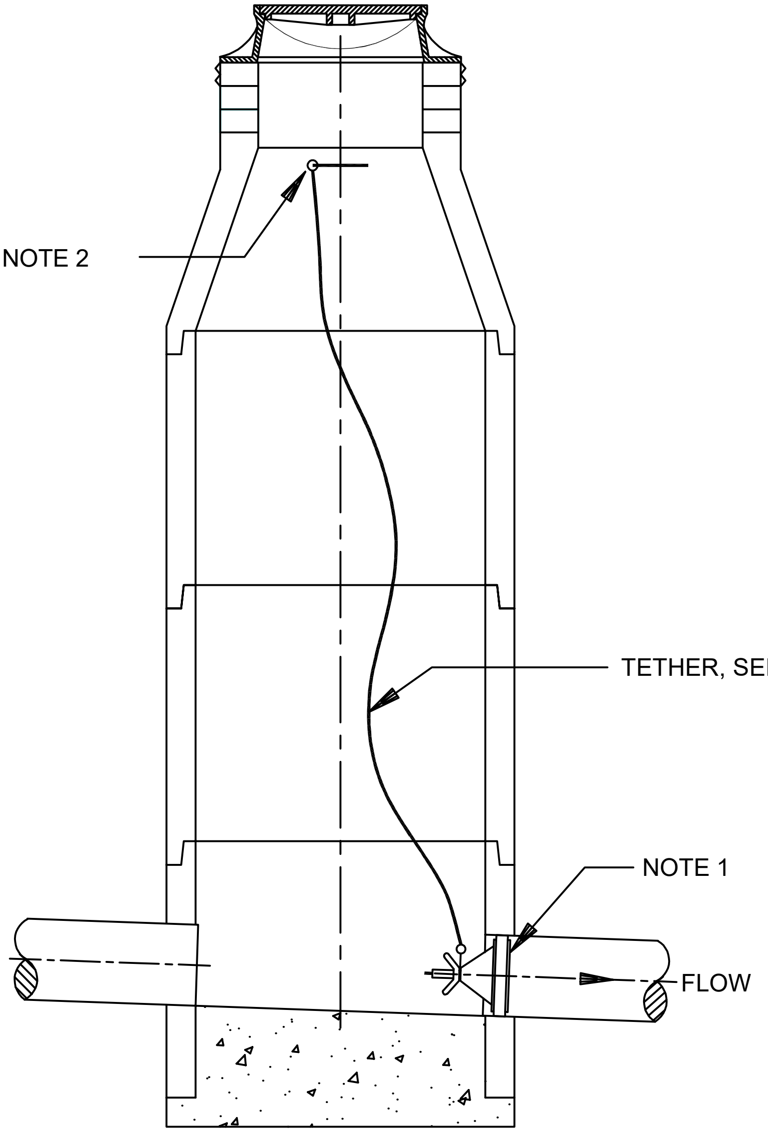
SANITARY SEWER MANHOLE PLUGGING DETAIL

SCALE: Not To Scale	DETAIL # 2532.04
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 2



NOTES:

1. PIPE PLUG SHALL BE A "CHERNE" IRON-GRIP BY-PASS STYLE MECHANICAL PLUG OR APPROVED EQUAL.

2. PIPE PLUG SHALL BE TETHERED TO THE MANHOLE TOP STEP OR OTHER PERMANENT ANCHOR POINT WITH A CORROSION AND ABRASION RESISTANT STAINLESS STEEL CABLE. ATTACHED TO THE CABLE SHALL BE A CORROSION RESISTANT METAL TAG WITH THE PLUG OWNERS NAME, ADDRESS AND 24-HOUR CONTACT INFORMATION.

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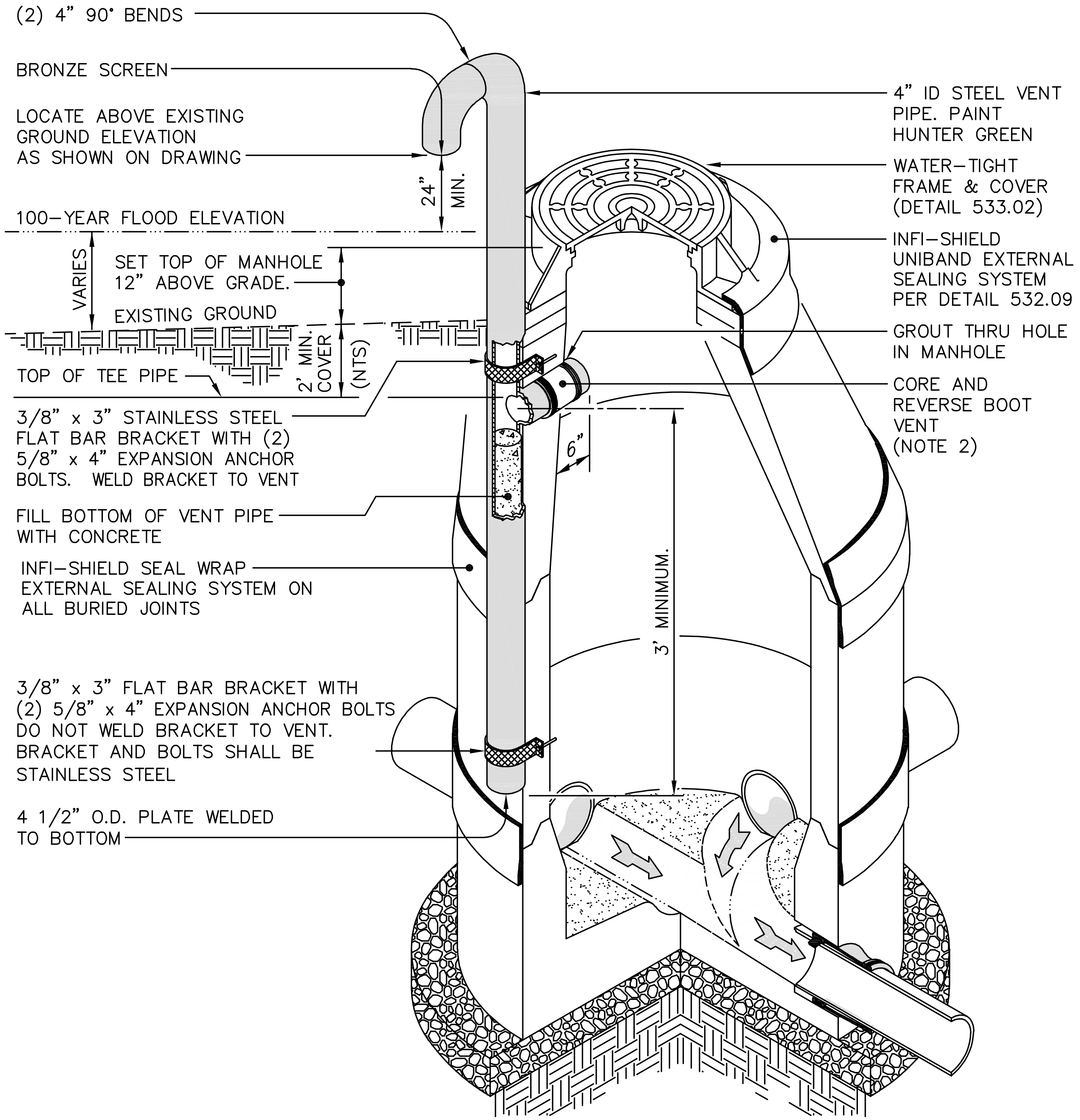
SANITARY SEWER MANHOLE PLUGGING DETAIL

SCALE:	DETAIL #
Not To Scale	2532.04
REVISION DATE:	SHEET #:
Jan 1, 2025	2 of 2



NOTES:

1. Locate vent pipe as shown or as directed by OWASA.
2. Connect 4" steel vent pipe to manhole with flexible boot.

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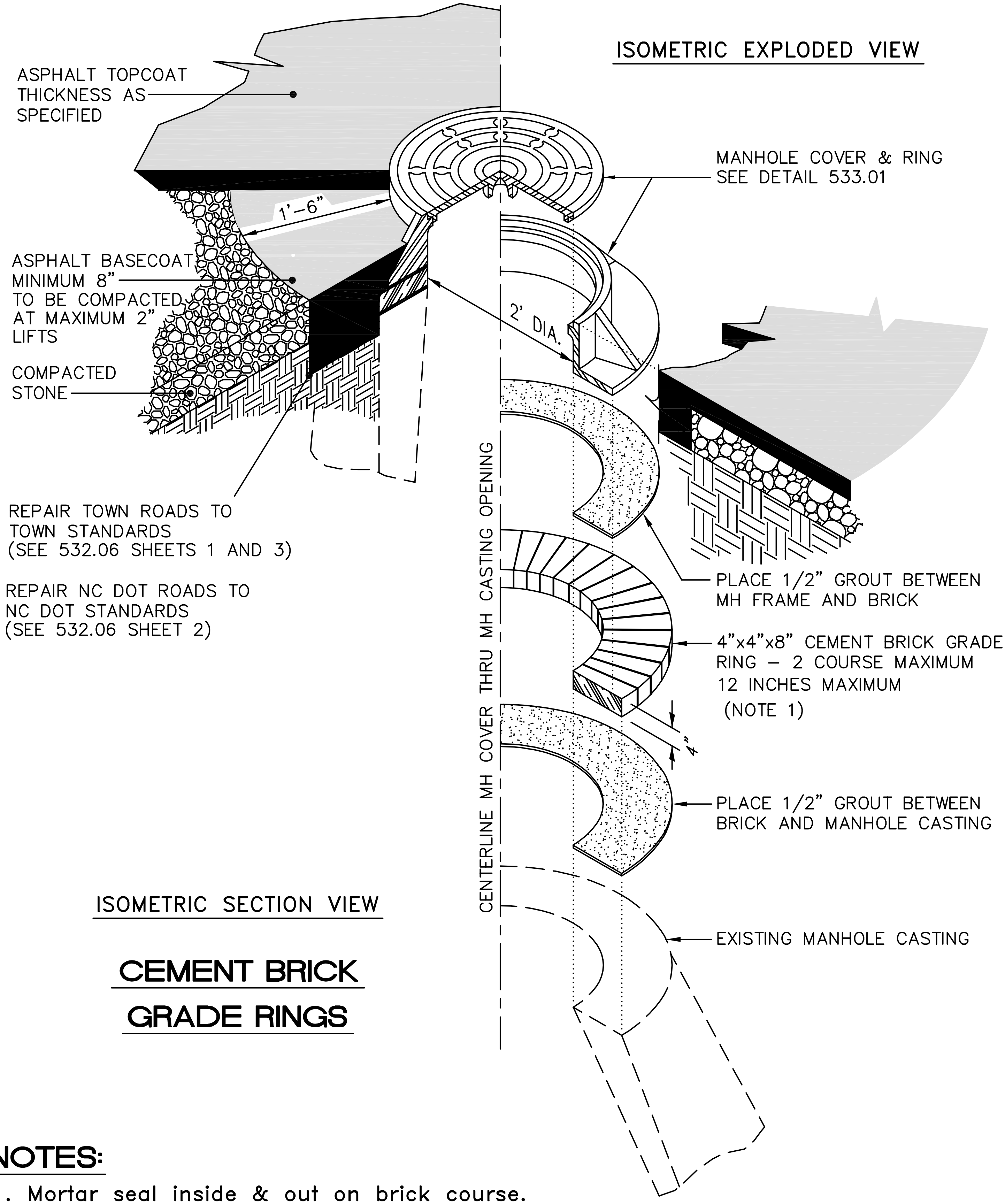
STANDARD MANHOLE VENTING DETAIL

SCALE: Not To Scale	DETAIL #: 532.05
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 1



CEMENT BRICK GRADE RINGS

NOTES:

1. Mortar seal inside & out on brick course.
2. Install Infi–Shield Uni–Band as manufactured by Sealing Systems, Inc. per detail 532.09.

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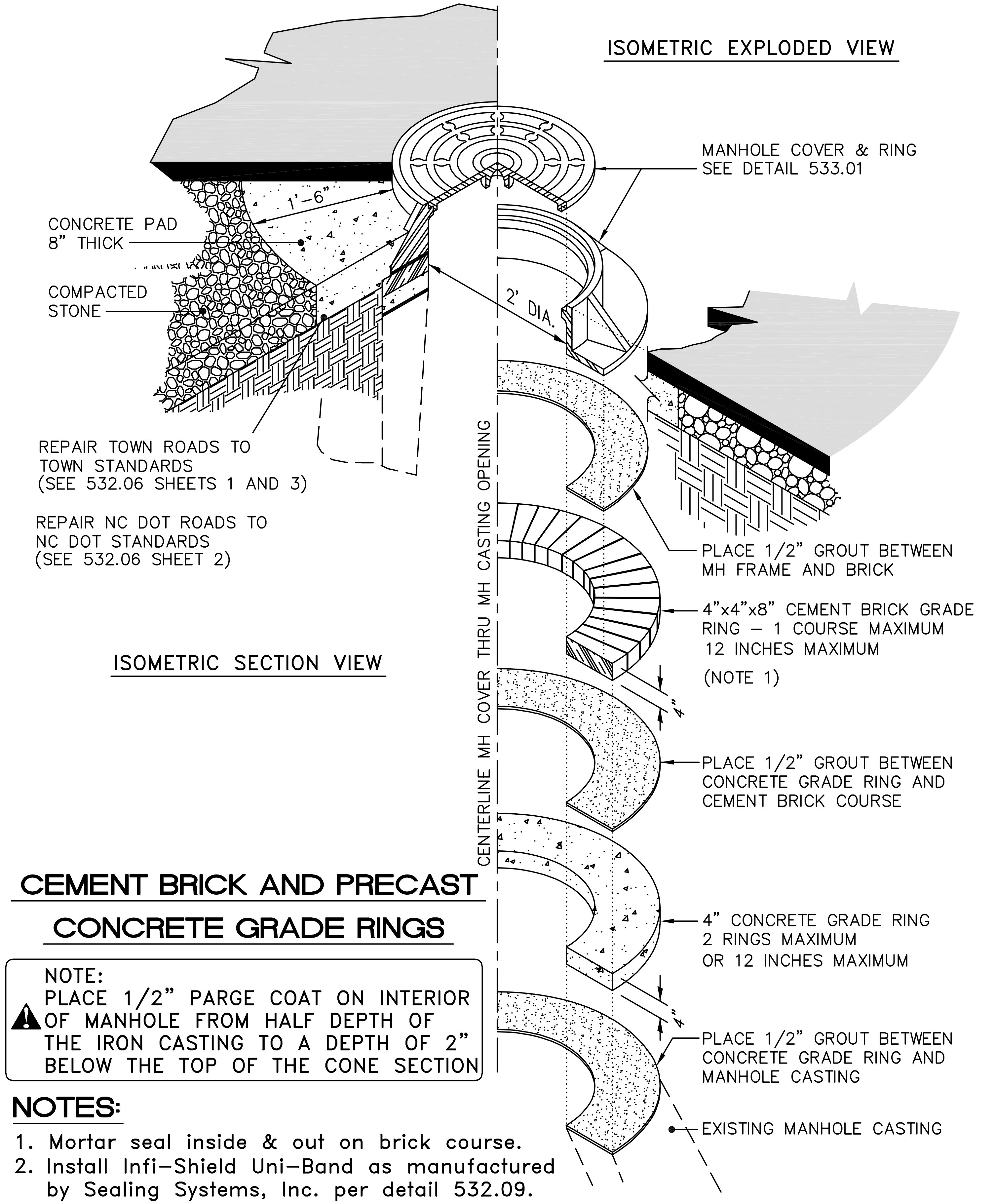
MANHOLE RING AND COVER GRADE ADJUSTMENT

SCALE: Not To Scale	DETAIL # 2 532.06
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 3



CEMENT BRICK AND PRECAST CONCRETE GRADE RINGS

NOTE:
PLACE 1/2" PARGE COAT ON INTERIOR OF MANHOLE FROM HALF DEPTH OF THE IRON CASTING TO A DEPTH OF 2" BELOW THE TOP OF THE CONE SECTION

NOTES:

1. Mortar seal inside & out on brick course.
2. Install Infi–Shield Uni–Band as manufactured by Sealing Systems, Inc. per detail 532.09.

