

GENERAL WATER AND SEWER CONSTRUCTION SPECIFICATIONS

Albemarle County Service Authority
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DIGITAL RESOURCES

QR Code to ACSA's New Construction Guidelines

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Part 1 – General Information and Administrative Policies

1.1 Purpose

These construction specifications of the Albemarle County Service Authority (ACSA) cover general conditions, technical specifications, and details for water and sewer utilities to be incorporated into the ACSA's infrastructure. These specifications are for use by experienced design professionals as they are minimum requirements and are not a substitute for well-reasoned and thoughtful engineering design. The design of water and sewer Facilities shall consider the future operation and maintenance of the Facilities.

Requests for additional information or clarification shall be submitted to the Director of Engineering, Albemarle County Service Authority, 168 Spotnap Road, Charlottesville, Virginia 22911. Additional information can be obtained on the ACSA website: www.serviceauthority.org.

If any part of these specifications is held to be invalid, it shall not affect the validity of any other part of these specifications.

The Virginia Department of Health (VDH) Waterworks Regulations and the Virginia Department of Environmental Quality (DEQ) Sewage Collection and Treatment Regulations are included herein by reference. In the event of any discrepancy between these specifications and applicable rules and regulations of the VDH or the DEQ, the more stringent requirement will govern.

1.2 Definitions

Unless the context specifically indicates otherwise, the meaning of terms used herein shall be as follows:

AASHTO – American Association of State Highway Transportation Officials.

ANSI – American National Standards Institute.

AWWA – American Water Works Association.

ACSA – The Albemarle County Service Authority, including its governing and operating bodies and designated agents. Any office referred to solely by title (e.g., Executive Director, Director of Engineering) shall be the person retained in this position by the ACSA.

As-Built Plans – Construction plans and details that have been updated after the Facilities have been constructed to reflect accurate locations and features of all Facilities. All structures shall have field survey information regarding their location. Sewer service connections shall be labeled with the distance to the nearest downstream manhole.

Construction Approval – A letter issued by the ACSA to a Developer which authorizes them to construct Facilities for which the Construction Plans have been approved by the ACSA.

Construction Plans – Plans that are prepared by the Developer's Engineer showing the Facilities that will be constructed as part of a development project. These plans will be reviewed and approved by ACSA prior to the start of construction.

Contractor – Any person, firm, group, or affiliates hired by the Developer to construct the Facilities.

County - The County of Albemarle, Virginia, its governing and operating bodies, and designated agents.

Equivalent Residential Connections (ERCs) - The conversion of metered services to the equivalent of single-family residential connections. See ACSA Rules and Regulations – Appendix B for the current conversion schedules.

DEQ – Virginia Department of Environmental Quality.

Developer – Any person, firm, corporation, or association having an interest in any land or parcel requiring the design and construction of Facilities which would be under the jurisdiction of the ACSA and would become part of the public utilities system of the ACSA.

Developer's Engineer – The Professional Engineer, hired by the Developer, that prepares and seals the Construction Plans showing the water and sanitary sewer Facilities that will be built by the Developer as part of their project.

EPA – U.S. Environmental Protection Agency.

Facilities – Any and all water and sewer infrastructure including waterlines and their appurtenances, water storage tanks, filtration or treatment facilities and pump stations, sewerlines and their appurtenances, sewage pumping stations and treatment plants that a Developer constructs and then dedicates to ACSA to become part of the public water and sewer systems that the ACSA owns and maintains.

OSHA – U.S. Department of Labor Occupational Safety and Health Administration, administered by the Virginia Department of Labor and Industry.

Public Sewer – A sanitary sewer which is owned and operated by the ACSA.

RWSA – The Rivanna Water and Sewer Authority, its representatives, and designated agents.

Sanitary Sewage – Water-carried waste which derives principally from dwellings, business buildings, institutions, industrial establishments, and the like, exclusive of any storm and surface waters.

Sanitary Sewer – A sewer that has its use limited to sanitary sewage and to which storm, surface and ground waters are not intentionally admitted.

Sewerline – A gravity sanitary sewer main that is owned by ACSA.

Sewer Lateral – The privately owned sanitary sewer pipe that extends from the ACSA sewerline to the building or point of use.

Shall or Will – Are mandatory; may is permissive.

VDH – Virginia Department of Health - Office of Drinking Water.

VDOT – Virginia Department of Transportation.

VMRC – Virginia Marine Resources Commission.

Water Service – The pipe which extends underground from the ACSA waterline to the ACSA water meter. This is owned and maintained by the ACSA.

Water Lateral – The privately owned water pipe that extends from the ACSA water meter to the building or point of use.

Waterline – A water main that is owned by ACSA.

1.3 Responsibility

The ACSA has entered a Memorandum of Understanding with the Virginia Department of Health (VDH) and the Virginia Department of Environmental Quality (DEQ) authorizing local review of utility designs. The ACSA is responsible to ensure construction of Facilities in accordance with these specifications as well as the regulations of the VDH and of the DEQ.

The Developer is responsible to employ reliable Contractors with sufficient skills and experience to perform all work in an acceptable manner relative to the Facilities herein described. Failure to do so may result in work stoppage and/or refusal by the ACSA to accept the project as part of its system.

The Contractor is responsible to ensure the safe and proper construction of the Facilities herein mentioned. If any person is in doubt as to the true meaning of any part of these specifications, a written request shall be submitted to the ACSA for interpretation. Any questions concerning the standards shall be governed by the final decision of the ACSA.

The Developer's Engineer is responsible for design and submission of the proper number of plans and specifications for the proposed work.

The ACSA reserves the right to make adjustments in types of materials and methods of construction required, should field inspections reveal unforeseen and/or unfavorable conditions for installation of the utilities, as designed.

All work relative to connecting the existing ACSA water and sewer systems shall be performed by the Contractor or ACSA work forces. All related costs shall be the responsibility of the Contractor and/or Developer, unless specifically preempted by a formal contractual arrangement.

1.4 Underground Utility Damage Prevention Act

In accordance with the Underground Utility Damage Prevention Act, no person shall begin excavation or demolition without making required notification and confirmation of cleared ticket.

1.5 Regulations and Ordinances of Other Agencies

All Developers and Contractors should be familiar with all policies and laws that involve the VDH, DEQ, VDOT, VMRC, and any State Building and Fire Codes. Specifically noted are rules governing cross connections and backflow prevention.

All Developers and Contractors should be familiar with and shall comply with the Ordinances of Albemarle County including the Building, Water Protection Ordinance, and Zoning requirements.

In addition to the regulations herein, utility designs shall comply with the following:

1. VDH Waterworks Regulations, 12 VAC 5-590, 2021 or latest revision.

2. DEQ Sewage Collection and Treatment Regulations 9 VAC 25-790, latest revision.

3. Local Ordinances and State Building Codes, as adopted.

4. Local and State stormwater and erosion control rules and regulations.

5. Any utility crossing navigable streams or regulated wetlands must meet the requirements of the U.S. Army Corp of Engineers, DEQ, and VMRC. A joint permit application should be made to VMRC for review by these agencies.

1.6 Extension of Water and Sewer Systems

Any new water or sanitary sewer systems to be connected to the public supply shall not be constructed until Construction Drawings are approved by the ACSA. Construction Plans shall be in sufficient detail to accurately indicate all pertinent design and construction details for a comprehensive interpretation of the work to be performed. The adequacy of the plans as designed will be determined by the ACSA.

It is recommended on large projects that the Developer and/or Developer's Engineer hold a preliminary conference with the ACSA regarding the project prior to its design phase. All water and sanitary sewer systems shown on the plans must be located and sized to serve the entire service area. Where it is determined by ACSA that water or sanitary sewer lines should serve adjoining properties or properties beyond the development in question, the Developer will be required to adequately design and construct the water and sewer systems at an appropriate location and depth to permit future extensions to be made.

The Developer's Engineer shall coordinate the location of all proposed water and sanitary sewer lines within existing and proposed rights-of-way with regard to existing and proposed roads and drainage structures. In addition, coordination shall be made with other utility companies and agencies regarding their existing easements, rights-of-way and facilities. Where there is a possibility of conflicts with existing utilities, the ACSA reserves the right to require the Developer's Engineer to secure accurate information on the horizontal and vertical location of such utilities through subsurface exploration prior to approving the Construction Plans.

1.7 Plan Review and Approval Process

If a Developer desires ACSA's review and feedback of proposed Facilities on preliminary plans, including rezoning documents and plats, the Developer shall submit a Utility Master Plan for the development to ACSA. If the Developer does not submit a Utility Master Plan, the proposed Facilities have not been approved by ACSA and significant changes to the development may be required once ACSA reviews the Construction Plans.

1.7.1 Utility Master Plan

For any phased development the Developer shall submit a Utility Master Plan to the ACSA for review. Utility Master Plans shall include the location, size, and approximate elevation (depth) of waterlines and sewerlines, all proposed ACSA easements, lot and road layouts, proposed grading, estimated build-out flow requirements for the development, and the proposed phasing of development. The Utility Master Plan shall be approved by ACSA prior to review of Construction Plans for any portion of the development. When Construction Plans are submitted for review and the proposed phase is not in accordance with the approved master plan, ACSA may require the master plan be amended and re-submitted for review and approval.

Approval of a Utility Master Plan is not a reservation of system capacity, either water or sewer, for the entire development. ACSA does not reserve capacity in its system. If the existing ACSA infrastructure is not adequate to serve the entire project, the Master Plan shall also address off-site utility improvements.

If the development build-out sewer flows exceed 40,000 gallons per day, a capacity certification from RWSA and/or the City of Charlottesville will be required. This certificate shall address capacity in the existing sewerlines, as well as the receiving

wastewater treatment plant. For any wastewater flows received downstream by the City of Charlottesville, the Developer shall consult with the City regarding sewer capacity.

1.7.2 Construction Plans

The Developer shall submit Construction Plans to ACSA for review and approval prior to beginning construction of any Facilities. ACSA may require digital and/or paper copies of plans to review depending on the project.

Drawings, plans, specifications, and engineer's reports submitted for approval shall be prepared by a Professional Engineer registered in the Commonwealth of Virginia. The front sheet of each set of Construction Plans shall bear the original imprint of the P.E. seal, signature, and date of the responsible registered professional and all following sheets shall bear at least a legible copy of that seal, signature, and date.

The VDH and DEQ have delegated certain rights to the ACSA to review local water and sewer projects. Any projects that include pump stations, pretreatment or storage facilities must also be submitted to VDH and/or DEQ for review. VDH and/or DEQ reserve the right to require any project regardless of size, and scope, to be submitted for their review.

Plan sheets shall be twenty-four (24) inches by thirty-six (36) inches. Each set of Construction Plans shall be provided with a cover letter and water and sewer data sheets. Any supplemental specifications shall be attached to or shown on plans to govern work not covered by these specifications. Each set of plans shall contain the current version of the ACSA General Water & Sewer Conditions.

1.7.3 Plan Review

The ACSA's goal is to review Construction Plans within forty-five (45) days of receipt. Comments on the plans shall be returned to the Developer and the Developer's Engineer. All plans will be stamped upon receipt and reviewed in order of receipt, except plans with minor edits requiring minimal review may be expedited at ACSA's discretion.

1.7.4 Plan Approval

Once the Construction Plans are approvable, two (2) paper copies and one (1) electronic copy shall be submitted to ACSA. ACSA will issue a Construction Approval to the Developer's Engineer. Approval is for basic compliance with these Specifications and does not relieve the Developer, Contractor, or Developer's Engineer from responsibility for their work.

Approvals are valid for a period of eighteen (18) months from date of issue. If water and sewer construction is not in progress at the end of that period, or if construction becomes inactive for a period of twelve (12) months, the ACSA approval shall be void.

Construction Plans may need to be submitted as a new project, if deemed necessary by the ACSA, to conform to the most current specifications.

1.7.5 Plan Review and Inspection Fee

To defray, in part, the cost of reviewing plans and inspecting the construction of new water and/or sanitary sewer infrastructure, ACSA charges a plan review and inspection fee for all projects. Fees must be paid prior to scheduling a Preconstruction Conference. The current fee schedule is posted in the ACSA Rules and Regulations.

1.7.6 Preconstruction Conference

Prior to beginning construction on the project, the Developer and Contractor must hold a preconstruction conference with ACSA personnel. To schedule a conference, contact the ACSA engineer who issued the Construction Approval.

1.8 Inspection

An inspector from the ACSA will be assigned to each project to ensure that all work is completed, and materials are installed, in compliance with these specifications. Any deviation from the approved Construction Plans must be approved by the ACSA before incorporation into the work. ACSA shall be permitted access to the construction of the Facilities at any time, including access to use the airspace above the locations of construction for flight of unmanned aerial vehicles for the purpose of imagery collection.

1.9 As-Built Plans

Construction Plans with field markups shall be maintained by the Contractor in the field. These shall be provided to the Developer or their representative to assist in the preparation of the final As-Built Plans. The Developer shall have all structures surveyed after installation to accurately show their location on the final As-Built Plans.

Where available, control shall be based on the Virginia State Plane Coordinate System South Zone NAD 1983. Vertical reference shall be based on NAVD 1988.

One (1) paper copy and one (1) PDF copy of the As-Built Plans shall be provided to the ACSA by the Developer. All plan preparation, printing and duplicating cost shall be borne by the Developer. ACSA's goal will be to review As-Built Plans within thirty (30) days after receipt. ACSA will provide comments to the Developer or their representative once the review of the As-Built Plans is complete. The As-Built Plans shall be approved prior to Initial Acceptance.

1.10 Dedication

Upon completion of construction of the Facilities, the Developer must dedicate the Facilities to the ACSA. See Section 3 of the ACSA Rules and Regulations for the requirements of dedicating the Facilities to ACSA and receiving Initial Acceptance. The entire set of

Construction Plans must receive Initial Acceptance before any water meters will be installed for that project. Construction of Facilities shown on a single set of Construction Plans cannot be subdivided into phases to receive Initial Acceptance for part of the project.

After completion of all sitework, paving, required landscaping and building construction, the Developer shall apply for Final Acceptance of the Facilities by the ACSA. The developer shall be responsible for any repair or maintenance of the Facilities during the time between Initial Acceptance and Final Acceptance and then for one (1) year from the date of Final Acceptance.

1.11 Easements

Easements shall be required for all water lines, sewer lines, and appurtenances that are not installed within a public right-of-way of VDOT. Easements will be a minimum of twenty (20) feet in width, centered on the utility line. Wider easements will be required based on the depth and size of the utility as shown in the table below.

Trench Depth (ft)	8-12" Diameter	15-18" Diameter	20-27" Diameter	30-36" Diameter	36+" Diameter
0-6	20'	20'	25'	25'	30'
6-8	20'	20'	25'	25'	30'
8-10	20'	25'	25'	25'	30'
10-12	25'	25'	25'	30'	30'
12-14	30'	30'	30'	35'	35'
14-16	35'	35'	35'	40'	40'
16-18	40'	40'	40'	40'	40'
18+	40'	40'	45'	45'	45'

If the utility is placed in a VDOT right-of-way but is closer than ½ the required easement width to the edge of the right-of-way, an ACSA easement shall be provided abutting the right-of-way so that ACSA has the equivalent of the full width easement. For example, if a waterline that requires a twenty (20) foot wide easement is installed seven (7) feet from the edge of the right-of-way but inside the right-of-way, then a three (3) foot wide easement abutting the right-of-way would be required.

The ACSA reserves the right to require additional easement width if construction or maintenance activities require it. The ACSA also reserves the right to require access easements where appropriate. All easements shall have the right of ingress and egress fully provided for in the recorded document. Where deemed necessary by the ACSA, easements shall extend to adjacent property for orderly extensions of service. Easements shall be corrected to reflect the as-built conditions and shall be recorded prior to Initial Acceptance being granted.

All appurtenances (blow-off, hydrants, etc.) shall be provided with an easement twenty (20) feet in width centered on the interconnecting piping and shall extend ten (10) feet beyond the center of the appurtenance.

No buildings or permanent structures shall be constructed within ACSA easements. No trees, shrubs, structures, fences, or obstacles shall be placed within an easement. Any person who constructs a structure within the utility easement shall be liable for the cost of removal and any damage to the ACSA infrastructure.

1.12 Liability

The ACSA shall have no liability, resulting from any reason whatsoever, in connection with the design, construction, installation, or testing of the Facilities.

Part 2 – Design of Water Systems

The water system must be designed and constructed through the development to facilitate future extensions and connections to neighboring properties. Typically, this will include the construction of waterlines along the full extent of any public road frontage of development. Waterlines shall be constructed beyond the proposed improvements within a development so that future extensions and interconnections to adjoining properties will not disrupt any improvements.

2.1 Independent Waterline Connections

All developments that have 100 or more ERCs or serve significant customers, such as schools, nursing homes or hospitals, must have two independent connections to the water distribution system. Phased developments may develop up to 100 ERCs without a second independent connection. At the time that more than 100 ERCs are approved, the second independent connection must be made. The distribution system shall be designed so that any portion of the development that has 100 or more ERCs or a significant customer shall have two independent connections.

2.2 Location of Waterlines

Generally, waterlines are to be installed along public or private streets or travel aisles so they can be easily accessed. Waterlines should not be placed under parking spaces. In subdivisions, waterlines will be permitted in easements only when there is no other feasible alternative.

Waterlines should be placed five (5) feet from the outside edge of the pavement or seven (7) feet from the face of curb on undivided roadways.

Dead-ends shall be minimized by looping all waterlines. It may be necessary to install waterlines in areas of limited accessibility to comply with requirements for looping waterlines. Where dead-ends are necessary they shall be provided with a fire hydrant, blow-off assembly, or automatic flushing assembly as directed by ACSA.

2.3 Flow Requirements

All distribution system additions shall be designed to provide a minimum residual pressure of twenty (20) pounds per square inch at all service connections. The design shall be based on the more restrictive condition of either the peak hour demand or the maximum daily demand plus applicable fire flows. The required fire flow is determined by the Albemarle County Department of Fire and Rescue.

To determine maximum daily demands and peak hourly demands the following multipliers shall be used:

Maximum Daily Demand (residential) = 1.8 times Average Daily Demand

Maximum Daily Demand (non-residential) = 1.3 times Average Daily Demand

Peak Hourly Demand = 2.7 times Average Daily Demand

In the design of new water distribution systems, a pipe friction factor of C=120 (as defined by the Hazen-Williams Equation) shall be used to calculate flow rates. The Developer's Engineer shall be responsible to properly design the water system. Hydraulic calculations for sizing the water system must be submitted to the ACSA for review.

2.4 Pipe Size

All waterlines shall be sized to adequately serve all the needs of the proposed subdivision or water system. The minimum size of the pipe where fire protection is to be provided or required shall be eight (8) inches in diameter. If a waterline will not be extended in the future and only serves a single fire hydrant, it may be six (6) inches in diameter. On dead end lines that will not be extended in the future, the waterline should be reduced to four (4) inches in diameter after the last fire hydrant.

ACSA may require a Developer to increase the size of the waterlines above what is required to serve the project in order to meet the overall needs of the area or to improve distribution system performance or reliability.

2.5 Depth of Cover

Water pipe shall be laid with a cover of three and one-half (3½) feet measured from established finished grade to the top of the pipe. For waterlines twelve (12) inches in diameter and larger, additional cover is required near gate valves to ensure that valve nuts have at least fourteen (14) inches of cover. Any potential changes in alignment or grade of roadways shall be considered in the original utility design. Excessive depth or loss of adequate cover will necessitate relocation or lowering of the water line. Every effort shall be made to maintain the finished grade to not exceed a trench depth of five (5) feet.

2.6 Pipe Deflection

Wherever it is necessary to deflect the pipe from a straight line, either in the vertical or horizontal plane, to avoid obstructions to plumb the line for valve installation, or where long-radius curves are permitted, the amount of deflection allowed shall not exceed the following table or 80% of the deflection allowed by the pipe manufacturer, whichever is less.

Pipe Size (inches)	Allowable Joint Deflection (degrees)	Minimum Allowable Radius (feet)	Offset per full length joint of pipe (inches)
4	4	286	17
6	4	286	17
8	4	286	17
10	4	286	17
12	4	286	17
16	3	382	13
18	3	382	13
20	2	573	8
24	2	573	8

2.7 Structural Design of Waterlines

The Developer's Engineer is responsible for the structural design of all waterlines and appurtenances. The table below lists the minimum allowable thickness class of ductile pipe for various sizes, but the Developer's Engineer shall determine if a thicker class of pipe should be utilized. The thickness class of all waterlines shall be identified on the Construction Plans.

Pipe Size (inches)	Minimum Thickness Class
4	53
6	52
8	52
10	52
12	51
16	50
18	50
20	50
24	50

2.7.1 Thrust Restraint

Waterlines and appurtenances shall be restrained against thrust forces and movement utilizing restrained joints. Unless otherwise approved by ACSA and specifically shown on the Construction Plans, all joints and fittings shall be restrained. Joints and fittings can be restrained with restrained push-on gaskets, specially designed push-on restrained joints or mechanical restrained joints. The method and all materials for restraint shall be approved by the pipe manufacturer.

Thrust blocking shall not be used unless approved by ACSA and specifically called out on the Construction Plans with the following exception: a thrust block shall be

poured behind the base of every fire hydrant as shown in Detail W-3. Fire hydrant leads shall also utilize restrained joints for every joint and fitting.

2.8 Separation from other Utilities

2.8.1 Separation from Sanitary Sewers

There shall be no physical connection between drinking water supplies and sewers or appurtenances. No sewer shall pass within 100 feet of a potable water supply well or other potable water supply source or structure unless special construction and/or pipe materials are used to obtain adequate protection. No water pipe shall pass through or come in contact with any part of a sewer manhole.

Parallel Installations

Water lines shall be laid at least ten (10) feet horizontally from a sewer or sewer manhole whenever possible; the distance shall be measured edge-to-edge.

When local conditions prevent a horizontal separation of ten (10) feet, the water line may be laid closer to a sewer or sewer manhole provided that the bottom (invert) of the waterline shall be at least eighteen (18) inches above the top (crown) of the sewer. Where this vertical separation cannot be obtained, the sewer shall be constructed of AWWA approved water distribution pipe, pressure tested in place without leakage prior to back-filling.

Any manhole within ten (10) feet of a waterline shall be of watertight construction and tested in place.

Crossing Installations

Waterlines crossing sewerlines shall be laid to provide a separation of at least eighteen (18) inches between the bottom of the waterline and the top of the sewerline. When local conditions prevent this vertical separation, the following construction shall be used:

1. Sewerlines shall be constructed of AWWA approved water distribution pipe and pressure tested in place without leakage prior to backfilling.
2. Sewer laterals shall be installed inside an appropriately sized Ductile Iron casing pipe, centered at the point of crossing.
3. Waterlines passing under sewers shall also be protected by providing:

    a) A vertical separation of at least eighteen (18) inches between the bottom of the sewer and the top of the waterline.

    b) Adequate structural support for the sewers to prevent excessive

deflection of the joints and the settling on and breaking of the waterline.

c) That the length of the water pipe be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewerline. The length of sewer pipe shall also be centered at the point of crossing, so that joints shall be equidistant and as far as possible from the waterline.

2.8.2 Horizontal Separation from other Utilities

Other utilities, excluding sanitary sewers, shall have a minimum of five (5) feet of horizontal separation with waterlines.

2.8.3 Vertical Separation from other Utilities

When other utilities, excluding sanitary sewers, must cross a waterline, eighteen (18) inches of vertical separation is preferred, with the other utility crossing below the waterline. If eighteen (18) inches of separation cannot be achieved, then twelve (12) inches of separation is acceptable.

Storm sewers will only be allowed to cross over waterlines when the storm sewer cannot be lowered to cross under the waterline. Avoiding lowering downstream sections of storm sewer is not an acceptable reason for a storm sewer to cross over a waterline.

When a storm sewer is crossing a waterline and the storm sewer cannot cross under the waterline with twelve (12) inches a separation, the required separation may be reduced to six (6) inches and the required cover over the waterline may be reduced to three (3) feet if these reductions allow the waterline to pass over the storm sewer.

2.8.4 Crossing Over or Under Culverts

The minimum vertical separation between a waterline and an open-ended culvert is twelve (12) inches with insulation to prevent freezing or twenty-four (24) inches without insulation. The type of insulation and the method of application shall conform to the manufacturer's published recommendation.

2.9 Installation Under Existing Roads

Waterlines under existing public highways shall be installed by open cutting if approved by VDOT. Otherwise, they shall be installed by bore and jacking with a spiral-welded steel casing pipe with a minimum thickness of one-half (1/2) inch. The casing pipe shall extend from back of curb to back of curb, beyond concrete or paved ditches, or a minimum of five (5) feet beyond the edge of pavement, whichever is greatest.

The steel casing pipe shall be no less than twice the diameter of the carrier pipe for water installations. All carrier pipe installed in steel casings shall be restrained joint ductile iron and shall be supported with steel casing spacers. See Detail W-15 for additional information.

Bore and jacking of pipe or tunneling under pavement shall be done only upon prior written approval by the ACSA. If any pipe is installed in this manner, the Contractor shall submit a detailed schedule of operation and shall show the equipment and the exact method to be used.

2.10 Pipeline Installation Under Railroads

Local railway companies require permits for any construction within the confines of their right-of-way limits or properties. All requirements relative to design and construction must be met prior to approval by the ACSA. Notice or verification of meeting such requirements shall be submitted to the ACSA with the Construction Plans. Approvals by the railway company involved and the ACSA are necessary prior to authorization of work to commence. See Detail W-16 for additional information.

2.11 Crossing Water Courses

Waterlines intended to cross streams, rivers, or other surface waters, either continuous or intermittent flows, present special problems and should be discussed with the ACSA and the VDH before final plans are prepared. The waterline shall be installed a minimum of five (5) feet under the stream or riverbed. Valves shall be provided at both ends of the water crossing so that the section can be isolated for tests or repairs; the valves shall be easily accessible and not subject to flooding. Permanent one (1) inch taps shall be made for testing and locating leaks at each end of the water crossing. The minimum thickness class for the pipe shall be Class 52. See Detail W-17 for additional information.

The Developer is reminded that specific requirements of the U.S. Army Corp of Engineers, DEQ, and/or VMRC may apply to perennial stream crossings. A joint permit application may be filed with VMRC for review of these agencies.

2.12 Appurtenances

2.12.1 Isolation Valves

Approved gate valves shall be installed at all pipe junctions and street intersections in such a manner as to control and cut off flows in all segments of the system. A minimum of three (3) valves are required at crosses and a minimum of two (2) valves are required at tees. The valves are to be placed on the smaller lines at each cross and tee location, unless otherwise approved by the ACSA. Additional valves may be required in many circumstances, such as in looped systems, where it is necessary to isolate limited areas. In other areas, valves will be required every 500 feet, except as may otherwise be approved by the ACSA. No valve shall be located under a concrete storm gutter, curb, or sidewalk.

Isolation valves will be gate valves for waterlines four (4) inches through twelve (12) inches in diameter. For waterlines larger than twelve (12) inches in diameter, butterfly valves may be used reduce the cover required over the waterline, if approved by ACSA. The type of valve shall be labeled on the Construction Plans for every valve.

2.12.2 Fire Hydrants

Fire hydrants shall be installed in such a manner as to provide the proper fire protection as approved by the County's Fire Official to all structures. Generally, fire hydrants shall be placed no closer than forty (40) feet to any major structure. Hydrants shall be placed every 500 feet measured along the centerline of the public right-of-way, private road, or other applicable access route. The maximum distance to a fire hydrant from any point on a dead-end street or road frontage shall be 200 feet. Where new waterlines are extended along streets where hydrants are not needed for fire protection, fire hydrants shall be provided at a spacing not to exceed 1,000 feet.

Fire hydrants shall be installed in areas where weep holes are above the prevailing groundwater table. Design elevations and the location of drainage structures shall be used to ensure the weep holes of the hydrant are not subject to groundwater immersion.

2.12.3 Blow-Offs

Provisions for flushing waterlines shall be made at all dead-ends and low points by means of a regular blow-off assembly or fire hydrant assembly, as directed by the ACSA. Blow-off assemblies shall be placed behind the curb. See Detail W-13 for additional information. Blow-off assemblies shall not be connected directly to any storm drain or sanitary sewer systems.

2.12.4 Air Release Valve Assemblies

Approved automatic air release valves shall be installed at the high points in the system when other means of removing air from the waterlines are not present. A one (1) inch diameter air release valve shall be used on waterlines smaller than twelve (12) inches in diameter. A two (2) inch diameter air release valve shall be used on waterlines equal to or larger than twelve (12) inches in diameter. All two (2) inch taps shall be made using saddles. See Detail W-14 for additional information.

2.12.5 Water Services and Meters

Water services are to be installed for all lots within the development and shall extend from the waterline to the property line of the lot or edge of the ACSA easement.

Detached single family and attached single family residences shall be served with a one (1) inch diameter water service and a three-quarter (¾) inch water meter. Two

(2) attached single-family residences can be served by a single one (1) inch water service as shown in Detail W-4.

Water meters that serve customers other than single family residences shall be sized by ACSA based on flow data provided by the Developer, typically plumbing fixture counts. Three-quarter (¾) inch and one (1) inch meters will be served by a one (1) inch water service as shown in Detail W-4. One and a half (1.5) inch and two (2) inch meters shall be served by a four (4) inch ductile iron water service that reduces to two (2) inch brass beyond the pavement or sidewalk as shown in Detail W-7. In lieu of a single three (3) inch meter, the typical installation shall be dual two (2) inch meters, each served by a separate four (4) inch ductile iron water service.

Meter boxes and meter vaults shall be in non-paved areas and outside of sidewalks. They should be located as close to the waterline as possible.

All irrigation systems shall be served by a separate water meter, sized based on system demand. Separate irrigation meters serving single family detached residences may be provided using the dual service detail shown in Detail W-4.

Pressure reducing valves shall be installed on the customer side of the meter by the builder or property owner when the service connection system pressure will be greater than eighty (80) psi. The pressure reducing valve shall be owned, operated and maintained by the property owner and shall be inspected by the County's building inspector.

2.12.6 Private Fire Protection Line

All fire sprinkler systems shall be designed with a gate valve at the connection with the ACSA waterline. This gate valve shall be restrained utilizing a method approved by the ACSA and will mark the end of the public water system (the valve is part of the public water system and owned by ACSA).

Private fire lines are required to have a private backflow prevention assembly installed prior to any branches or tees in the fire line. The maximum allowable distance between the ACSA gate valve and the backflow prevention assembly is seventy-five (75) feet, measured along the route of the water pipe.

2.13 Cross Connections and Backflow Prevention Assemblies

Any cross connection between the ACSA potable water system and a non-potable system, or between the ACSA potable water system and another system containing water of unknown or questionable quality, is strictly prohibited, except where an approved backflow prevention assembly has been installed, tested, and maintained.

The installation of an approved private backflow prevention assembly on a customer's Water Lateral, or within a customer's building, is required for all commercial, industrial, institutional, multi-family, irrigation, and fire suppression connections to the ACSA

distribution system. The backflow prevention assembly shall be installed after the water meter and before any branches or tees in the Water Lateral.

The installation, maintenance, and testing of a backflow prevention assembly on the customer's Water Lateral, or within the customer's building, shall be the sole responsibility of the customer. Backflow assembly inspection and testing must be coordinated with the County and ACSA.

2.14 Pressure Reducing Valve and Check Valve Vaults

The ACSA, during its plan review of proposed Construction Plans, may identify locations where the installation of a Master Pressure Reducing Valve Vault or a Master Check Valve Vault may be necessary to reduce the water pressure for an area, to reduce water age in an area, or to provide a redundant water supply to an area. All Pressure Reducing Valve Vaults and Master Check Valve Vaults shall be designed and constructed in close coordination with ACSA.