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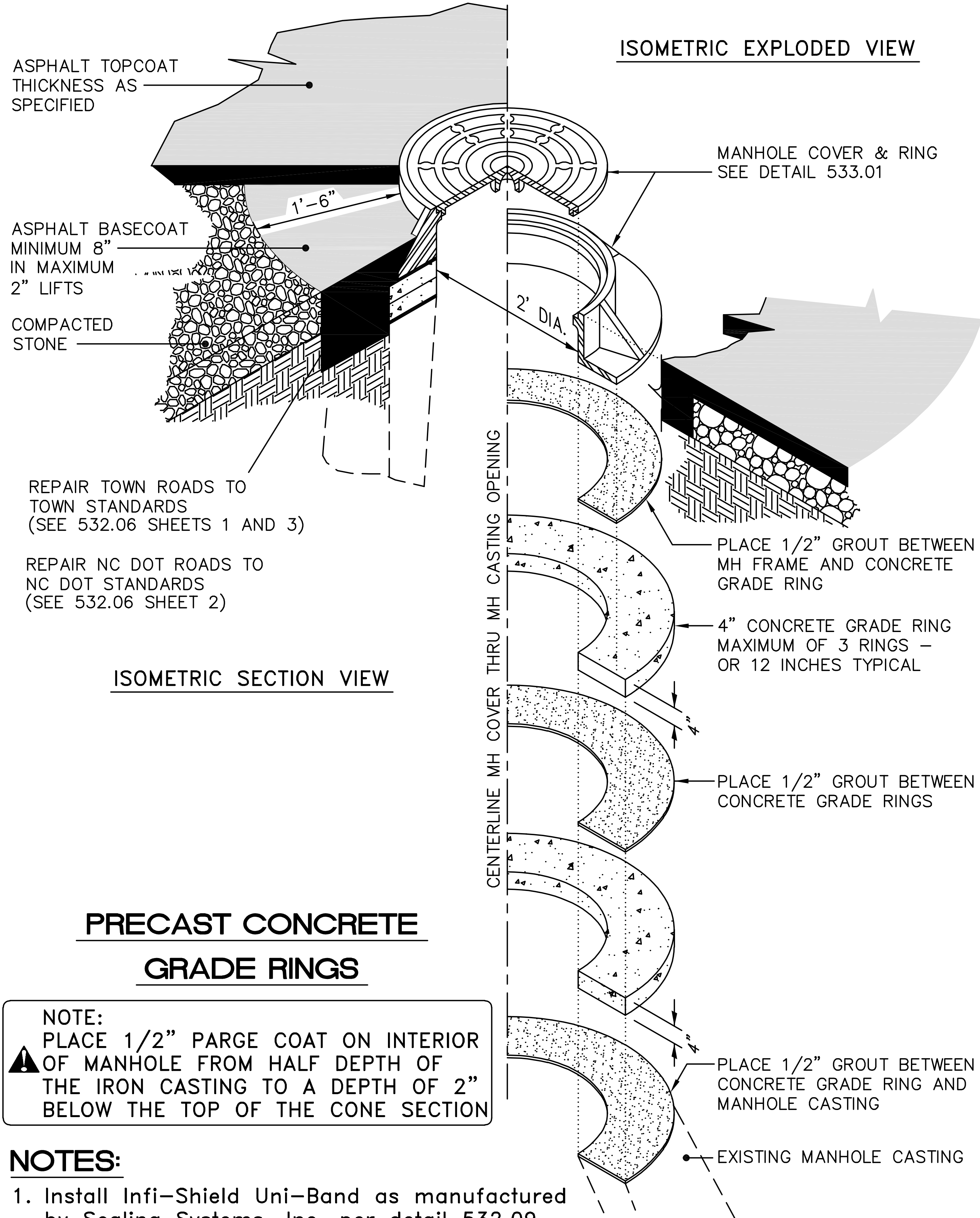
MANHOLE RING AND COVER GRADE ADJUSTMENT

SCALE: Not To Scale	DETAIL #: 2 532.06
REVISION DATE: Jan 1, 2025	SHEET #: 2 of 3



NOTE:
PLACE 1/2" PARGE COAT ON INTERIOR OF MANHOLE FROM HALF DEPTH OF THE IRON CASTING TO A DEPTH OF 2" BELOW THE TOP OF THE CONE SECTION

NOTES:

1. Install Infi–Shield Uni–Band as manufactured by Sealing Systems, Inc. per detail 532.09.

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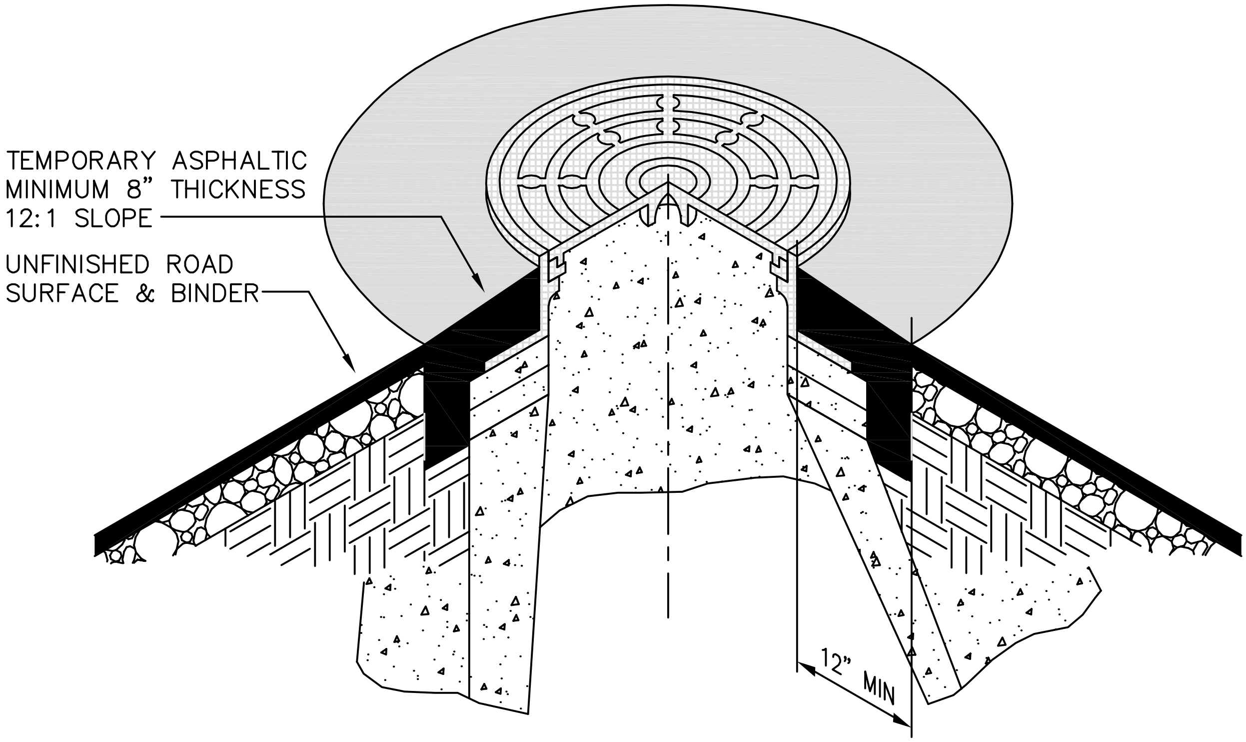
MANHOLE RING AND COVER GRADE ADJUSTMENT

SCALE: Not To Scale	DETAIL # 2 532.06
REVISION DATE: Jan 1, 2025	SHEET #: 3 of 3



NOTES:

1. When the rim & cover of a manhole or a valve box extends more than 1" above an unfinished road surface, a temporary layer of asphaltic concrete feathering shall be required to provide a smooth transition from 1" below the edge of the rim & cover to the unfinished road surface. A 12 to 1 slope ratio shall be used. The exposed sides of the valve box and/or manhole cover shall be painted bright orange or as specified by OWASA inspector.
2. Prior to final paving contractor shall remove feathering, completely, & apply asphalt tack coat to binder to insure proper asphalt adhesion.

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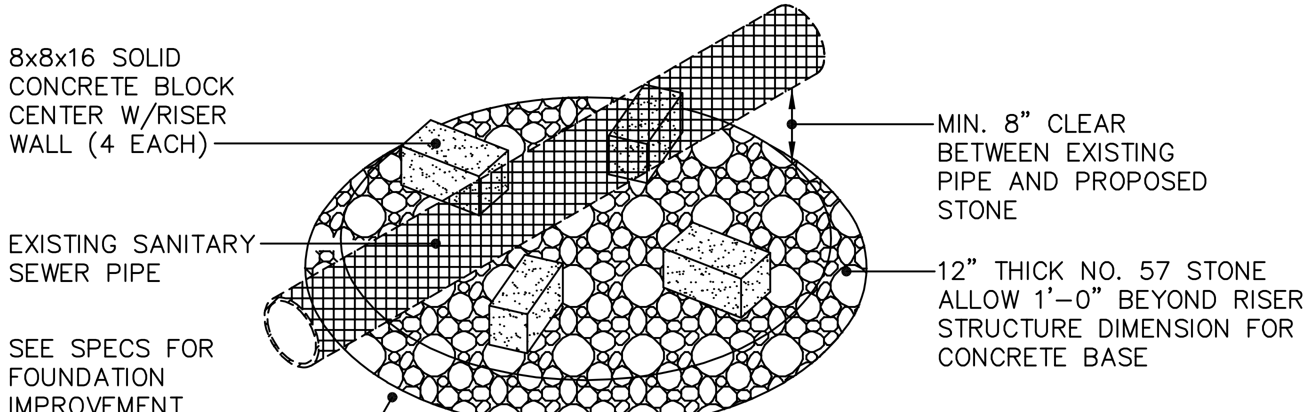
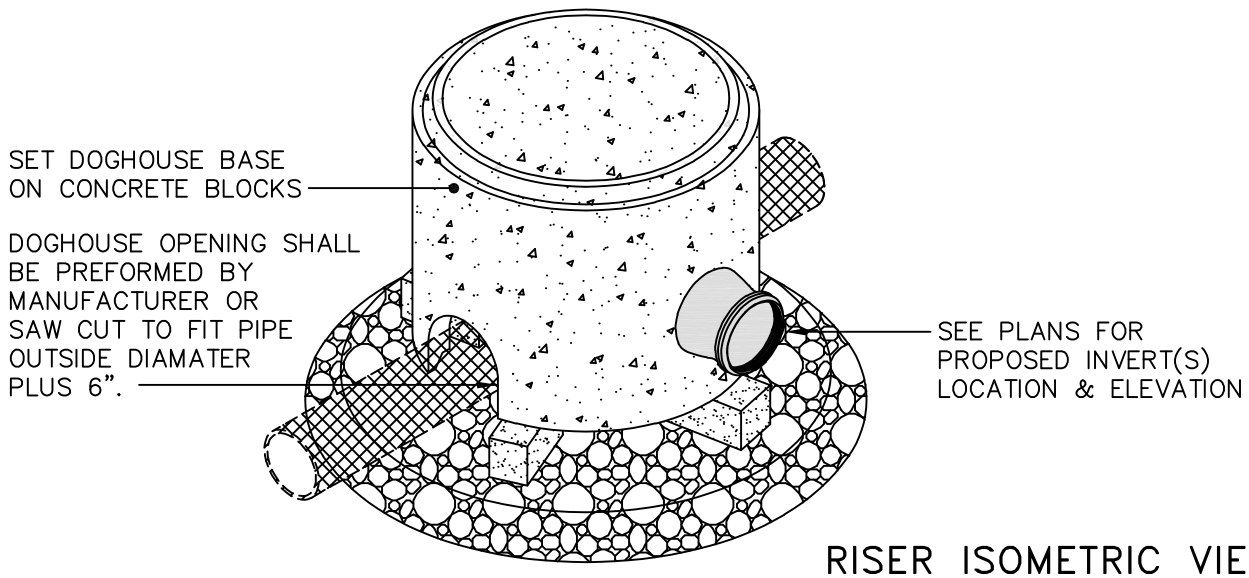
STRUCTURE PROTECTION UNFINISHED ROAD GRADE

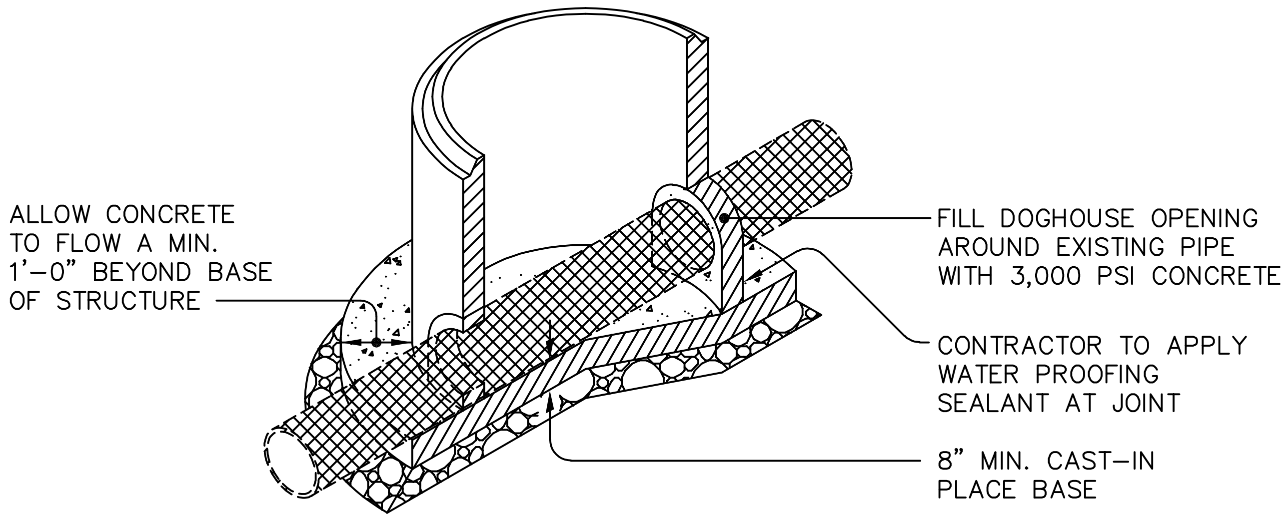
SCALE: Not To Scale	DETAIL # 2532.07
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 1



BASE ISOMETRIC VIEW



RISER ISOMETRIC VIEW



FOUNDATION SECTION VIEW

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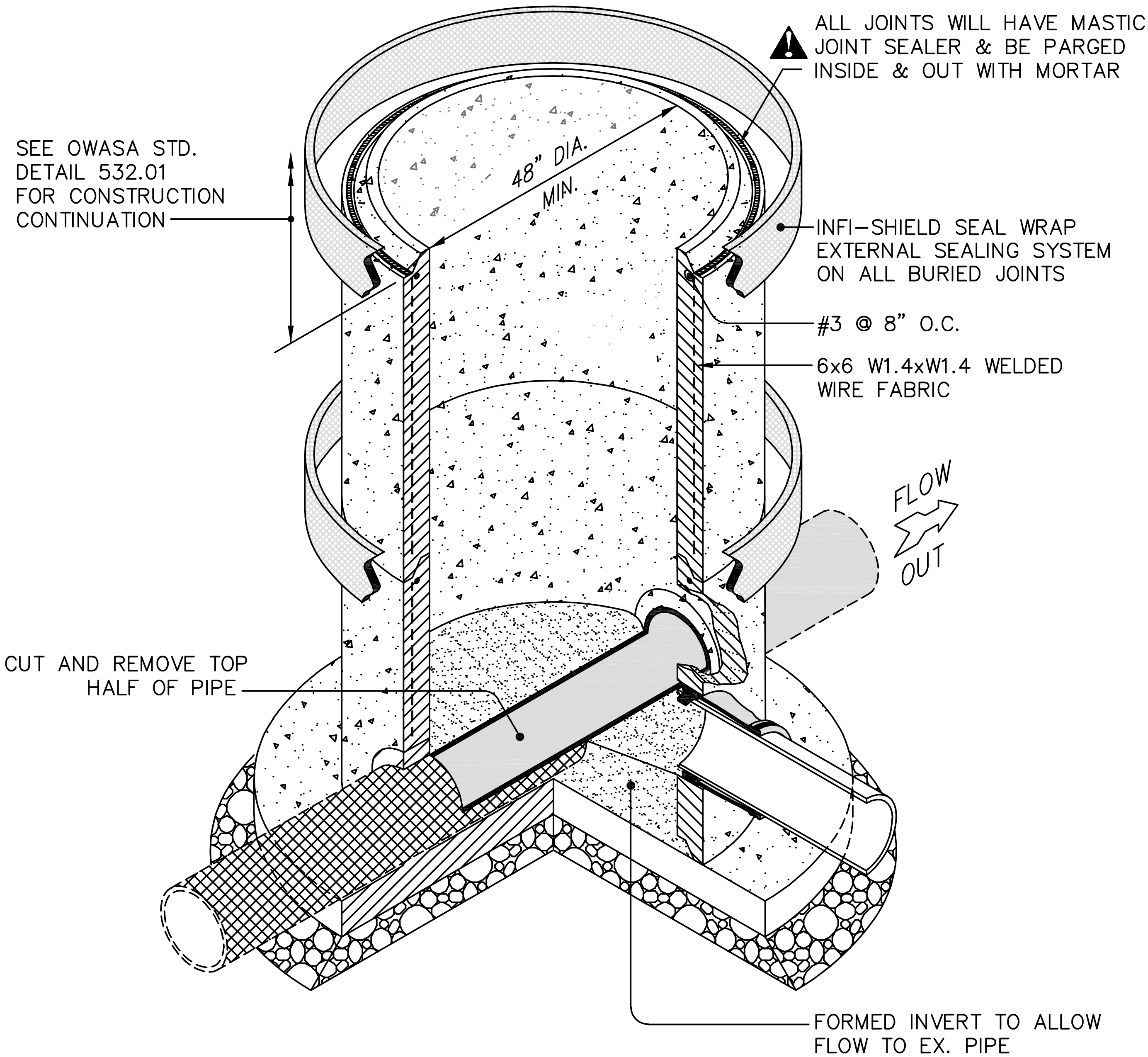
PRECAST CONCRETE DOGHOUSE MANHOLE

SCALE: Not To Scale	DETAIL # 2532.08
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 2



INVERT SECTION VIEW

NOTES:

1. All service laterals into manhole to be core drilled and booted.
2. Maximum depth 4' dia. manhole = 10' (see specifications). Use 5' dia. manhole for depth greater than 10'.
3. Shelf to be formed to an elevation 3/4 the height of the pipe.

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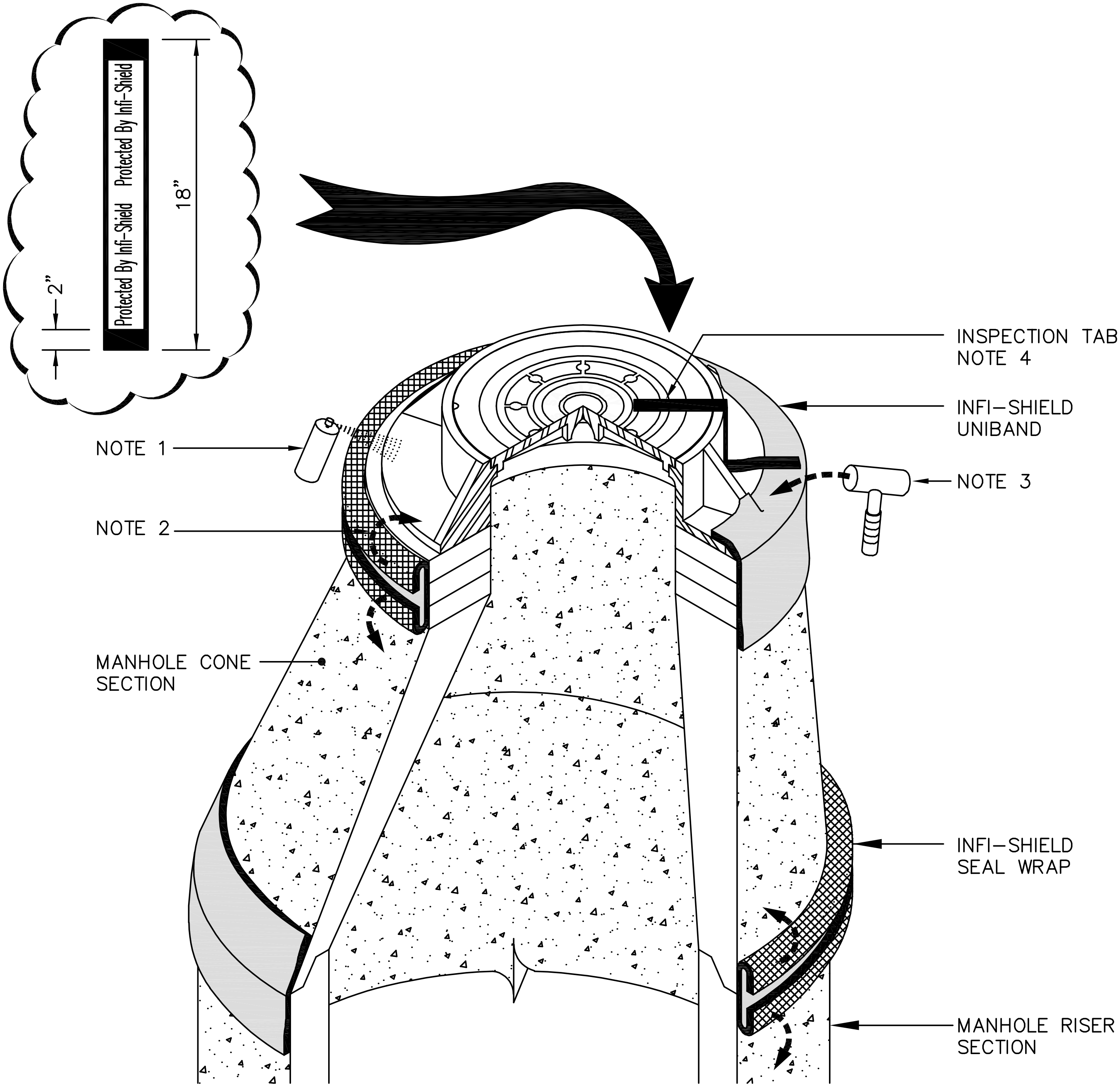
PRECAST CONCRETE DOGHOUSE MANHOLE

SCALE: Not To Scale	DETAIL # 2 532.08
REVISION DATE: Jan 1, 2025	SHEET #: 2 of 2



MANHOLE APPLICATION

INSTALLATION NOTES:

1. Clean casting frame, riser rings and cone section. Spray primer to areas where attaching non-hardening butyl mastic.
2 Install the Infi-shield External Seal on the outside surface of the adjustment ring area covering all grade rings. Remove protective tape and fold back on to the structure.
3. Useing a rubber hammer, tap the sealing surface area.
4. Ensure lid and casting is clean. Attach inspection tab to manhole lid and backfill.
5. Contact Sealing Systems Inc. for additional installation instructions @ 800-478-2054.

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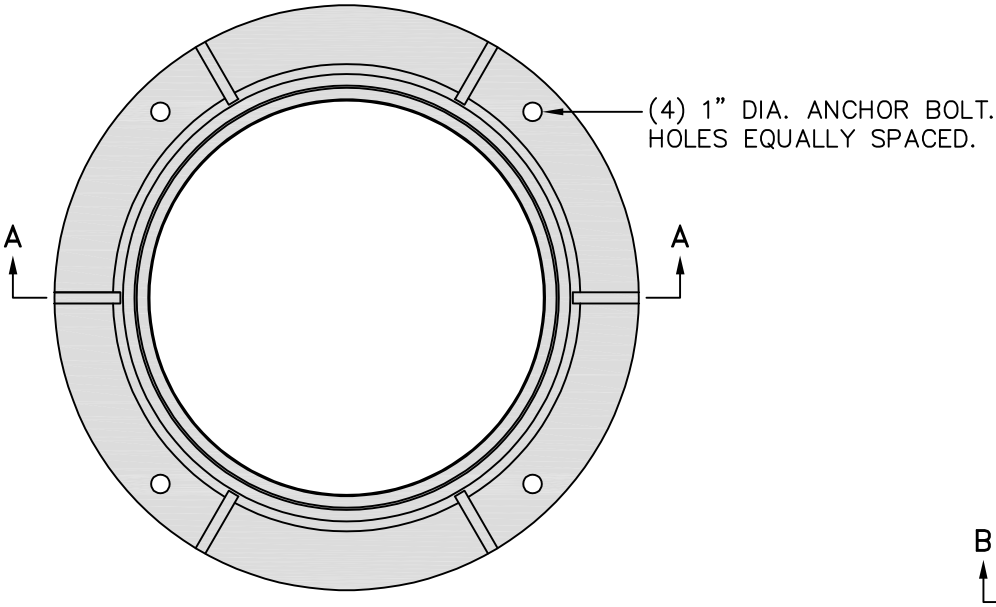
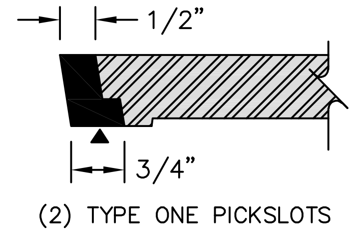
INFI-SHIELD EXTERNAL SEALING DETAIL

SCALE: Not To Scale	DETAIL # 2532.09
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 1

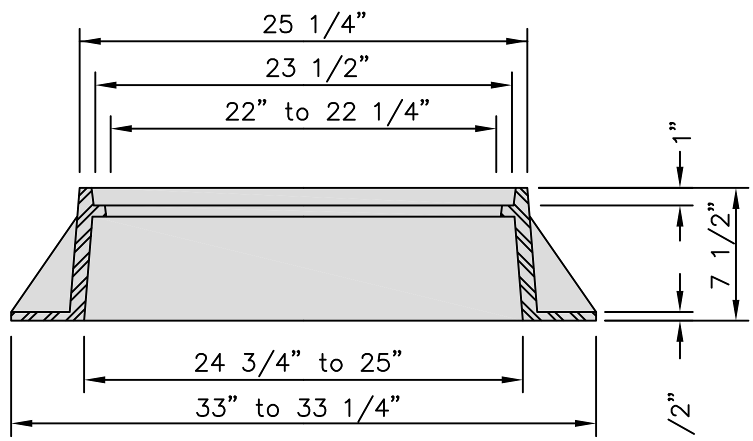


FRAME TOP

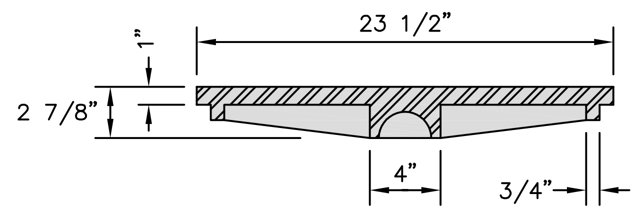


PICKHOLE DETAIL

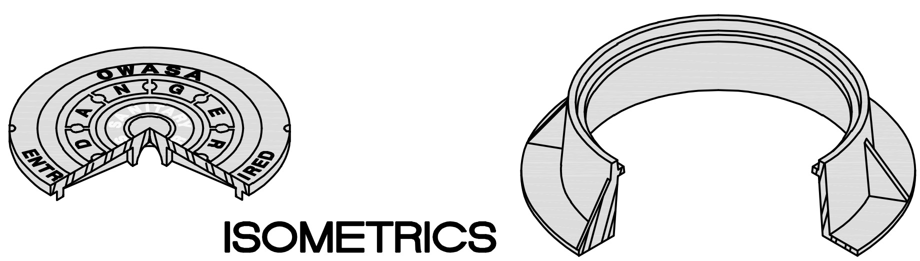
COVER FACE



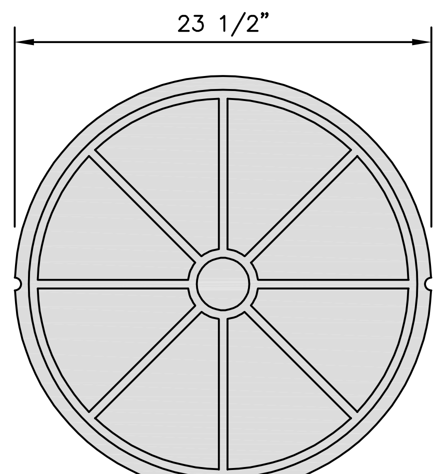
FRAME SECTION A-A



COVER SECTION B-B



ISOMETRICS



COVER BACK

APPROVED MODELS	EAST JORDAN IRON WORKS V–1384	US FOUNDRY USF–669	CAPITOL FOUNDRY MH–2001
COVER WEIGHT	135 Lbs.	125 Lbs.	120 Lbs.
FRAME WEIGHT	180 Lbs.	190 Lbs.	190 Lbs.
LOAD RATING	HEAVY DUTY	HEAVY DUTY	HEAVY DUTY
MATERIAL	ASTM A 48 CLASS 35B	ASTM A 48 CLASS 35B	ASTM A 48 CLASS 35B
FINISH	UNCOATED	UNCOATED	UNCOATED

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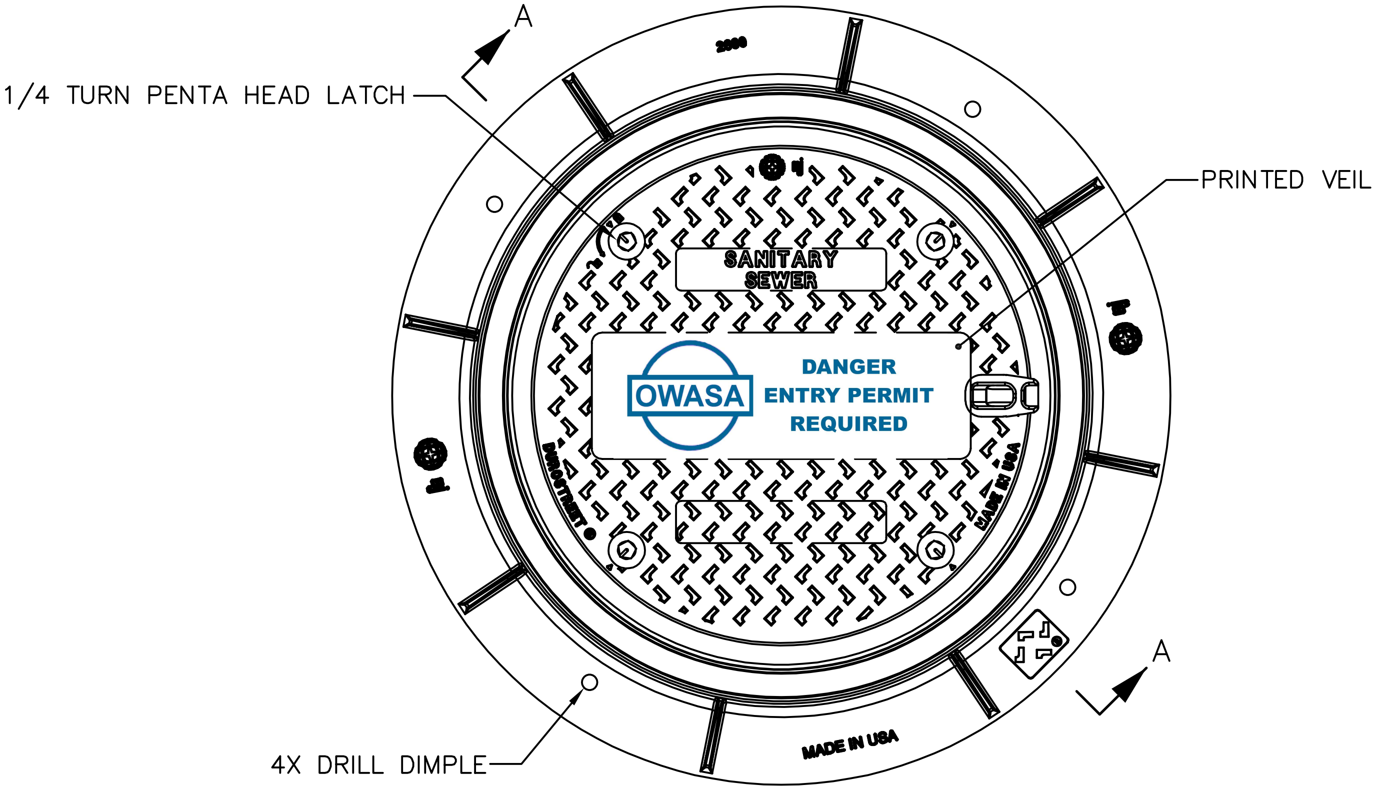
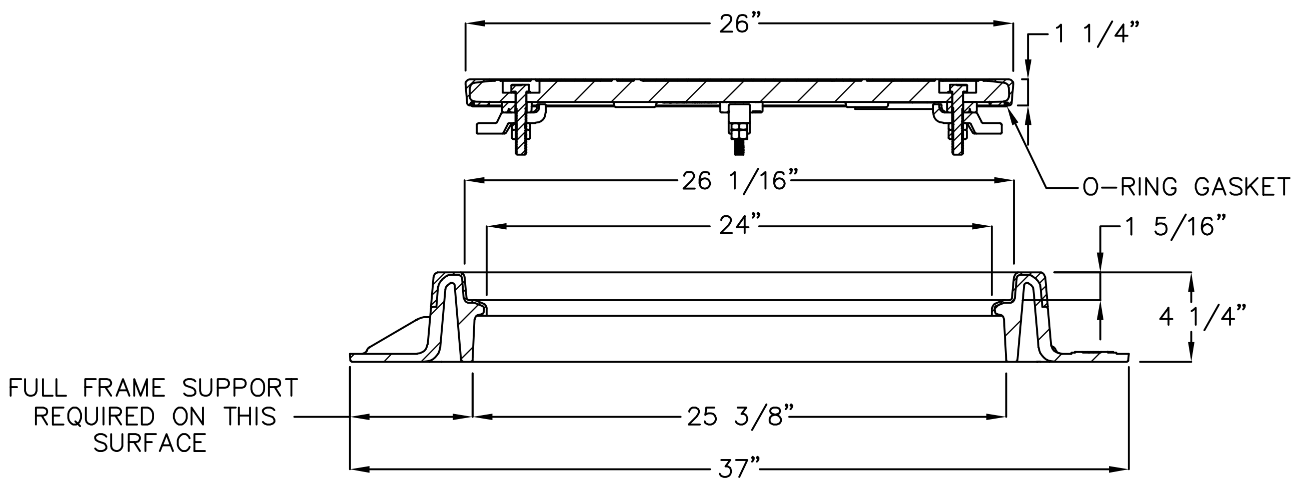
SANITARY SEWER MANHOLE FRAME and COVER

SCALE:	DETAIL #
Not To Scale	2533.01
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 2



COVER FACE AND FRAME



FACE AND FRAME SECTION A-A

APPROVED MODELS	EJ DUROASSEMBLY COM260379A01
LOAD RATING	H25 50,000 lb
COMPONENTS	COM260210 COM260379
MATERIAL	COMPOSITE

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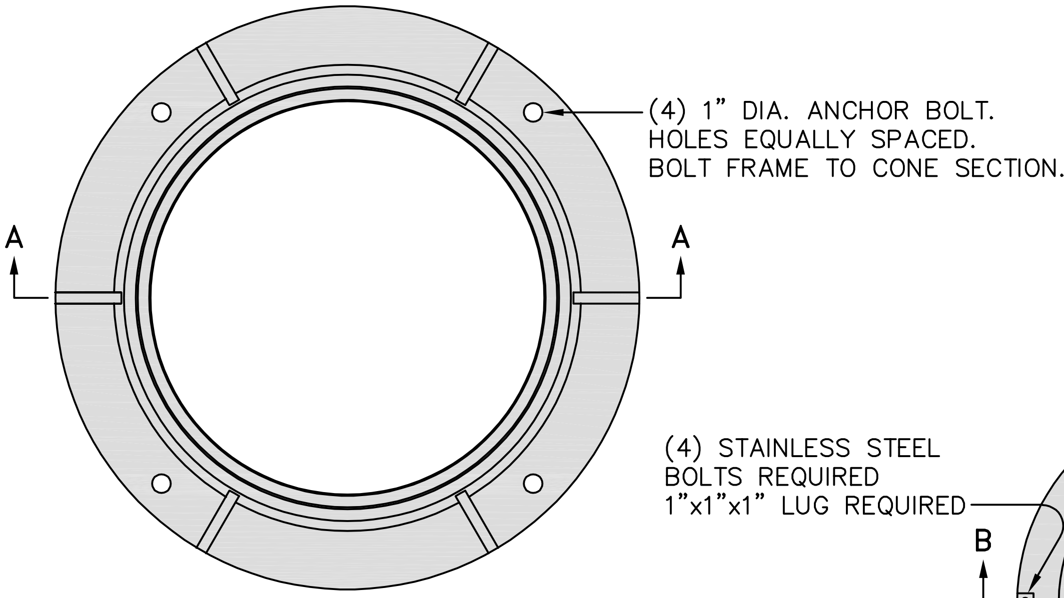
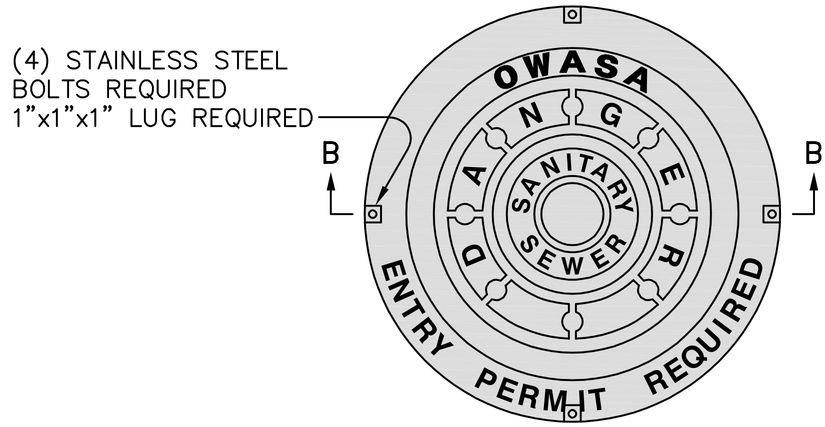
SANITARY SEWER COMPOSITE MANHOLE FRAME and COVER