Part 3 – Design of Sewer Systems

The sanitary sewer system must be designed and constructed through the development to facilitate future extensions and connections to neighboring properties. Sanitary sewers shall be constructed beyond the proposed improvements within a development so that future extensions to adjoining properties will not disrupt improvements. Elevations of the sanitary sewer system must be designed such that future extensions are taken into consideration to allow service to entire area which naturally drains towards the system.

Sanitary sewers that are located on a parcel, only serve that parcel, and will not be extended in the future to serve other parcels shall be privately owned and maintained.

3.1 Location of Sewerlines

It is understood that topographic constraints dictate the appropriate location for installation of sanitary sewers. Sewers shall be designed to accommodate gravity sewer flow. Whenever possible, sanitary sewers shall be constructed within VDOT right-of-way or adjacent to the right-of-way. When sewers must be located in other locations, they should be located in common areas rather than on private lots whenever possible.

Sanitary manholes and surface structures should be located outside the roadway and beyond the back of the curb or ditch line whenever practicable. Connecting lines between manholes will be allowed under the pavement around curves. Special situations beyond these guidelines, including placing manholes under the pavement should be coordinated with ACSA and VDOT. The Developer's Engineer should provide supporting documentation for the design.

Whenever possible, sewers should not be in areas subject to flooding, in drainage ditches, or in any location that would encourage inflow and infiltration. Structures located by necessity in areas prone to inundation shall be provided with watertight covers.

3.2 Hydraulic Design

Sewer collection systems shall be designed to serve buildout of the planned development.

Hydraulic analysis of the sewer system should be completed using the Manning Formula with an "n" value of 0.014.

Projected flows should be based on the following table. When existing flows are unknown, the unit flows in the table should be used.

Discharge Facility	Contributing Design Units	Flow gpd	Flow duration, hrs.
Dwellings	Per unit	270	24
Schools w/ showers and cafeteria	Per person	16	8
Schools w/out showers w/ cafeteria	Per person	10	8
Boarding Schools	Per person	75	16
Motels @ 65 gal. per person (rooms only)	Per room	130	24
Trailer courts	Per trailer	270	24
Restaurants	Per seat	50	16
Interstate or through highway restaurants	Per seat	180	16
Interstate rest areas	Per person	5	24
Service Stations	Per vehicle served	10	16
Factories	Per person/per 8 hr shift	25	Match Shifts
Shopping centers	Per 1,000 square feet of ultimate floor space	250	12
Commercial Office	Per 1,000 square feet	90	12
Hospitals	Per bed	300	24
Nursing Homes	Per bed	200	24
Doctor's offices in medical centers	Per 1,000 square feet	500	12
Laundromats, 9-12 machines	Per machine	500	16
Community colleges	Per student & faculty	15	12
Swimming pools	Per swimmer	10	12
Theaters (drive-in type)	Per car	5	4
Theaters (auditorium type)	Per seat	5	12
Picnic areas	Per person	5	12
Camps, resort day & night w/ limited plumbing	Per camp site	50	24
Luxury camps w/ flush toilets	Per camp site	100	24

The minimum allowable peaking factors, of the average design flow, are shown in the table below.

Sewer Type	Min. Peaking Factor
Submain	400%
Main or Trunk	250%
Interceptor	200%

ACSA may require a Developer to increase the size of the sewerlines above what is required to serve the project to meet the overall needs of the area.

3.2.1 Downstream Improvements

If the projected flows from a development will cause any downstream sewerline to be at ninety percent (90%) or more of full pipe capacity during peak flows, as determined solely by ACSA, then the Developer shall be responsible for the design and construction of a larger replacement sewerline as part of their development. If a development is phased, the Developer shall design the replacement sewerline before Construction Plan approval of the portion of the development that causes the downstream sewerline to be at eighty percent (80%) of full pipe capacity. Similarly, the Developer shall construct the replacement sewerline before Initial Acceptance of the portion of the development that causes the downstream sewerline to be at ninety percent (90%) of full pipe capacity.

3.3 Minimum Size

The minimum size for public sewerlines shall be eight (8) inches in diameter. The minimum size for sewer lateral connections is four (4) inches in diameter.

The diameter of a sewerline should increase as its drainage area increases. A larger diameter pipe should not flow into a smaller diameter pipe.

3.4 Slope

Sewers shall have a uniform slope and straight alignment between manholes. Minimum grades are shown in the table below, but whenever possible, the slope on eight (8) inch sewerlines should be at least one percent (1.0%).

Sewer Diameter	Minimum Slope
8"	0.50%
10"	0.28%
12"	0.22%
14"	0.17%
15"	0.15%
18"	0.12%
21"	0.10%
24"	0.08%

Pipe sizes shall not be arbitrarily increased to take advantage of a flatter grade.

3.4.1 Sewers Exceeding Twenty Percent (20%) Slope

Whenever possible, sewers shall not be laid at slopes greater than twenty percent (20%). Sewers on a twenty percent (20%) slope or greater shall be anchored securely with concrete anchors and be constructed of C900 PVC or other abrasion-resistant

material shall be used (See Detail S-11). Anchor spacing shall be in accordance with the following table.

Sewer Slope	Required Anchor Spacing
20% to 35%	every other joint of pipe
35% or greater	every joint of pipe

The first anchor shall be placed on the first joint upstream from the lower manhole. The location of the first anchor and the maximum spacing required shall determine the number of anchors used between manholes.

The use of transition fittings at the upper and lower manholes along steep sewers shall be permitted as approved by the ACSA.

3.5 Structural Design and Pipe Material

The Developer's Engineer is responsible for the structural design of all sewerlines and appurtenances. SDR 26 and AWWA C900, Pressure Class 235, DR 18 are the only allowable classes of PVC sewer pipes. The minimum allowable thickness class for ductile iron sewerlines is Class 50. The Developer's Engineer shall determine if PVC SDR 26 or PVC C900 pipe is acceptable. If it is not, they shall determine the appropriate thickness class of ductile iron pipe. If a sewer has less than three (3) feet of cover, the pipe shall be Class 52 ductile iron and adequately protected.

Sewer Pipe Material	Acceptable Depth and Application
SDR 26 PVC	3 feet – 12 feet
C900 PVC	Greater than 12 feet, steep grades and velocities greater than 15 feet per second
DIP	Less than 3', stream crossings, aerial sewers, or as determined by ACSA

The pipe material shall be the same for the entire length of sewer pipe between manholes. The pipe material and thickness class of all sewer pipe shall be labelled on the Construction Plans.

3.6 Depth of Cover

Generally, sewerlines should be constructed with six (6) to eight (8) feet of cover. This typically allows the sewerlines to cross under waterlines with eighteen inches of clearance and to provide gravity sewer service to the primary floor of adjacent lots. Greater depths

may be required to provide service to adjacent properties or to serve lower-lying properties. Sewers with more than sixteen (16) feet of cover shall only be allowed when no practical alternative exists. The minimum allowable cover over sewerlines is three (3) feet. Only under extraordinary conditions shall any sewerline be installed with less than three (3) feet of cover.

3.7 Separation from other Utilities

See Part 2.8.1 regarding the separation requirements between waterlines and sanitary sewers.

Storm sewers and natural gas lines should have a minimum of ten (10) feet of horizontal separation with sanitary sewers, unless the other utility is installed below the sanitary sewer. In that instance, five (5) feet of horizontal separation is acceptable. Other utilities should have a minimum of five (5) feet of horizontal separation with sanitary sewers.

When other utilities cross a sewerline, eighteen (18) inches of vertical separation is preferred. If eighteen (18) inches of separation cannot be achieved, then twelve (12) inches of separation is acceptable.

3.8 Installation Under Existing Roads

Sanitary sewerlines under existing public highways shall be installed by open cutting if approved by VDOT. Otherwise, they shall be installed by bore and jacking with a spiral-welded steel casing pipe with a minimum thickness of one-half (1/2) inch. The casing pipe shall extend from back of curb to back of curb, beyond concrete or paved ditches, or a minimum of five (5) feet beyond the edge of pavement, whichever is greatest.

The steel casing pipe shall be no less than three (3) times the diameter of the carrier pipe for gravity sewer installations and two (2) times the diameter of the carrier pipe for force main installations. All gravity carrier pipe installed in steel casings shall be restrained joint AWWA C900, Pressure Class 235, DR 18 and shall be supported with steel casing spacers. All force main carrier pipe installed in steel casings shall be restrained joint ductile iron and shall be supported with steel casing spacers. See Detail S-12 for additional information.

Bore and jacking of pipe or tunneling under pavement shall be done only upon prior written approval by the ACSA. If any pipe is installed in this manner, the Contractor shall submit a detailed schedule of operation and shall show the equipment and the exact method to be used.

3.9 Pipeline Installation Under Railroads

Local railway companies require permits for any construction within the confines of their right-of-way limits or properties. All requirements relative to design and construction must be met prior to approval by the ACSA. Notice or verification of meeting such requirements

shall be submitted to the ACSA with the Construction Plans. Approvals by the railway company involved and the ACSA are necessary prior to authorization of work to commence.

The steel casing pipe shall be no less than three (3) times the diameter of the carrier pipe for gravity sewer installations. All gravity carrier pipe installed in steel casings shall be restrained joint AWWA C900, Pressure Class 235, DR 18 and shall be supported with steel casing spacers. All force main carrier pipe installed in steel casings shall be restrained joint ductile iron and shall be supported with steel casing spacers. See Detail S-13 for additional information.

3.10 Stream Crossings

Sewers crossing streams shall remain fully operational during flooding. Sewers shall be watertight when located within the 100-year Flood Plain. Sewers shall be constructed of watertight restrained joint ductile iron pipe from manhole to manhole. The pipe and joints shall be tested in place, shall exhibit zero infiltration, and shall be designed, constructed and protected against anticipated hydraulic and physical, longitudinal, vertical and horizontal loads and erosion and impact.

Where stream crossings are proposed below the channel, the tops of all sewers crossing streams shall be five (5) feet below the natural bottom of the stream to protect the sewerline. The sewer pipe shall be restrained joint ductile iron with a minimum thickness class of Class 52. See Detail S-14 for additional information.

Sewers laid on piers across ravines or streams shall be allowed only when it can be demonstrated that no other practical alternative exists. Construction methods and materials of construction shall be such that sewers will remain watertight and free from change in alignment or grade. Pier and pipeline design shall be prepared by a Professional Engineer and submitted to the ACSA for approval.

3.11 Manhole Requirements

Manholes shall be provided at all intersections with other sewerlines, at all points of change in alignment, change in sewerline grade, change in pipe material, and change in pipe size. The maximum distance between manholes shall be 400 feet. All sewerlines shall be straight between manholes. A manhole shall be constructed at the end of all lines, regardless of length.

Sewer manholes for sewers up to twenty-four (24) inch diameter shall not be less than forty-eight (48) inch inside diameter. Manholes for sewers larger than twenty-four (24) inches and up to forty-eight (48) inches shall have an inside diameter of not less than sixty (60) inches. The minimum angle between an incoming sewerline and the outgoing sewerline is ninety (90) degrees. The angles between incoming sewerlines shall be large enough that there is a minimum of six (6) inches of concrete between the two manholes cores on the interior wall of the manhole.

Incoming sewerlines, that are the same diameter, shall enter a manhole at the same invert elevation. If the incoming lines are different sizes, the crowns of the pipes shall be the same elevation. Typically, the outgoing pipe invert elevation shall be two tenths (0.2) of a foot below the lowest incoming pipe invert elevation. If the incoming and outgoing sewers are steep, the elevation drop across the manhole can match the slope of the sewers, up to maximum of a one (1) foot drop across the manhole.

Manhole top elevations shall be above the 100-year flood elevation or watertight. Manholes in unmaintained areas shall have top elevations six (6) inches above grade.

When a new sewerline needs to connect to an existing sewerline at a location between existing manholes, the standard practice shall be to cut in a new precast manhole. A doghouse manhole will only be allowed when cutting in a standard manhole is not practical, as determined solely by ACSA.

3.11.1 Drop Manhole Requirements

The use of drop manholes shall be minimized to the fullest extent possible. Ease of construction or cost of excavation are not acceptable reasons to utilize a drop manhole.

If a drop manhole is used in new construction, it shall be an internal drop manhole. Manholes with a sewerline internal drop connection shall have an inside diameter of at least sixty (60) inches. Manholes with two eight (8) inch diameter internal drop connections, a single ten (10) inch internal drop connection, or a single twelve (12) inch diameter internal drop connection shall have an inside diameter of at least seventy-two (72) inches.

If a sewerline internal drop connection needs to be added to an existing forty-eight (48) inch diameter manhole, the manhole shall be replaced with a larger diameter manhole. An external drop connection shall only be allowed when adding a drop sewerline connection to an existing manhole and the replacement of the existing manhole is not feasible. One (1) sewer lateral internal drop connection is allowed in an existing forty-eight (48) inch diameter manhole.

3.11.2 Ventilation

Ventilation of gravity sewers shall be provided where continuous watertight sections greater than 1,000 feet in length are incurred. Vents shall be protected against the 100-year flood either by elevation or mechanical means.

3.12 Sewer Laterals

A sewer lateral shall be required for each customer and/or lot, unless otherwise approved by the ACSA. Sewer laterals shall be constructed to the property line or edge of the ACSA easement and sealed until said sewer lateral is put in use. In no case shall the gravity lateral

be less than four (4) inches in diameter. All sewer laterals shall be privately owned from the point of connection at the sewerline or manhole, to the structure served.

When new sewerlines are installed, sewer laterals shall connect to the sewerline with an inline tee-wye fitting. When a new sewer lateral connects to an existing sewerline, it shall connect to the sewerline utilizing an approved saddle. If multiple new sewer lateral connections are proposed on an existing run of sewerline, ACSA may require the sewerline to be replaced with tee-wye fittings rather than having multiple saddles installed on the existing sewerline.

Private force mains smaller than four inches in diameter conveying wastewater from a grinder pump shall connect to a ten-foot section of four (4) inch diameter gravity sewer lateral before connecting to the ACSA sewerline or manhole, unless field conditions dictate otherwise (See Detail S-10).

Sewer lateral connections to sewerlines eighteen (18) inches in diameter, or larger, shall only be made at manholes. If necessary, a new manhole shall be installed on the existing sewerline to accommodate a new connection.

No sewer lateral connections shall be allowed on sewerlines with more than fifteen (15) feet of cover. A sewer lateral connection can be made at a manhole but a parallel sewer that has less cover may need to be installed to accommodate multiple sewer laterals.

3.13 Protection of Potable Water

The proposed design shall identify and adequately address the protection of all potable water supply structures within 100 feet of the proposed project.

3.14 Industrial Waste

Sources of waste other than domestic sewage shall be evaluated on an individual basis and plans of all industrial or commercial pretreatment facilities shall be reviewed by the ACSA in accordance with current ACSA and RWSA regulations.

3.15 Grease Control Devices

The installation of a grease control device is mandated for most restaurants and other food service establishments by Section 19 of the ACSA Rules and Regulations. Details of the design, sizing, and installation requirements of grease traps and grease interceptors is found in Section 19.

A grease control device shall receive the discharge of only gray water associated with kitchen activities. All other domestic wastewater shall drain separately from the facility and enter the sewer lateral downstream from the grease control device discharge.

Part 4 – Water System Materials

4.1 Water Pipe Material and Jointing

All pipe shall be approved by the ACSA.

Unless otherwise approved in writing by the ACSA, all waterlines and distribution lines shall be of the material herein listed. The ACSA reserves the right to select the type and/or class material which shall be used.

4.1.1 Ductile Iron Pipe and Fittings

Ductile iron pipe shall be centrifugally cast pipe manufactured in accordance with AWWA C151, current revision. The joints shall be push-on, mechanical or flanged in accordance with AWWA C111, current revision. All ductile iron pipe shall have a cement mortar lining in accordance with AWWA C104, current revision.

Ductile iron fittings shall have standard mechanical joints manufactured in accordance with AWWA C110, current revision, or AWWA C153, current revision. All fittings shall be cement mortar lined inside in accordance with AWWA C104, current revision.

The exterior surface of all ductile iron pipe and fittings shall be coated with arc-sprayed zinc per ISO 8179. The application rate shall be a minimum of 200 grams per square meter of pipe surface area. A finishing layer topcoat shall be applied to the zinc.

4.1.2 Copper Pipe and Fittings

Copper pipe for Water Services shall be soft type "k" copper with standard water works flare or compression fittings.

4.1.3 Brass Pipe and Fittings

Brass pipe and fittings shall conform to ASTM B-43, current revision, and shall only be used for two (2) inch diameter Type A blow-off assembly piping, piping to one and one-half (1.5) inch and two (2) inch meters, or for piping in two (2) inch air release valve assemblies. Brass pipe threads shall conform to ASME B1.20.1, current revision.

4.1.4 Jointing

Jointing of all pipes shall conform to the manufacturer's published recommendations and specifications. Gaskets for water pipe and fittings shall be vulcanized natural or vulcanized synthetic rubber, free of porous areas, foreign material, or visible defects. Rubber gaskets shall conform to all applicable provisions of AWWA C111, current revisions. Gaskets shall be protected from exposure to excessive heat and cold, direct

sunlight, ozone (from electric motors and equipment), oil, grease or other contaminants.

4.2 Valves and Accessories

4.2.1 Gate Valves

Gate valves shall be resilient seated. They shall be non-rising stem, fully encapsulated wedge in accordance with AWWA C509 or AWWA C515, current revision.

Gate valves shall be one make and shall open by a counterclockwise rotation of the valve stem with a two (2) inch square operating nut. Operating nuts placed greater than five (5) feet below finished ground shall be equipped with approved operating nut extensions to meet the minimum depth requirement.

Gate valves fourteen (14) inches and larger shall have a working pressure of no less than 250 psi and a test pressure of 300 psi. Four (4) inch to twelve (12) inch gate valves shall have a working pressure of no less than 250 psi and a test pressure of 400 psi. Gate valves shall have one O-ring above and one O-ring below the stem thrust collar. The thrust collar shall be lubricated with oil to ensure positive operation in opening and closing.

4.2.2 Butterfly Valves

Butterfly valves shall be designed, manufactured, and tested in accordance with the provisions and requirements of AWWA C504, current revision. All valves shall be drop-tight when subjected to the specified working pressure (differential pressure), and all valves shall be capable of drop-tight seating under bidirectional flow conditions (maximum working pressure applied as differential pressure from either direction). All valves shall open counterclockwise.

Operator extension, valve box, indicator, and cover shall be provided for each valve. Operating nuts placed greater than five (5) feet below finished ground shall be equipped with approved operating nut extensions to meet the minimum depth requirement.

4.2.3 Tapping Valves

Tapping valves shall meet the same specifications as gate valves, except they shall have a full, unobstructed opening to receive a full-size shell cutter. They shall have a standard mechanical joint on one end and a flanged joint on the other end.

4.2.4 Tapping Sleeves

Tapping sleeves may be split sleeve with mechanical joint type end seals or stainless-steel meeting the requirements of AWWA C223, current revision. They shall have the same working and test pressures as noted for the gate valves.

4.2.5 Check Valves

Check valves shall be designed for 250 psi working pressures and 350 psi test pressures for sizes up to twelve (12) inches. Check valves from fourteen (14) inches to twenty-four (24) inches shall have an opening suitable for cleaning without disconnecting from the pipe. Check valves shall conform to AWWA C-508, current revision.

4.2.6 Valve Boxes

Each valve on underground piping shall be provided with a screw-type, adjustable, cast-iron, heavy-duty traffic-rated, valve box. They shall have a round shaft five and one-quarter (5 ¼) inch inside diameter, a flared base, and a coat of bituminous paint applied to both surfaces. Also, the lid shall be cast iron, round, and have the word "Water" cast on it.

Riser rings for valve boxes shall have an internal set screw.

4.3 Fire Hydrants

Hydrants shall be manufactured in accordance with AWWA C502, current revision, and shall be approved by the National Board of Fire Underwriters. Hydrants shall have a six (6) inch barrel with five and one-quarter (5¼) inch clear opening through the valve and shall be provided with a four and one-half (4½) inch pumper connection and two (2) two and one-half (2½) inch inner diameter hose connections.

Hydrants shall be of the frost-proof and non-flooding type which will not flood in case the barrel or valve stem is damaged, with orifices for draining the hydrant when the valve is closed. Hydrants shall have a forty-two (42) inch minimum bury and be designed for 150 psi working pressure and 300 psi hydrostatic pressure. All working parts shall be bronze to bronze. All hydrants shall open counterclockwise and be preceded in the line by a gate valve. The pumper connection shall face the roadway. Fire hydrants shall have a moisture-proof chamber around operating threads filled with USDA H-1 food grade oil or grease which shall lubricate the threads.

The threads on the four and one-half (4½) inch pumper (steamer) connection and on the operating nut shall be National Standard threads. The threads on the hose connections shall be Albemarle County Service Authority standard thread (Charlottesville thread), 3-21/64" female, 3-9/32" male, eight threads per inch (Gauge 8-322) except for the Scottsville service area which are National Standard threads. All threads shall be thoroughly lubricated with a food grade lubricant. All male connections shall have caps. The cap nuts and the operating nut shall be a one and one-half (1 ½) inch pentagon and shall open counterclockwise.

4.4 Blow-Off Assemblies

All pipe work for the hydrant blow-off assemblies shall conform in all respects to applicable portions of these specifications and to the Construction Plans.

Dead-end blow-off assemblies (Type A) shall be installed as shown. Blow-off lines shall be two (2) inch diameter brass pipe. A brass nipple shall be provided at the end of the assembly with a PVC threaded cap. The threads between the nipple and the cap shall be lubricated before installation to allow removal when needed. Gate valves and boxes shall be of the type described in the applicable sections of these specifications.

4.5 Air Release Valve Assemblies

Each assembly shall consist of a corporation stop, riser pipe, ball valve, fittings, and either a precast concrete manhole cone section (including frame and cover with the word "WATER" cast on it), or a meter box depending upon traffic loading or location requirements. The riser shall be Type K copper for one (1) inch air release valves or brass pipe for two (2) inch air release valves and shall be installed with a continuous rise from the pipe to the air release valve. Fittings shall be brass or bronze. See Detail W-14 for additional information.

Air release valve assemblies shall not be connected directly to any storm drain or sanitary sewer systems

4.6 Corporation Stops

All corporation stops shall have ball style valves and have a pressure rating of 300 psi.

4.7 Coppersetters

All three-quarter (3/4) inch and one (1) inch water meters shall be placed in a horizontal inlet and outlet coppersetter. The coppersetter shall have a multi-purpose connection on the customer side and the supply side. It shall also have a lock-winged ball valve on the supply side and a ball valve on the customer side.

All one and one-half (1½) inch and two (2) inch water meters shall be placed in a horizontal inlet and outlet two-inch coppersetter. The coppersetter shall have FIP threads on the customer side and the supply side. It shall also have a lock-winged ball valve on the supply side and a ball valve on the customer side. The coppersetter shall be fifteen (15) inches tall.

4.8 Meter Boxes and Meter Vaults

4.8.1 Meter Boxes

All meter boxes shall have non-locking lids and will be used for water meters up to and including one (1) inch in size. See Detail W-5 for additional information. Lids shall be provided with a two (2) inch recessed hole tapped into the lid. Blind taps or plugs shall be provided to prevent debris from entering the box prior to use. The

Contractor must ensure a clear two (2) inch opening where the hole is cast into the lid to accommodate a touch read sensor.

4.8.2 Meter Vaults

1½" and 2" Meters

Meter vaults shall be heavy duty monolithic boxes with a nominal size of twenty-four (24) inches wide, thirty-six (36) inches long and twenty-four (24) inches tall. The base shall flare out. The box and lid shall be rated for ANSI/SCTE Tier 15 loading. The lid shall have a two (2) inch diameter hole. See Details W-8 and W-9 for additional information.

Meters 3" and Larger

A concrete structure shall be used for meters three (3) inches or larger. The outside shall be waterproofed with a tar-based paint or approved equal. Sleeves will be required around the water pipe entering and leaving the vault. The openings around the sleeves shall be sealed against water seepage. A positive drain extending to grade, or a sump pump shall be provided, whichever is more practical. A sump shall be located on the side of the vault with the floor sloping to it. The top shall be made of reinforced concrete or metal with two (2) metal door inserts. In any case, the access doors must be waterproof, air-tight, two (2) feet by three (3) feet in size, one (1) located over the meter and the other against a wall, and easy for one (1) person to lift. The door located over the meter shall be provided with a two (2) inch hole, properly plugged, for future installation of a Touch-Read sensor. Doors shall have a lift handle and hinges. See Details W-10, W-11, and W-12 for additional information.

Part 5 – Sewer System Materials

5.1 General Requirements

Unless otherwise approved in writing by the ACSA all sanitary sewerlines and appurtenances shall be of the material herein listed. The ACSA reserves the right to select the type and/or class material which shall be used.

5.2 Sewerlines

5.2.1 Ductile Iron Pipe and Fittings

Ductile iron pipe shall be centrifugally cast pipe manufactured in accordance with AWWA C151, current revision. All ductile iron pipe shall have a cement mortar lining and a seal coat of asphaltic material in accordance with AWWA C104, current revision.

Fittings shall be standard mechanical joint fittings in accordance with AWWA C110 current revision, AWWA C153, current revision and AWWA C111, current revision. All fittings shall be cement mortar lined inside and have a seal coat of asphaltic material in accordance with AWWA C104, current revision.

Ductile iron pipe and fittings for both gravity sewerlines and sewer force mains shall have an interior epoxy coating that is resistant to hydrogen sulfide corrosion. The lining shall be applied by a certified firm with a successful history of applying linings to the interior of ductile iron pipe and fittings. The lining shall have a nominal dry thickness of forty (40) mils and shall be applied in strict conformance with the manufacturer's requirements regarding surface preparation, temperature, and number of coats.

5.2.2 Polyvinyl Chloride (PVC) Pipe

SDR 26 Heavy Wall PVC

PVC pipe shall only be used for non-pressure sewerlines. PVC gravity sewer pipe shall be manufactured of compounds conforming to ASTM D-1784, current revision. Pipe and fittings shall meet and/or exceed all the requirements of ASTM D-3034, current revision, for SDR 26 heavy wall PVC.

AWWA C900, Pressure Class 235, DR 18

C900 PVC gravity and pressure pipe shall comply at a minimum with AWWA C900, Pressure Class 235, DR 18, unless otherwise approved by ACSA, and shall be green for sewer applications. PVC shall be supplied in minimum 20-foot lengths with bell end with gasket and spigot end joints. Pipe shall also meet all applicable ASTM Standards,

including ASTM D2122, ASTM 3034, and ASTM D3139. 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.

PVC pipe shall be shipped and stored so that warping of pipe does not occur. PVC pipe to be stored outside should be covered to protect it against the sun's rays, per manufacturer's published recommendation.

Certificates of compliance with applicable ASTM designations and strength classifications covering the pipe, joints, gaskets, and fittings will be required directly from the pipe manufacturer as deemed necessary by the ACSA.

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.

5.2.3 Joints

Jointing of ductile iron and PVC pipe shall conform to the manufacturer's published recommendations and specifications.

Joints in sewer pipe shall conform to the following:

Ductile Iron Pipe

Gravity Sewers without Restrained Joints: Push-on joints in accordance with AWWA C111, current revision.

Sewer Force Mains and Gravity Sewers with Restrained Joints: All joints and fittings in sewer force mains shall be restrained. Restrained joints can be restrained utilizing restrained push-on joint gaskets, specially designed push-on restrained joints or mechanical restrained joints as long as the method of restraint is approved by the pipe manufacturer and meets AWWA C111, current revision.

Polyvinyl Chloride Pipe

Gravity Sewers without Restrained Joints: PVC pipe shall be joined by bell and spigot type connections. The pipe joint shall be tightly sealed against infiltration and exfiltration by means of a locked-in rubber sealing ring conforming to ASTM D-3212, current revision. The connection shall also permit the thermal expansion or contraction of the pipe.

Gravity Sewers with Restrained Joints: PVC pipe requiring restraint must be installed in accordance with AWWA C900, current revision, manufacturer's recommendations, and approved by the ACSA.

5.2.4 Gaskets

Gaskets for sewer pipe and fittings shall be vulcanized natural or vulcanized synthetic rubber free of porous areas, foreign material or visible defects. Rubber gaskets for ductile iron pipe shall conform to all applicable provisions of AWWA C111, current revision.

Gaskets shall be protected from exposure to excessive heat, cold, direct sunlight, ozone (from electric motors and equipment), oil, grease, or other contaminants.

5.3 Precast Concrete Manholes

5.3.1 General Information

Manholes shall be constructed of precast reinforced concrete manhole sections conforming to ASTM C-478, current revision. Manholes will be required to have a flexible boot connection at the pipe entry to prevent infiltration.

The minimum inside diameter of the manhole shall conform to the requirements of Section 3.11, unless otherwise approved by the ACSA.

The uppermost section of the manhole shall be tapered eccentrically and shall be a minimum of three (3) feet in height. Where field conditions dictate their use, "flat top" manhole sections can be utilized with the approval of the ACSA. The height of the base section of the manhole shall be at least three (3) times the diameter of the largest sewer pipe entering the section and in no case less than two (2) feet.

5.3.2 Concrete

The walls of the manholes shall have a minimum thickness of five (5) inches and shall be constructed of reinforced concrete with a compressive strength of 3000 psi at twenty-eight (28) days. If the manhole bottom is not monolithically molded with the walls, a concrete floor slab shall be provided with a minimum thickness of twelve (12) inches and a minimum outside diameter of five (5) feet, ten (10) inches. The concrete shall have a minimum compressive strength of 3000 psi at twenty-eight (28) days.

5.3.3 Joints

The joints between manhole sections shall be tongue and groove with an O-ring rubber gasket or "STEP" section with sliding flap seal ring, conforming to ASTM designation C-443, current revision. Jointing of the precast manhole sections shall conform to the manufacturer's published recommendations and specifications. A flexible joint sealant may be required between precast manhole sections.

5.3.4 External Sealant

The entire exterior surface of all manholes shall be coated with a coal-tar epoxy type bituminous coating to a minimum thickness of twenty-three (23) mils. An external wrap shall be used at all joints where precast concrete manhole sections join. The wrap shall be made of a stretchable, self-shrinking, intra-curing halogenated based rubber with a minimum thickness of thirty (30) mils and a minimum width of twelve (12) inches. The wrap shall have a non-hardening butyl adhesive backing used to attach the wrap to the structure. The external wrap shall meet or exceed the requirements of ASTM C877 Type III and C990-o1a, current revisions. All external sealants shall be applied in strict conformance with manufacturer's recommendations.

5.3.5 Steps

Manhole steps shall be designed for installation in a sanitary sewer and shall be steel encapsulated in corrosion resistant rubber and shall be in accordance with OSHA standards and ASTM C-478, current revision. Manhole steps shall be a minimum of ten (10) inches wide and shall project no less than five (5) and no more than seven (7) inches from the wall. Vertical spacing of manhole steps shall be uniform with a maximum of sixteen (16) inches and a minimum of twelve (12) inches.

5.3.6 Inverts

Standard practice shall be for the manhole inverts and benches to be provided from the precast manhole manufacturer. All flow lines shall be constructed through manholes to a minimum of three-fourths (3/4) the depth of the largest contributing sewerline. Inverts shall be true to line and grade with flow lines having the fall that is specified in the Construction Plans.

If the inverts and channels are constructed in the field, the sides of flow lines shall be built up with low slump concrete to provide a smooth channel and prevent solids deposition. No filler material is allowed when constructing inverts and channels. Manhole benches shall be sloped to drain to flow lines.