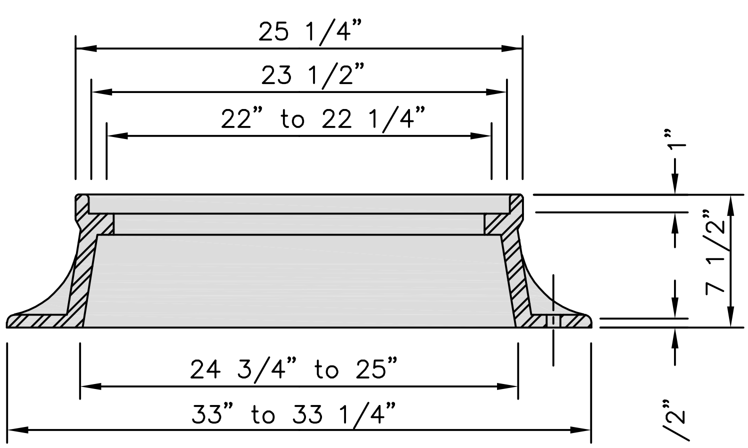
SCALE: Not To Scale	DETAIL # 2533.01
REVISION DATE: Jan 1, 2025	SHEET #: 2 of 2



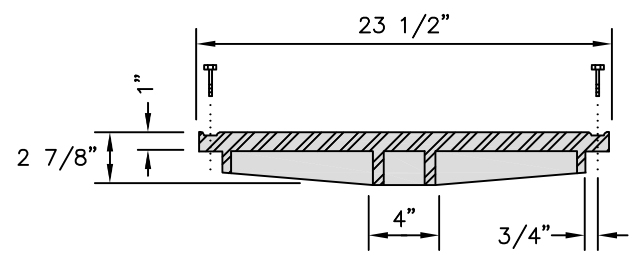
FRAME TOP



COVER FACE

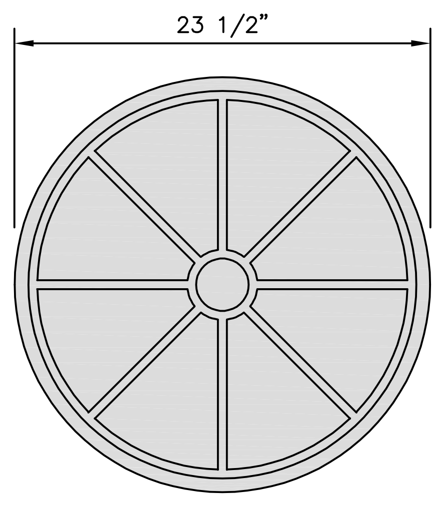


FRAME SECTION A-A



COVER SECTION B-B

ISOMETRICS



COVER BACK

APPROVED MODELS	EAST JORDAN IRON WORKS BOLT-DOWN V-2384	US FOUNDRY 669-KL-BWT	CAPITOL FOUNDRY MH-2001-WT
COVER WEIGHT	135 Lbs.	125 Lbs.	120 Lbs.
FRAME WEIGHT	180 Lbs.	190 Lbs.	190 Lbs.
LOAD RATING	HEAVY DUTY	HEAVY DUTY	HEAVY DUTY
MATERIAL	ASTM A 48 CLASS 35B	ASTM A 48 CLASS 35B	ASTM A 48 CLASS 35B
FINISH	UNCOATED	UNCOATED	UNCOATED

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SANITARY SEWER WATERTIGHT MANHOLE FRAME and COVER

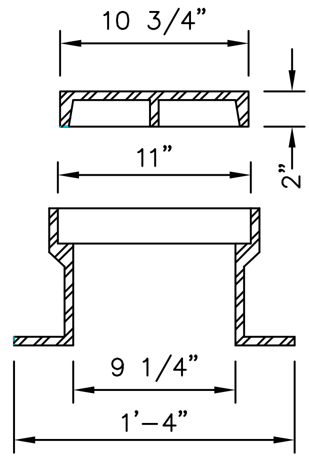
SCALE: Not To Scale

DETAIL # 2533.02

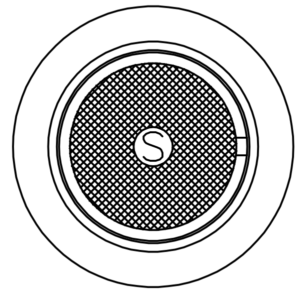
REVISION DATE: Jan 1, 2025

SHEET #: 1 of 1

US FOUNDRY 7610 FC or CAPITOL FOUNDRY VB–9 BY–PASS VALVE BOX ITEM NUMBER VB–9*S	
MATERIAL SPECIFICATION	COATING
GRAY IRON ASTM A48 CLASS 30	BITUMEN



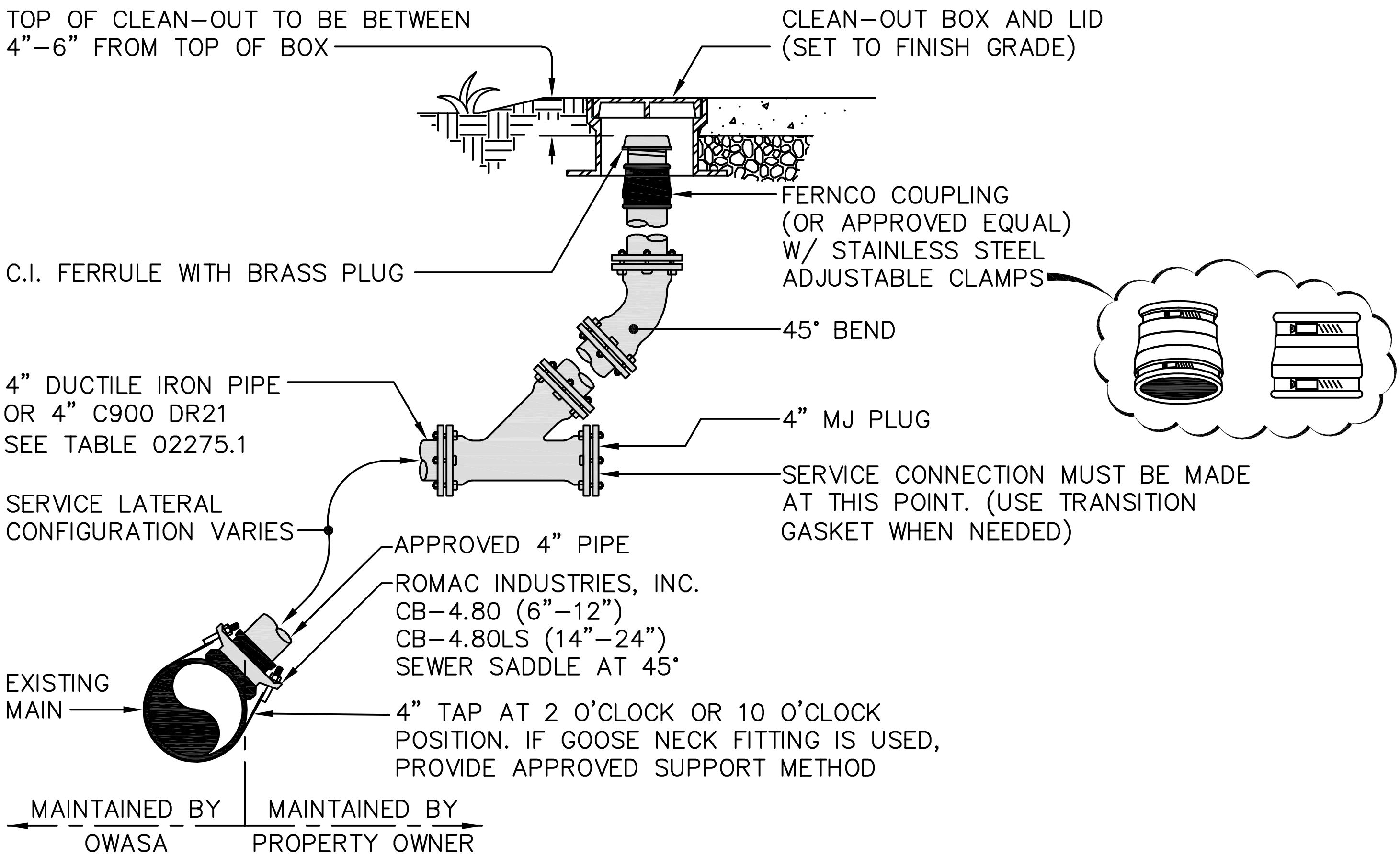
PROFILE



PLAN VIEW

TURF APPLICATION

PAVED APPLICATION



NOTES:

1. This detail depicts a typical layout. Variations may be approved.
2. Service saddles may be used only on existing sewer mains. Tees / Wyes shall be used for new construction.
3. PVC may be used when installed at depths provided in Table 02275.1.

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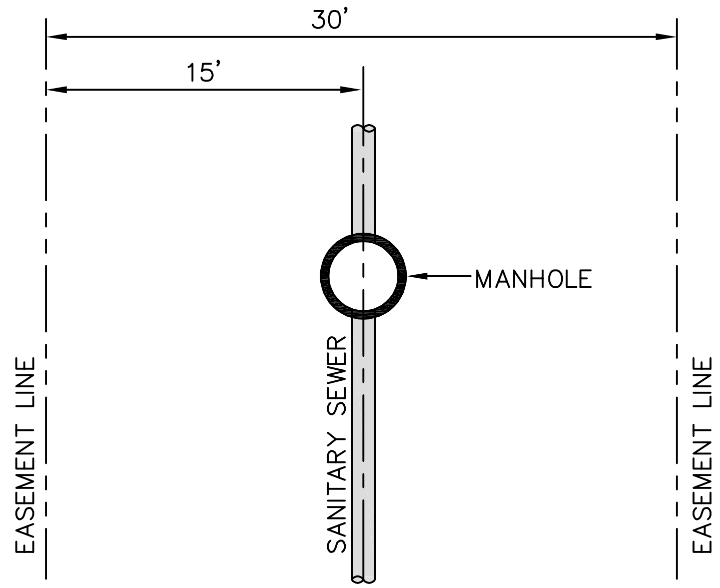
4" SEWER TAP and STUB-OUT PAVED APPLICATION CLEAN OUT

SCALE: Not To Scale

DETAIL #: 2534.01

REVISION DATE: January 1, 2025

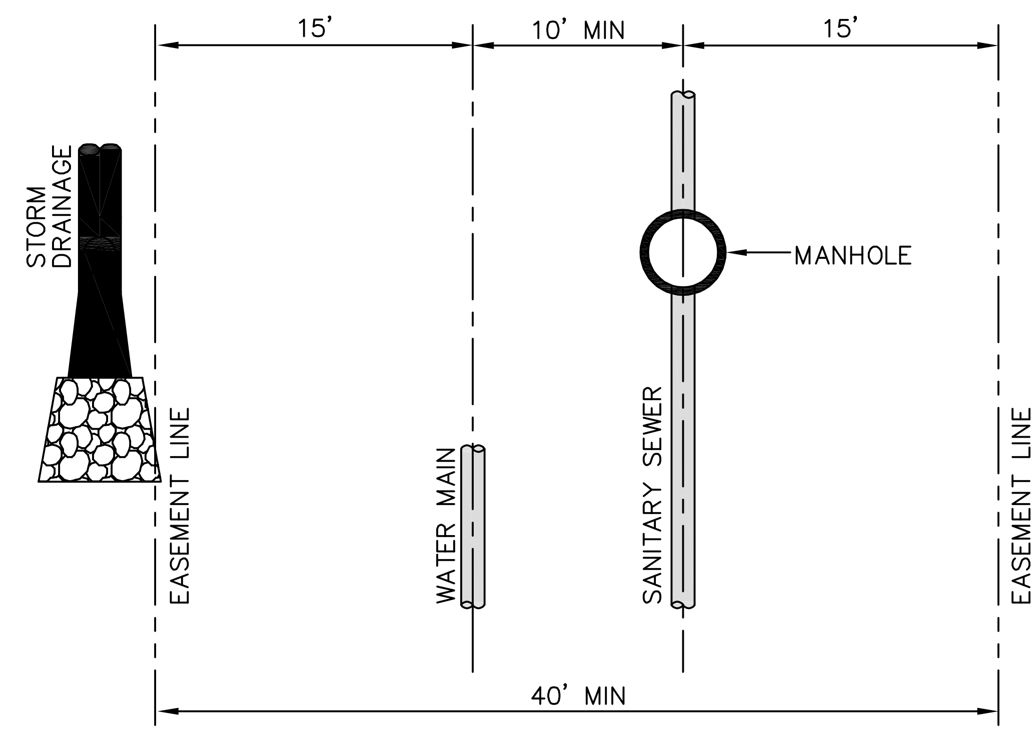
SHEET #: 1 of 1



TYPICAL SEWER EASEMENT

NOTES:

1. Center sewer line & manholes within sewer easement.



TYPICAL COMBINED EASEMENT

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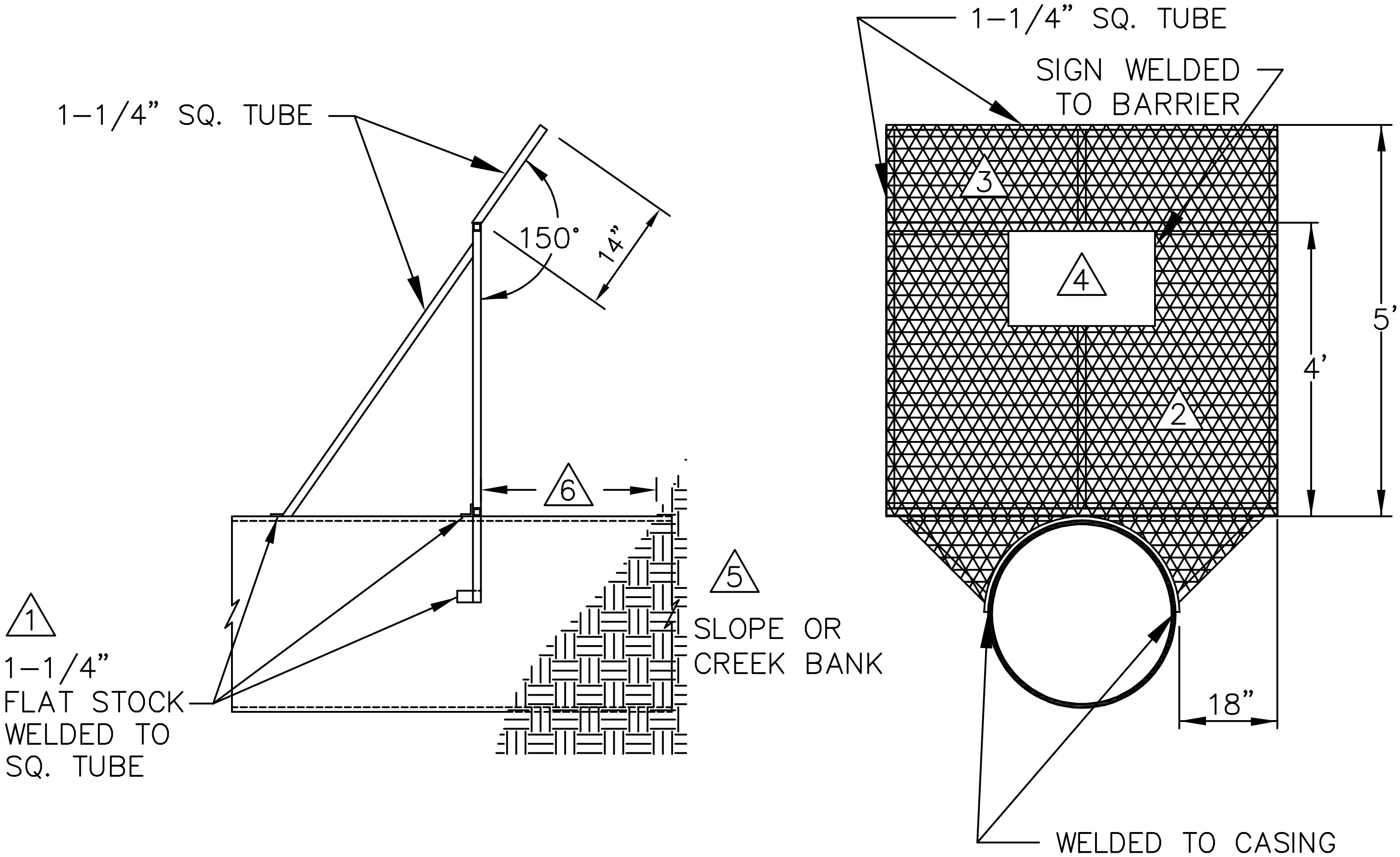
TYPICAL SEWER AND COMBINED EASEMENT DETAILS

SCALE: Not To Scale	DETAIL # 2534.02
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 1



1. BOLT OR WELD TO CASING
2. BLACK OR HUNTER GREEN PAINT COLOR
3. 1/8" EXPANDED METAL GRATING
4. SIGN – SEE 3 OF 3
5. BARRIER TO BE PLACED ON CROSSING UPSTREAM AND DOWNSTREAM
6. DISTANCE FROM SLOPE OR CREEK BANK TO BARRIER TO BE DETERMINED IN FIELD

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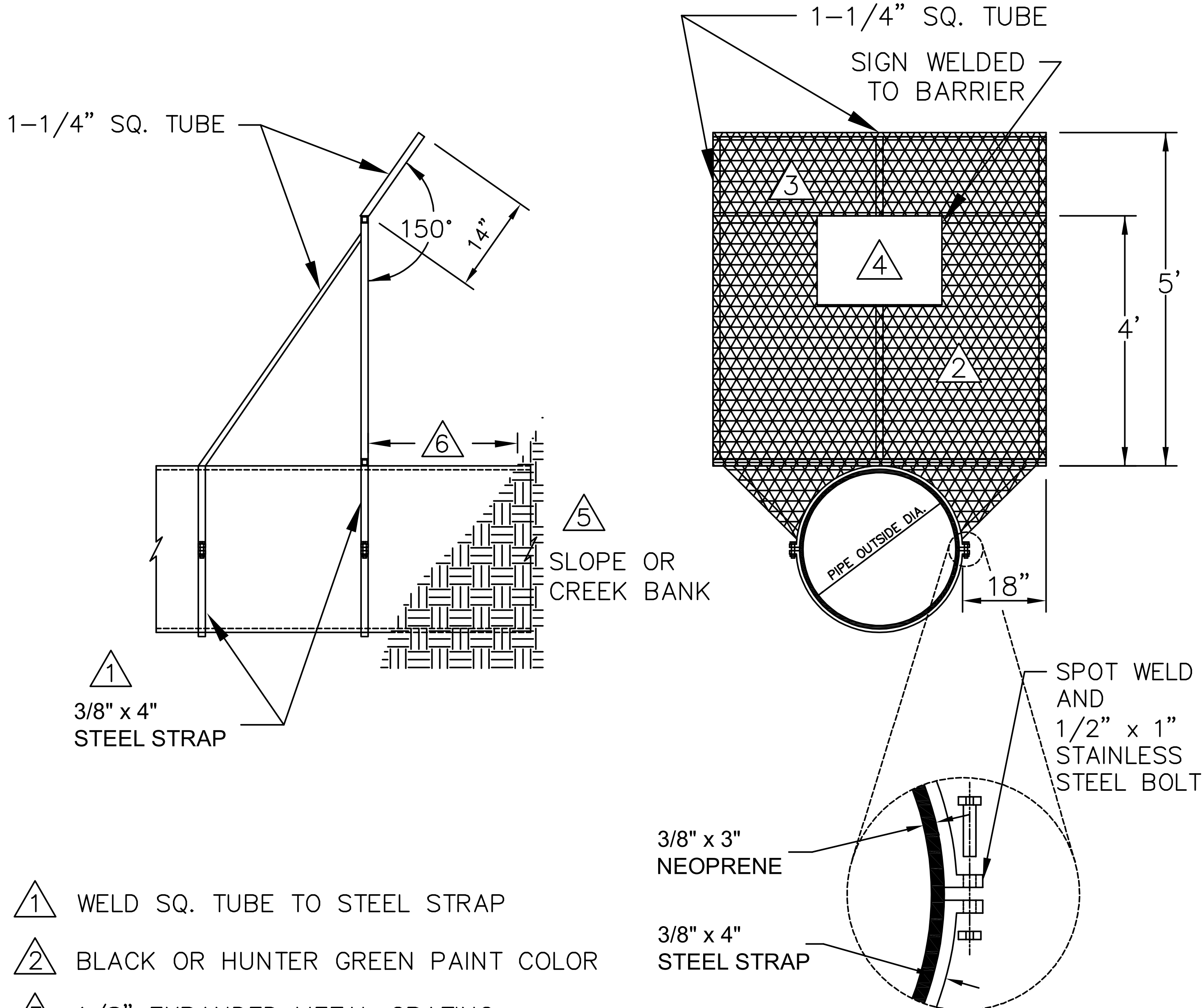
CASING PIPE PEDESTRIAN BARRIER

SCALE: Not To Scale	DETAIL # 2535.01
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 3



1. WELD SQ. TUBE TO STEEL STRAP
2. BLACK OR HUNTER GREEN PAINT COLOR
3. 1/8" EXPANDED METAL GRATING
4. SIGN – SEE 3 OF 3
5. BARRIER TO BE PLACED ON CROSSING UPSTREAM AND DOWNSTREAM
6. DISTANCE FROM SLOPE OR CREEK BANK TO BARRIER TO BE DETERMINED IN FIELD

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CARRIER PIPE PEDESTRIAN BARRIER

SCALE: Not To Scale	DETAIL # 2535.01
REVISION DATE: Jan 1, 2025	SHEET #: 2 of 3

1. WHITE DUTCH ARIAL TYPE ON DARK GREEN BACKGROUND WITH WHITE BORDER
2. CENTER TEXT ON SIGN
3. 0.080 THICK ALUMINUM

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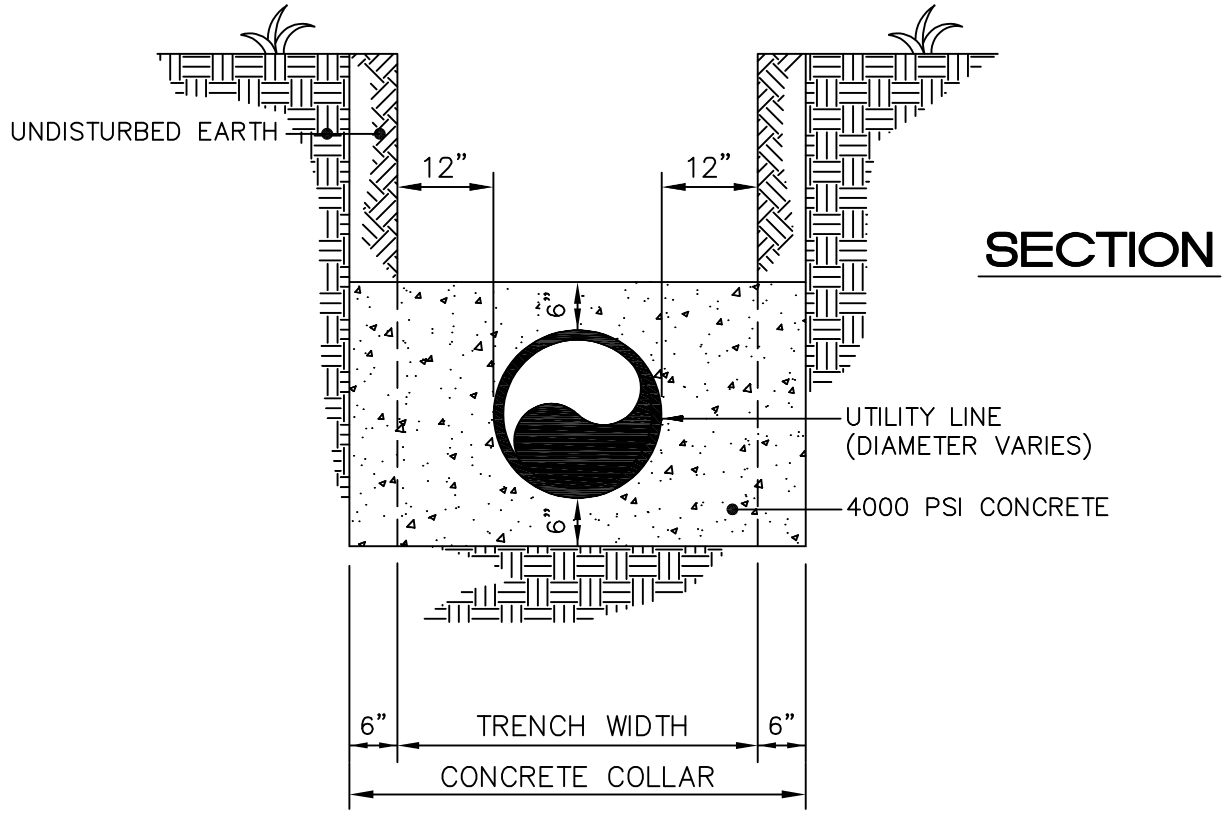
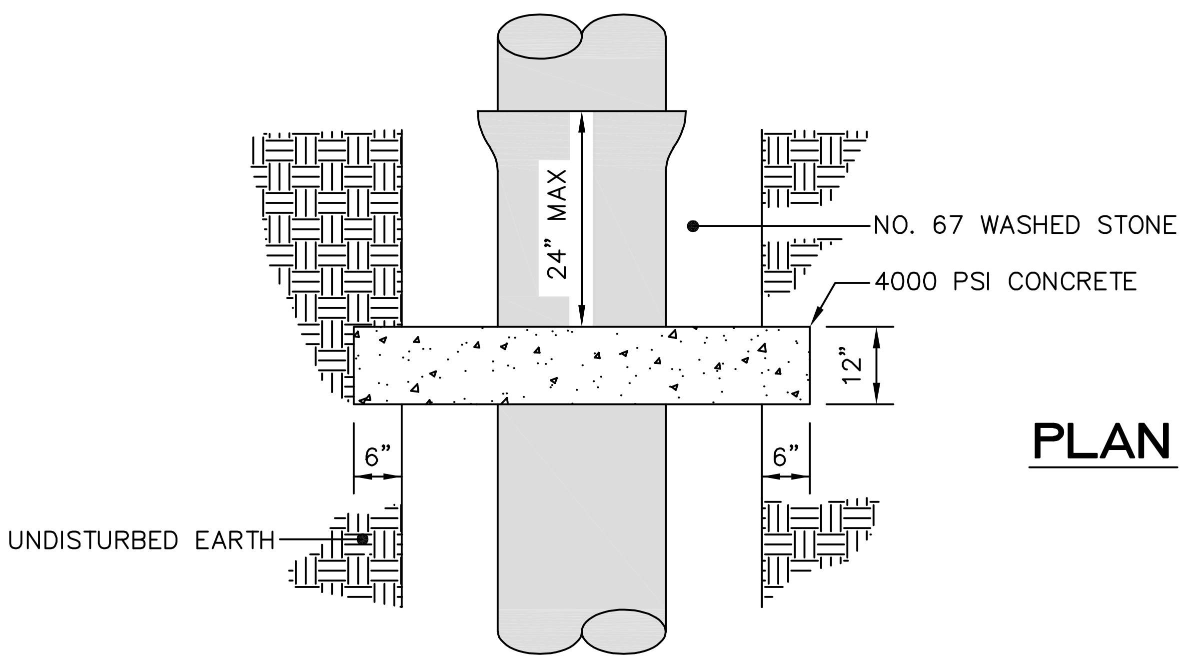
SIGN FOR AERIAL CROSSING

SCALE:	DETAIL #
Not To Scale	2535.01
REVISION DATE: Jan 1, 2025	SHEET #: 3 of 3





NOTES:

1. Sewer lines on 20% slope or greater shall be anchored securely with concrete collars.
2. Minimum 1 concrete collar per pipe joint. Additional collars may be required by OWASA.

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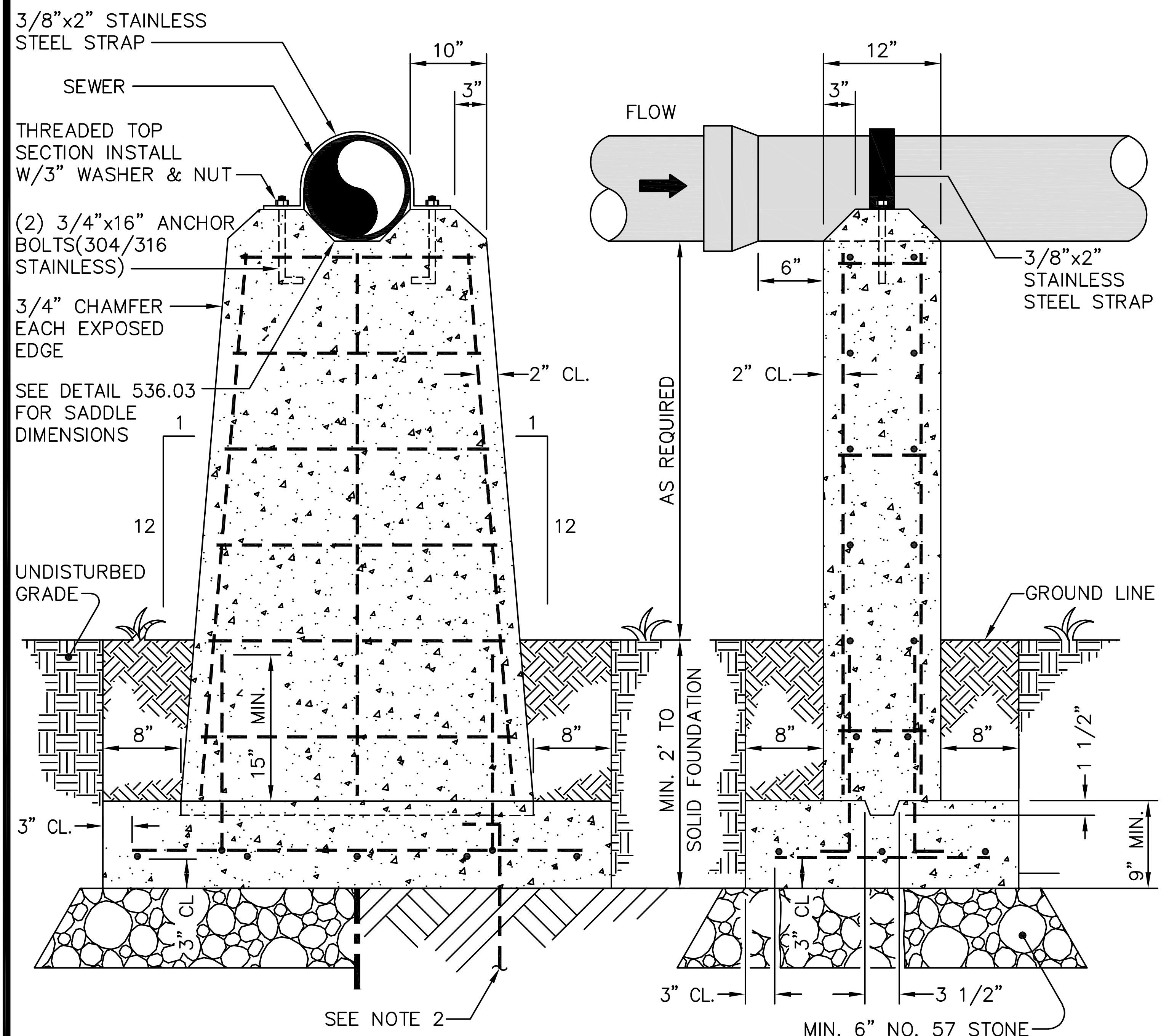
CONCRETE COLLAR DETAIL	SCALE: Not To Scale	DETAIL # 2536.01
	REVISION DATE: Jan 1, 2025	SHEET #: 1 of 1



NOTES:

1. All hardware to be stainless steel and coated to prevent galling or use stainless steel anti-seize compound.
2. A North Carolina Professional Engineer shall provide the necessary structural design for the pier sufficient to resist the forces acting on the pier/pipe system. Where shallow rock is found to exist, pin footing to rock by drilling & epoxying dowels into the rock. Provide computations to OWASA w/design parameters, assumptions, and safety factors used in the design of the piers.
3. See detail 536.04 for steel I beam.
4. All concrete to be 4,000 psi @ 28 days.

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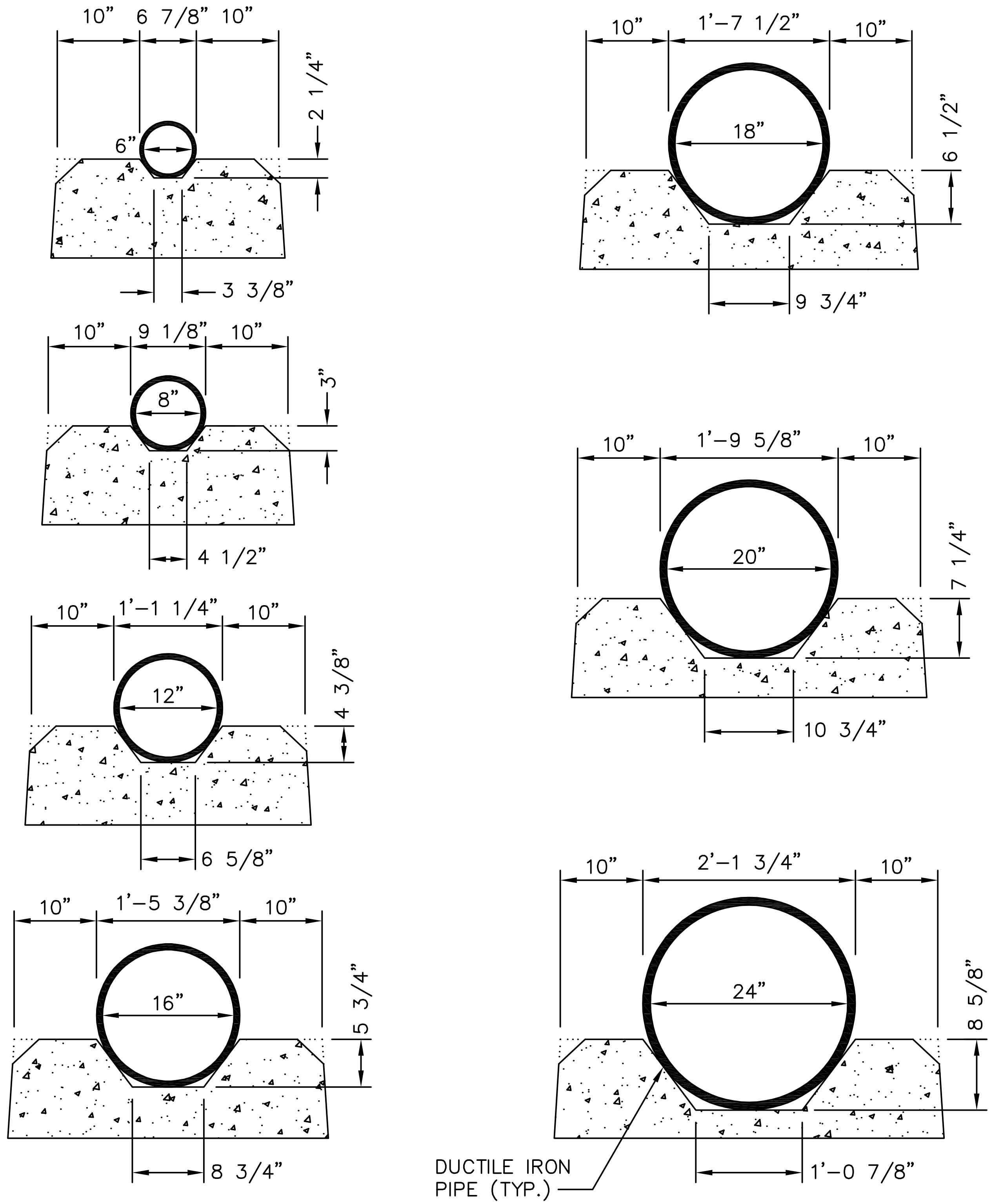
CONCRETE PIER DETAIL