5.4 Frames and Covers

Manhole frames and covers shall be heavy duty, traffic-rated, gray cast iron. Frame and cover castings shall conform to the details and dimensions shown in these specifications and shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow-holes, and other defects in positions affecting their strength and value for the use intended. They shall be boldly filleted on angles and the arises shall be sharp and perfect. They shall be sand blasted or otherwise cleaned or scaled to present a smooth, clean, and uniform surface.

Standard and watertight manhole covers shall have no pick holes. The marking "Sewer" must be cast in their body. Watertight manhole covers provided with locking lugs or similar restraints shall be required in all low-lying areas subject to flooding and as required by the ACSA.

Part 6 – General Construction Requirements

6.1 Safety of Public

Construction operations shall be scheduled to interfere as little as possible with public travel, whether vehicular or pedestrian. Whenever it is necessary to cross or interfere with roads, driveways, and walkways, whether public or private, suitable and safe bridges, detours, or other temporary provisions for the accommodation of public and private travel shall be provided and maintained. Reasonable notice shall be given to owners of private driveways before disturbing the driveway. The Contractor shall designate a safety officer from their staff to be responsible for their operation. The Contractor shall adhere to all VDOT requirements when working in the public right-of-way.

6.2 Protection of Existing Facilities

All construction operations in the vicinity of other existing utilities shall be performed with great care to prevent damage to these utilities. Prior to construction operations commencing, all utility companies shall be requested to verify location of their utilities in the field. It shall be the Contractor's responsibility to conduct the work in such a manner as to avoid damage to, or interference with, other utilities. If damage or interruption of service occurs because of their work, it is the Contractor's responsibility to promptly notify the ACSA inspector and the utility owner and to repair or correct it immediately at the Contractor's expense and to the satisfaction of the ACSA and the utility owner.

In accordance with the Underground Utility Damage Prevention Act and specifically Section 56-265.17 of the Virginia Code, no person shall begin or make any excavation or demolition without making required notification.

6.3 Pipeline Installation in VDOT Right-Of-Way

Work in public right-of-way shall be subject to VDOT approval. A VDOT Land Use Permit must be obtained before beginning any work. Permit requirements are outlined in the VDOT Land Use Permit Manual, current revision. The VDOT Regional Traffic Operations Center shall be contacted for all work in VDOT right-of-way. No work will be authorized by the ACSA that has not been approved by VDOT. VDOT Specifications regarding work within public right-of-way shall govern this work and where there is a conflict between the VDOT specifications and these specifications, the more stringent requirement shall apply.

Construction operations in public streets, roads, or alleys shall be confined to as small a working space as practical so as not to cause undue inconvenience to the public or to adjacent properties. At the time of undertaking the work, the Contractor shall comply with all VDOT notification requirements in advance of construction.

6.3.1 Pavement and Shoulder Replacement

The work includes the replacement of all pavement and shoulders removed or damaged by the Contractor during construction. All work replaced shall match the existing work as nearly as practicable. Materials to be replaced shall be as required in the VDOT Land Use Permit, but no less than one and one-half (1½) times the thickness of the component layers removed and shall be in accordance with the VDOT Road and Bridge Specifications, latest revision.

6.4 Blasting

Blasting, where required, shall be done with care by skilled and experienced blasters and in accordance with all applicable Federal, State, and local laws, ordinances, rules, and regulations. A blasting permit must be obtained from Albemarle County Fire Rescue prior to commencing the work. All Federal, State, and local regulations governing construction safety shall be adhered to and any violation of such regulations shall be deemed the sole responsibility of the Contractor and Developer. Proper notification shall be given to the ACSA and the public prior to the commencement of blasting operations. Blasting on Saturdays, Sundays, and holidays will only be permitted with written permission from the ACSA.

Precautions shall be taken to prevent injury to persons and damage to property. No blasting shall be done within twenty-five (25) feet of any completed work or adjacent to any other structures or ACSA infrastructure. Ends of utility lines adjacent to the blasting area shall be covered to avoid debris and damage. Any damage because of blasting operations shall be the sole responsibility of the Contractor and Developer.

6.5 Restoration

The Contractor shall restore all surfaces disturbed by their operations to a condition at least equal to that which existed prior to commencement of the work. Restoration work shall be commenced immediately following the completion of the work on any section of the project.

All drainage structures shall be restored using like materials and details. All ditches shall be restored to the prior existing grade and cross section. All pavement, walks, curbs, gutters, and entrances removed or damaged by the Contractor shall be replaced to equal or better condition. All public streets, roads, and highways shall be restored as required by VDOT. All private streets shall be restored to VDOT standards with materials one and one-half (1½) times the thickness of the surface disturbed.

Work performed on private property shall be confined to the easements obtained and the area shall be seeded or sodded. Landscaping, fences, or other improvements shall be restored, where applicable, to their original condition.

The Developer shall be responsible for all restoration necessary because of the Contractor's operations for the period of one (1) year following Final Acceptance of the Facilities by the ACSA.

6.6 Erosion Control

Prior to beginning any land disturbing activity, the Developer and Contractor shall obtain all required stormwater management and soil erosion control permits from the Albemarle County Department of Community Development. Special precaution shall be taken for activities occurring within the drainage basin of any water supply impoundment.

Part 7 – Water System Construction

Construction of waterlines and appurtenances shall be in accordance with the approved Construction Plans. The ACSA shall insist that good workmanship and standard waterline construction principles are used in the construction of the Facilities. ACSA reserves the right to refuse acceptance of the Facilities if there are concerns regarding the materials, construction methods, or workmanship.

Waterlines shall be installed and maintained to the required lines and grades with fittings, valves, hydrants, and accessories set at the required locations as indicated on the Construction Plans. The Contractor shall establish adequate elevation control to ensure that, upon final grading, a minimum of forty-two (42) inches of cover over the waterlines is maintained. It shall be the Contractor's responsibility and expense to verify the cover at any location questioned by the ACSA. No waterline shall terminate under a curb, gutter, ditch, or storm drainage structure.

Wherever obstructions are encountered during progress of the work, the ACSA or its representative shall be advised. If any deviation is contemplated from the approved Construction Plans, details shall be submitted for review and approval before construction. Verbal approval may be granted for minor alterations. Major alterations will require written approval. The severity of the alteration and its remedial action shall be determined by the ACSA.

7.1 Handling of Materials

Pipe, fittings, valves, hydrants, and accessories shall be loaded and unloaded by lifting with hoists or skidding to avoid shock or damage. Under no circumstances shall they be dropped. Pipe shall not be skidded or rolled against pipe already on the ground. Pipe shall be handled so that the coating and lining are not damaged. ACSA, at its sole discretion, has the right to reject any materials.

7.2 Tapping Waterlines

All tapping of existing waterlines shall be accomplished with ACSA forces or an approved contractor. Taps shall be located at least eighteen (18) inches from a fitting or joint. Tapping procedures shall be in accordance with the manufacturer's published recommendations. Tapping sleeves and valves shall be used on four (4) inch or larger taps. All two (2) inch taps for Air Release Valves shall be made using saddles.

Tapping sleeves shall be subjected to an air pressure test or a hydrostatic pressure test prior to making the tap. For an air pressure test, the sleeve shall hold thirty-five (35) psi of pressure for a duration of five (5) minutes. For a hydrostatic pressure test, the sleeve shall hold 200 psi of pressure for 120 minutes.

7.2.1 Special Requirements for Tapping PVC Pipe

1. Only one (1) tap shall be located in a common line parallel to the longitudinal axis.

2. When multiple taps are necessary on the same joint of pipe, they shall be located on slightly different planes and separated by at least three (3) feet.
3. Saddles shall be used on all taps.
4. Tapping sleeves shall be supported by a concrete pad, cast in-place, prior to the tap being made. Alternatively, a concrete block may be used instead of the concrete pad. A concrete thrust block shall also be provided behind the tapping sleeve.
5. No taps shall be made where the pipe is discolored.
6. The pipe shall be tapped only when the ambient temperatures fall within the following range:

Connection	Minimum	Maximum
Dry Taps	0° F (-18° C)	100° F (38° C)
Wet Taps	32° F (0° C)	90° F (32° C)

7.2.2 Special Requirements for Tapping Asbestos-Cement (AC) Pipe

1. Only one (1) tap shall be located in a common line parallel to the longitudinal axis.
2. When multiple taps are necessary on the same joint of pipe, they shall be located on slightly different planes and separated by at least three (3) feet.
3. Saddles shall be used on all taps.
4. Tapping sleeves shall be supported by a concrete pad, cast in-place, prior to the tap being made. Alternatively, a concrete block may be used instead of the concrete pad. A concrete thrust block shall also be provided behind the tapping sleeve.
5. Special precautions shall be taken preparing and tapping AC pipe. The EPA has recognized asbestos as presenting a cancer or lung disease health hazard. The EPA in conjunction with the OSHA have established regulations to address asbestos exposure. 29 CFR 1926.1101 addresses asbestos in the construction industry and 29 CFR 1910.134 addresses the use of respirators approved for use working with asbestos products. Any Contractor working with or around asbestos-cement pipe shall be familiar with and abide by these regulations.

7.3 Excavation

Waterline construction shall be made by open cut unless otherwise specified or required. All open trenches shall be adequately shored and braced to provide a safe working environment. It is the Contractor's responsibility to comply with the requirements of OSHA as pertaining to people working in an open trench.

During the excavation operations, material suitable for backfilling shall be piled in an orderly manner a sufficient distance from the banks of the trench to avoid overloading and

to prevent slides or cave-ins. All excavated material not suitable for backfill shall be removed and disposed of in an acceptable manner. The trench shall be kept free of water during the laying operation and any water accumulating therein shall be removed by approved methods. No more than one hundred (100) feet of trench shall be opened in advance of the installed waterline when located along streets or highways, and no more than two hundred (200) feet at other locations.

7.3.1 Construction in Fill Areas

Where pipelines are to be installed in fill areas, the fill shall be compacted to ninety-five percent (95%) of the optimum density as determined by AASHTO T-99 before excavation begins for the pipe trench. Certification shall be required of all compaction in fill areas, at intervals as directed by the ACSA. This certification shall be signed by a Professional Geologist or a Professional Engineer and shall state the exact area the certification applies to.

7.3.2 Trench Size

Whenever the trench depth is less than five (5) feet, the trench width shall be as narrow as is practicable to permit the pipe to be laid and joined properly, and to permit the backfill to be placed and compacted properly. In general, the clear width of the trench at an elevation of one (1) foot above the top of the pipe shall be approximately equal to the external diameter of the pipe plus sixteen (16) inches. The provisions of this section shall not relieve the Contractor from responsibility to ensure all trenching methods are in accordance with the appropriate safety requirements and the applicable OSHA regulations. Whenever the trench depth exceeds five (5) feet, approved shoring or trench boxes shall be used.

7.3.3 Rock Excavation

Where rock is encountered in trench excavation, whether solid or in the form of loose rock, shale, or large boulders, it shall be removed by approved methods to the extent that no projection of rock shall be nearer than six (6) inches to any part of the water pipe, valves and fittings when laid, nor project beyond the lines and grades of structures.

7.3.4 Over Excavation

Where the excavation has been carried too deep, the Contractor shall refill the over-excavated trench with VDOT No. 57 or No. 68 stone to the required depth.

7.4 Pipe Foundation

The trench shall be excavated to a depth required to provide a uniform and continuous bearing and support for the pipe. It shall be permissible to disrupt the finished surface of the trench over a maximum length of eighteen (18) inches near the middle of each length of

pipe for the withdrawal of pipe slings or other lifting tackle. The finished subgrade shall be prepared accurately by means of hand tools.

See Detail W-1 for bedding requirements for different soil conditions. Whenever the soil at the bottom of the trench is soft, unstable, or saturated with water, VDOT No. 57 or No. 68 stone shall be placed as bedding to the depth required to stabilize the soil and shall be thoroughly compacted. If necessary, a suitable foundation shall be established prior to placement of bedding material. The bedding material shall extend evenly to the trench wall. See Detail W-1 for additional information.

7.5 Pipe Installation

Ductile iron pipe shall be installed in accordance with AWWA C600, current revision. When installing pipe in the trench, proper implements, tools, and equipment, satisfactory to the ACSA and as recommended by the material manufacturer, shall be provided and used by the Contractor for the safe and convenient prosecution of the work. All pipe, valves, fittings, hydrants, and accessories shall be carefully lowered into the trench piece by piece by means of a derrick, ropes, slings, or other suitable tools or equipment in such a manner as to prevent damage to the waterline materials and any protective coatings and linings. Under no circumstances shall waterline materials be dropped or dumped into the trench. The exposed end of all pipes shall be fully closed by means of an approved stopper or plug to prevent earth, water, or other substances from entering the pipe.

All pipe joints and connections to fittings and appurtenances shall be restrained from thrust forces and movement utilizing restrained joints. Joints can be retrained utilizing restrained push-on joint gaskets, specially designed push-on restrained joints or mechanical restrained joints as long as the method of restraint is approved by the pipe manufacturer.

7.5.1 Condition of Pipe

All lumps, blisters, and excess coal tar coating shall be removed from the ends of each pipe. The outside of the spigot and the inside of the bell shall be thoroughly cleaned and be free from oil and grease before the pipe is joined.

7.5.2 Special Precautions

The Contractor shall visually examine each joint of pipe to prevent foreign material from entering the pipe while it is being placed in the trench. During the laying operations, no debris, tools, clothing, or other materials shall be placed in the pipe. Water lines shall be plugged at the end of each construction day to prevent foreign matter from entering them.

7.5.3 Cutting of Pipe

The cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or cement lining and to leave a smooth end at right angles to the axis of the pipe.

When machine cutting is not available for cutting pipe twenty (20) inches in diameter or larger, the electric-arc cutting method will be permitted using a carbon or steel rod. Only qualified and experienced workmen shall undertake this work. The flame cutting of pipe by means of an acetylene torch shall not be allowed.

7.5.4 Pipe Deflection

See Section 2.5 for allowable joint deflection of ductile iron waterline. Pipe should not be deflected at connections to valves, bends or other fittings.

7.5.5 Polyethylene Encasement

Where new ductile iron pipe is to be installed in potentially corrosive environments, as determined solely by ACSA, the pipe shall be protected with polyethylene encasement. At a minimum, eight (8) mil thick V-Bio polyethylene encasement is required. Copper service lines shall also be polywrapped a minimum of three (3) feet out from the connection to the ductile iron waterline. Installation by Modified Method A, as outlined in AWWA C105, current revision, shall be followed.

The corrosiveness of the environment where the ductile iron pipe is to be installed shall be determined using the 10-Point Soil Evaluation Procedure included in the Appendix to the AWWA C105 Standard. The ACSA reserves the right to specify soil corrosion testing prior to Construction Plan approval or pipe installation. The requirement of polyethylene encasement for ductile iron pipe shall be at the sole discretion of the ACSA.

7.5.6 Marking Tape

Blue water marking tape, a minimum of two (2) inches wide, shall be buried approximately two (2) feet above all waterlines to alert future construction workers that a water pipe is below. The marking tape shall be continuous. Marking tape disturbed during construction on existing waterlines shall be restored to its original condition and to the satisfaction of the project inspector.

7.6 Appurtenances and Fittings Construction

7.6.1 Restraint of Fittings

All tees, valves, fittings, plugs, caps, and fire hydrants shall be restrained using mechanical joint restraints.

7.6.2 Fitting Installations

Hydrants, valves, and valve boxes shall be set plumb, and centered, with valve boxes placed directly over the valves. Valves shall be backfilled with no less than four (4) cubic feet of clean VDOT No. 57 or No. 68 stone to a depth six (6) inches above the base of the valve box. VDOT No. 57 or No. 68 stone shall be carefully tamped around the valve box to a distance of four (4) feet on all sides of the box, or to the undisturbed trench face if less than four (4) feet.

7.6.3 Valve Box Installation

Valve boxes shall be adjusted flush with the finish grade. If the street surfaces are renewed or replaced after the water system has been approved and accepted by the ACSA, but while such streets are still the obligation of the Developer, the valve boxes therein shall be readjusted to the proper finished grade at the Developer's expense. The use of a single valve box riser ring with set screws is permitted on new construction.

In remote areas, valve boxes shall extend six (6) inches above finished grade and have a witness post securely placed next to the box. The witness post shall consist of a five (5) foot long, two (2) inch diameter galvanized pipe, capped on either end and painted blue.

7.6.4 Fire Hydrant Installation

If, during construction, groundwater is observed in the trench, the fire hydrant shall be moved to higher ground and the separation between fire hydrants will be adjusted accordingly. Hydrants shall be set plumb with the centerline of the pumper connection no less than eighteen (18) inches and no more than twenty-two (22) inches above grade. For new construction, the maximum number of allowable hydrant risers for each hydrant is one (1). Unless the hydrant location is specifically indicated otherwise, it shall be located so that the center is between two and ten feet from the back of the curb of the adjacent street. The pumper connection should face the street, unless directed otherwise by the Fire Official. The connecting pipe shall have the same depth of cover as the waterline and shall not include bends.

The base and back of the hydrant, opposite the pipe connection, shall have a thrust block poured behind it as shown in Detail W-3. Fire hydrant leads shall also utilize restrained joints for every joint and fitting.

Not less than seven (7) cubic feet of VDOT No. 57 or 68 stone shall be placed around the base of the hydrant to ensure drainage. The backfill around hydrants shall be thoroughly compacted to grade line. Hydrants and valves shall have the interiors cleaned of all foreign matter before installation. The hydrant and valve shall be inspected in open and closed positions, to see that all parts are in working condition. Black bags shall be tied securely over all fire hydrants as soon as they

are installed. These bags shall not be removed until approved by the ACSA. Each new fire hydrant shall be painted, if the ACSA determines the factory finish has been compromised.

7.6.5 Corporation Stops

At the location indicated on the plans and where directed, corporation stops with eighth-bend couplings, if required, shall be furnished, and installed approximately forty-five (45) degrees below the top of the pipe in accordance with AWWA C800, current revision.

7.6.6 Water Service Construction

Water Services are to be installed at a minimum depth of thirty-six (36) inches below finished grade from the waterline to a meter setter. Meter boxes with coppersetters are to be installed at the end of each water service.

For two-inch brass service lines, a three-part union shall be installed on the supply side of the coppersetter.

See Details W-4 for additional information on one (1) inch service lines and W-7 for additional information on two (2) inch service lines.

7.6.7 Meter Coppersetters

For three quarter (¾) inch and one (1) inch meters, the coppersetter shall be installed no less than twelve (12) inches or more than sixteen (16) inches from the top of the meter box. For one and one-half (1.5) inch and two (2) inch meters, the coppersetter shall be installed twelve (12) inches from the top of the meter box. See Details W-4 and W-9 for additional information on coppersetter installation.

7.6.8 Meter Box and Meter Vault Installation

Meter boxes and vaults of appropriate size shall be installed around all meter coppersetters as indicated on the plans. They shall be installed in non-paved areas. The box/vault and lid shall conform to the finished grade after installation. Meter boxes and vaults shall be located and installed to prevent water, dirt, or debris from entering or covering them. If changes in grade at the meter box or vault are made before Final Acceptance is granted or during the 1-year warranty period after Final Acceptance, the Developer is responsible for resetting the meter box or vault to match the finished grade.

7.7 Backfilling and Compaction

All trenches or excavations shall be backfilled to the original surface of the ground or to such other grades as may be shown on the approved plans. The ACSA inspector shall make the final determination on all backfill requirements. All backfilling shall be carried along as

speedily as possible. New trenching will not be permitted when earlier trenches need backfilling or labor is needed to restore the surfaces of streets or other areas to a safe and proper condition.

Backfilling shall be done in such a way as to prevent dropping of material directly on top of the pipe from more than a three (3) foot vertical distance. When placing material from a bucket it must be lowered so that the shock of the falling earth will not damage the waterline.

7.7.1 Materials

All material used for backfilling of trenches shall be free of excessive amounts of unsuitable materials such as all organic material, frozen clods, and sticky masses of clay and gumbo which are difficult to properly compact. Backfill material shall contain no rock or asphalt larger than six (6) inches in any dimension and in no case shall rock or asphalt be placed closer than two (2) feet vertically to the installed pipe.

7.7.2 Backfilling

Backfill, over all pipe to a depth of twenty-four (24) inches, shall be carefully placed in layers approximately six (6) inches thick, each layer being thoroughly tamped and compacted by hand or pneumatic tamper in place. Special care shall be taken in using a mechanical tamper directly over the pipe.

In traffic areas, backfill more than twenty-four (24) inches above the pipe shall be deposited in six (6) inch layers or a thickness which will permit compaction of at least ninety-five percent (95%) of the optimum density, as determined by AASHTO T-99. Backfill in existing traffic areas shall be in accordance with VDOT standards.

In non-traffic areas, backfill more than twenty-four (24) inches above the pipe shall be deposited in twelve (12) inch layers or a thickness which will permit compaction of at least ninety percent (90%) of the optimum density, as determined by AASHTO T-99.

7.7.3 Compaction

Unless otherwise shown on the plans, the backfill in all trenches shall be thoroughly compacted. The compacting shall be done by suitable mechanical means. In all cases, special care shall be taken to see that the spaces at the sides of the trench are thoroughly filled and compacted. If necessary, the earth shall be moistened during the operations.

The Contractor may be required, at the sole discretion of the ACSA, to conduct compaction tests on trench backfill. The Contractor shall bear the expense of all compaction tests. The location of tests shall be selected in the field by the ACSA and will not necessarily be limited to regular intervals.

The results of all compaction tests shall be submitted to the ACSA for review and approval prior to acceptance of construction. The degree of compaction required for trenches in streets and paved areas is ninety-five percent (95%) of maximum density and for trenches in all other areas the required density shall be ninety percent (90%) of maximum density. If the tests indicate the required density has not been obtained, the Contractor shall remove, replace and recompact the material to the specified density. Failure of any compaction tests may result in additional compaction tests being required at the Contractor's expense.

7.8 Pressure Testing

All pressure testing will be performed in accordance with the AWWA C600, current revision. The Contractor shall provide the ACSA with two (2) business days' notice prior to undertaking any tests.

All newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure of at least two hundred (200) psi or one hundred fifty percent (150%) of the average working pressure, whichever is greater. The test duration shall be two (2) hours, and the pressure shall not vary by more than five (5) psi without adding any additional water to the line once the test begins.

Each valved section of pipe shall be filled with water slowly and the specified test pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the ACSA. The water and container used to pressurize the line shall be properly disinfected. Before applying the specified test pressure, air shall be expelled completely from the pipe, valves, and hydrants.

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

7.9 Disinfection

Precautions shall be taken to protect pipe interior, fittings, and valves against contamination. When pipe laying is not in progress, all openings in the pipeline shall be closed with watertight plugs. If water accumulates in the trench, plugs shall remain in place until the trench is dry. All pipe and fittings shall be kept free of dirt or any foreign material.

The Contractor shall provide the ACSA with two (2) business days' notice prior to undertaking any disinfection efforts.

Waterlines shall be disinfected by the continuous feed method or the tablet method in accordance with AWWA C651, current revision, except as specified otherwise or approved in writing by the ACSA.

1. Continuous Feed Method

Prior to feeding chlorine, the water line shall be thoroughly flushed with potable water to remove any debris that may have entered the line during construction. Potable water shall be introduced into the pipeline at a constant flow rate, protected by an approved backflow prevention assembly or other precautionary measures. Liquid sodium hypochlorite solution shall be added at a constant rate to this flow so that the chlorine concentration in the water in the pipe is at least fifty (50) mg/L. The highly chlorinated water shall remain in the waterline for twenty-four (24) hours and a chlorine residual of at least ten (10) mg/L must be present after this initial period.

2. Tablet Method

Tablets or granules of calcium hypochlorite, shall be placed into the waterline as it is constructed. The tablets or granules should contain sixty-five percent (65%) available chlorine by weight. Calcium hypochlorite tablets for swimming pool or spa disinfection are not allowed.

After completion of the construction, the waterline shall be filled with water at a velocity of less than one (1) foot per second in accordance with the following table:

Pipe Diameter	Maximum Fill Rate (gpm)
4"	40
6"	90
8"	160
10"	260
12"	350
14"	500
16"	600
18"	800
20"	1,000
24"	1,400

A minimum concentration of fifty (50) mg/L of chlorine shall be in the waterline after it is filled. The highly chlorinated water shall remain in the waterline for twenty-four (24) hours and a chlorine residual of twenty-five (25) mg/L must be present after this initial period.

Required Calcium Hypochlorite Dosing For Every Twenty (20) Feet of Waterline to Achieve a Fifty (50) mg/L Chlorine Concentration							
Waterline Size (inches)	4”	6”	8”	10”	12”	16”	24”
Number of five (5) gram tablets	1	2	4	5	7	13	28
Weight of Granules (grams)	4	9	15	24	34	61	137

All valves and appurtenances shall be operated while the highly chlorinated water is in the pipeline. After the retention period, the waterline shall be flushed of the high chlorine water until the water leaving the system shows a chlorine concentration of less than one (1) mg/L or no higher than that prevailing in the water used for flushing. Water with a chlorine concentration greater than two (2) mg/L shall either be dechlorinated or the high chlorine water shall be discharged directly to sanitary sewer line. After this flushing, two (2) sets of water samples shall be collected at least sixteen (16) hours apart for bacteriological tests. The samples shall be collected at regular intervals not to exceed 1,200 feet throughout the length of the pipe. All bacteriological samples collected following disinfection shall be analyzed by a lab certified by the Virginia Department of General Services, Consolidated Laboratory Services. The results of these samples must indicate the absence of coliform contamination.

Disinfection shall include hydrants and other special pipe, taps and fittings used at connections to existing piping. These shall be thoroughly disinfected before installation. Excavation for such connections shall be kept free from water until the connection is completed and great care shall be exercised to prevent contamination of the pipe and connection fittings.

It is the Contractor's and Developer's responsibility to ensure their operations do not contaminate the public water supply. If at any time the water in the existing system becomes contaminated, they shall be held financially accountable for any corrective action taken by the ACSA. In addition, the Contractor and Developer shall be responsible for the cost of defending and settlement of all claims resulting from their actions including, but not limited to, court costs and attorney's fees.

7.10 Flushing

Every effort shall be made to prevent any debris from entering the water pipes during construction.

All new waterlines shall undergo a thorough flushing at a flow rate of at least three (3) feet per second, prior to being placed into service. Flushing shall be accomplished using a combination of fire hydrants and blow-off assemblies, as directed by the ACSA. In the case of looped portions of the new water distribution system, valves shall be operated to create uni-directional flows through the looped areas.

Part 8 – Sewer System Construction

8.1 General Requirements

Construction of sanitary sewer lines and appurtenances shall be in accordance with the approved Construction Plans. The ACSA shall insist that good workmanship and standard sewerline construction principles are used in the construction of the Facilities. ACSA reserves the right to refuse acceptance of the Facilities if there are concerns regarding the materials, construction methods or workmanship.

Sewerlines shall be installed at the required lines and grades with manholes, lateral connections, and other appurtenances set at the required locations as indicated on the Construction Plans. The Contractor shall be required to field verify the installed pipe slope for each run of sewer before continuing additional sewerline installation. If the installed slope does not match the approved Construction Plans, the Contractor shall make necessary revisions as determined by the ACSA.

Whenever obstructions are encountered during progress of the work, which interfere to such an extent that an alteration in plans is required, the ACSA shall be notified. If any deviation is contemplated in location, alignment, or grade of any sewerline, concrete structure, or accessory from that shown on the plans approved by the ACSA, details of the proposed deviation shall be submitted to the ACSA for review and approval before the changes are constructed. Verbal approval may be granted for minor alterations. Major alterations will require written approval before such alterations are put into effect. The severity of the alteration and its remedial action shall be determined by the ACSA.

8.2 Excavation

Sewerline construction shall be made by open cut unless otherwise specified or required. All open trenches shall be adequately shored and braced to provide a safe working environment. It is the Contractor's responsibility to comply with the requirements of OSHA as pertaining to people working in an open trench.

During the excavation operations, material suitable for backfilling shall be piled in an orderly manner a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins. All excavated material not suitable for backfill shall be removed and disposed of in an acceptable manner. The trench shall be kept free of water during the laying operation and any water accumulating therein shall be removed by approved methods. No more than one hundred (100) feet of trench shall be opened in advance of the installed sewerline when located along streets or highways, and no more than two hundred (200) feet at other locations.

8.2.1 Construction in Fill Areas

Where pipelines are to be installed in fill areas, the fill shall be compacted to ninety-five percent (95%) of the optimum density, as determined by AASHTO T-99, before

excavation begins for the pipe trench. Certification of compaction at intervals determined by the ACSA shall be required in fill areas.

8.2.2 Trench Width

The width of the trench at any point below the crown of the pipe shall be no greater than the width necessary to accommodate shoring the trench, setting, and aligning the pipe. Minimum clearance between side of trench and pipe shall be eight (8) inches. Trench walls in this area shall be kept as nearly vertical as possible. Trench walls above the crown of the pipe may be sloped or shored to meet the applicable OSHA trenching standards.

Excavation at manholes and similar structures shall be sufficient to leave at least twelve (12) inches clearance between their outer surface and the embankment or sheeting.

8.2.3 Rock Excavation

Where rock is encountered in trench excavation, whether solid or in the form of loose rock or shale, or large boulders, it shall be removed to the extent that no projection of rock shall be nearer than six (6) inches to any part of the sewer pipe when laid, nor project beyond the lines and grades of structures.

8.2.4 Over Excavation

Where the excavation has been carried too deep the Contractor shall refill the over excavated trench with VDOT No. 57 or No. 68 stone to the required depth.

8.3 Pipe Foundation

8.3.1 Foundation in Good Soil

For PVC pipe, the bottom of the trench shall be excavated four (4) to six (6) inches below the bottom of the barrel of the pipe and a bedding shall be provided of VDOT No. 57 or No. 68 Stone. The bedding shall be shaped to the top of the exterior diameter of the pipe to support the pipe for the entire length of the barrel and shall extend to the trench walls.

For ductile iron pipe, the bottom of the trench shall be scraped and compacted, and all stones shall be removed, or a four (4) inch bedding of VDOT No. 57 or No. 68 stone shall be provided. Bell holes shall be cut to prevent the pipe from resting on the bells.

Where excavation is made in rock or boulders a bedding of VDOT No. 57 or No. 68 stone with a minimum thickness of six (6) inches shall be provided for both PVC and ductile iron pipe. The bedding material shall extend evenly to the trench wall.

8.3.2 Foundation in Poor Soil

Whenever the soil at the bottom of the trench is soft, unstable, or saturated with water, VDOT No. 57 or No. 68 stone shall be placed as bedding to the depth required to stabilize the soil and shall be thoroughly compacted. If necessary, a suitable foundation shall be established prior to placement of bedding material. The bedding material shall extend evenly to the trench wall.

8.4 Pipe Installation

When installing pipe in the trench proper implements, tools, and equipment, satisfactory to the ACSA and as recommended by the material manufacturer, shall be provided and used by the Contractor for the safe and convenient prosecution of the work. All sewers shall be laid true to line and grade with bells upstream. The sections of pipe shall be so laid and fitted together that, when complete, the sewer will have a smooth and uniform invert. PVC pipe shall be installed in strict conformance with ASTM D-2321, current revision.

All pipe, fittings, and accessories shall be carefully lowered into the trench piece by piece by means of a derrick, ropes, slings, or other suitable tools or equipment in such a manner as to prevent damage to the sewerline materials. Under no circumstances shall sewerline materials be dropped or dumped into the trench. Lined ductile iron pipe and fittings shall be handled from the outside; no forks, chains, straps, hooks, etc. shall be placed inside the pipe or fittings, for lifting, positioning, or laying.