SCALE: Not To Scale	DETAIL #: 2536.02
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 1



NOTES:

1. Dimensions were calculated to the nearest 1/8".
2. For complete pier detail, see detail 536.02

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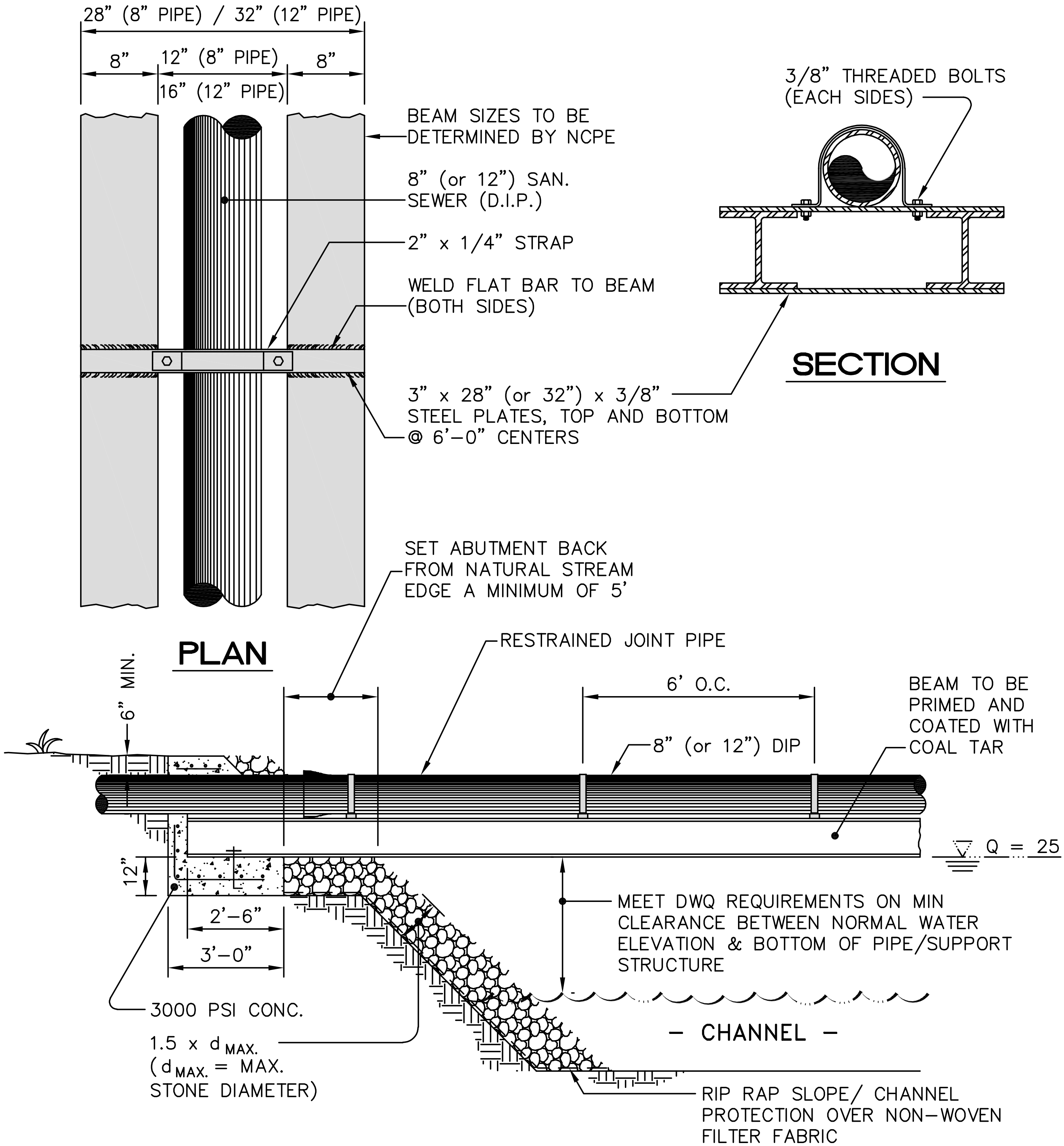
CONCRETE PIER SADDLES DETAIL

SCALE: Not To Scale	DETAIL #: 2 536.03
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 1



CHANNEL SECTION

NOTES:

1. Concrete to extend 6" out from each side of flange.
2. Anchor bolts and straps to be galvanized and hot asphalt dipped.
3. Abutment design to withstand both dynamic force of water and buoyant forces with a 2.0 safety factor.
4. Abutment size and reinforcing to be determined by NCPE.

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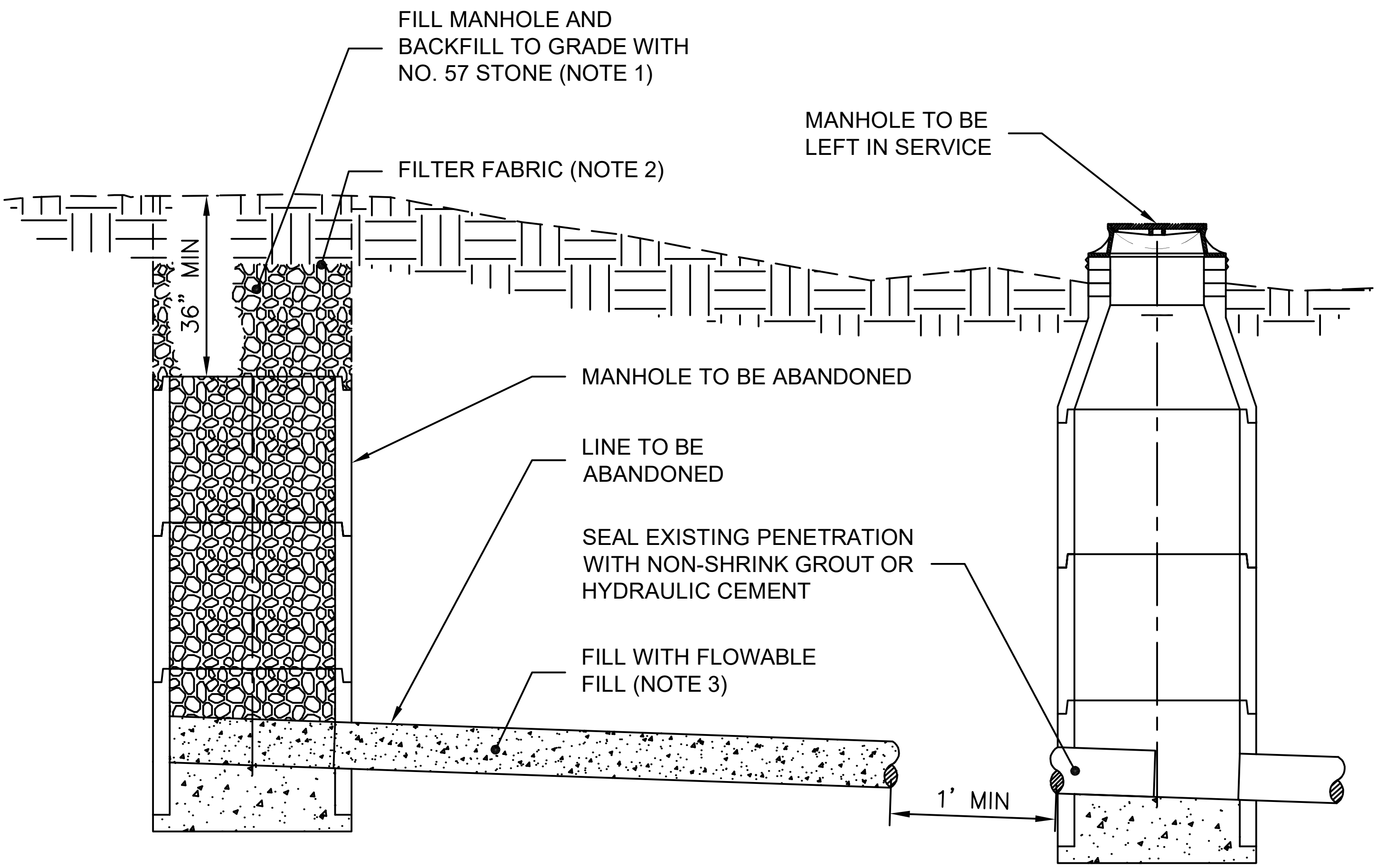
DETAIL OF BRACING FOR CHANNEL CROSSINGS

SCALE: Not To Scale	DETAIL # 2536.04
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 1



NOTES:

1. BACKFILL WITH NO. 57 STONE COMPACTED IN PLACE OR WITH FLOWABLE FILL CONCRETE (50 PSI MINIMUM/ 150 PSI MAXIMUM).
2. OUTSIDE ROADWAY RIGHT OF WAYS, FILTER FABRIC SHALL BE PLACED OVER THE STONE AND SUITABLE MATERIAL OF A COMPACTABLE NATURE PLACED OVER CONCRETE MANHOLE PAD. FILTER FABRIC SHALL BE EXTENDED 1' BEYOND THE DIAMETER OF THE MANHOLE TO BE ABANDONED.
3. REMOVE OR FILL PIPES WITH FLOWABLE FILL CONCRETE (50 PSI MINIMUM/ 150 PSI MAXIMUM) IN ACCORDANCE WITH THE FOLLOWING CRITERIA:
   a. PIPES LARGER THAN 24-INCHES DIAMETER.
   b. PIPES LOCATED WITHIN ROADWAY SECTION AND MEETING ONE OF THE FOLLOWING CONDITIONS:
      I. PIPES THAT ARE 12-INCHES DIAMETER UP TO AND INCLUDING PIPES THAT ARE 24-INCHES DIAMETER AND ARE BURIED LESS THAN 20 FEET BELOW FINISHED GRADE.
      II. PIPES THAT ARE 6-INCHES DIAMETER UP TO 12-INCHES DIAMETER THAT ARE NOT CAST IRON, DUCTILE IRON, PVC, OR HDPE AND ARE BURIED LESS THAN 12 FEET BELOW FINISHED GRADE.
   c. PIPES LOCATED BELOW GROUNDWATER TABLE THAT COULD BECOME A CONDUIT FOR WATER MOVEMENT.

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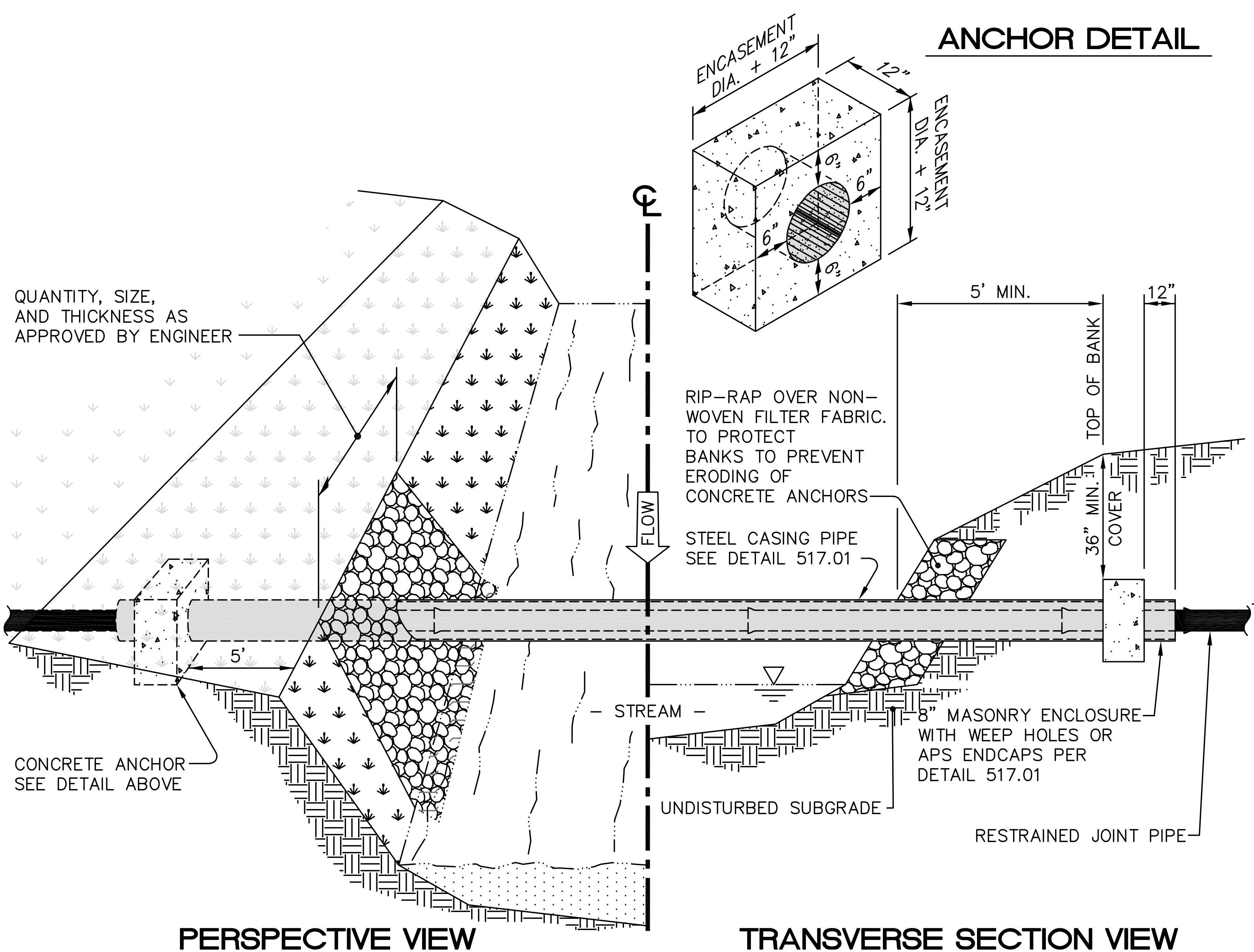
SANITARY SEWER LINE AND MANHOLE ABANDONMENT DETAIL

SCALE: Not To Scale	DETAIL # 2536.05
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 1



NOTES:

1. Concrete anchor to be minimum 3,000 psi @ 28 days.

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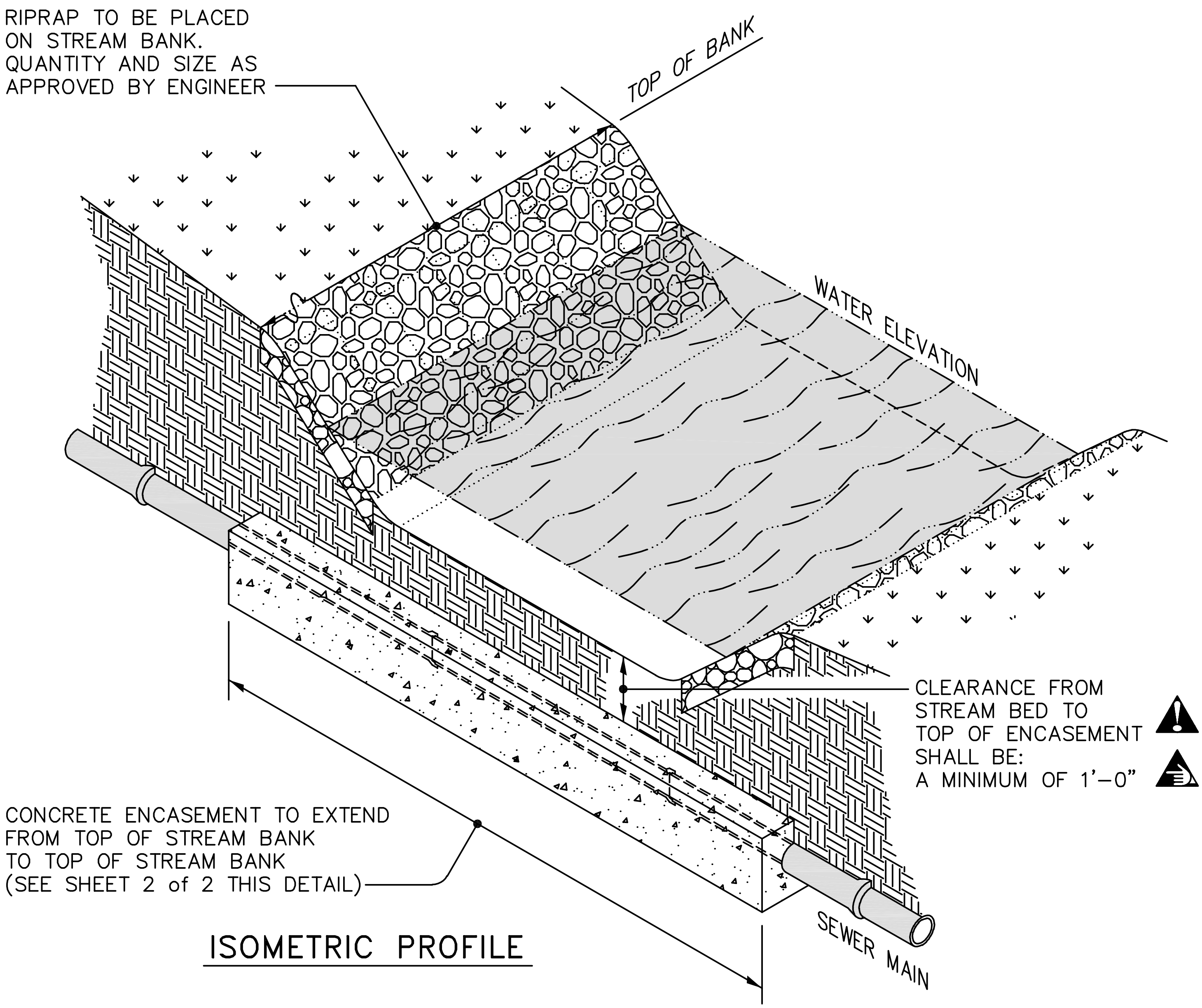
STREAM CROSSINGS for SEWER MAINS

SCALE: Not To Scale	DETAIL # 2 536.06
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 1



ISOMETRIC PROFILE

NOTES:

1. Concrete to be 3,000 psi.
2. Encasement to be used only where specified on plans.
3. Pipe shall be ductile iron pipe.
4. Filter fabric to be placed under rip–rap and keyed into embankment.