Where a proposed sewerline connects to part of the existing ACSA sewer system, the outlet pipe of the first manhole upstream from the connection shall be completely blocked with an expansion plug. This plug shall be securely fastened to a step and remain in place throughout the construction and testing phases of the project and shall not be removed until authorized by the ACSA.

8.4.1 Condition of Ductile Iron Pipe

All lumps, blisters and excess coal tar coating shall be removed from the ends of each pipe. The outside of the spigot and the inside of the bell shall be thoroughly cleaned and be free from oil and grease before the pipe is laid.

8.4.2 Special Precautions

Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the trench. During the laying operation, no debris, tools, clothing, or other materials shall be placed in the pipe. The exposed end of all pipes shall be fully closed by means of an approved stopper or plug to prevent earth, water, or other substances from entering the pipe.

8.4.3 Pressure Sewer

For pressure sewers, all fittings and joints shall be restrained with mechanical joint restraint or other pipe joint restraint approved by the pipe manufacturer. Thrust blocks or concrete bracing shall not be used.

8.4.4 Marking Tape

Green sewer marking tape, a minimum of two (2) inches wide, shall be buried approximately two (2) feet above the top of all sewerlines to alert future construction crews that a sewer pipe is below. The marking tape shall be continuous between manholes. Marking tape disturbed during construction on existing sewerlines shall be restored to its original condition and to the satisfaction of the ACSA inspector.

8.5 Backfilling and Tamping

All trenches or excavations shall be backfilled to the original surface of the ground or to such other grades as may be shown on the approved plans. The ACSA inspector shall make the final determination on all backfill requirements. All backfilling shall be completed promptly. Backfilling around structures should be started as soon as the concrete is sufficiently set. New trenching will not be permitted when earlier trenches need backfilling or labor is needed to restore the surfaces of streets or other areas to a safe and proper condition.

Backfilling shall be done in such a way as to prevent dropping of material directly on top of the pipe from more than a three (3) foot vertical distance. When placing material from a bucket it must be lowered so that the shock of the falling earth will not damage the sewer line or structure.

8.5.1 Materials

All material used for backfilling of trenches shall be free of excessive amounts of unsuitable materials such as all organic material, frozen clods, and sticky masses of clay and gumbo which are difficult to properly compact. Backfill material shall contain no rock or asphalt larger than six (6) inches in any dimension and in no case shall rock or asphalt be placed closer than two (2) feet vertically to the installed pipe.

8.5.2 Backfilling

Backfill over all pipe to a depth of twenty-four (24) inches shall be carefully placed in layers approximately six (6) inches thick, each layer being thoroughly tamped and compacted in place. Special care shall be taken in using a mechanical tamper directly over the pipe. Above this point, backfill shall be deposited in layer thicknesses which will permit compaction to a density of at least ninety-five percent (95%) of the maximum density at optimum moisture content as determined by the AASHTO T-99. Backfill in existing traffic areas shall be in accordance with the VDOT's standards.

8.5.3 Compaction

The contractor may be required, at the sole discretion of the ACSA, to conduct compaction tests on trench backfill. The location of tests shall be selected in the field by the ACSA and will not necessarily be limited to regular intervals. The Contractor shall bear the expense of all compaction tests.

The results of all compaction tests shall be submitted to the ACSA for review and approval prior to acceptance of construction. The degree of compaction required for trenches is 95% of maximum density. If the tests indicate the required density has not been obtained, the Contractor shall remove, replace, and re-compact the material to the specified density. Failure of any compaction tests may result in additional compaction tests being required at the Contractor's expense.

8.6 Manholes

Where practical, manholes shall be placed on undisturbed soil. Where manholes must be installed in fill areas, the fill shall be compacted to ninety-five percent (95%) of the optimum density, as determined by AASHTO T-99, to an elevation not less than thirty-six (36) inches above the proposed invert before excavation begins. Certification of compaction at the manhole location shall be provided before setting the manhole base.

Height control rings may be used to adjust manhole tops to proper grade; however, a maximum of twelve (12) inches total of height control rings will be permitted. In no case shall more than three (3) height control rings be used.

8.6.1 Connecting to Manholes

Pipe connections to manholes shall be made with flexible boot connections. Existing manholes not provided with flexible boot connections already cast in place, shall be field cored and have boots installed.

Sealing around all pipes entering manholes shall be done with a quick setting non-shrinking grout.

Whenever connections are to be made to an existing manhole, care shall be taken to prevent debris from entering the sewerline. Flow into existing manholes will not be permitted until all "upstream" sewerlines have been tested, approved and thoroughly cleaned of all debris.

Force mains shall connect at the invert of a manhole.

8.6.2 Drop Manholes

Drop manholes shall only be allowed when they are specifically called out on the Construction Plans. They shall be constructed in one of two configurations. An

internal drop pipe in a minimum five (5) foot diameter precast concrete manhole shall be standard practice for new drop manholes. Internal drop connections shall be PVC pipe bolted to the manhole wall with stainless steel straps. See Detail S-4 for additional information.

An external drop pipe with tee fitting for vertical pipe shall only be allowed for making a new drop connection to an existing manhole and where specifically called out on the Construction Plans. External drop connections shall be ductile iron pipe, backfilled in six (6) inch lifts and compacted by hand tampers. See Detail S-5 for additional information.

8.6.3 Doghouse Manholes

The standard practice for connecting a new sewerline to an existing sewerline is to cut in a new precast manhole. Doghouse manholes are only allowed when they are specifically called out on the Construction Plans. They shall be made by constructing a "doghouse" style manhole with a base as shown in Detail S-6. The doghouse opening shall be no less than four (4) inches or more than eight (8) inches greater than the outside diameter of the existing pipe. The doghouse shall sit on a twelve (12) inch thick stone sub-base and twelve (12) inch concrete base. The new sewer shall connect with a flexible boot at the pipe entry. An invert shall be formed in the shelf to allow flow to the existing pipe. The space between the existing pipe and doghouse opening shall be filled with 3,000 psi concrete and coated with a waterproof sealant. The manhole shall be tested in accordance with these specifications prior to cutting into the existing sewerline. The top half of the pipe shall be cut and removed after the shelf and invert have cured.

8.7 Frame and Cover Installation

Manhole frame and cover castings shall be installed so that the cover shall be exposed and flush with the existing street surface. In no case shall the existing pavement surface be raised or lowered to meet the grade of installed manhole frame and cover castings. If street surfaces are renewed or replaced after the sewer system has been approved and accepted by the ACSA, but while such streets are still the obligation of the Developer, the manhole frames and covers therein shall be readjusted to proper location relative to new street surfacing by the Developer. Where frames and covers are in off-street areas, they shall be placed flush with the finished grade. Where manholes are installed in sloped areas, the finished grade of the slope shall intersect the top rim of the frame and cover on the uphill side.

The manhole frame shall be sealed to the concrete manhole section using a bed of mortar on either side of a butyl rubber sealant. The frame shall be mortared to the outside of the concrete manhole section.

Four (4) anchor bolts, five-eights (5/8) inch in diameter, shall be placed in the cone section of watertight manholes to secure the manhole frame to the concrete cone.

8.8 Sewer Lateral Construction

When new sewerlines are installed, sewer laterals shall connect to the sewerline with an inline tee-wye fitting. When a new sewer lateral connects to an existing sewerline, it shall connect to the sewerline utilizing a saddle. Saddles shall be approved by the ACSA, prior to installation.

Where dissimilar materials exist between along the sewer lateral, a satisfactory adaptor shall be provided to ensure a tight joint and smooth transition.

8.8.1 Marking

All sewer lateral stub-outs shall be capped and marked with a pressure treated 2x4 piece of lumber no less than four (4) feet in length. The 2x4 shall extend approximately two (2) feet above grade and shall be painted green. The depth to the sewer lateral shall be noted on the 2x4. Alternate markers may be approved by the ACSA.

8.8.2 Inspection

All sewer lateral saddles shall be left exposed for visual inspection by the ACSA. The Contractor shall obtain measurements to the nearest downstream manhole for all inline wyes, tees, or saddle connections for inclusion on the As-Built Plans.

8.9 Sewer Testing

All sanitary sewerlines and manholes shall be subjected to the applicable tests described in this section. All labor and equipment for such tests shall be furnished by the Contractor. If leakage exceeds the stated allowance in any section tested, the Developer shall cause such repairs to be made to the line, manholes or appurtenances as may be necessary to comply with the specifications, to the satisfaction of the ACSA. The Contractor shall provide the ACSA with two (2) business days' notice prior to undertaking any tests.

8.9.1 Gravity Sewers

Alignment

The Contractor is responsible for completing an alignment test of each sewerline. A light will be flashed between manholes by means of a flashlight or reflection of sunlight with a mirror or by other methods. If the illuminated interior to the pipe shows poor alignment, displaced pipe, blockages or other defects, the defects shall be corrected to meet all standards governing the construction of sewerlines. All costs involved shall be borne by the Contractor.

Deflection

All PVC gravity sewerlines shall be subject to vertical deflection testing as deemed necessary by the ACSA. The maximum allowable deflection following completion of backfill shall not exceed 5% of the pipe's internal diameter. Deflection testing shall be conducted by the Contractor using methods approved by the ACSA. Any sewer sections failing to meet deflection requirements shall, at the Contractor's expense, be corrected to meet all standards governing the construction of sewerlines.

Low Pressure Air Test

A low air pressure test shall be used to test all gravity sewerlines. The air test is to be conducted between two (2) consecutive manholes. The test equipment shall consist of two (2) plugs (one tapped and equipped for air inlet connection), a shut-off valve, a pressure regulating valve, a pressure reduction valve, and a monitoring pressure gauge having a pressure range from zero (0) to five (5) psi, graduated in one-tenth (0.10) psi increments with an accuracy of plus or minus four-hundredths (+/- .04) psi. The test equipment shall be set up outside the manhole for easy access and reading. No person shall remain in the manhole while the pipe is being pressurized or throughout the test for safety reasons.

Air shall be supplied to the equipment slowly and shall be regulated to prevent the pressure inside the pipe from exceeding five (5.0) psig. The pipeline shall be filled until a constant internal pressure of three and one-half (3.5) psi is maintained. The internal pressure shall be maintained at three and one-half (3.5) psi or slightly above for a five (5) minute stabilization period, after which time the internal pressure will be adjusted to three and one-half (3.5) psi, the air supply shut off and the test will begin.

The table below specifies the minimum allowable time for the pressure to drop one half (0.5) psi based on the pipe diameter and length of sewer pipe being tested.

Pipe Dia. (inches)	Minimum Allowable Time for a 0.5 psi Pressure Drop for Various Lengths of Sewerline (minutes:seconds)							
	<100 ft	100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft
8	3:47	3:47	3:47	3:47	3:47	3:48	4:26	5:04
10	4:43	4:43	4:43	4:43	4:57	5:56	6:55	7:54
12	5:40	5:40	5:40	5:42	7:08	8:33	9:58	11:24
15	7:05	7:05	7:05	8:54	11:08	13:21	15:35	17:48
18	8:03	8:03	9:37	12:49	16:01	19:14	22:26	25:38
21	9:55	9:55	13:05	17:27	21:49	26:11	30:32	34:54
24	11:20	11:24	17:57	22:48	28:30	34:11	39:53	45:35
27	12:45	14:25	21:38	28:51	36:04	43:16	50:30	57:42

An air pressure correction for groundwater shall be required when the prevailing groundwater table is above the sewer being tested and shall be calculated as follows:

$$\frac{\text{Groundwater Depth (ft. above sewer line)}}{2.31} + 3.5 \text{ psi} = \text{Starting Pressure (psi)}$$

Ending Test Pressure ≥ Starting Pressure (psi) – 0.5 psi

There is no change in the time requirement when the groundwater correction is applied.

Should any test on any section of the pipeline disclose an air loss rate greater than permitted, the Contractor shall, at their own expense, locate and repair the defective joints or pipe sections. After the repairs are completed, the section shall be retested until the air loss rate is within the specified allowance.

8.9.2 Manhole Testing

All manholes shall be tested by vacuum. Installation and operation of vacuum testing equipment and indicating devices shall be in accordance with ASTM C1244, current edition. Testing shall include the joint between the concrete cone section and the manhole frame, unless otherwise directed by the ACSA. Stub-outs, boots, and pipe plugs shall be secured to prevent movement while the vacuum is being drawn.

A measured vacuum of ten (10) inches of mercury shall be established in the manhole. The time for the vacuum to drop to nine (9) inches of mercury shall be recorded. The time recorded for the pressure drop must be greater than the time listed in the table below for the manhole to pass the vacuum test. Manholes greater than twenty-five (25) feet in depth shall be reviewed and testing requirements established on a case-by-case basis.

Manhole Diameter	Manhole Depth	Minimum Time for a 1" Hg Pressure Change
4 feet	Less than 10 ft.	60 seconds
4 feet	Between 10 ft. and 15 ft.	75 seconds
4 feet	Between 15 ft. and 25 ft.	90 seconds
5 feet	Less than 10 ft.	75 seconds
5 feet	Between 10 ft. and 15 ft.	90 seconds
5 feet	Between 15 ft. and 25 ft.	105 seconds
6 feet	Less than 10 ft.	90 seconds
6 feet	Between 10 ft. and 15 ft.	105 seconds
6 feet	Between 15 ft. and 25 ft.	120 seconds

If the manhole fails the test, necessary repairs shall be made, and the vacuum test shall be repeated until the manhole passes the test. If a manhole joint mastic is pulled

out during the vacuum test, the manhole shall be disassembled, and the mastic replaced. The test shall then be repeated as specified above.

8.9.3 Pressure Sewer

All sewer force mains shall be tested at a hydrostatic pressure of one hundred fifty (150) psi or one hundred fifty percent (150%) of the design operating pressure, whichever is greater. The test duration shall be two (2) hours, and the pressure shall not vary by more than five (5) psi without adding any additional water to the force main once the test begins. The method and equipment for conducting this test and specific pressure of the test shall be subject to the approval of the ACSA.

8.9.4 Acceptance

Should deflection, air test, vacuum test or pressure leakage limits be exceeded as specified above, the ACSA reserves the right to reject all or any portion of the Facilities. Any project or portion of a project rejected by the ACSA or its authorized representative shall not be permitted to discharge into any part of the ACSA sewer system.

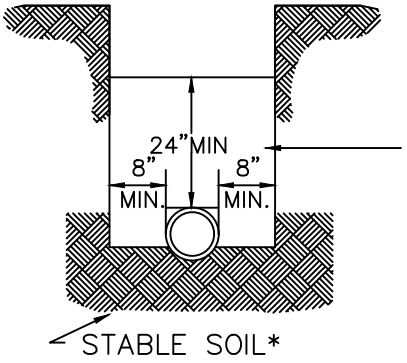
All repair methods, other than replacement of the defective area with new sound materials, shall be subject to prior approval of the ACSA. Grouted, collared, clamped or otherwise patched-up sewerline or force main sewer pipe will not be acceptable.

Upon completion of such inspection or tests as required in these specifications, all foreign matter, including sand, rock, gravel, etc. shall be removed from all sewers and manholes before final approval is granted.

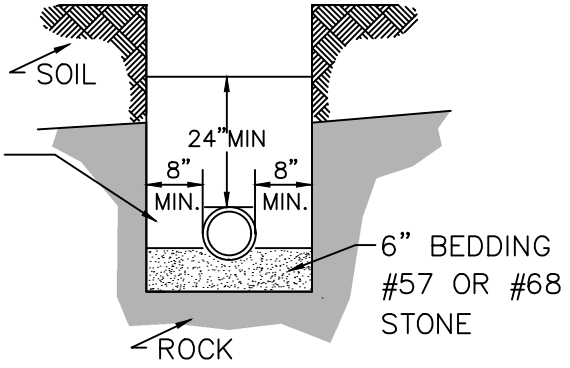
Part 9 – Details

A. Water Details
B. Sewer Details

GOOD FOUNDATION MATERIAL

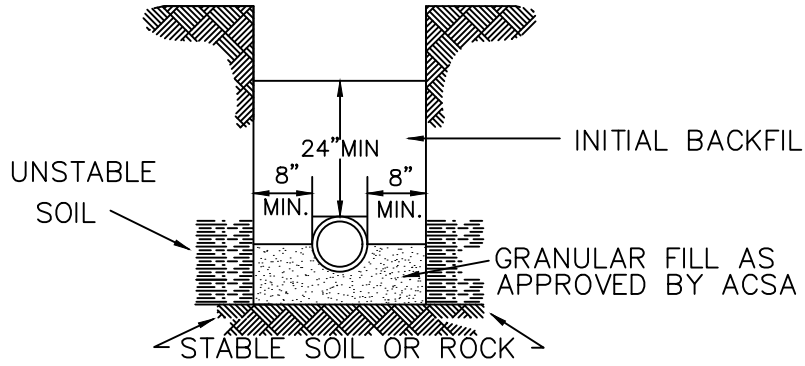


ROCKY FOUNDATION MATERIAL

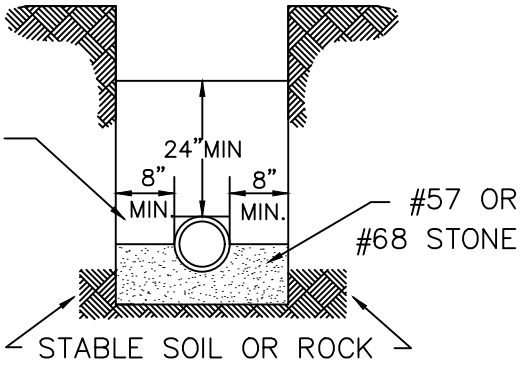


* SCRAPE THE BOTTOM OF THE TRENCH. REMOVE ALL STONES TO ENSURE THE PIPE DOESN'T REST ON ROCK AND THEN COMPACT THE SOIL OR PROVIDE A 4" BEDDING OF #57 OR #68 STONE.

FOUNDATION IN POOR SOIL



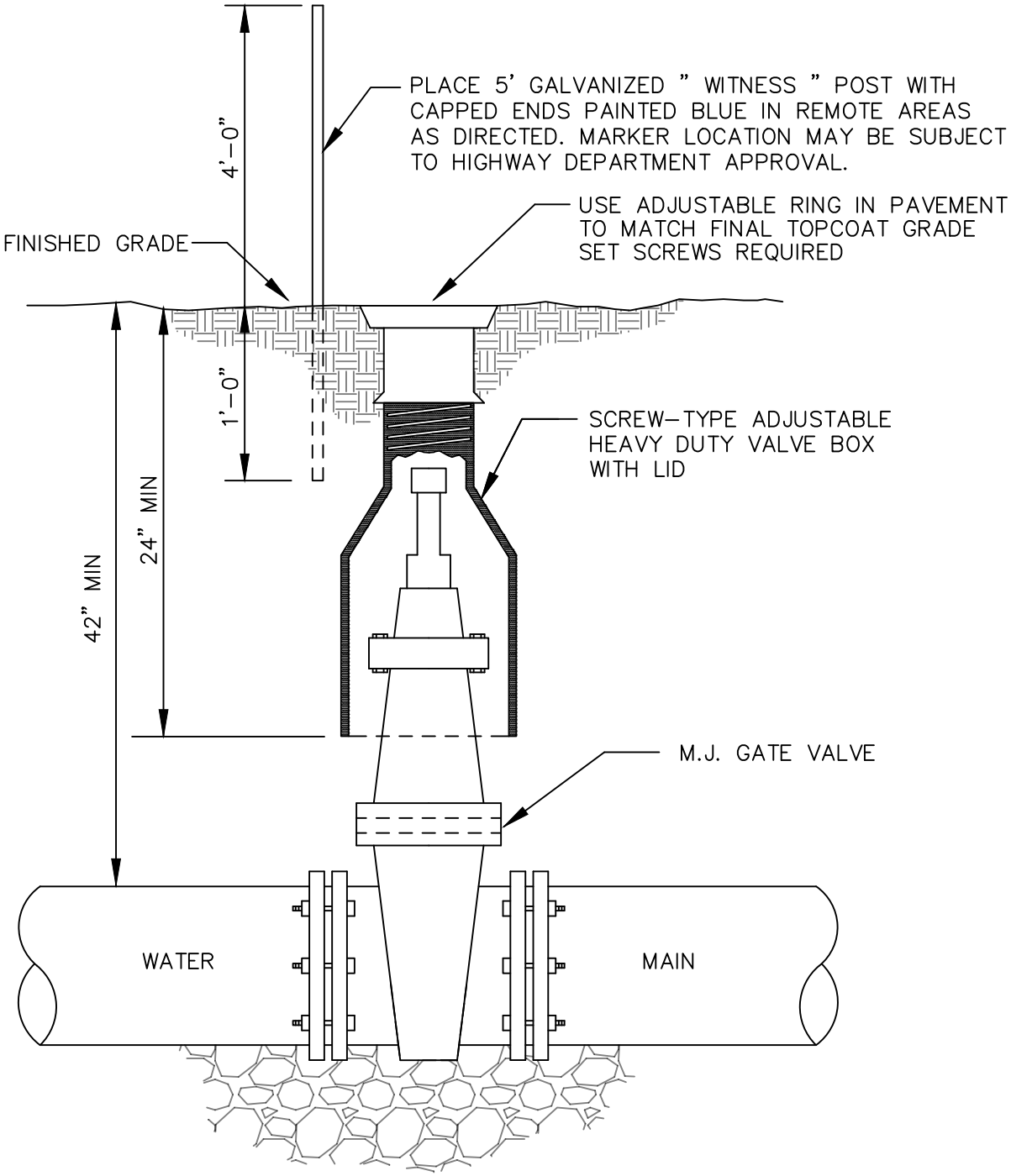
UNDER-CUT CONDITION



NOTES:

1. NO ROCKS SHALL BE ALLOWED WITHIN 24" OF THE WATER LINES.
2. NO ROCKS LARGER THAN 6" IN ANY DIMENSION SHALL BE ALLOWED ABOVE THE INITIAL BACKFILL.
3. THE INITIAL BACKFILL SHALL BE PLACED AND COMPACTED IN 6" LIFTS.
4. NO ORGANIC OR FROZEN MATERIAL OR DEBRIS SHALL BE ALLOWED IN THE TRENCH.
5. BELL HOLES SHALL BE DUG OUT IN ALL CASES.
6. OPEN CUTS IN PAVED AREAS WITHIN EXISTING VDOT RIGHT-OF-WAY SHALL BE BACKFILLED ENTIRELY WITH NO. 21A STONE.

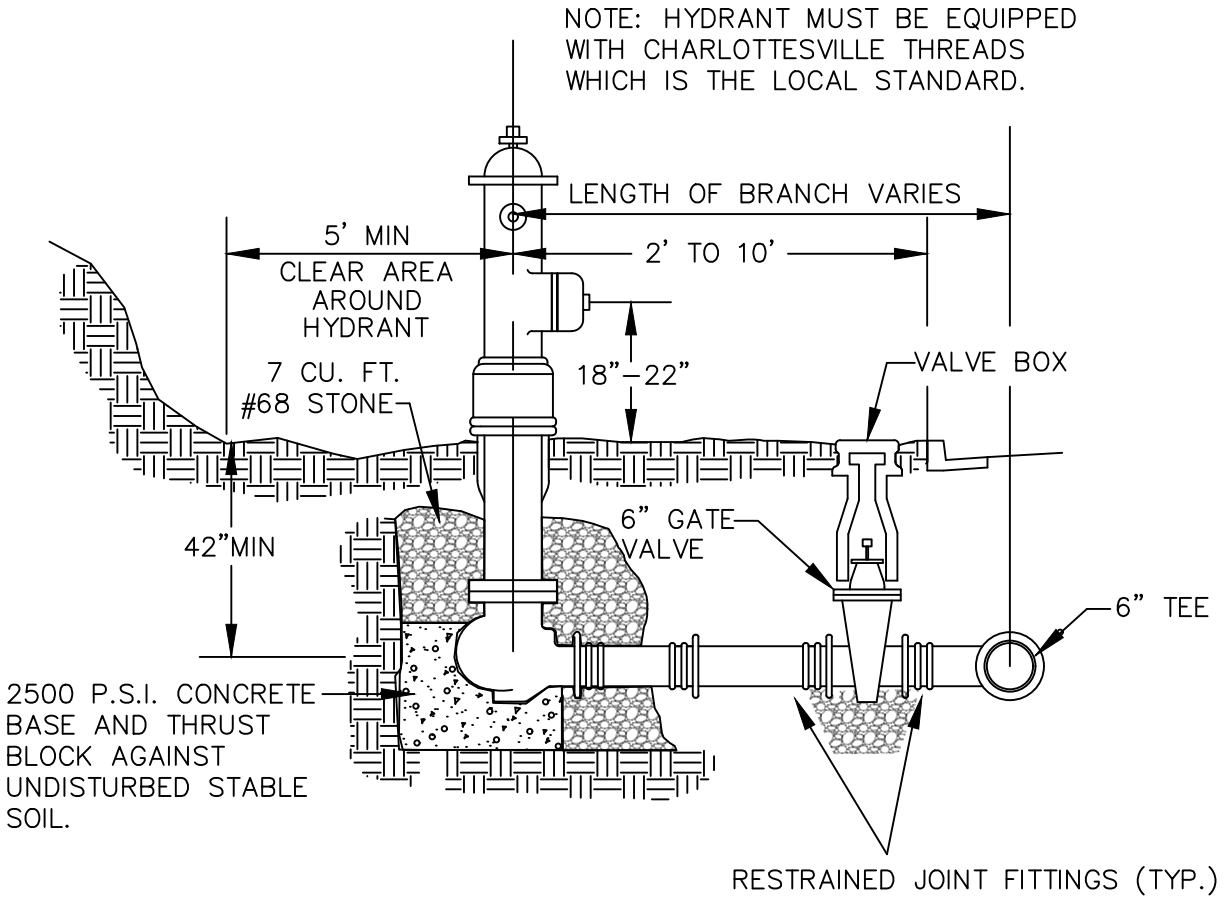
ALBEMARLE COUNTY SERVICE AUTHORITY	DUCTILE IRON WATER MAIN INSTALLATION AND BEDDING NOT TO SCALE	REV 8/6/2024 DETAIL W-1



NOTES:

1. MINIMUM 6" OF #57 OR #68 STONE TO BE PLACED UNDER GATE VALVE.
2. IN REMOTE AREAS, VALVE BOXES SHALL EXTEND SIX (6) INCHES ABOVE GRADE.

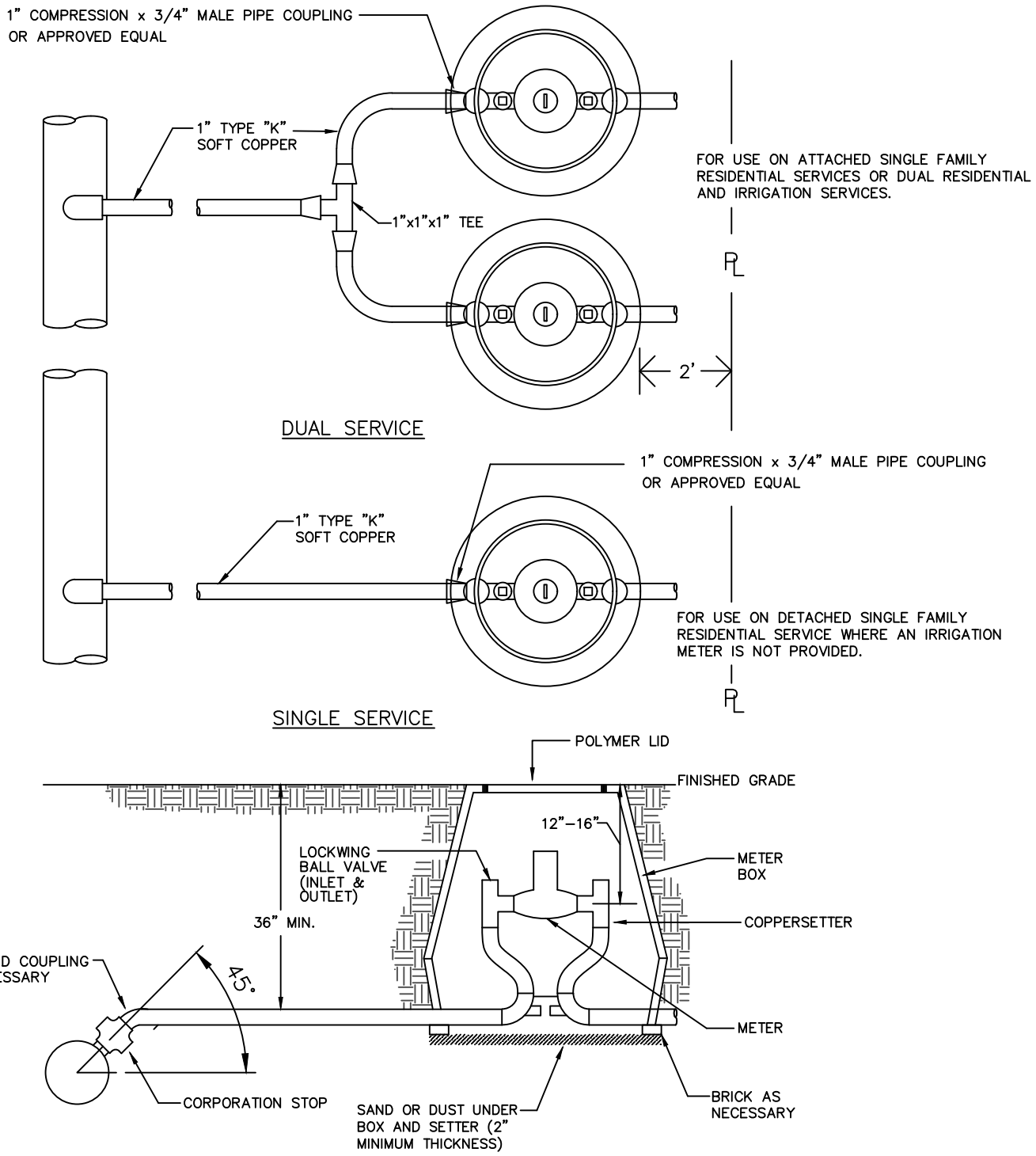
ALBEMARLE COUNTY SERVICE AUTHORITY	TYPICAL GATE VALVE NOT TO SCALE	REV 8/6/2024 DETAIL W-2



NOTES:

1. SURROUND WEEP HOLES WITH GRAVEL AND KEEP FREE OF CONCRETE.
2. MAINTAIN A 42" MINIMUM COVER FROM THE MAIN TO THE FIRE HYDRANT (INCLUDING DITCHES)
3. FINISHED GRADE SHALL SLOPE AWAY FROM THE FIRE HYDRANT AND VALVE BOX.
4. THE GATE VALVE IS PREFERRED IN PAVEMENT AFTER TEE WITH MAIN. IT IS ALLOWED IN SHOULDER, OR BEHIND DITCH, BUT NOT ALLOWED IN DITCH OR GUTTER.
5. FIRE HYDRANTS SHALL BE INSTALLED AT LOCATIONS WHERE WEEP HOLES ARE ABOVE THE PREVAILING GROUNDWATER ELEVATION. IF REQUIRED TO BE IN WET AREAS, THE WEEP HOLES SHALL BE PLUGGED AND THE HYDRANT SHALL BE PUMPED DRY.