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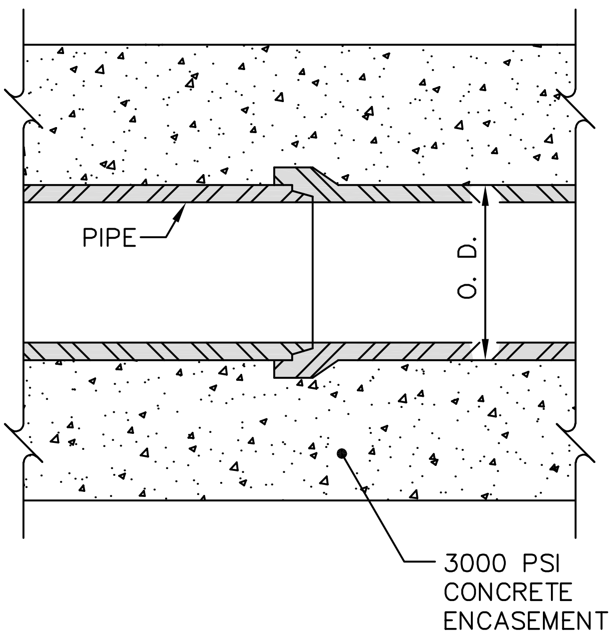
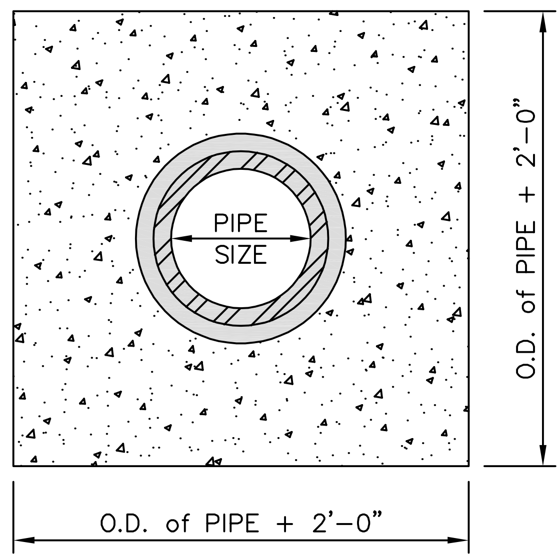
SEWER LINE CROSSING BENEATH STREAM BED	SCALE: Not To Scale	DETAIL # 2536.08
	REVISION DATE: Jan 1, 2025	SHEET #: 1 of 2



LONGITUDINAL SECTION



TRANSVERSE SECTION

NOTES:

1. Concrete to be 3,000 psi.
2. Encasement to be used only where specified on plans.

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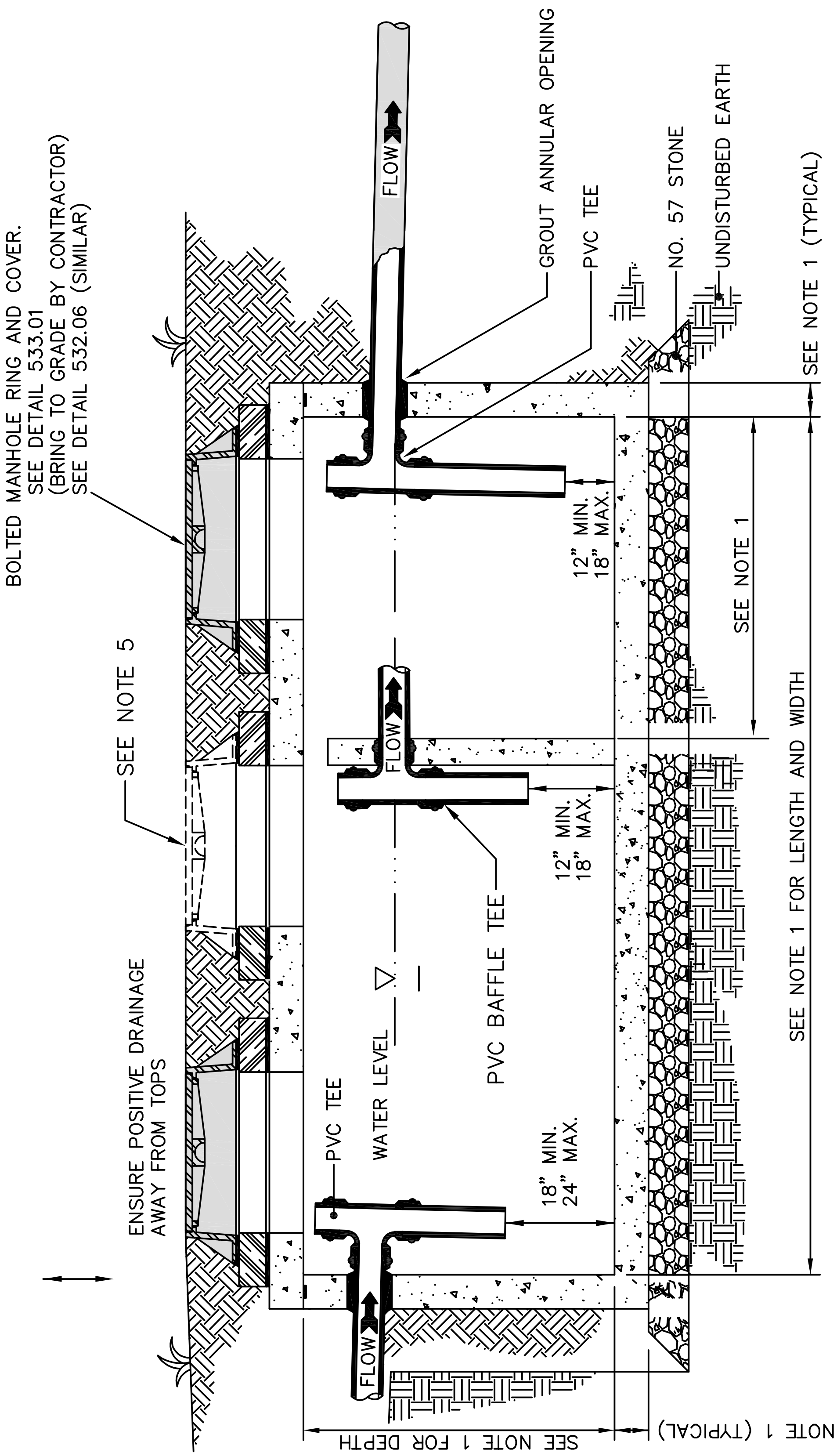
SEWER LINE CROSSING BENEATH STREAM BED

SCALE: Not To Scale	DETAIL # 2536.08
REVISION DATE: Jan 1, 2025	SHEET #: 2 of 2



NOTES:

1. Sizes and dimensions to be determined by NCPE and approved by OWASA.
2. Concrete to be a minimum of 4,000 PSI @ 28 days.
3. Reinforcing to comply with H-20 loading.
4. See OWASA Std. detail 531.01 for pipe bedding and trenching.
5. Third manhole required on grease traps of 1000 gallons or larger.
6. The collection area for any exterior drain shall be sloped to the drain and covered. The collection area shall be protected from all other runoff or rainfall limited to the minimum dimensions necessary in accordance with the OWASA Sewer Use Ordinance.
7. The drain shall not allow any material greater than 0.5" in an direction to enter the sanitary sewer.

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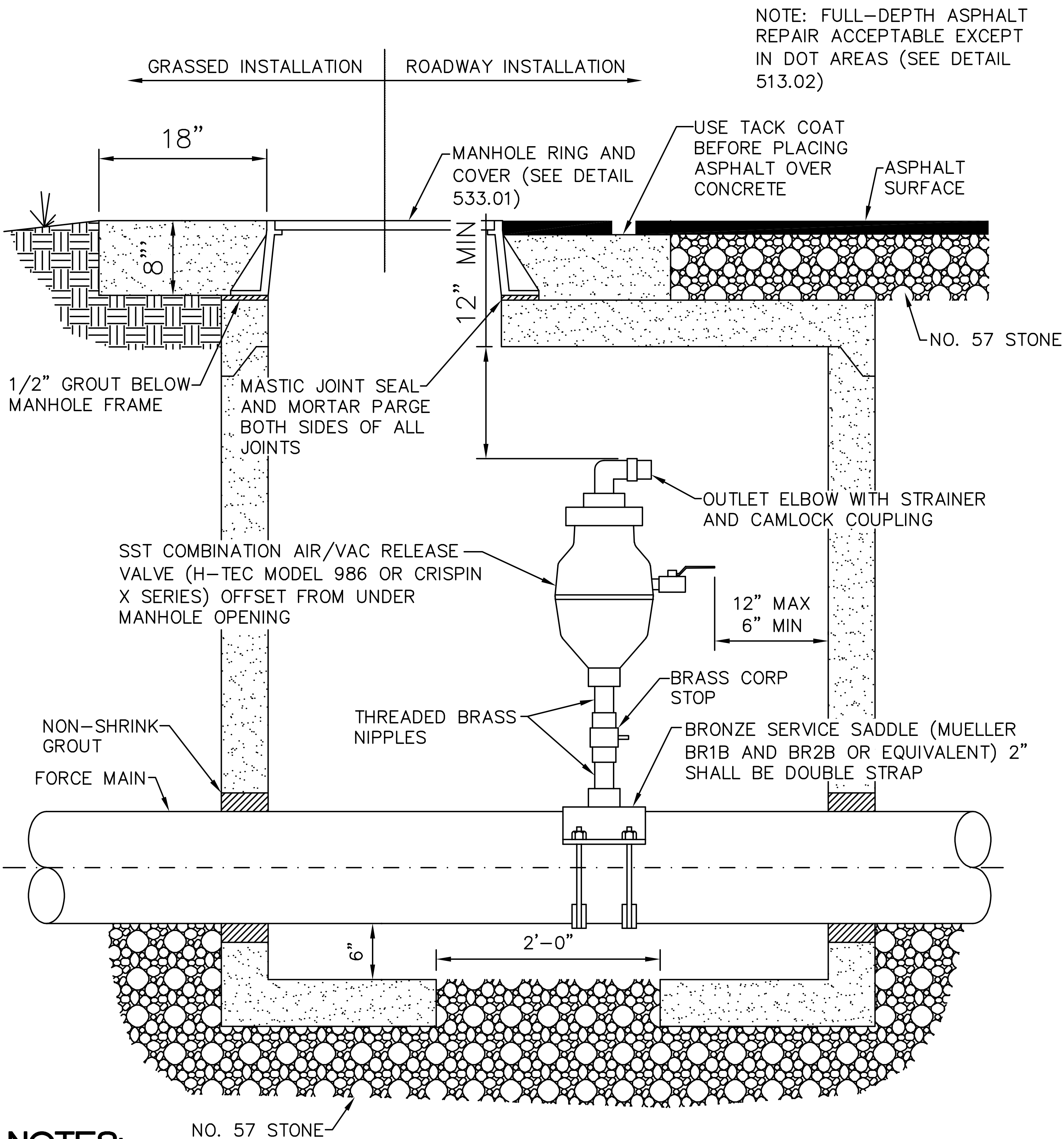
GREASE INTERCEPTOR AND OIL SAND SEPARATOR DETAIL

SCALE: Not To Scale	DETAIL # 2 537.01
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 1



NOTES:

1. Where 12" clearance above valve cannot be maintained, use Detail 538.01 (Sheet 2 of 2).
2. Force mains 4" dia. and smaller shall have one full joint of pipe centered on the ARV.
3. Manholes shall be 5'–0" Diameter minimum.
4. Pipe and size to be determined by engineer.
5. ARV shall be offset from under manhole opening to allow for maximum egress.

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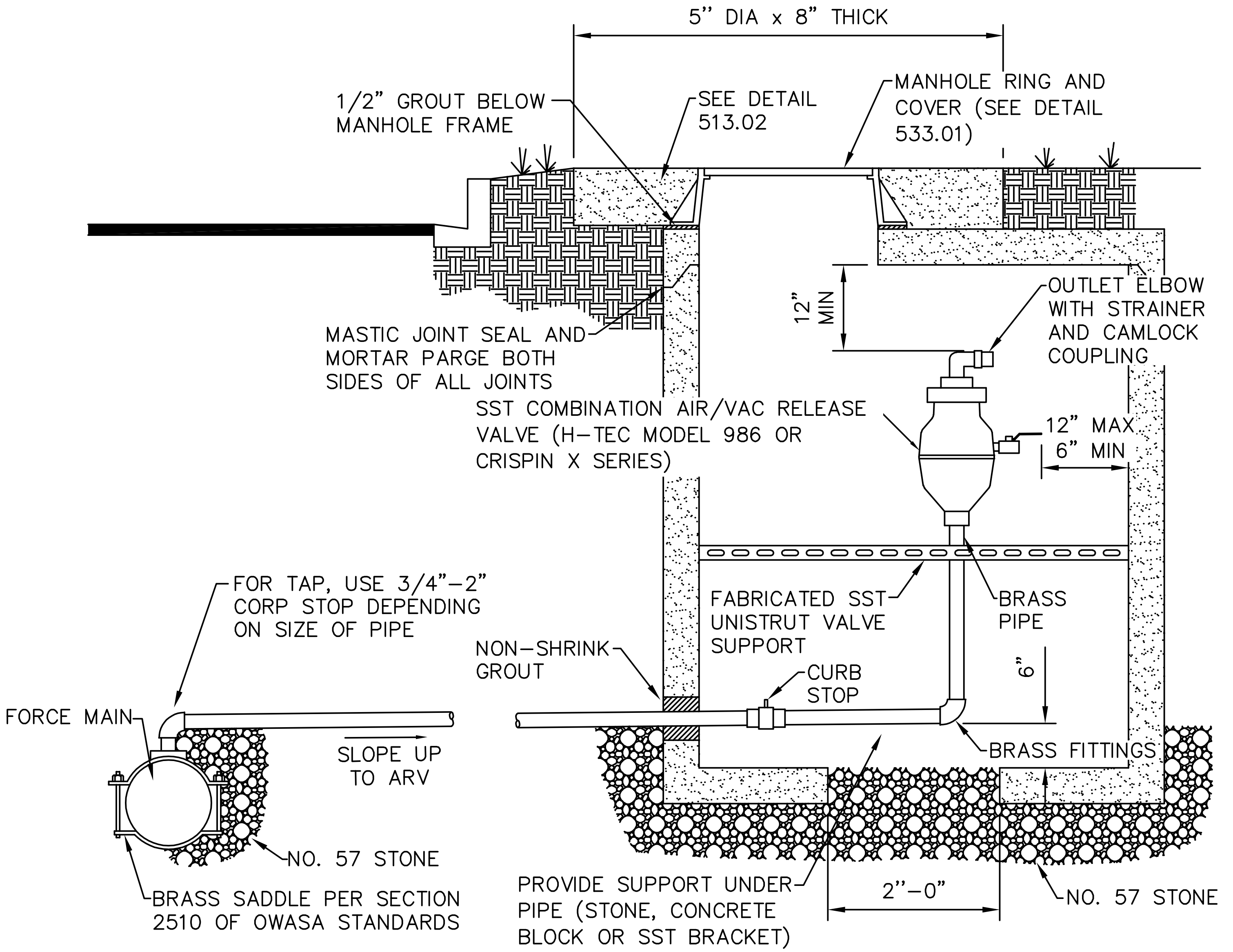
COMBINATION AIR VALVE AIR RELEASE MANHOLE

SCALE: 3/4" = 1'-0"	DETAIL # 2538.01
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 2

NOTE: IF MANHOLE IS INSTALLED IN UNPAVED, NON–TRAFFIC AREA, MANHOLE HEIGHT MAY BE ADJUSTED AS NEEDED ABOVE GRADE



NOTES:

1. Manholes shall be 5'–0" diameter minimum.
2. Pipe and size of valves to be determined by engineer.
3. ARV shall be offset from under manhole opening to allow for maximum egress.
4. 2–inch fiberglass meter vault will be acceptable in unpaved non–traffic areas.

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ORANGE WATER AND SEWER AUTHORITY

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FAX (919) 968-4464
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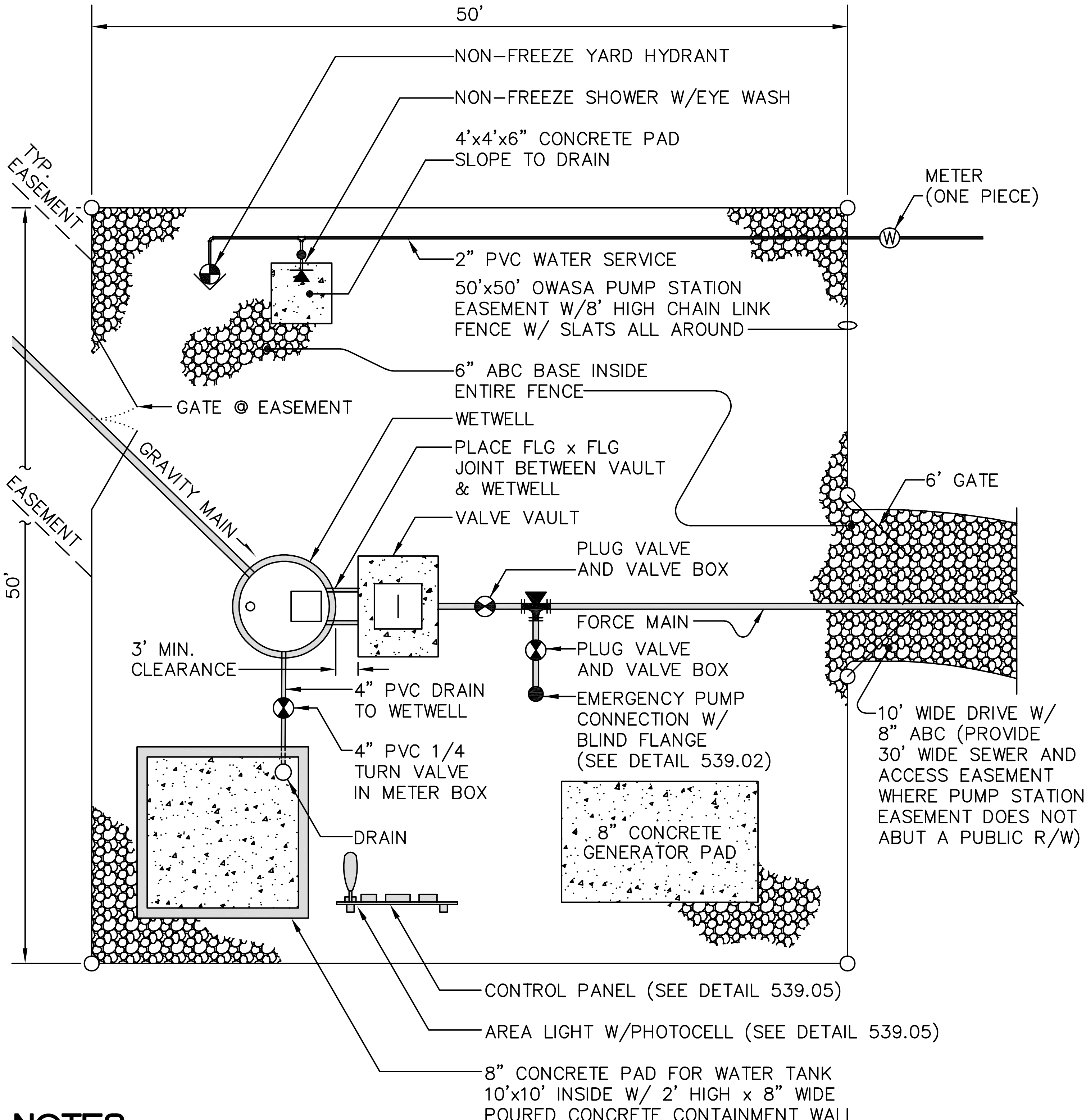
COMBINATION AIR VALVE AIR RELEASE MANHOLE

SCALE: 1/2" = 1'-0"	DETAIL # 2538.01
REVISION DATE: Jan 1, 2025	SHEET #: 2 of 2



NOTES:

1. Generator to be painted forest green by the manufacture.
2. Pump controls to be Timemark 403.
3. In wet well, use floats. Transducers not permitted.
4. Automatic dialer to have dedicated telephone line, arranged for by the contractor, and placed in the name of OWASA for billing purposes. Auto dialer to be Raco Guardit.