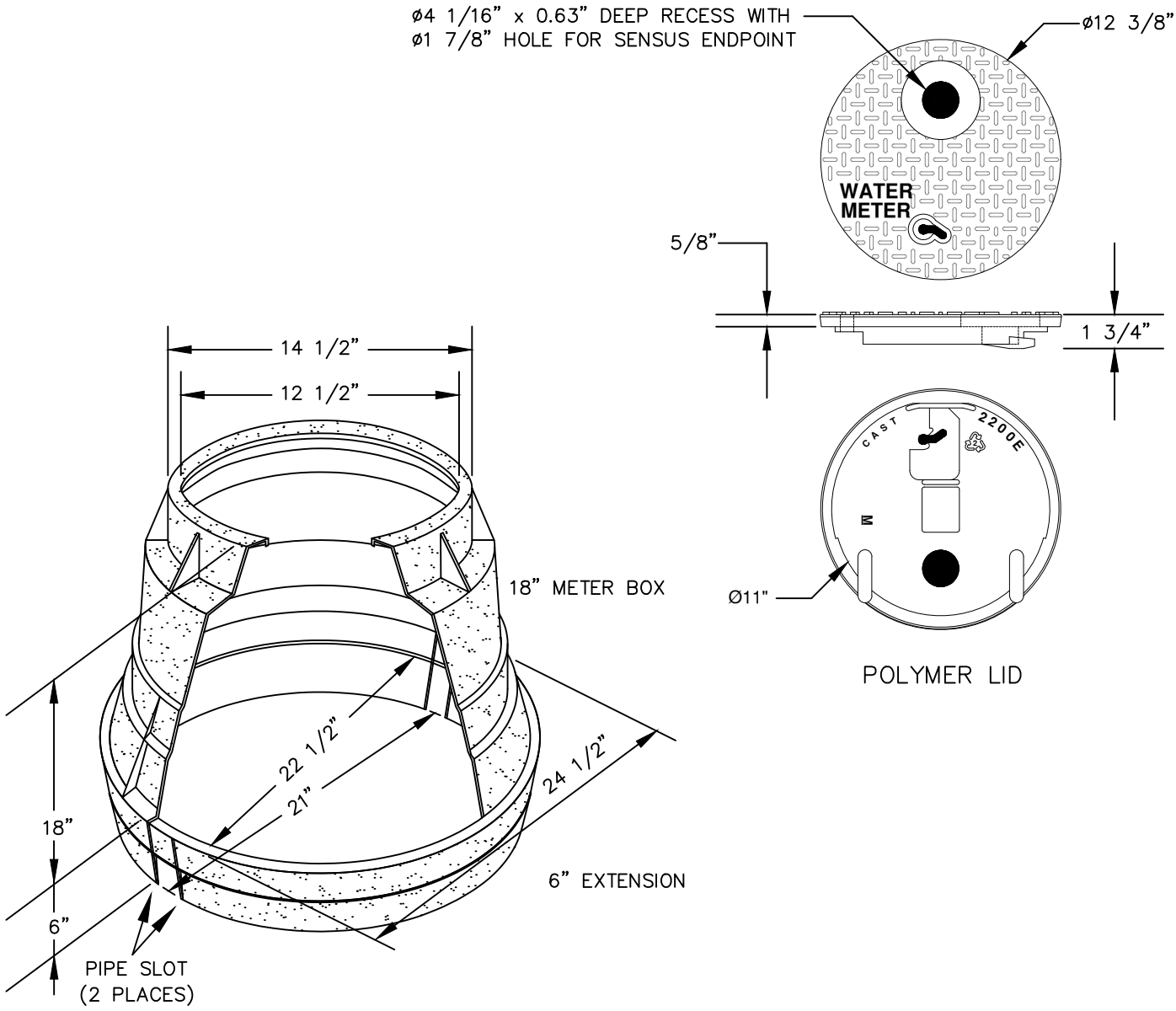
ALBEMARLE COUNTY SERVICE AUTHORITY	TYPICAL FIRE HYDRANT ASSEMBLY DETAIL NOT TO SCALE	REV 8/6/2024 DETAIL W–3



NOTES:

1. SADDLES SHALL BE USED TO TAP PLASTIC AND AC WATER MAINS.
2. NO SWEATED FITTINGS.
3. 36 INCHES OF COVER OVER SERVICE LINE SHALL BE MAINTAINED FOR UP TO 5 FEET BEFORE METER BOX. SERVICE LINE SHALL BE BROUGHT TO SETTER ELEVATION WITHIN THE LAST 5 FEET TO METER BOX.

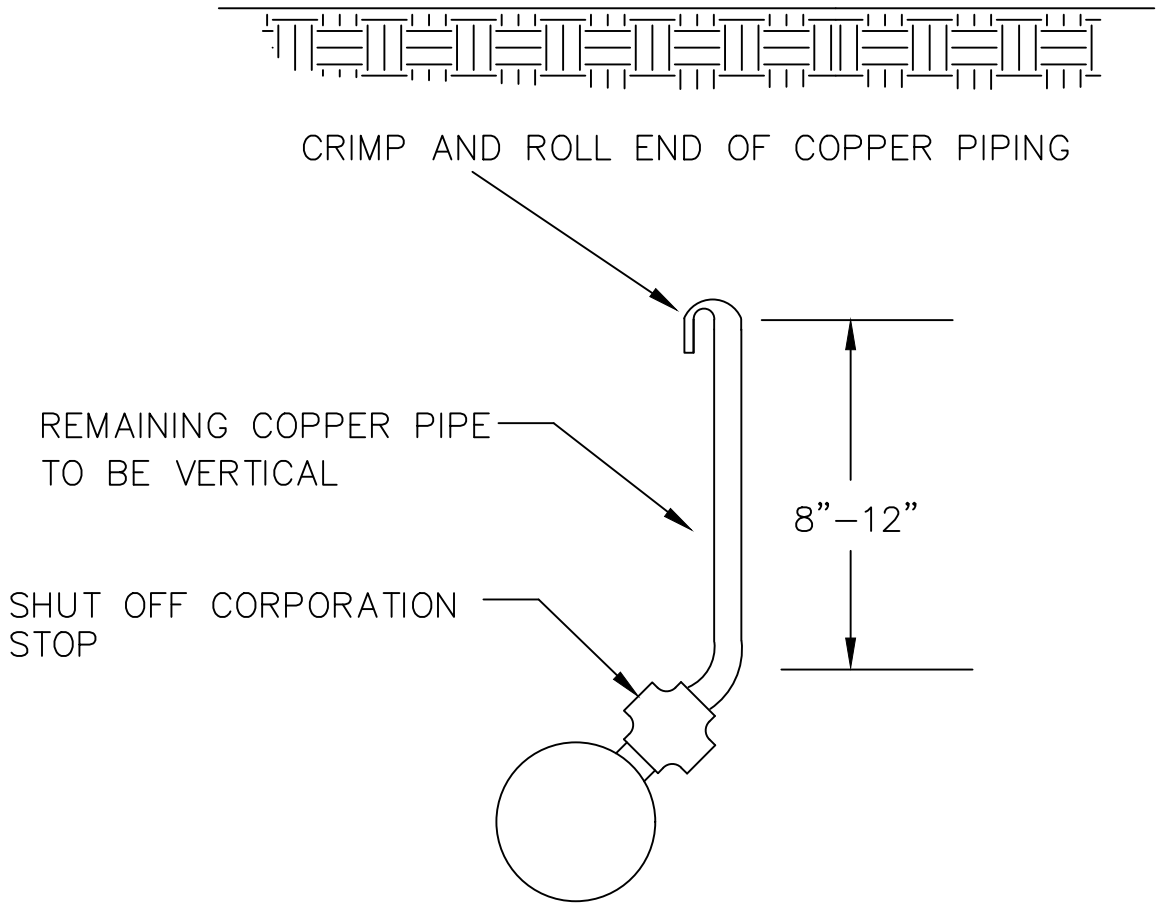
ALBEMARLE COUNTY SERVICE AUTHORITY	TYPICAL SERVICE LATERAL INSTALLATION (3/4" AND 1" METERS) NOT TO SCALE	REV 8/6/2024
		DETAIL W-4



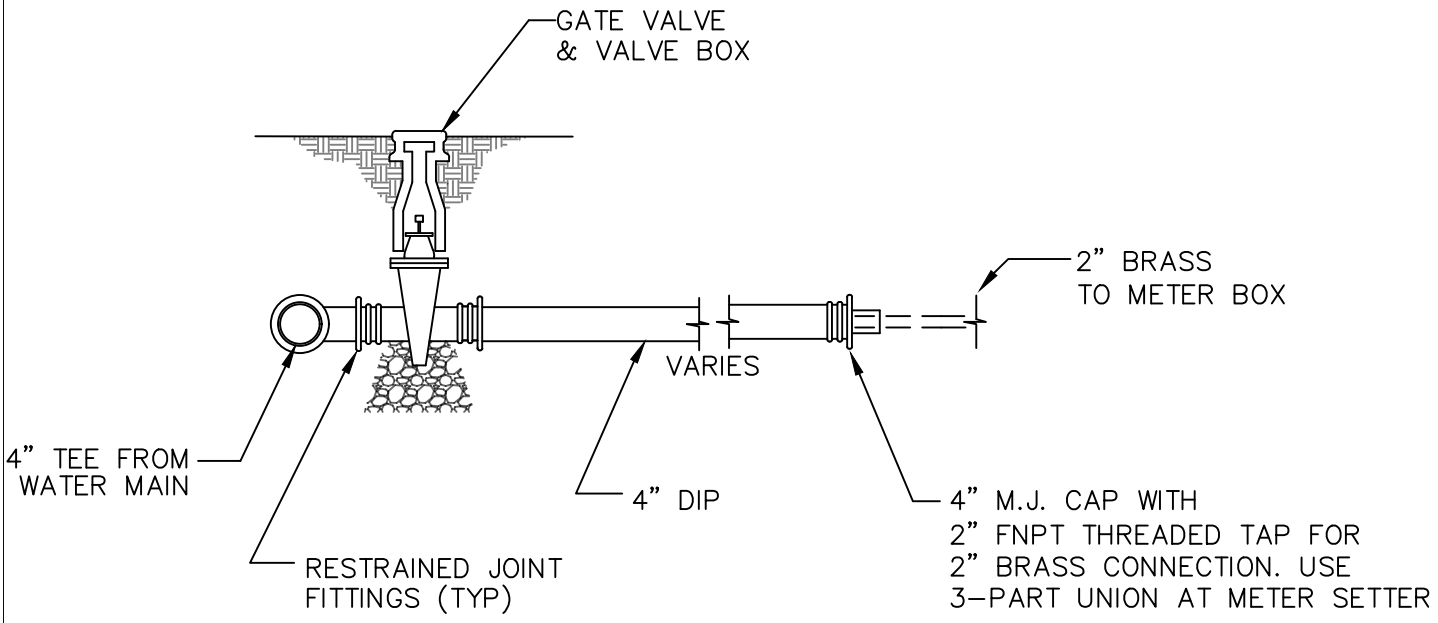
NOTES:

1. THE POLYMER LID SHALL HAVE A MOLDED KEYHOLE OR PICK BAR FOR LID REMOVAL.
2. THE POLYMER LID SHALL HAVE A MAGNET OR REBAR MOLDED WITHIN THE LID FOR LOCATING.
3. THE POLYMER LID SHALL BE BLACK.
4. BOX SHALL BE TRAFFIC RATED IF A 1" METER IS INSTALLED.

ALBEMARLE COUNTY SERVICE AUTHORITY	TYPICAL METER BOXES (3/4" AND 1" METERS) NOT TO SCALE	REV 8/6/2024
		DETAIL W–5



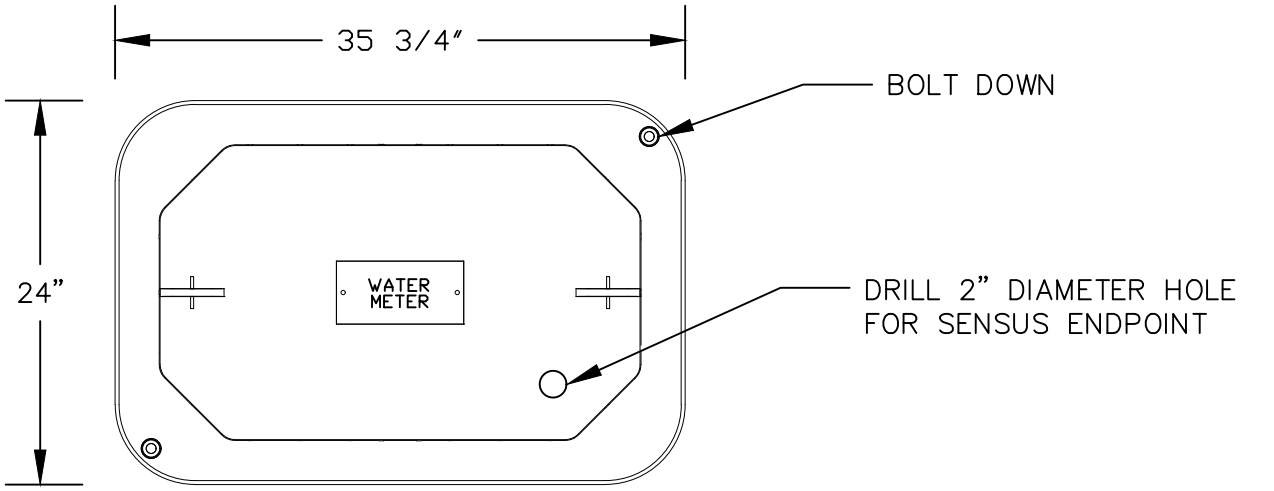
ALBEMARLE COUNTY SERVICE AUTHORITY	TYPICAL SERVICE TAP ABANDONMENT NOT TO SCALE	REV 8/6/2024 DETAIL W–6



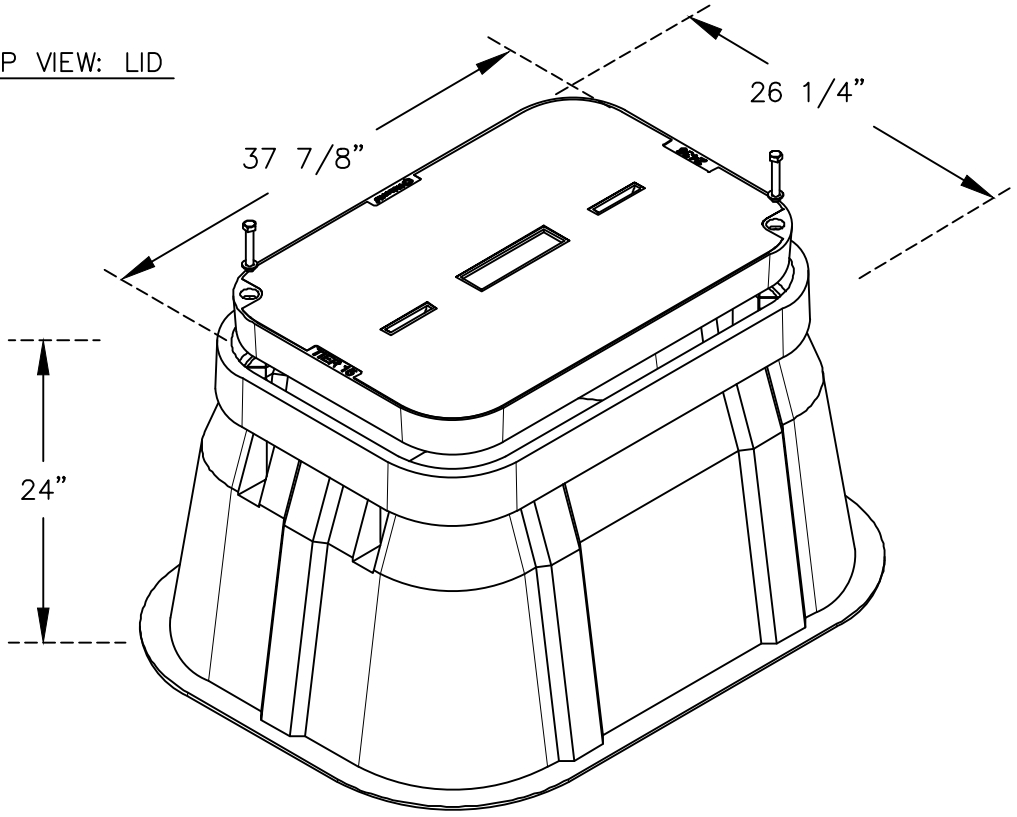
NOTES:

1. GATE VALVE WILL BE 4" UNLESS OTHERWISE SPECIFIED BY THE ACSA.
2. DIP TO EXTEND AT LEAST 24" BEYOND CURB, OR TO WITHIN 24" OF METER BOX.
3. SERVICE LINE CONNECTS AT MAIN WITH X"x4" TEE (OR TAPPING SLEEVE FOR RETROFIT).

ALBEMARLE COUNTY SERVICE AUTHORITY	LARGE METER SERVICE LINE NOT TO SCALE	REV 8/6/2024 DETAIL W-7



TOP VIEW: LID

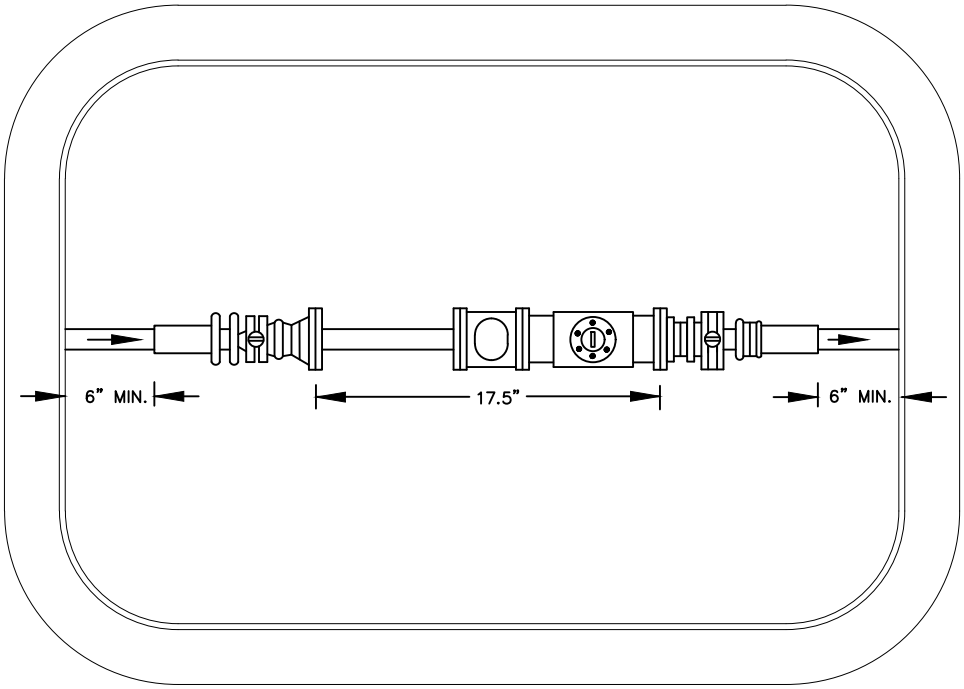


PERSPECTIVE: BOX

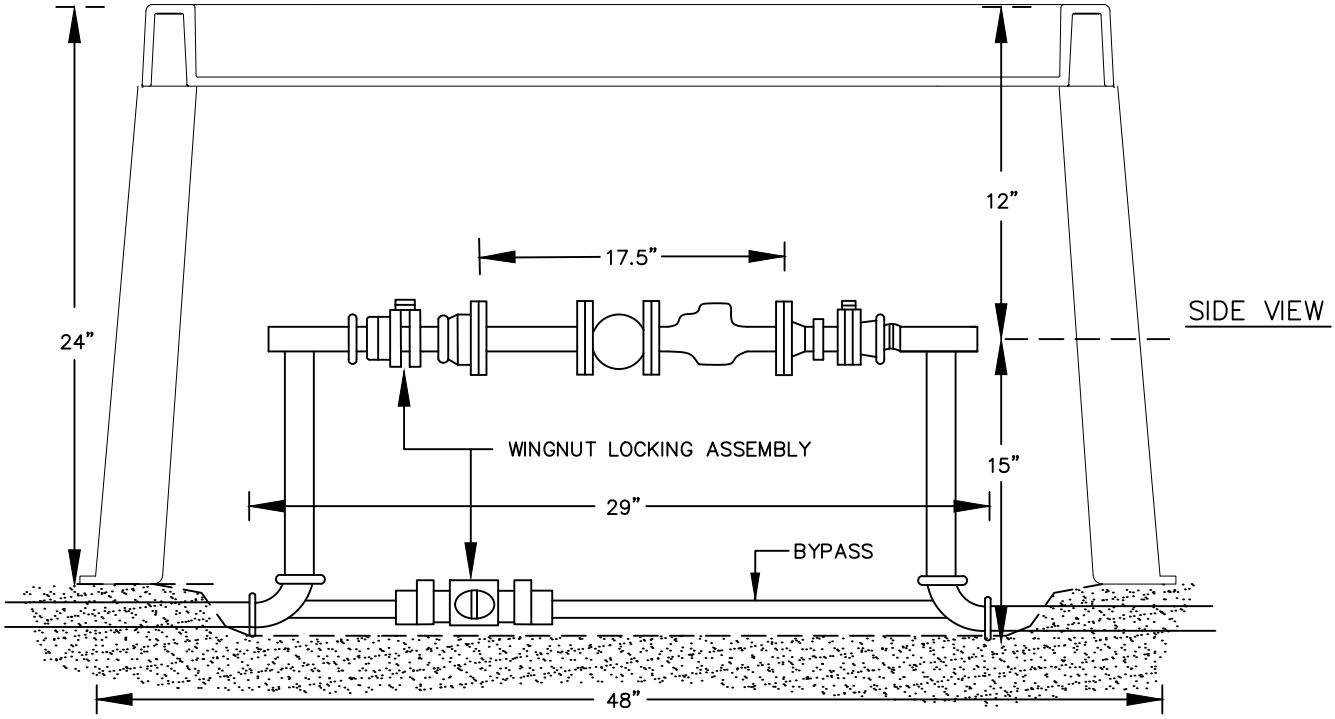
NOTES:

1. METER BOX TO BE ANSI TIER 15 RATED
2. LID SHALL BE POLYMER MATERIAL
3. BOX SHALL BE FLARED OUTWARD AT BOTTOM
4. BOX SHALL BE LOCATED IN TURF OR LANDSCAPE STRIP

ALBEMARLE COUNTY SERVICE AUTHORITY	TYPICAL METER BOXES (1.5" AND 2" METERS) NOT TO SCALE	REV 8/6/2024 DETAIL W–8



TOP VIEW



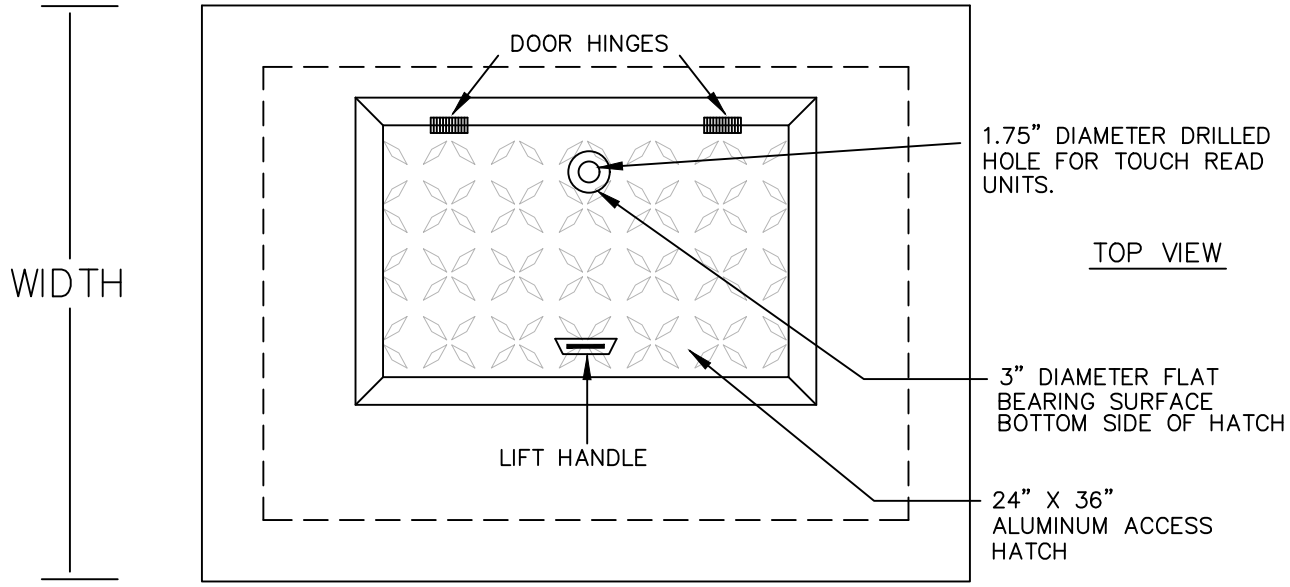
SIDE VIEW

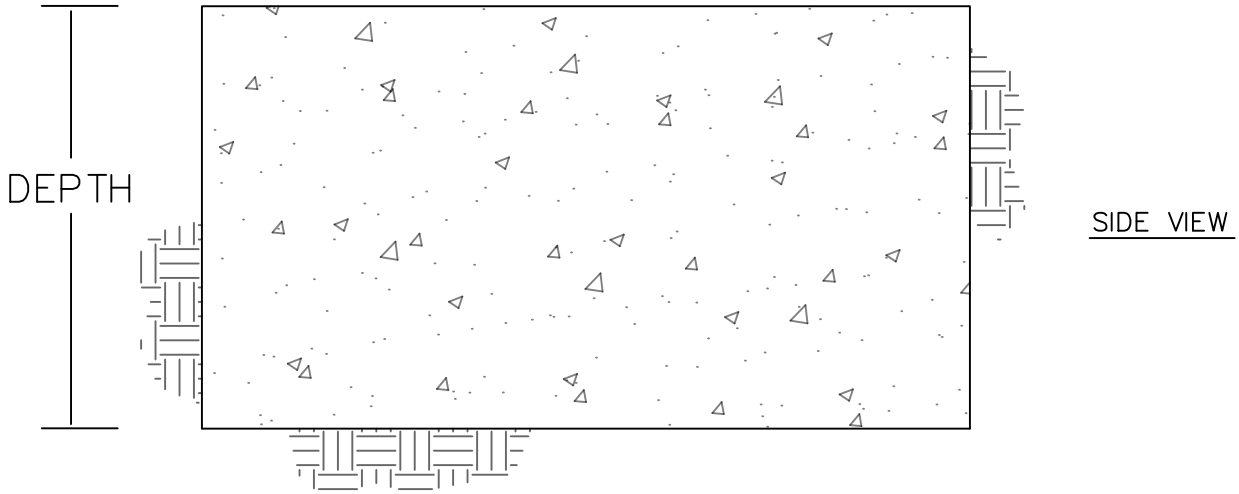
NOTES:

1. 2" WATER METER FEED SHALL BE LOCATED BELOW BASE OF BOX.
2. PROVIDE A 6" THICK GRAVEL BED BENEATH THE METER BOX.

ALBEMARLE COUNTY SERVICE AUTHORITY	TYPICAL METER INSTALLATION (1.5" AND 2" METERS) NOT TO SCALE	REV 8/6/2024 DETAIL W–9

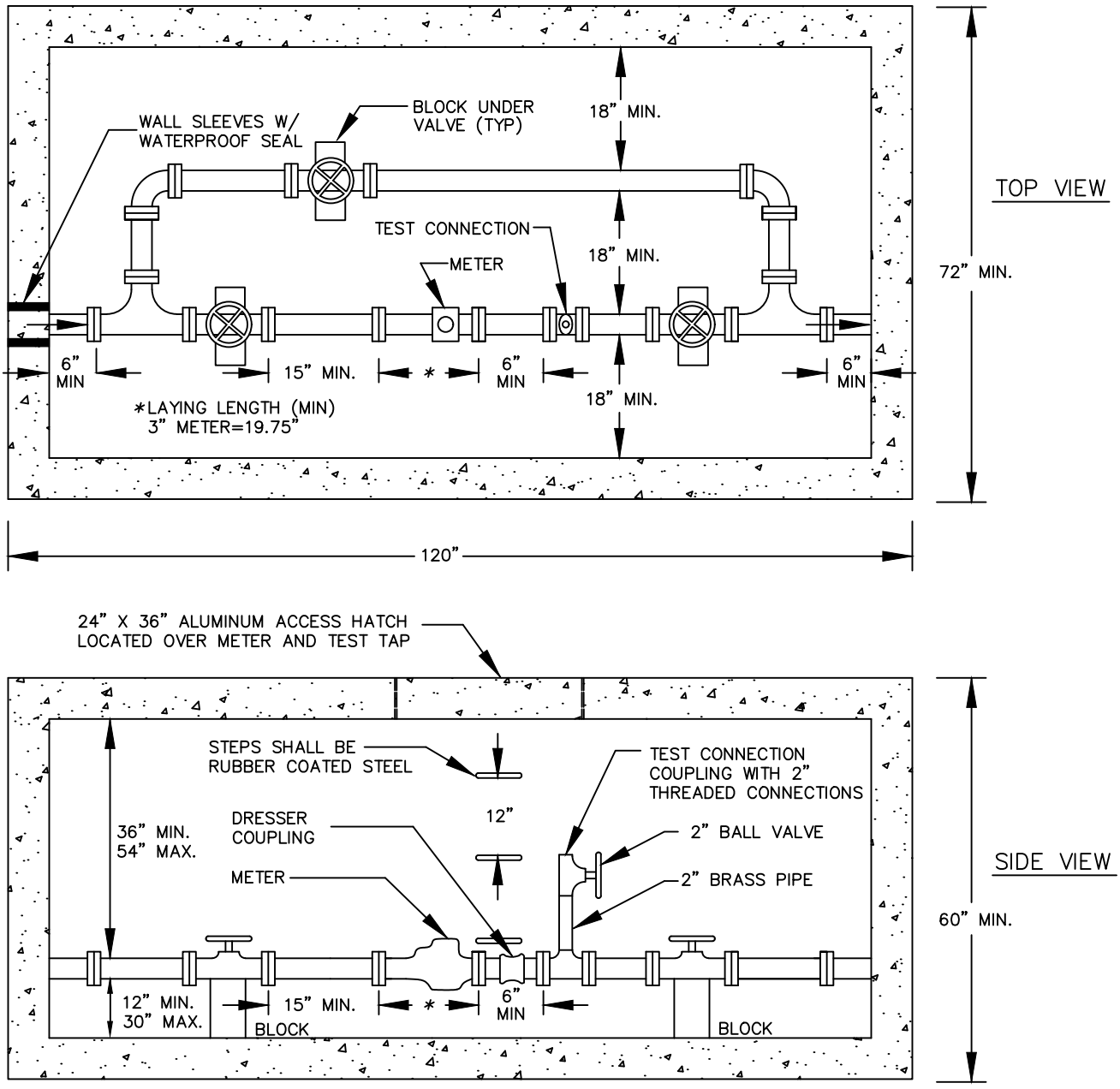
METER SIZE	DEPTH	LENGTH	WIDTH
3"	5' MIN.	10' MIN.	6' MIN.
4"	5' MIN.	12' MIN.	6' MIN.
GREATER THAN 4"	PROPOSALS WILL BE SUBMITTED.		





NOTE: CONSULT WITH ALBEMARLE COUNTY SERVICE AUTHORITY BEFORE SPECIFYING 3" OR 4" METER VAULT

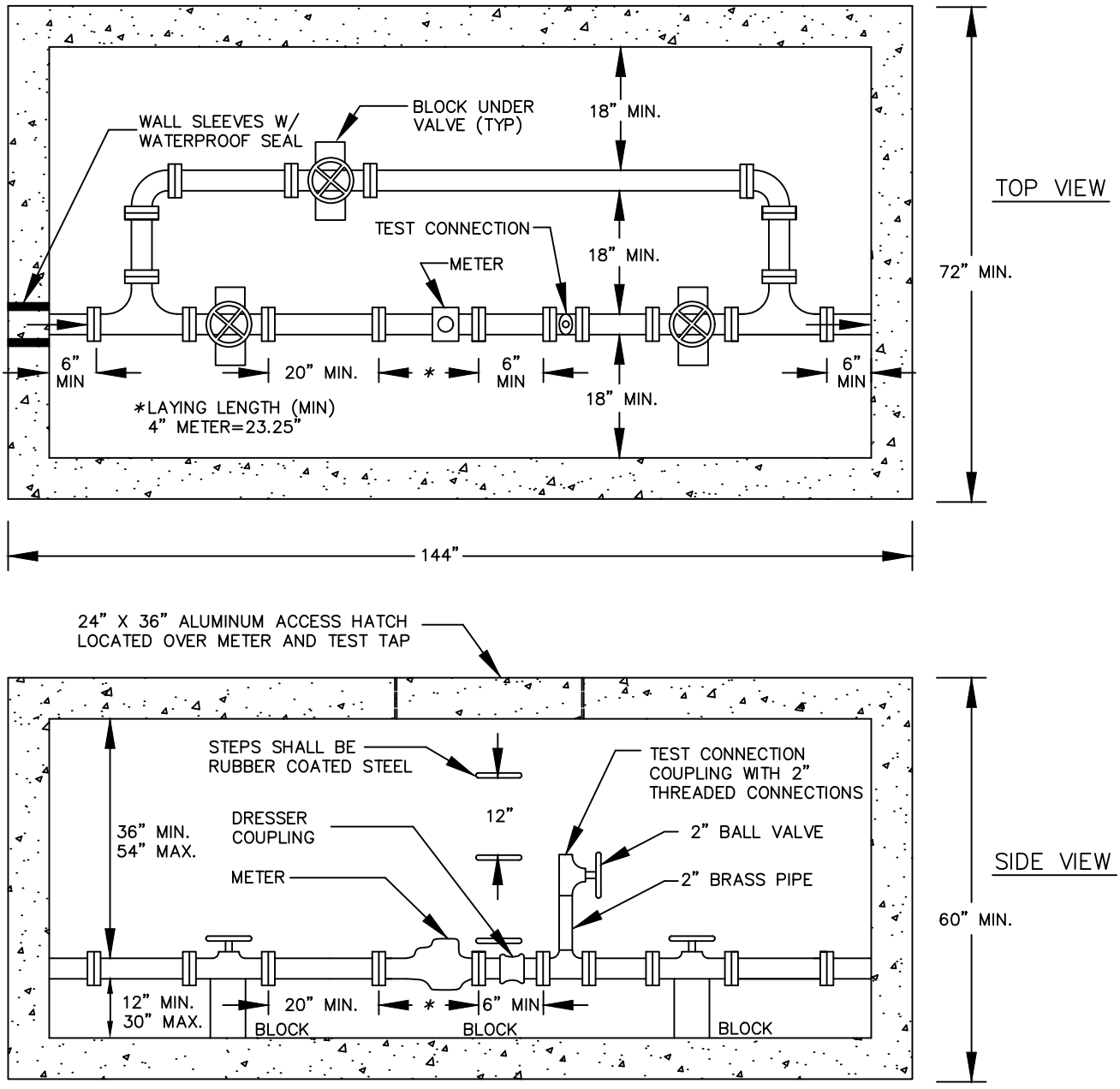
ALBEMARLE COUNTY SERVICE AUTHORITY	TYPICAL METER VAULT (3" AND 4" METERS) NOT TO SCALE	REV 8/6/2024
		DETAIL W–10



NOTES:

1. CONSULT WITH ALBEMARLE COUNTY SERVICE AUTHORITY BEFORE SPECIFYING 3" OR 4" METER VAULT
2. MINIMUM WALL THICKNESS FOR PRECAST OR POUR-IN-PLACE VAULTS SHALL BE 4".
3. THE OUTSIDE OF THE VAULT BELOW GRADE SHALL BE COATED WITH AN APPROVED WATERPROOFING COMPOUND.
4. PROVIDE A FLOOR DRAIN WITH A 2" DRAIN PIPE RUN TO DAYLIGHT OR INSTALL A SUMP PUMP. IN EITHER CASE THE FLOOR OF THE VAULT SHALL SLOPE TO THE DRAIN OR SUMP.

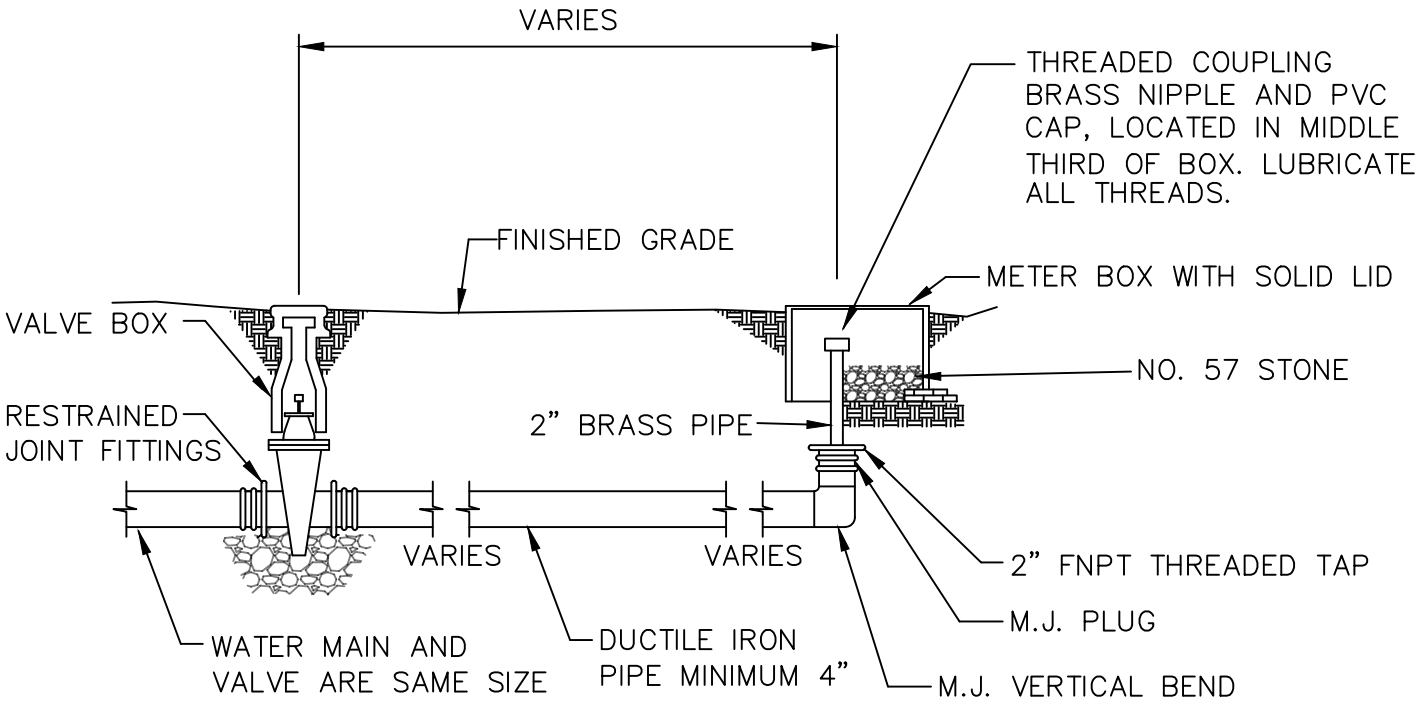
ALBEMARLE COUNTY SERVICE AUTHORITY	TYPICAL METER INSTALLATION (3" METER) NOT TO SCALE	REV 8/6/2024
		DETAIL W-11



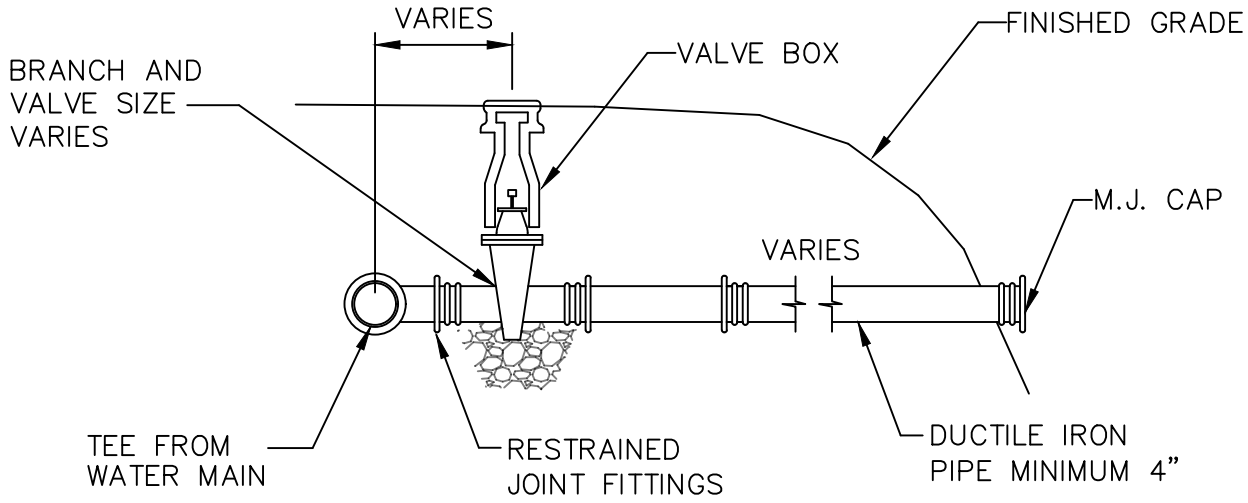
NOTES:

1. CONSULT WITH ALBEMARLE COUNTY SERVICE AUTHORITY BEFORE SPECIFYING 3" OR 4" METER VAULT
2. MINIMUM WALL THICKNESS FOR PRECAST OR POUR-IN-PLACE VAULTS SHALL BE 4".
3. THE OUTSIDE OF THE VAULT BELOW GRADE SHALL BE COATED WITH AN APPROVED WATERPROOFING COMPOUND.
4. PROVIDE A FLOOR DRAIN WITH A 2" DRAIN PIPE RUN TO DAYLIGHT OR INSTALL A SUMP PUMP. IN EITHER CASE THE FLOOR OF THE VAULT SHALL SLOPE TO THE DRAIN OR SUMP.

ALBEMARLE COUNTY SERVICE AUTHORITY	TYPICAL METER INSTALLATION (4" METER) NOT TO SCALE	REV 8/6/2024
		DETAIL W-12

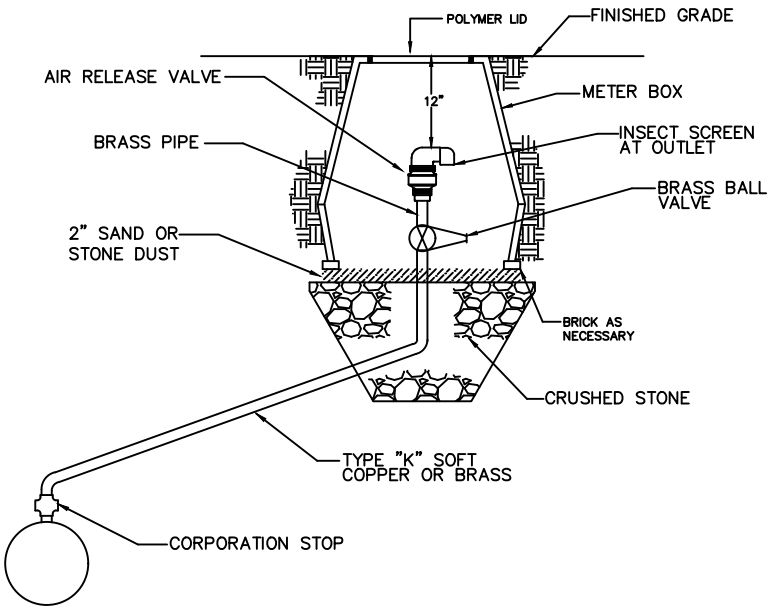


DEAD END
(TYPE "A")

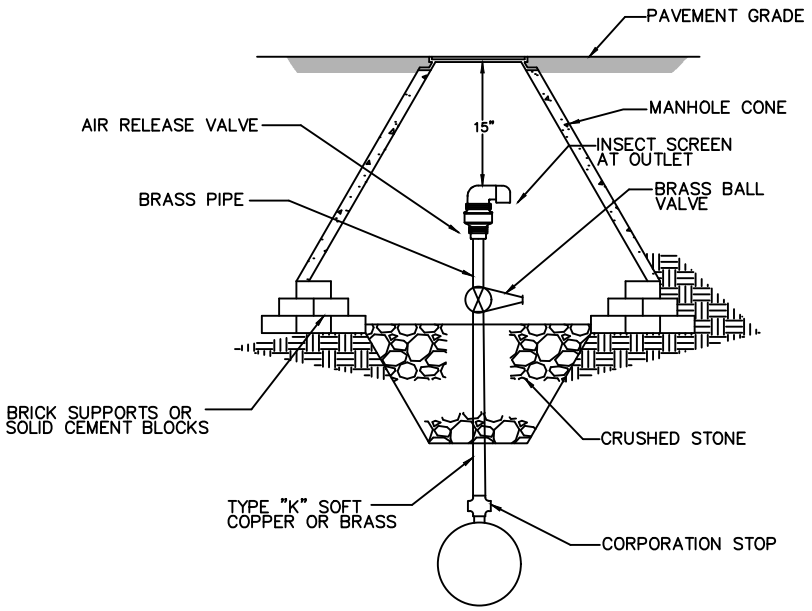


ON–LINE
(TYPE "B")

ALBEMARLE COUNTY SERVICE AUTHORITY	TYPICAL BLOW–OFF ASSEMBLY (BOA) NOT TO SCALE	REV 10/29/2025 DETAIL W–13



NON–PAVEMENT AREA

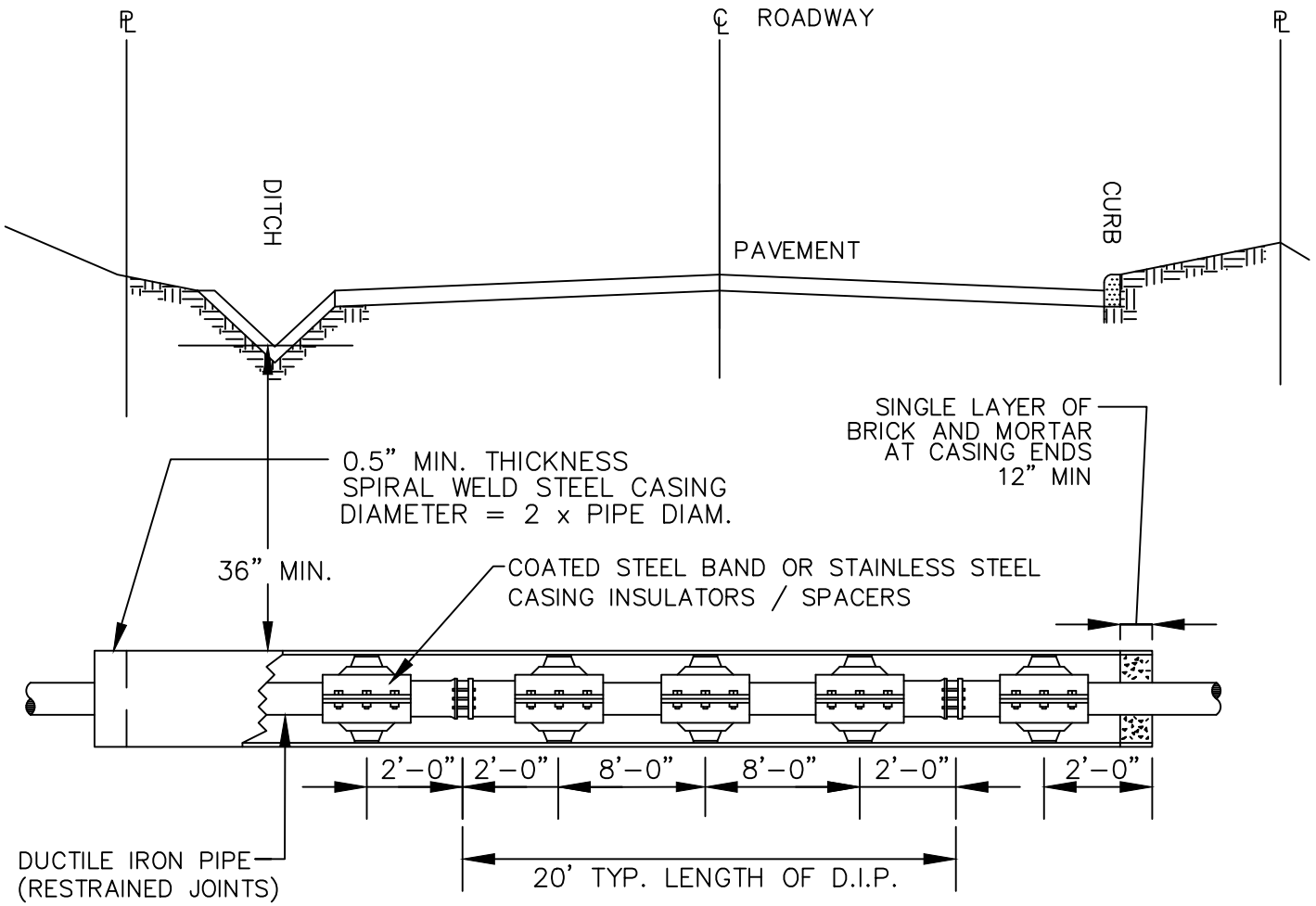


PAVEMENT AREA

NOTES:

1. USE PRECAST MANHOLE CONE AND COVER, WITH "WATER" CAST ON LID FOR TRAFFIC AREAS.
2. FOR WATER MAINS SMALLER THAN 12" USE A 1" ARV AND FITTINGS. FOR WATER MAINS 12" AND LARGER USE 2" ARV AND FITTINGS.
3. TWO INCH TAPS MUST USE SADDLE FOR CONNECTION TO WATER MAIN.
4. IN SITUATIONS WHERE THE ARV ASSEMBLY CANNOT BE OFFSET FROM THE MAIN, AN ADEQUATE FOUNDATION SHALL BE INSTALLED SO THE WATER LINE DOES NOT SUPPORT THE MANHOLE CONE.

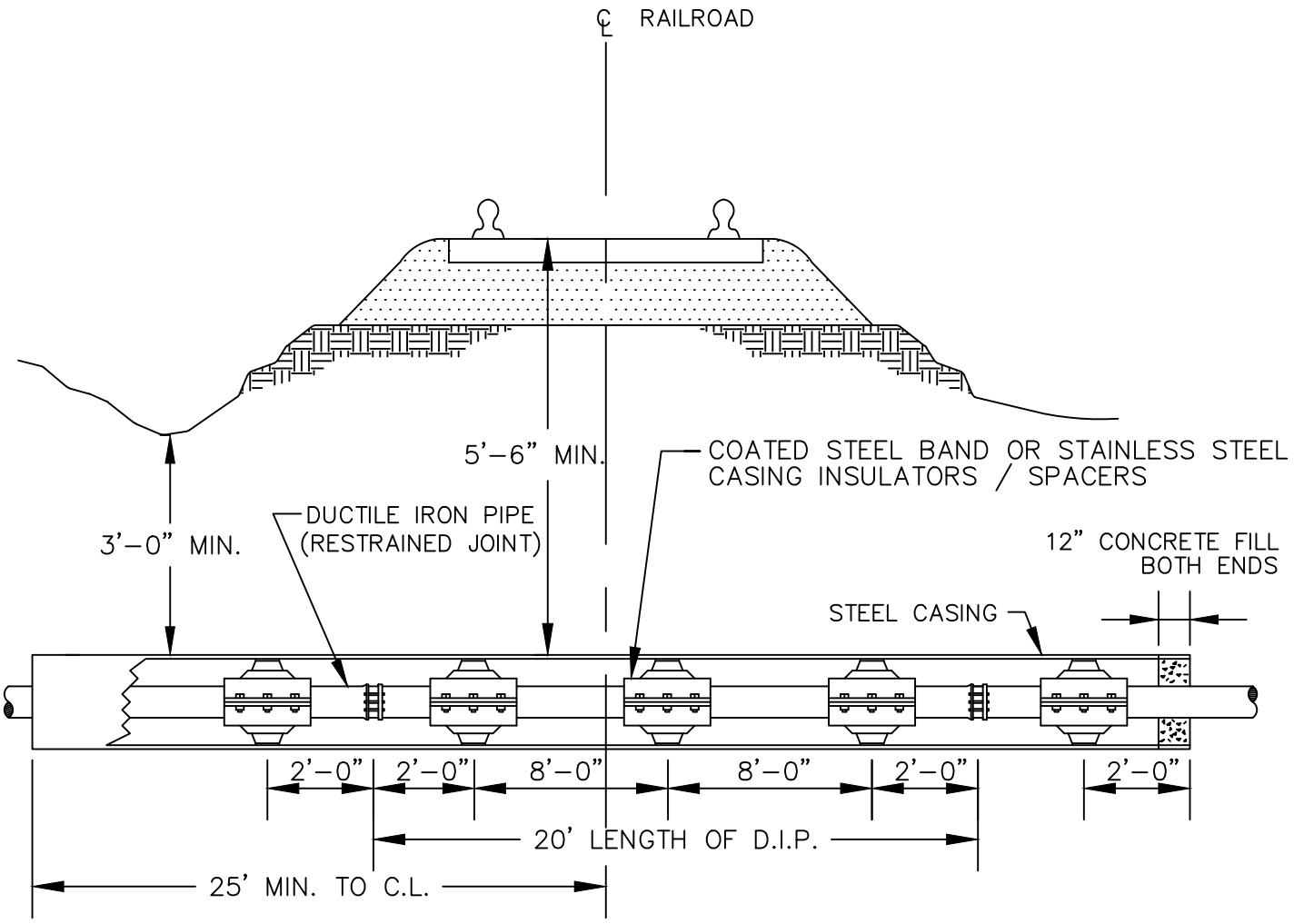
ALBEMARLE COUNTY SERVICE AUTHORITY	TYPICAL AIR RELEASE VALVE (ARV) NOT TO SCALE	REV 8/6/2024 DETAIL W–14



NOTES:

1. STEEL CASING TO EXTEND TO BACK OF CURB, DITCH, SIDEWALK, ETC. OR A MINIMUM OF 5' BEYOND THE EDGE OF PAVEMENT, WHICHEVER IS GREATER.
2. MIDDLE SPACER SHALL BE PLACED AT THE CENTERPOINT OF PIPE.
3. THREE CASING SPACERS TO BE USED PER STICK OF PIPE.

ALBEMARLE COUNTY SERVICE AUTHORITY	TYPICAL STEEL SLEEVE INSTALLATION UNDER ROADWAYS NOT TO SCALE	REV 8/6/2024 DETAIL W–15

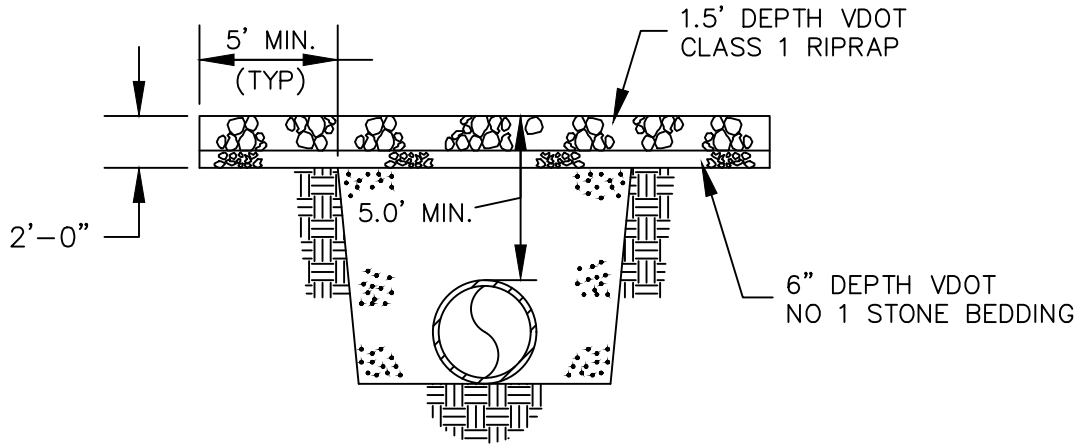


ALSO SEE THE "AREA MANUAL FOR RAILWAY ENGINEERING – PART 5, PIPELINES"

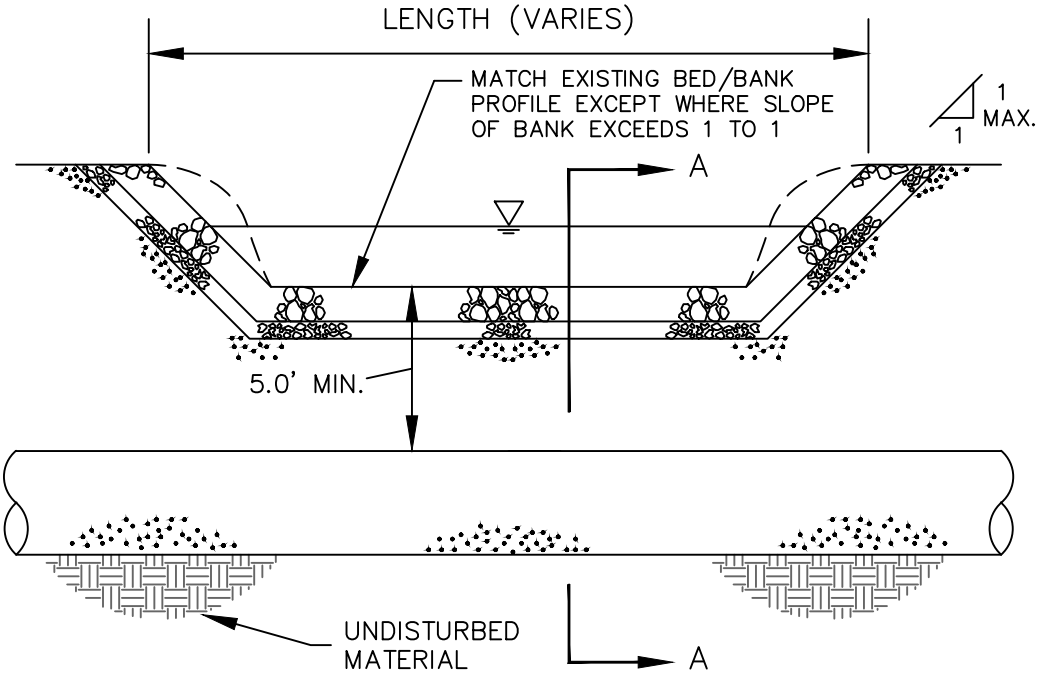
NOTES:

1. MIDDLE SPACER SHALL BE PLACED AT THE CENTERPOINT OF PIPE.
2. THREE CASING SPACERS TO BE USED PER STICK OF PIPE.

ALBEMARLE COUNTY SERVICE AUTHORITY	TYPICAL STEEL SLEEVE INSTALLATION UNDER RAILROADS NOT TO SCALE	REV 8/6/2024 DETAIL W–16



SECTION A–A

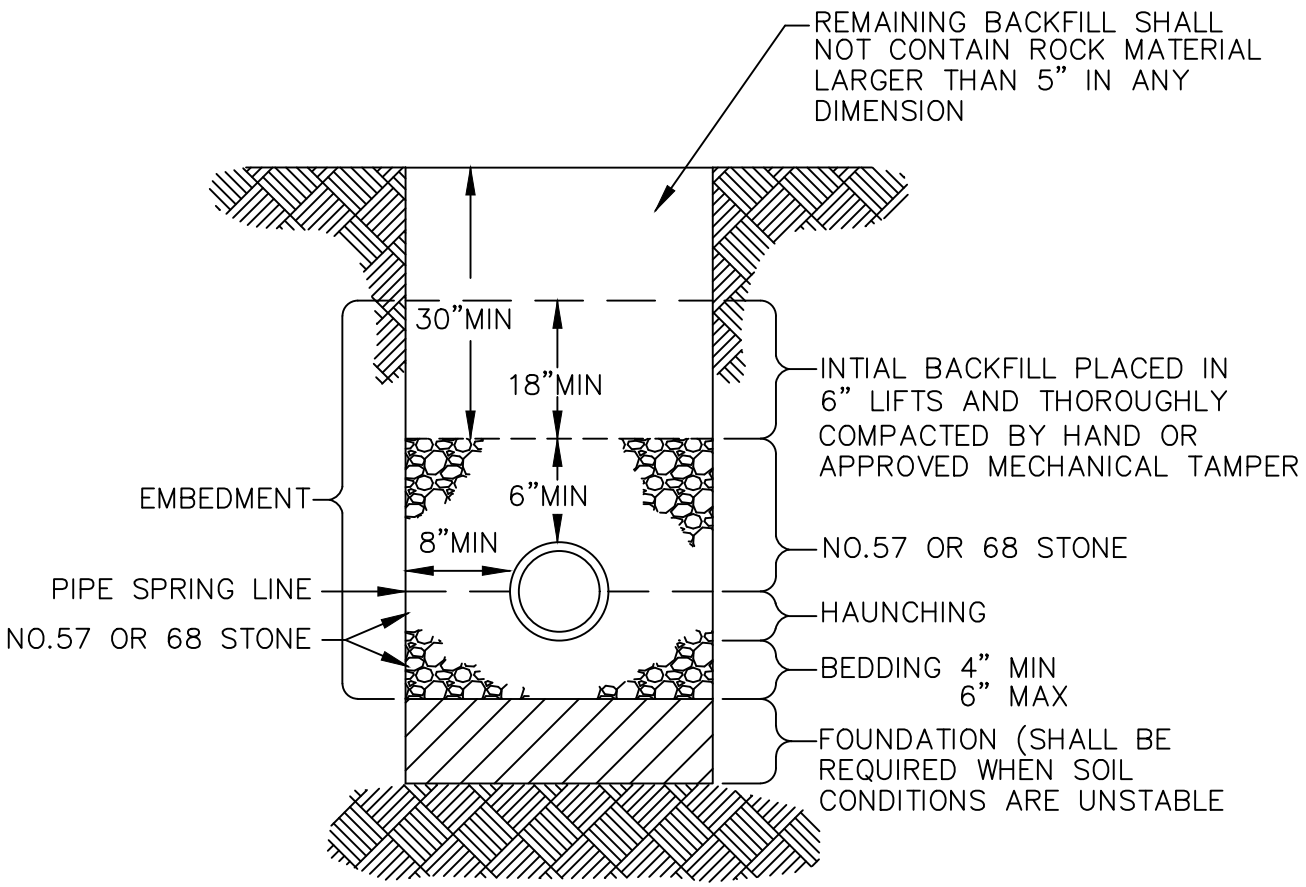


ELEVATION

NOTES:

1. RESTRAINED JOINTS REQUIRED.
2. WHEN BEDROCK IS ENCOUNTERED AND COVER EQUALS OR EXCEEDS 3', THE TRENCH SHALL BE BACKFILLED WITH COMPACTED 21A STONE AND TOPPED WITH 18" OF VDOT CLASS 1 RIPRAP.