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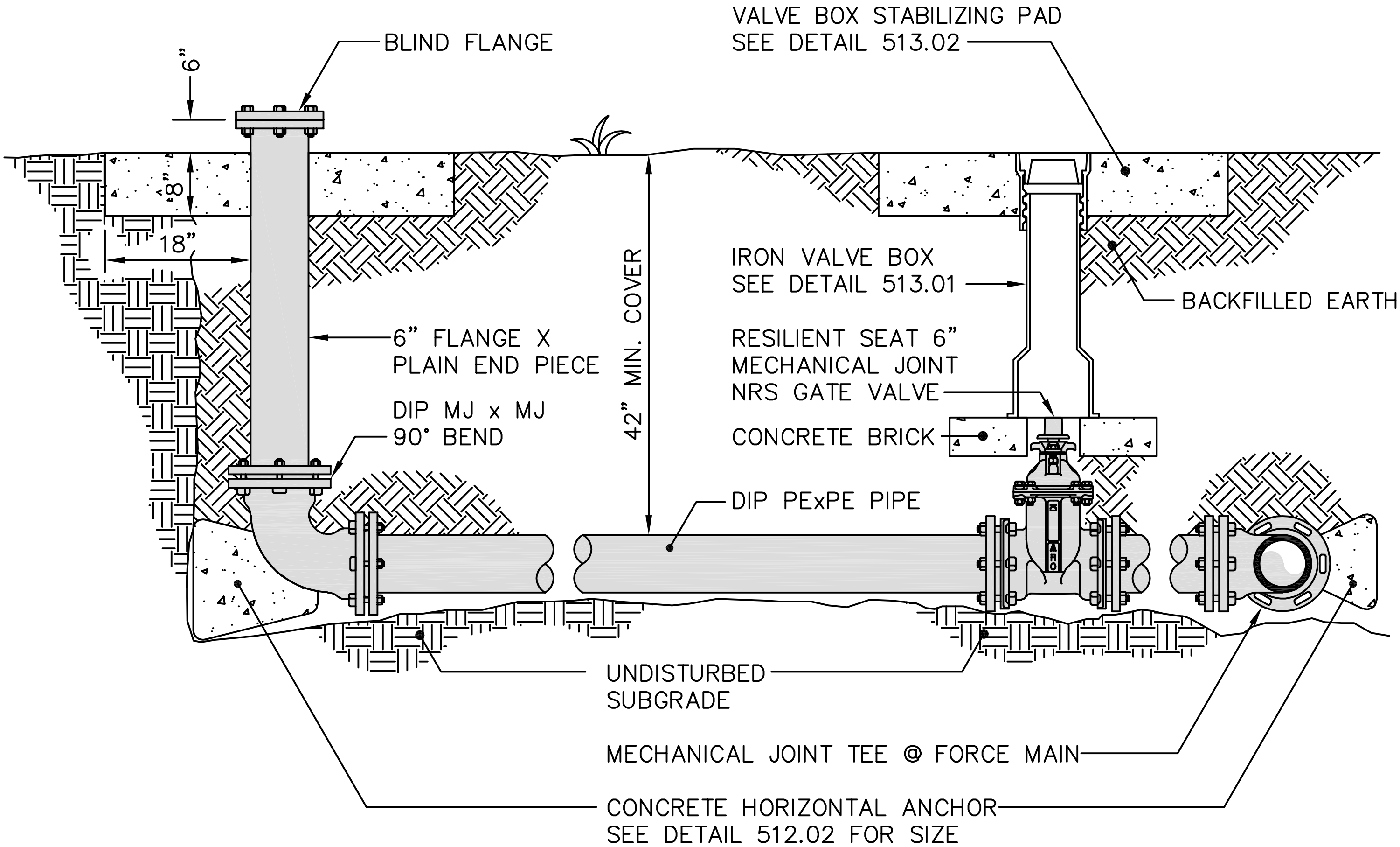
TYPICAL SUBMERSIBLE PUMP STATION SITE LAYOUT

SCALE: Not To Scale	DETAIL # 2539.01
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 1



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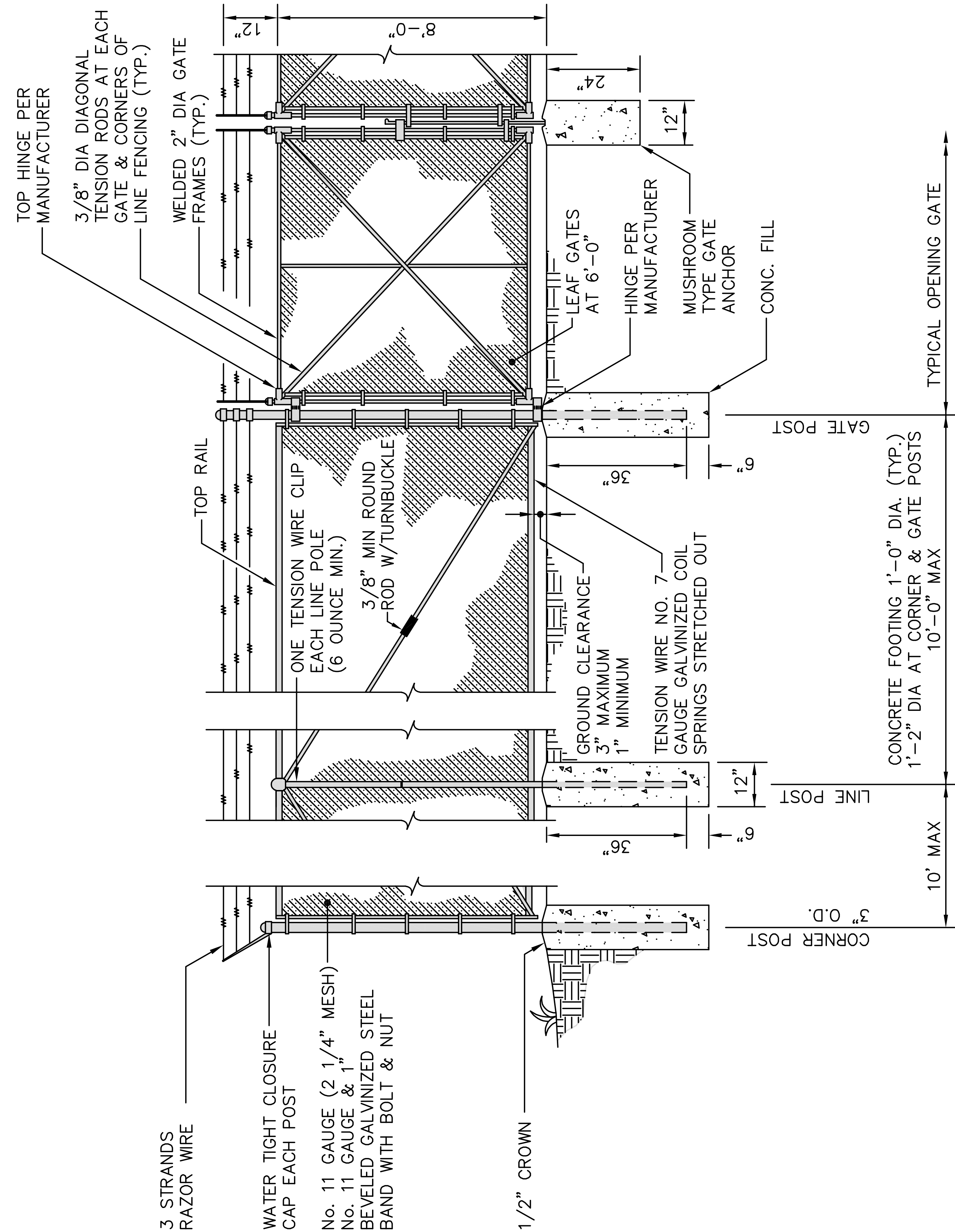
TYPICAL EMERGENCY PUMP CONNECTION

SCALE:	DETAIL #
Not To Scale	539.02
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 1



NOTES:

1. Chain link fabric to have slats & must be opaque.

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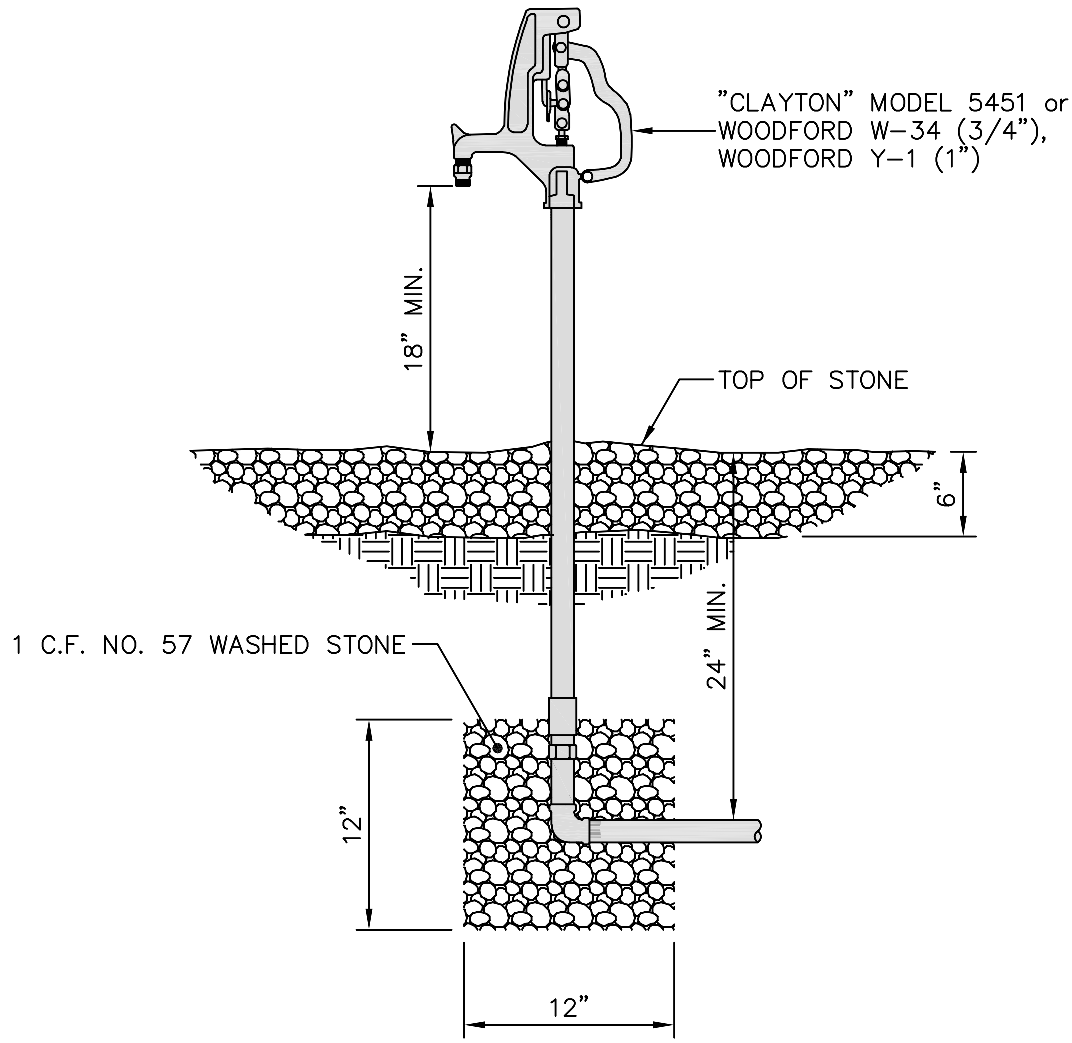
TYPICAL CHAIN-LINK FENCE DETAIL - 8 FT. HEIGHT

SCALE: Not To Scale	DETAIL # 2539.03
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 1



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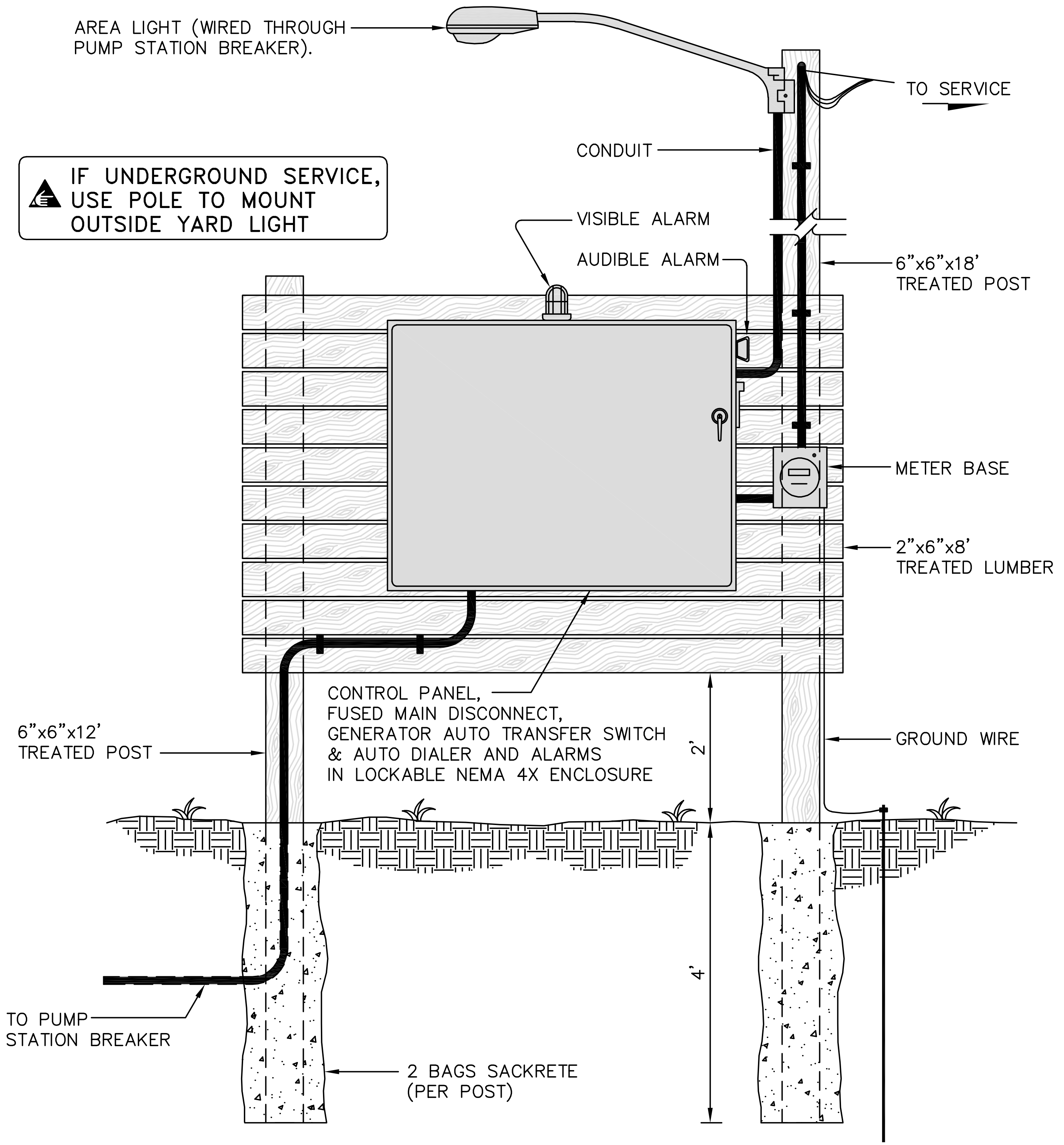
YARD HYDRANT (NON-FREEZE)

SCALE: Not To Scale	DETAIL # 2539.04
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 1



NOTES:

1. (4) lag bolts per board.
2. (1) 6"x6"x18' treated post & (1) 6"x6"x12' treated post.
2. (10) 2"x6"x8' treated lumber (bolted on w/lag bolts).
3. (4) bags sackrete.

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PUMP STATION SERVICE PANEL DETAIL

SCALE: Not To Scale	DETAIL # 2539.05
REVISION DATE: Jan 1, 2025	SHEET #: 1 of 1