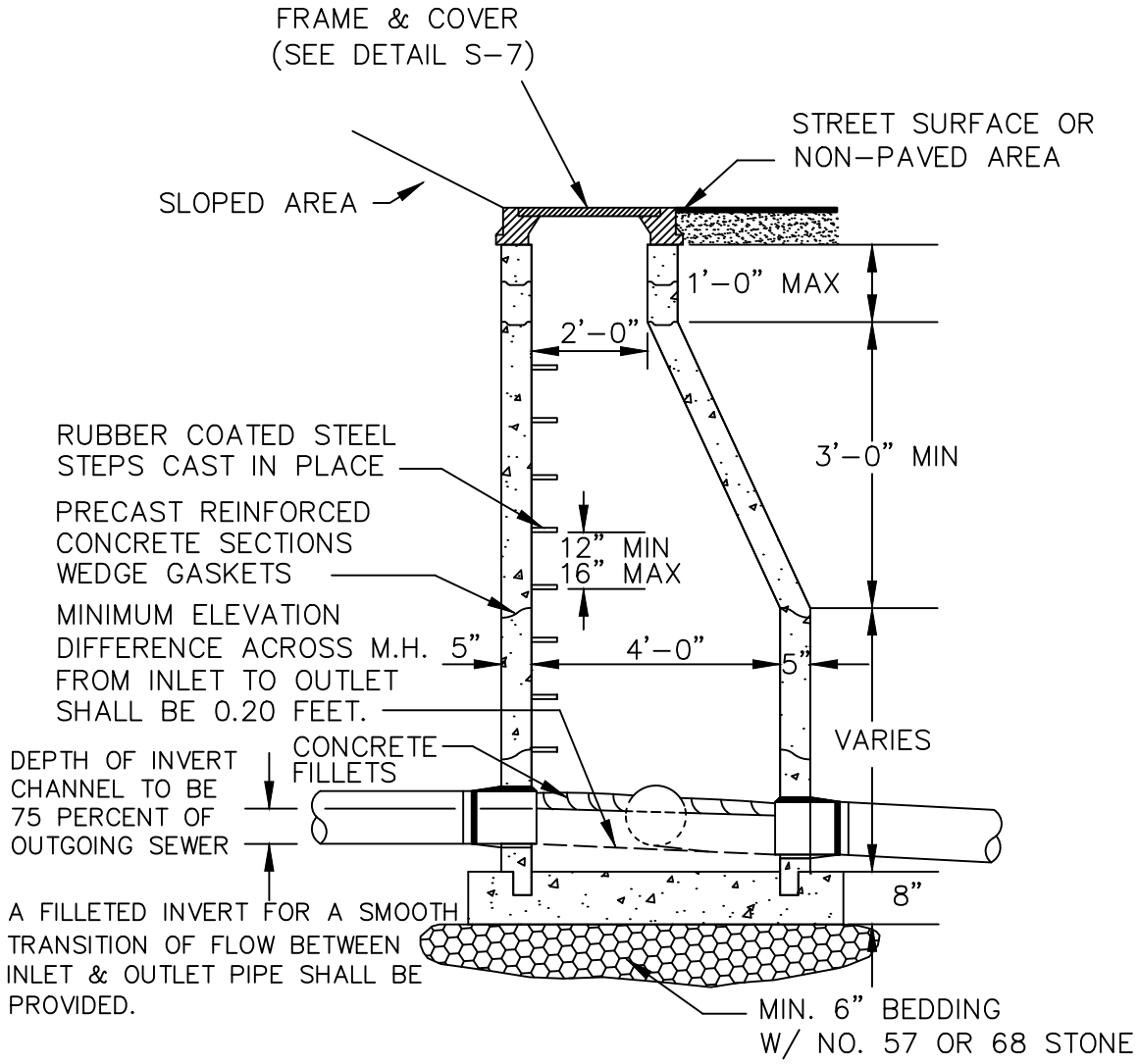
ALBEMARLE COUNTY SERVICE AUTHORITY	TYPICAL STREAM CROSSING NOT TO SCALE	REV 8/6/2024 DETAIL W–17



NOTES:

1. OPEN CUTS IN PAVED AREAS WITHIN EXISTING VDOT RIGHT-OF-WAY SHALL BE BACKFILLED ENTIRELY WITH NO. 21A STONE.
2. FOR DUCTILE IRON PIPE THE BOTTOM OF THE TRENCH SHALL BE SCRAPED AND COMPACTED, AND ALL STONES REMOVED OR A 4" BEDDING OF NO. 57 OR 68 STONE SHALL BE PROVIDED.
3. WHERE ROCK IS ENCOUNTERED PIPE SHALL BE INSTALLED ON A MINIMUM 6" BEDDING OF NO. 57 OR 68 STONE.

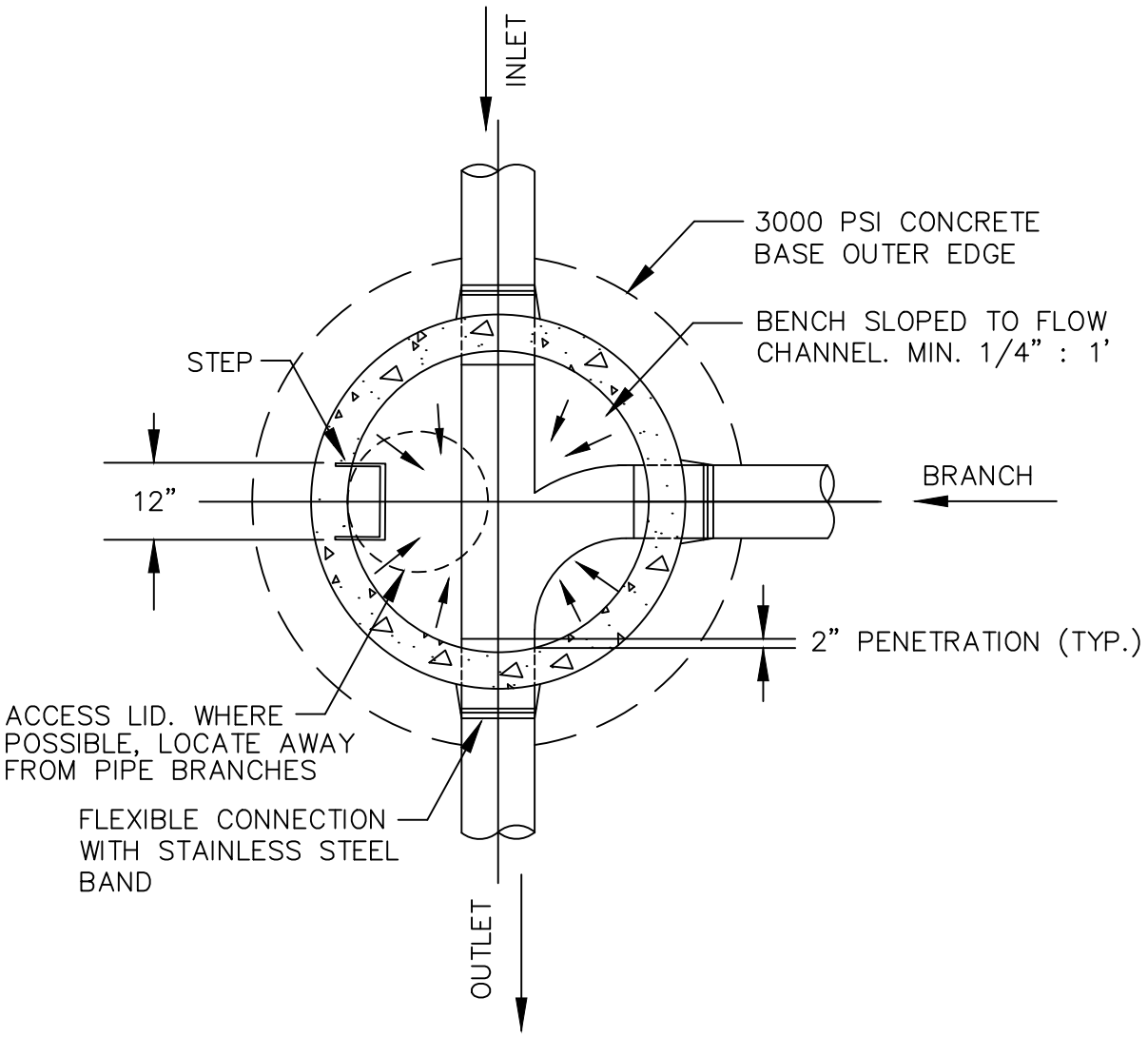
ALBEMARLE COUNTY SERVICE AUTHORITY	TYPICAL SEWER PIPE INSTALLATION IN TRENCH NOT TO SCALE	REV 8/6/2024 DETAIL S-1



NOTES:

1. BEDDING THICKNESS REQUIREMENT SHOWN IS MINIMUM AND SHALL BE SPECIFICALLY DETERMINED BY THE CONSULTANT FOR THE SOIL CONDITIONS.
2. THE DEVELOPER'S ENGINEER WILL DETERMINE WHETHER MANHOLES SHALL HAVE EXTENDED OR NON-EXTENDED BASES.
3. ALL JOINTS AND LIFT HOLES TO BE SEALED & GROUTED OUTSIDE OF MANHOLE. INLETS AND OUTLETS TO BE SEALED & GROUTED INSIDE AND OUTSIDE OF MANHOLE.
4. BUOYANCY CALCULATIONS FOR MANHOLE BASES TO BE SUBMITTED FOR MANHOLES WITHIN 100-YEAR FLOODPLAIN.
5. ELEVATION DIFFERENCE ACROSS M.H. FROM ANY INLET TO OUTLET SHALL BE MINIMUM 0.2 FEET, MAXIMUM EQUAL TO THE OUTLET PIPE DIAMETER.

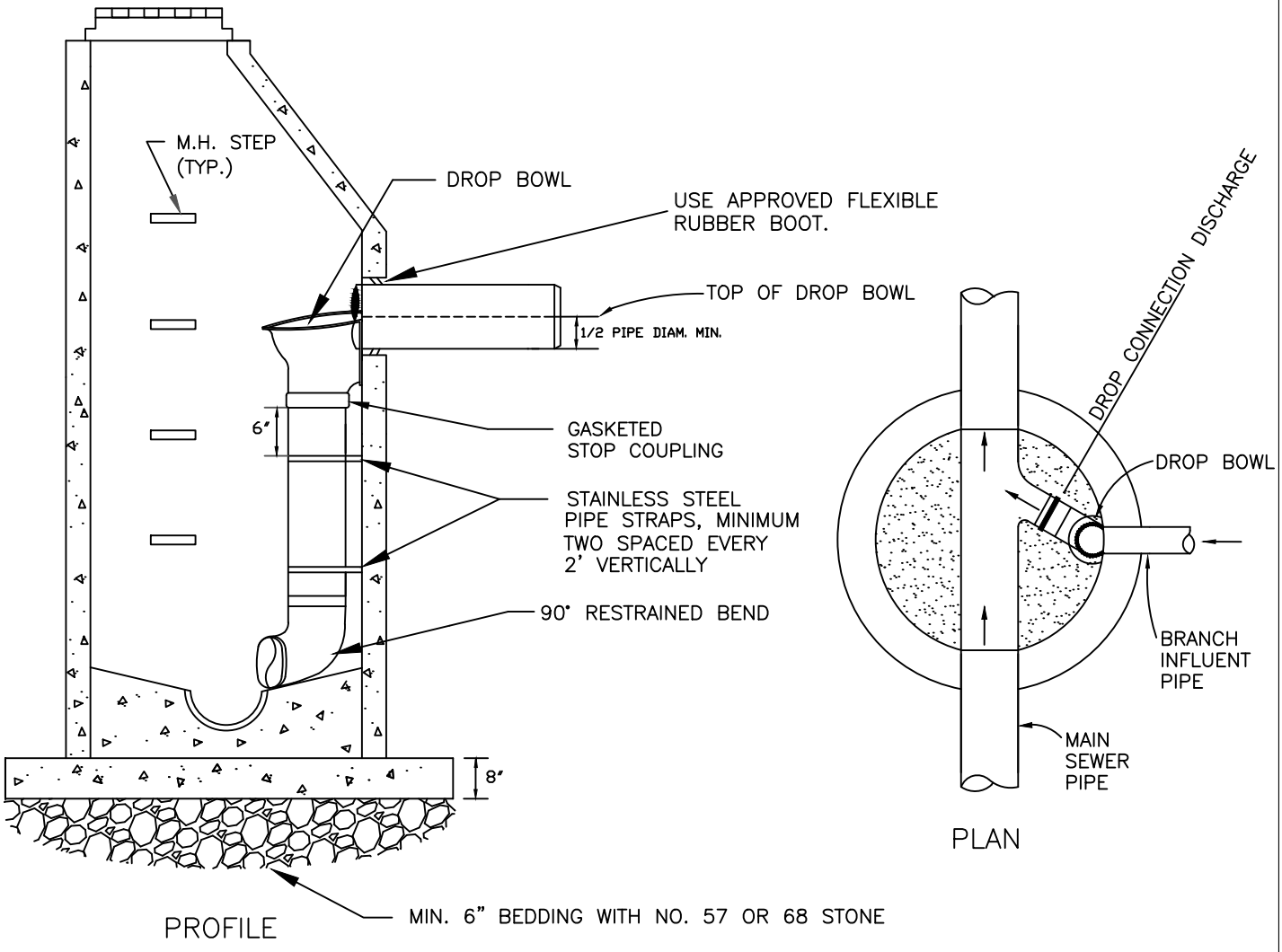
ALBEMARLE COUNTY SERVICE AUTHORITY	TYPICAL MANHOLE SECTION SHOWING BRANCH TIE-IN NOT TO SCALE	REV 8/6/2024 DETAIL S-2



NOTES:

1. ALL CONNECTIONS TO EXISTING MANHOLES SHALL BE CORED AND A FLEXIBLE CONNECTION " BOOT " INSTALLED.
2. MANHOLE BENCH AND INVERT TO BE FACTORY–POURED OR SOLID CONCRETE.
3. BRANCH CONNECTIONS SHALL OCCUR WITH MINIMUM 90° ANGLE FROM OUTLET.

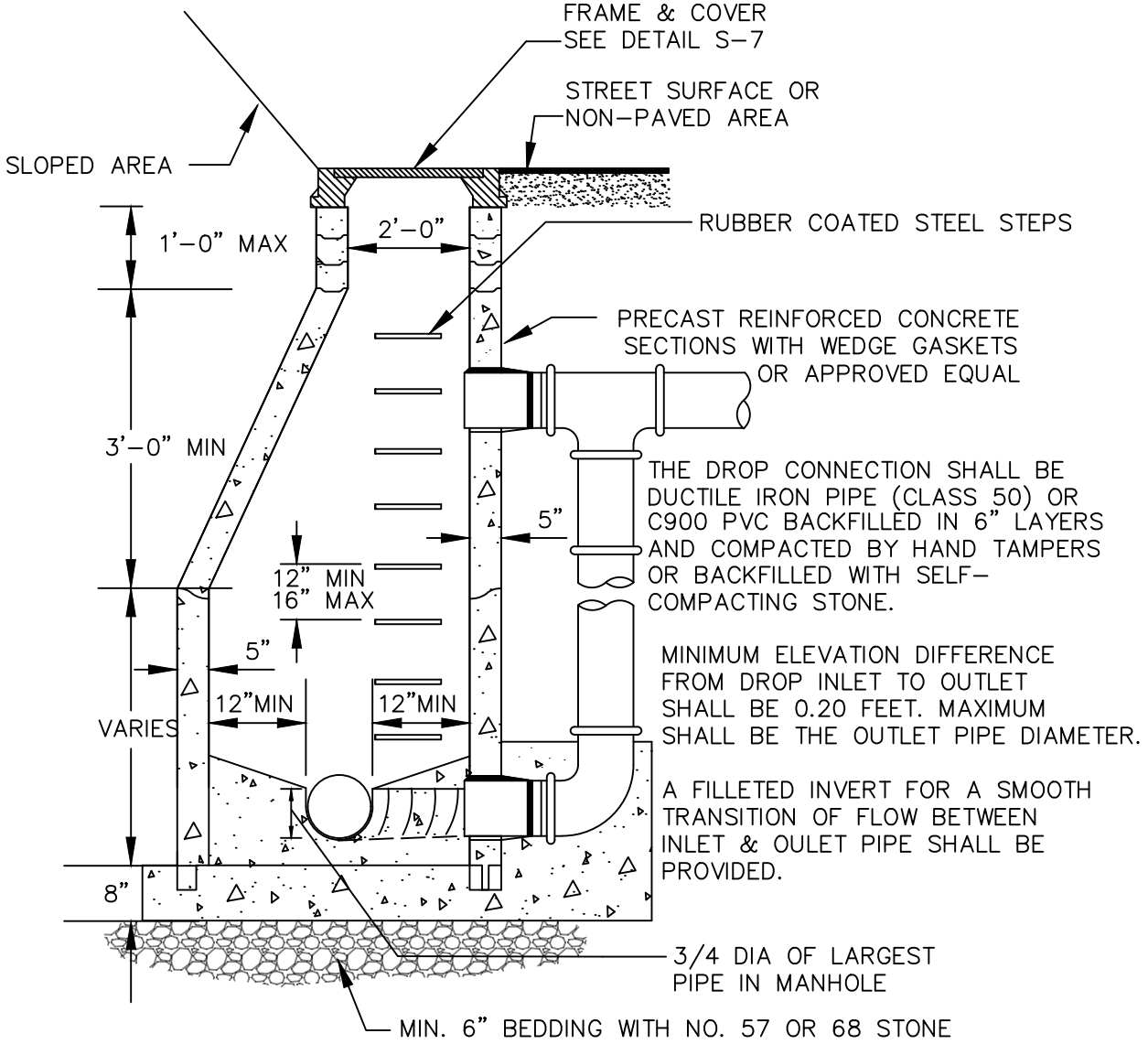
ALBEMARLE COUNTY SERVICE AUTHORITY	TYPICAL MANHOLE PLAN SHOWING BRANCH TIE–IN NOT TO SCALE	REV 8/6/2024 DETAIL S–3



NOTES:

1. VERTICAL DROP PIPE SHALL BE SDR 26 OR C900 P.V.C, SIZED THE SAME AS THE INCOMING PIPE AND CONNECTED TO THE DROP FITTING WITH STANDARD GASKET JOINT.
2. VERTICAL DROP PIPE SHALL BE STRAPPED TO THE MANHOLE AT PIPE JOINTS. STRAPS SHALL BE MADE OF STAINLESS STEEL.
3. SHAPE INVERT AS NEEDED TO PROVIDE SMOOTH TRANSITION FROM DROP CONNECTION DISCHARGE POINT TO SPRING LINE OF MANHOLE INVERT.
4. DROP CONNECTION DISCHARGE FITTING SHALL BE ORIENTED AT 45 DEGREES, INTO THE FLOW.
5. VERTICAL DROP PIPE SHALL BE INSTALLED AT 90 DEGREES FROM THE ACCESS STEPS.
6. MINIMUM 60" DIAMETER MANHOLE IS REQUIRED. MINIMUM 72" DIAMETER MANHOLE REQUIRED FOR A SINGLE 10" OR 12" DIAMETER DROP CONNECTION, OR TWO 8" DIAMETER DROP CONNECTIONS.
7. IF 90–DEGREE BEND IS NOT IN CHANNEL, PVC PIPE SHALL EXTEND TO THE EDGE OF THE CHANNEL. HORIZONTAL PIPE SHALL BE GLUED TO THE 90–DEGREE FITTING. STRAP, AS NEEDED, TO BE DETERMINED BY ACSA.

ALBEMARLE COUNTY SERVICE AUTHORITY	STANDARD INTERNAL DROP CONNECTION NOT TO SCALE	REV 10/28/2026 DETAIL S–4

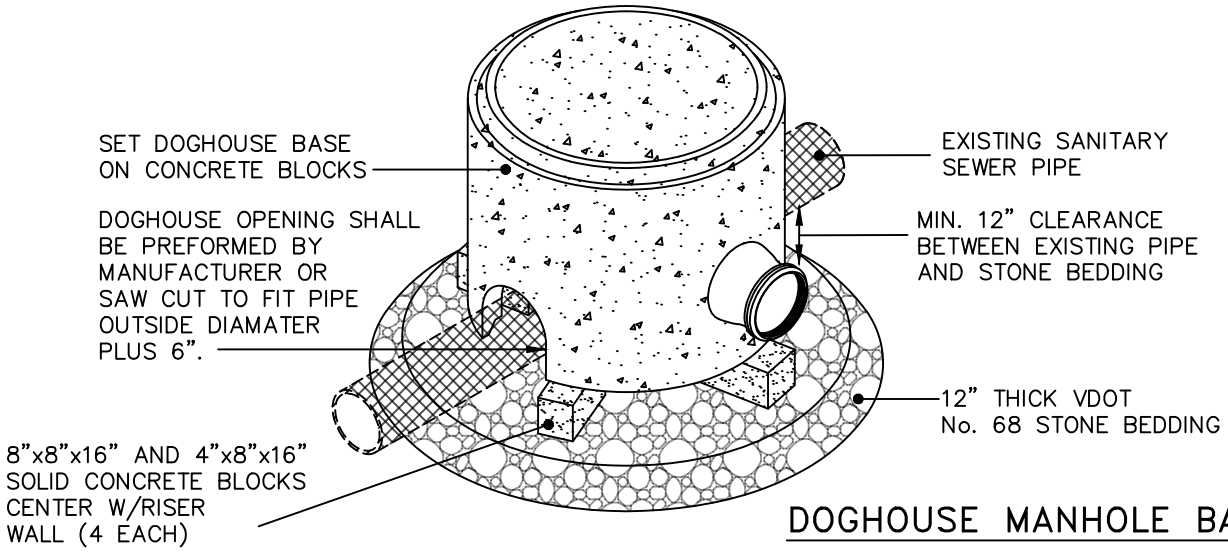


NOTES:

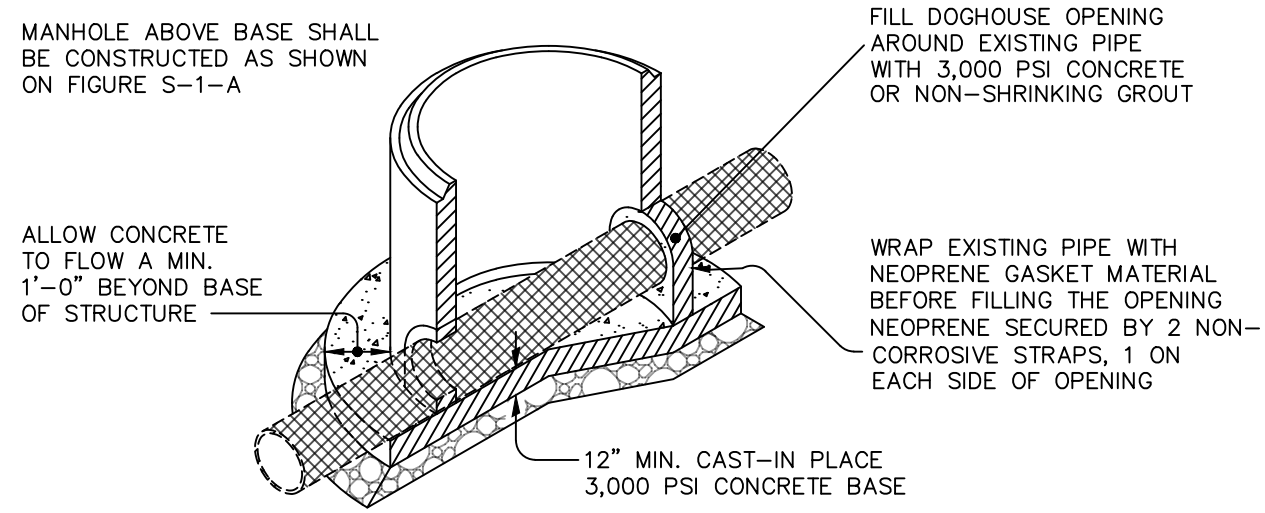
1. BEDDING THICKNESS REQUIREMENTS SHOWN ARE MINIMUM AND SHALL BE SPECIFICALLY DETERMINED BY THE CONSULTANT FOR THE SOIL CONDITIONS.
2. THE DEVELOPER'S ENGINEER SHALL DETERMINE WHETHER MANHOLES SHALL HAVE EXTENDED OR NON-EXTENDED BASES.
3. ALL JOINTS, LIFT HOLES, INLETS, OUTLETS TO BE SEALED & GROUTED INSIDE AND OUT.
4. SPECIAL CONSIDERATION SHALL BE GIVEN FOR ENTRANCE DESIGN ON SEWERS WITH STEEP SLOPES.
5. IMPORTANT: EXTERNAL DROP CONNECTIONS TO ONLY BE USED FOR NEW CONNECTIONS TO EXISTING SANITARY MANHOLES.

ALBEMARLE COUNTY SERVICE AUTHORITY	STANDARD EXTERNAL DROP CONNECTION NOT TO SCALE	REV 10/22/2026 DETAIL S-5

PRECAST CONCRETE MANHOLE BASES SHALL BE FABRICATED IN ACCORDANCE WITH DETAIL S–2 OF THESE SPECIFICATIONS.



DOGHOUSE MANHOLE BASE

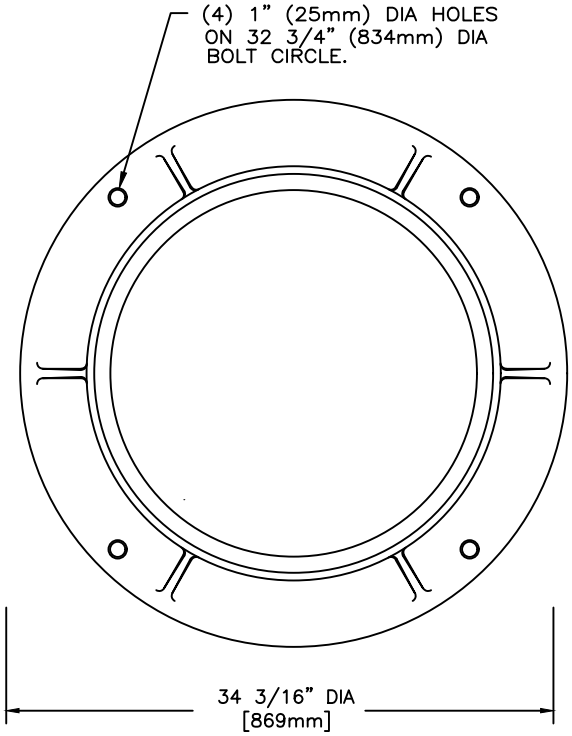


FOUNDATION SECTION VIEW

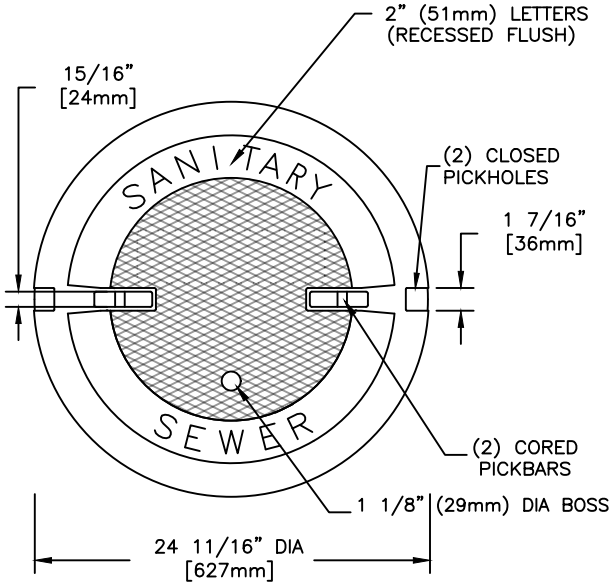
NOTES:

1. CONSTRUCT A FORMED INVERT FROM NEW SEWER LINE TO ALLOW FLOW TOWARD THE EXISTING OUTLET PIPE.
2. POUR A SHELF TO THE LOWER HALF OF THE EXISTING PIPE.
3. CUT AND REMOVE THE TOP HALF OF EXISTING PIPE TO WITHIN 6" OF THE MANHOLE WALLS AFTER THE INVERT AND SHELF HAVE BEEN FORMED, AND THE MH HAS BEEN FULLY TESTED IN ACCORDANCE WITH THESE SPECIFICATIONS.

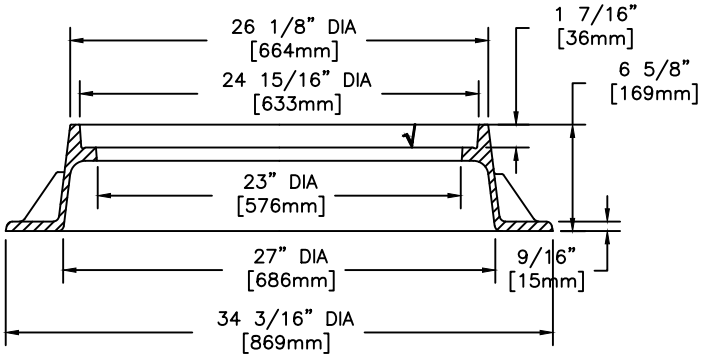
ALBEMARLE COUNTY SERVICE AUTHORITY	TYPICAL MANHOLE BASE SHOWING "DOGHOUSE" INSTALLATION NOT TO SCALE	REV 8/6/2024 DETAIL S–6



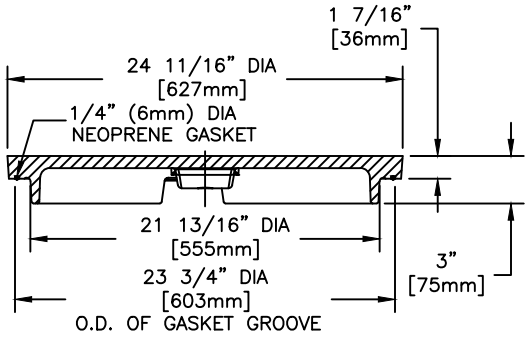
FRAME PLAN



COVER PLAN

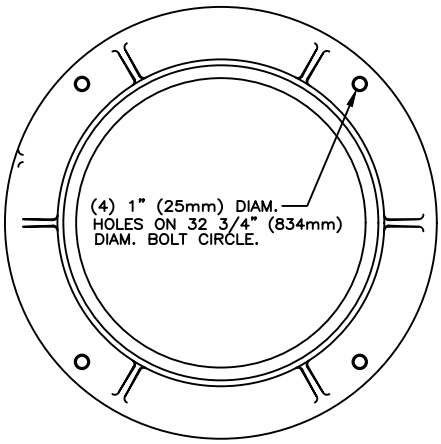


FRAME SECTION

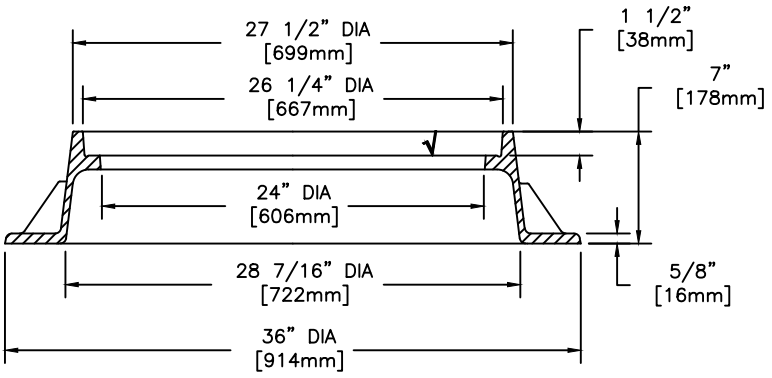


COVER SECTION

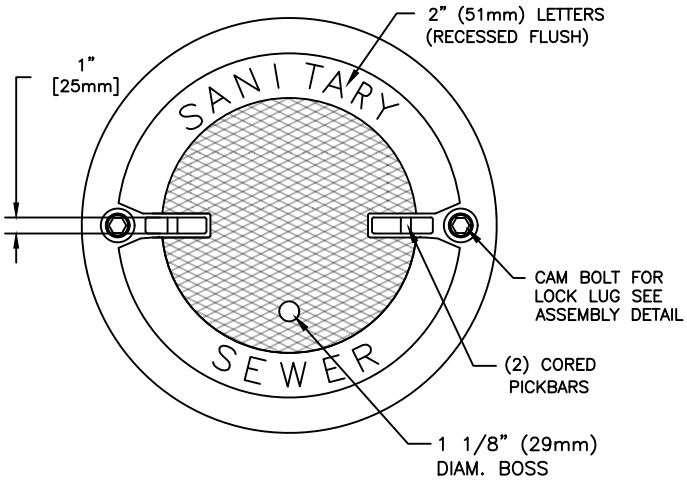
ALBEMARLE COUNTY SERVICE AUTHORITY	TYPICAL MANHOLE FRAME AND COVER NOT TO SCALE	REV 8/6/2024 DETAIL S-7



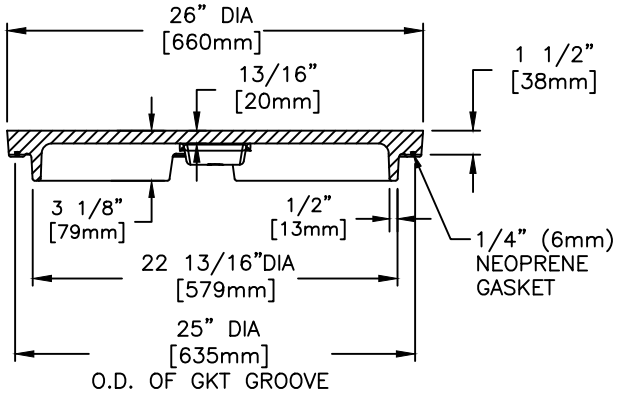
COVER UNDERSIDE



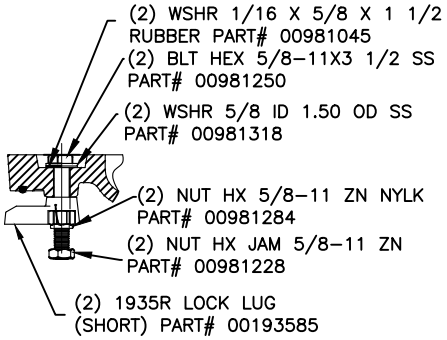
FRAME SECTION



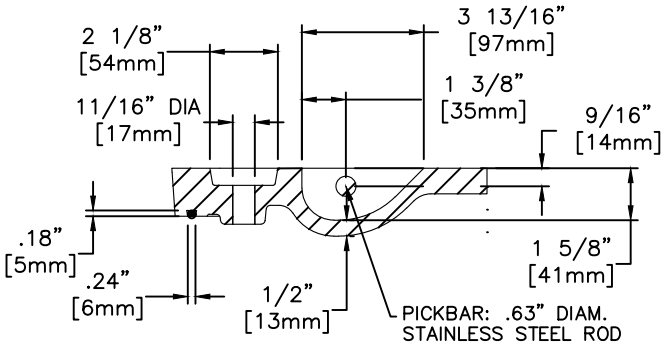
COVER PLAN VIEW



COVER SECTION



LOCK LUG ASSEMBLY

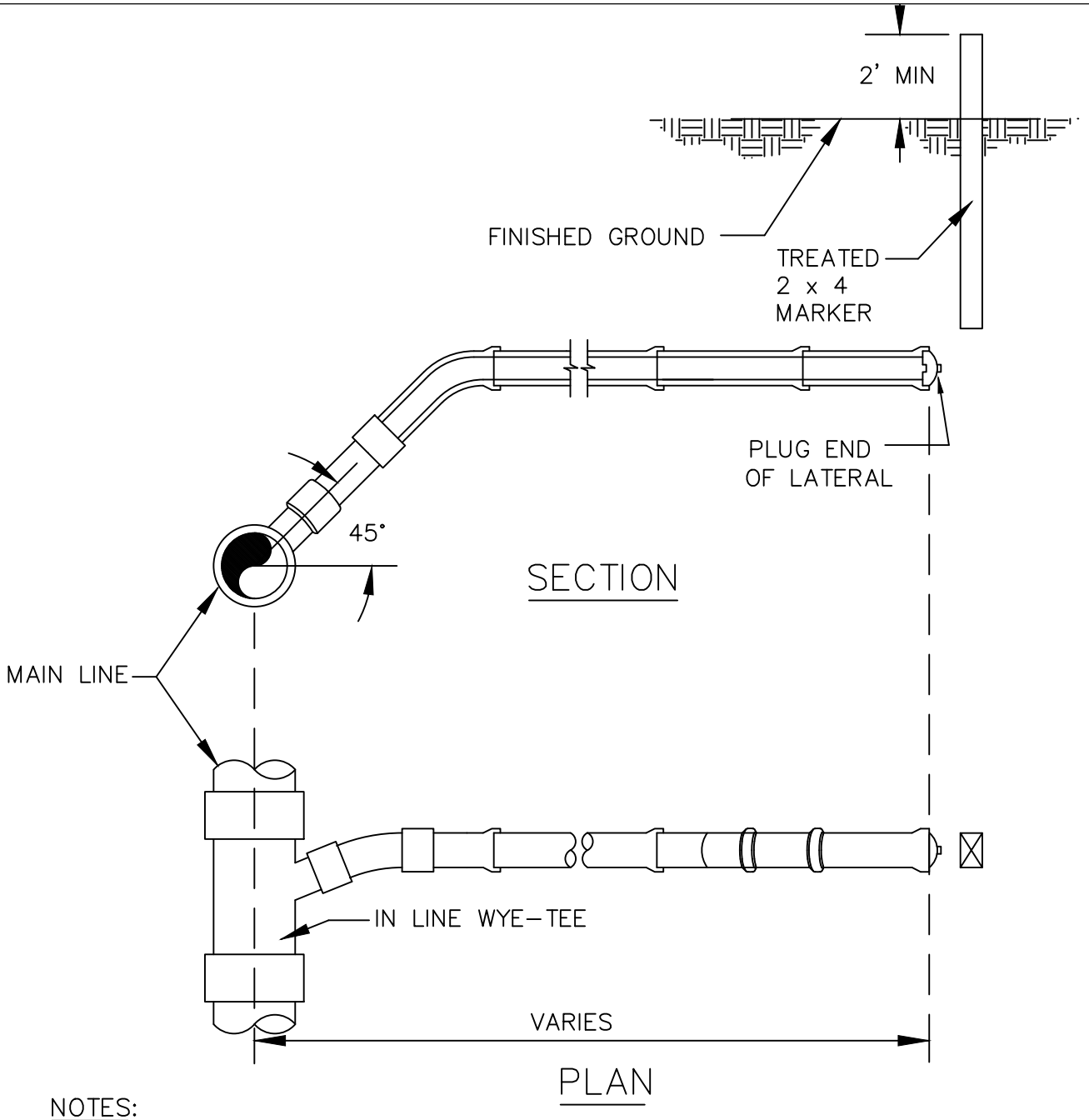


PICKBAR & LUG HOLE DETAIL

NOTES:

1. ALL MANHOLES WITHIN 100 YEAR FLOODPLAIN OR LOCATED IN AREAS SUBJECT TO FLOODING SHALL HAVE WATERTIGHT FRAME & COVER.
2. ALTERNATIVE DESIGN FOR WATERTIGHT COVERS MAY BE CONSIDERED.
3. COVERS SHALL BE FIXED TO FRAMES WITH LOCKING LUGS OR SIMILIAR ASSEMBLY.

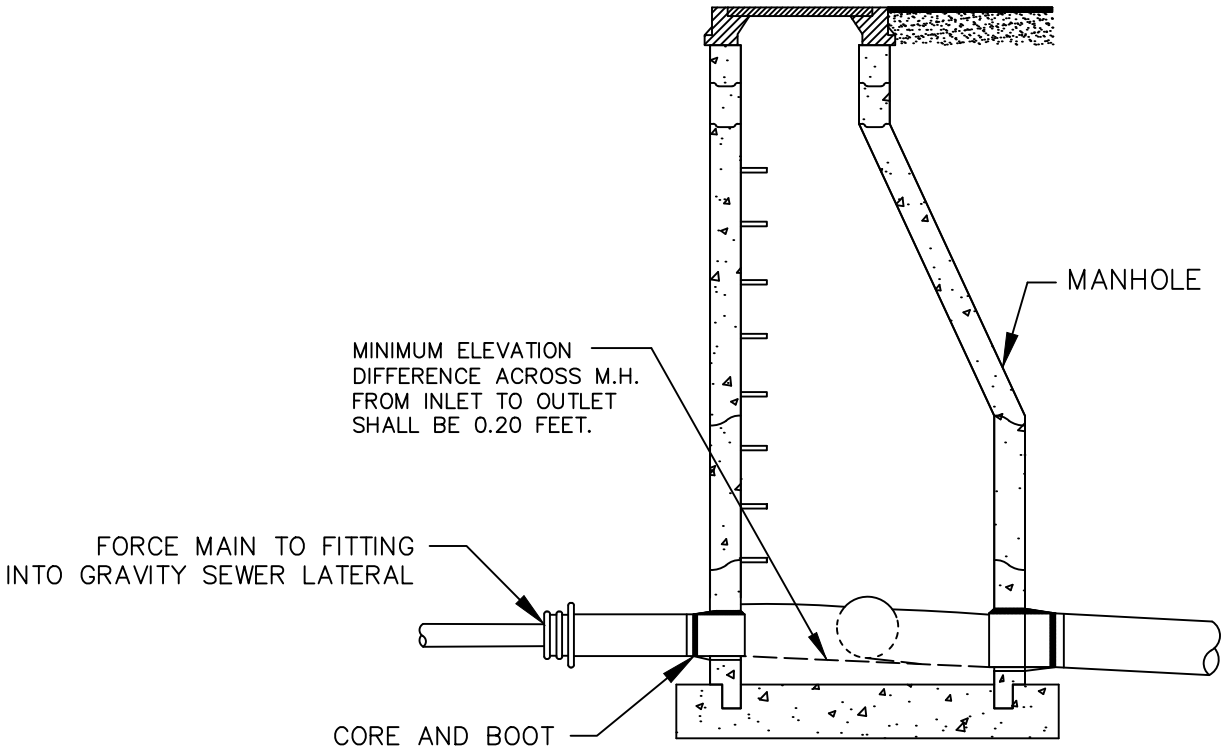
ALBEMARLE COUNTY SERVICE AUTHORITY	TYPICAL WATERTIGHT MANHOLE FRAME AND COVER NOT TO SCALE	REV 8/6/2024 DETAIL S-8

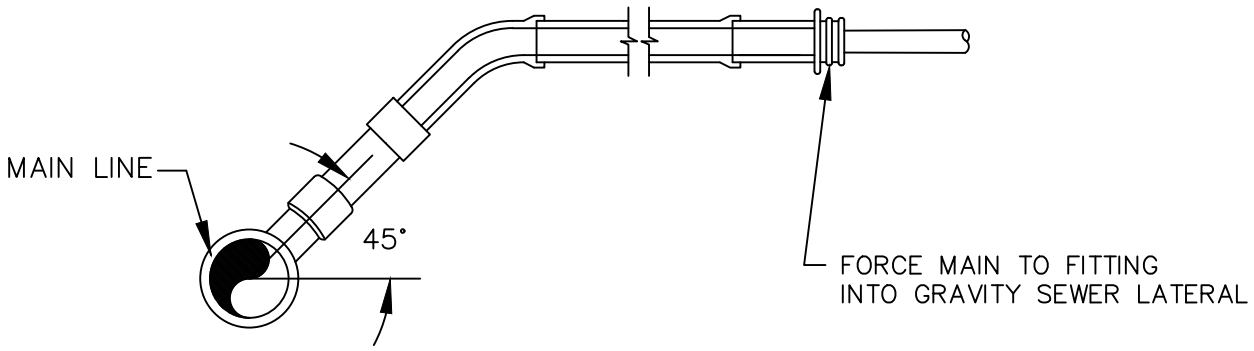


NOTES:

1. WHERE A SEWER SERVICE LATERAL CONNECTS TO A MANHOLE AND NO INVERT ELEVATION FOR THE SERVICE LATERAL IS INDICATED, THE TOP (CROWN) ELEVATION OF THE SERVICE LATERAL PIPE SHALL BE AT LEAST 0.2' HIGHER THAN THE TOP (CROWN) ELEVATION OF THE THE LOWEST PIPE CONNECTED TO THE MANHOLE.
2. SEWER LATERALS TAPPED INTO AN EXISTING SEWER MAIN SHALL BE CONNECTED USING A PIPE SADDLE.
3. SEWER LATERAL SHALL BE SLOPED PER PLUMBING CODE. MINIMUM 2% (1/4" PER FOOT) IS DESIRED.
4. ALL SEWER LATERALS SHALL HAVE A MINIMUM DIAMETER OF 4".

ALBEMARLE COUNTY SERVICE AUTHORITY	SEWER SERVICE LATERAL CONNECTION NOT TO SCALE	REV 8/6/2024 DETAIL S-9

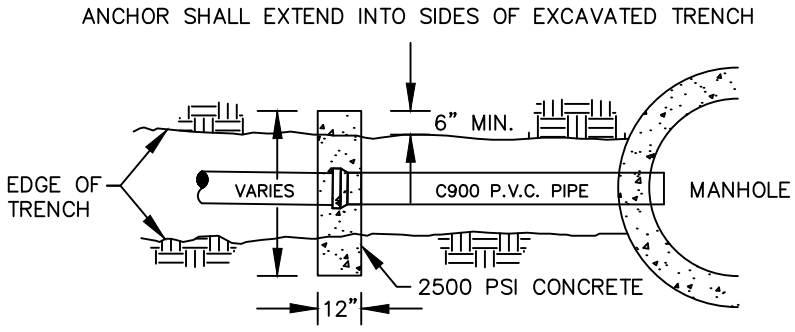




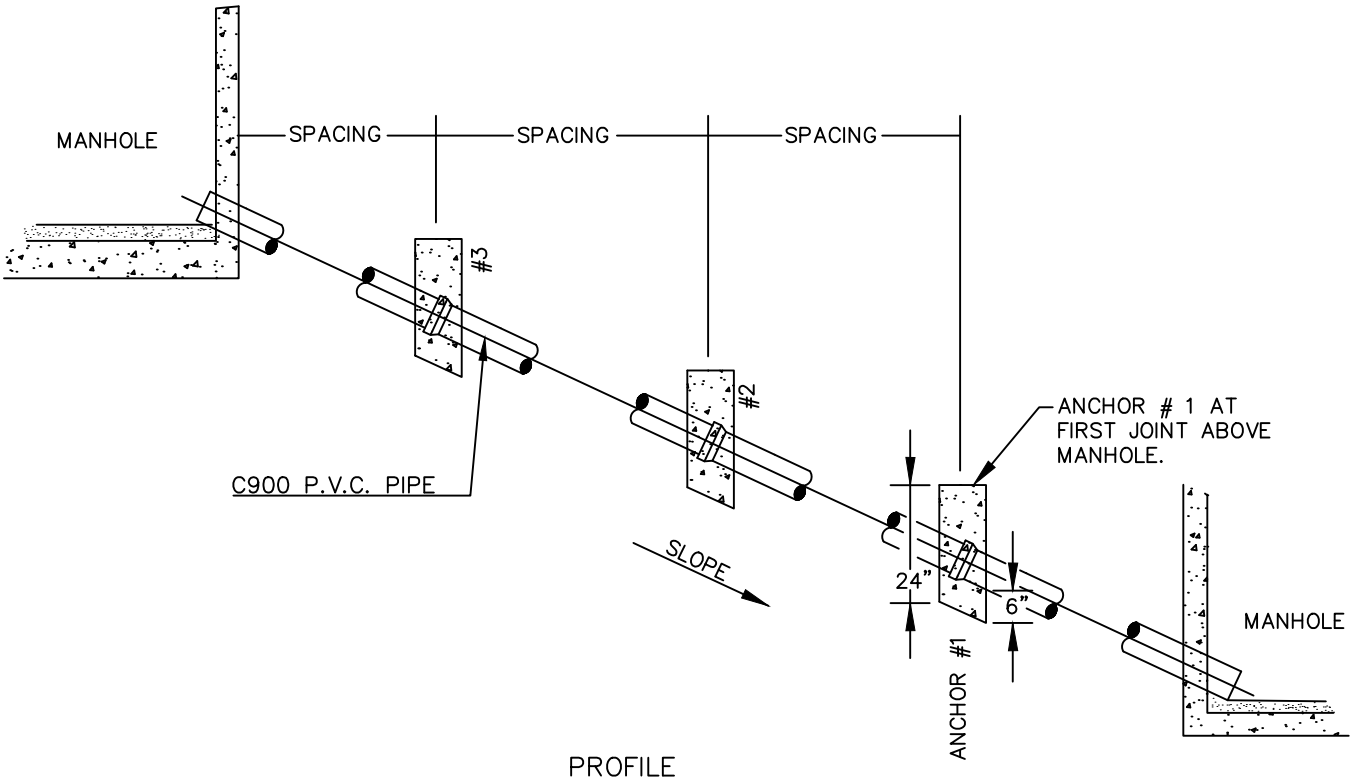
NOTES:

1. PROVIDE A FILLETED INVERT FOR A SMOOTH TRANSITION OF FLOW BETWEEN INLET & OUTLET.
2. EXTEND GRAVITY SEWER LATERAL 5–10 FEET AT 2% POSITIVE SLOPE FROM SEWER MANHOLE OR MAIN FOR FORCE MAIN CONNECTION.

ALBEMARLE COUNTY SERVICE AUTHORITY	TYPICAL FORCE MAIN CONNECTION NOT TO SCALE	REV 8/6/2024 DETAIL S–10



PLAN

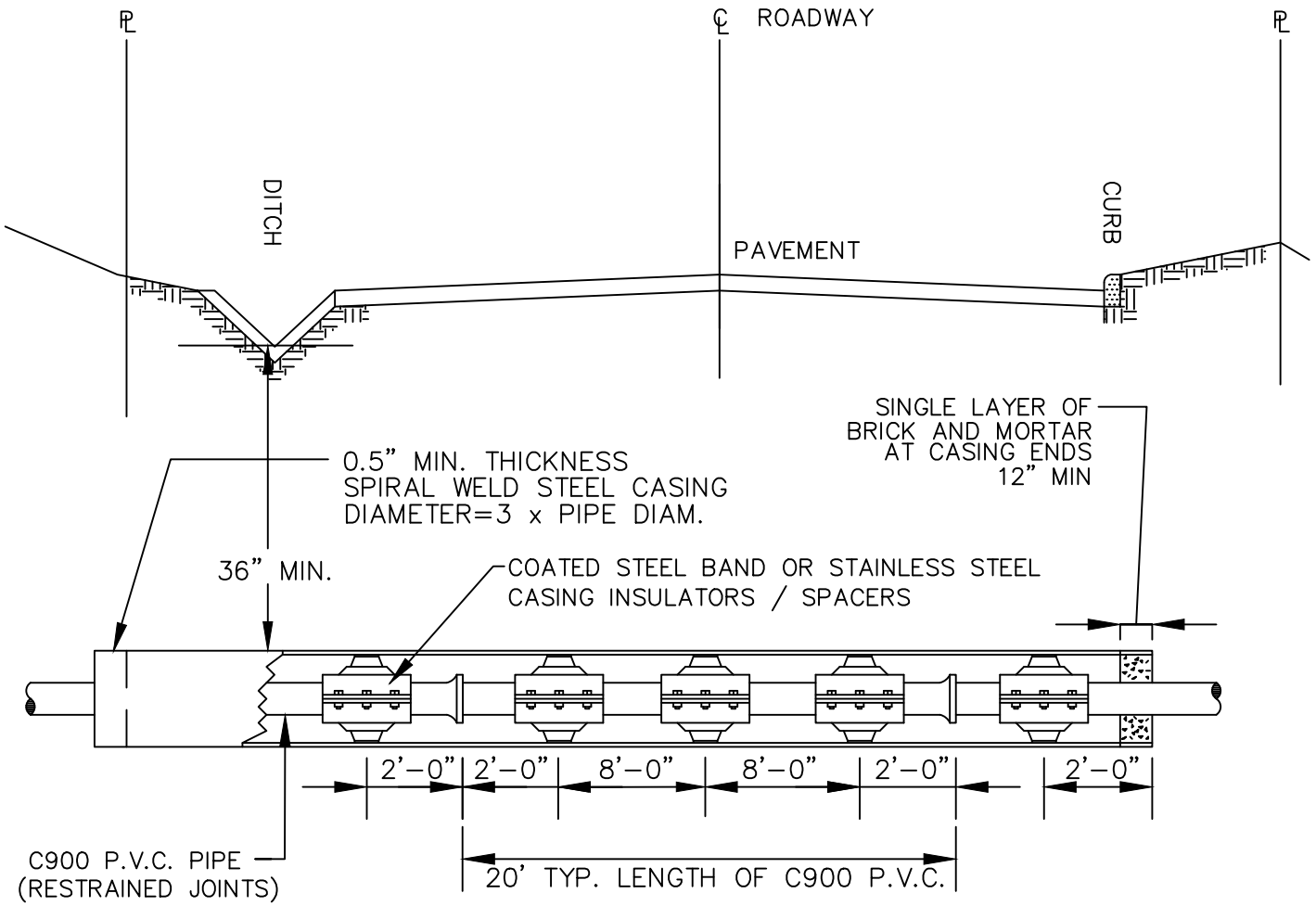


PROFILE

NOTES:

1. FOR SLOPES LESS THAN 35%, MAX. SPACING = 40' (ANCHOR TO BE USED EVERY OTHER JOINT).
2. FOR SLOPES 35% AND GREATER, MAX. SPACING = 20' (ANCHOR TO BE USED AT EVERY JOINT).

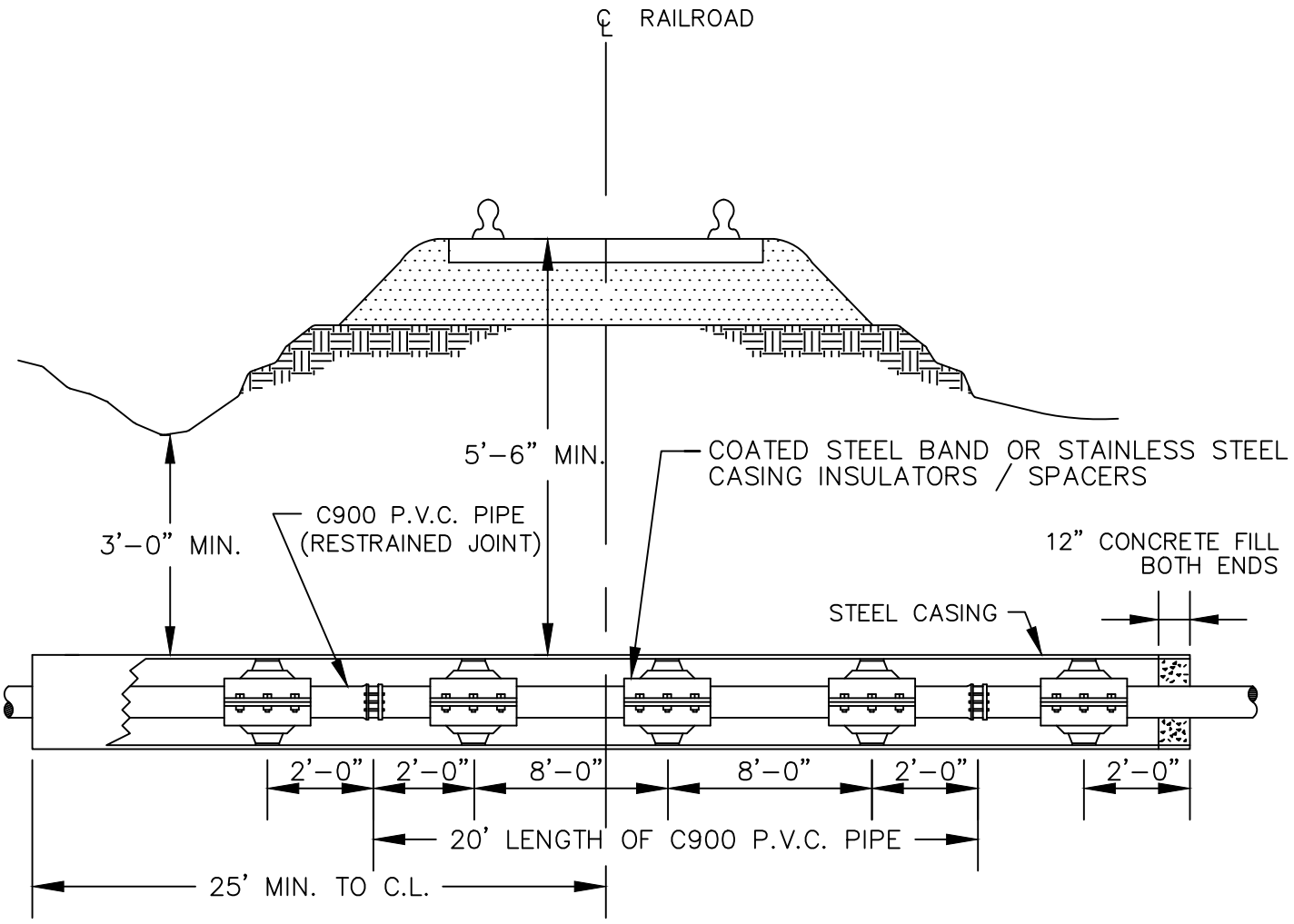
ALBEMARLE COUNTY SERVICE AUTHORITY	TYPICAL ANCHOR DETAIL FOR SEWERS ON GRADES 20% AND GREATER NOT TO SCALE	REV 10/23/2026 DETAIL S–11



NOTES:

1. STEEL CASING TO EXTEND TO BACK OF CURB, DITCH, SIDEWALK, ETC. OR A MINIMUM OF 5' BEYOND THE EDGE OF PAVEMENT, WHICHEVER IS GREATER.
2. MIDDLE SPACER SHALL BE PLACED AT THE CENTERPOINT OF PIPE.
3. THREE CASING SPACERS TO BE USED PER STICK OF PIPE.

ALBEMARLE COUNTY SERVICE AUTHORITY	TYPICAL STEEL SLEEVE INSTALLATION UNDER ROADWAYS NOT TO SCALE	REV 10/23/2026 DETAIL S-12

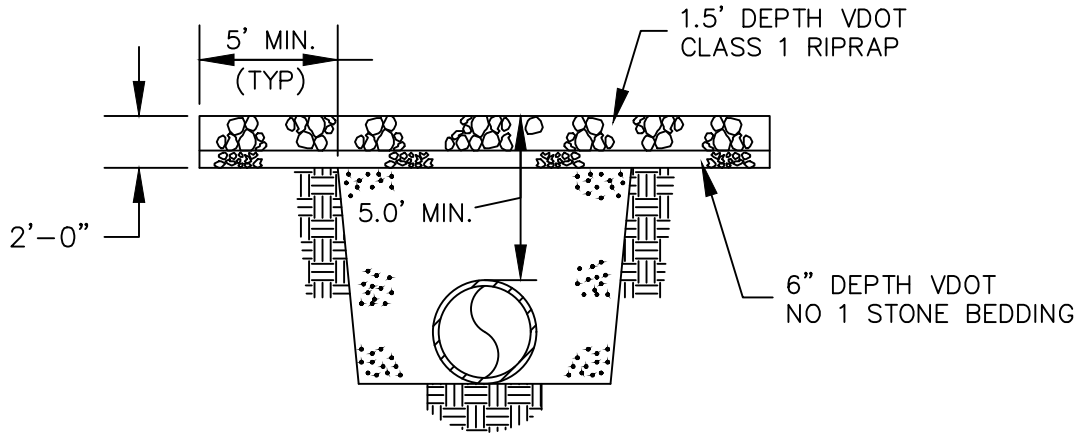


ALSO SEE THE "AREA MANUAL FOR RAILWAY ENGINEERING – PART 5, PIPELINES"

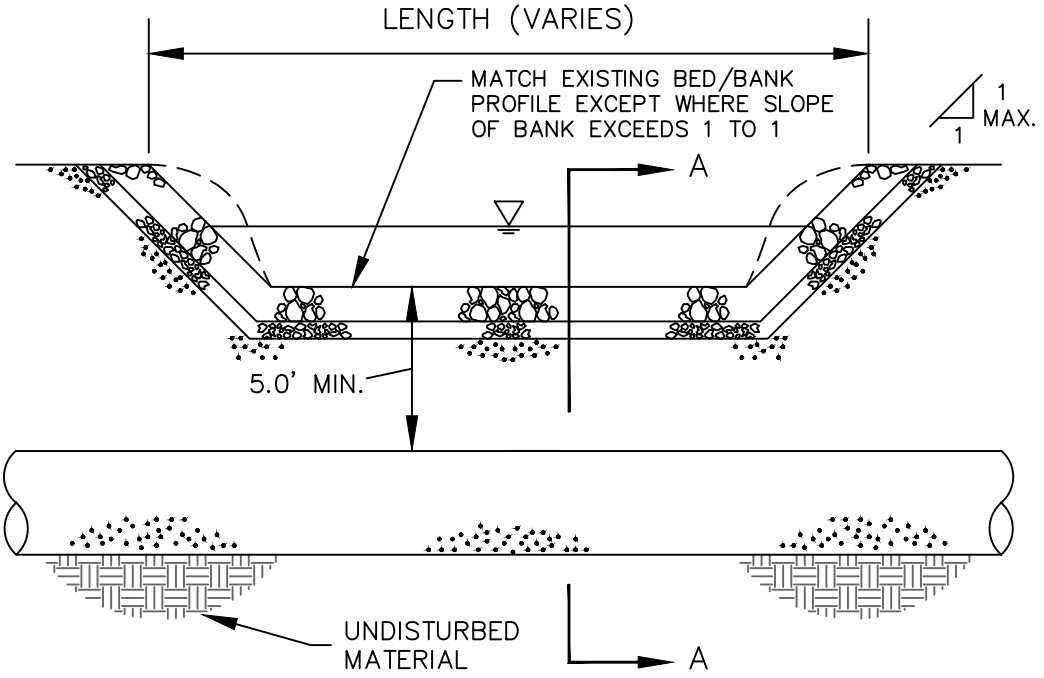
NOTES:

1. MIDDLE SPACER SHALL BE PLACED AT THE CENTERPOINT OF PIPE.
2. THREE CASING SPACERS TO BE USED PER STICK OF PIPE.

ALBEMARLE COUNTY SERVICE AUTHORITY	TYPICAL STEEL SLEEVE INSTALLATION UNDER RAILROADS NOT TO SCALE	REV 10/23/2026 DETAIL S–13



SECTION A-A



ELEVATION

NOTES:
1. RESTRAINED JOINTS REQUIRED.
2. WHEN BEDROCK IS ENCOUNTERED AND COVER EQUALS OR EXCEEDS 3', THE TRENCH SHALL BE BACKFILLED WITH COMPACTED 21A STONE AND TOPPED WITH 18" OF VDOT CLASS 1 RIPRAP.

ALBEMARLE COUNTY SERVICE AUTHORITY	TYPICAL STREAM CROSSING NOT TO SCALE	REV 8/6/2024 DETAIL S-14